



Hazeldean Crossing Inc.

Geotechnical Investigation

Type of Document
Final

Project Name
Proposed Residential Development
5924 and 5938 Hazeldean Road, Ottawa, Ontario

Project Number
OTT-00250806-A0

Prepared By: Maxime Leroux , P.Eng.

Reviewed By: Ismail Taki, P.Eng.

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada

Date Submitted:
May 14, 2019

Hazeldean Crossing Inc..

521 Kilspindie Ridge
Ottawa, Ontario
K2J 5M8

Attention: Mr. Carmine Zayoun

Geotechnical Investigation

Type of Document:

Final

Project Name:

Proposed Residential Development
5924-5938 Hazeldean Road, Ottawa, Ontario

Project Number:

OTT-00250806-A0

Prepared By:

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada
T: 613-688-1899
F: 613-225-7337
www.exp.com



Maxime Leroux, P.Eng.
Project Engineer, Geotechnical Services
Earth and Environment



Ismail Taki, M.Eng, P.Eng..
Manager, Geotechnical Services
Earth and Environment



Date Submitted:

May 14, 2019

EXP Services Inc.

Client: Hazeldean Crossing Inc.
Geotechnical Investigation, Proposed Residential Development
5924 and 5938 Hazeldean Road, City of Ottawa, Ontario
OTT-00250806-A0
May 14, 2019

Legal Notification

This report was prepared by EXP Services Inc. for the account of **Hazeldean Crossing Inc.**

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.



Executive Summary

A geotechnical investigation was undertaken at the proposed residential development to be located at the site encompassing the two properties registered by the street addresses of 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario. This work was authorized by Mr. Carmine Zayoun on behalf of Hazeldean Crossing Inc.

The geotechnical investigation was completed concurrently with Phase I and II Environmental Site Assessments (ESA), which are reported under separate covers.

Preliminary plans call for the development of the site with twelve (12) blocks of two (2) to ten (10) units of residential townhouses, each with one basement level. Preliminary grading plans call for the proposed underside of footings to be at Elevations 112.4 m to 114.65 m and the finished grades around the units to range between Elevation 115.5 m to 113.91 m, resulting in up to 2 m of grade raise at the site.

The fieldwork for the geotechnical investigation comprised of the drilling of fourteen (14) boreholes to refusal/ termination depths of 0 to 6.4 m and the excavation of three (3) test pits to refusal depths ranging between 0.1 m to 0.9 m below the existing ground surface. Monitoring wells/standpipes were installed in the majority of the boreholes for long-term sampling and monitoring of the groundwater at the site.

The investigation has revealed that the subsurface conditions comprise of topsoil, shallow deposit of fill, silty sand to sand underlain by bedrock contacted at depths ranging between 0 m to 3.6 m (Elevation 111.3 m to 114.3 m). The deeper fill overburden was contacted at the location of Borehole Nos. 1, 2, and 11 drilled at the locations of the underground fuel storage tanks that were previously located at 5938 Hazeldean Road property. This condition of the relatively deep overburden should be considered as localized to this area only. Wash boring and core drilling used to advance Borehole Nos. 1A, 2A, 3A, 4, 5 and 9 to 11 below the refusal depths revealed that the bedrock underlying the site within the depths cored comprises of sandstone with seams of limestone and shale.

Groundwater measurements taken in standpipes and monitoring wells installed in some of the boreholes indicate that the groundwater table to be at depths of 1.47 m to 3.42 m below the existing ground surface (Elevation 109.98 m to 112.72 m). the groundwater table is subject to seasonal fluctuation and may be at higher depths during wet weather conditions

The proposed grade raise of up to 2 m is considered feasible at the site from a geotechnical point of view.

Based on the results of the investigation and available proposed grading plan, the majority of the blocks will be founded on the surface of the bedrock or in the bedrock. Footings designed to bear on the surface or in the bedrock below any weathered or fractured zones may be designed for a bearing pressure at Ultimate Limit State (ULS) of 250 kPa. Since the bedrock in most of the site is present at shallow depth, the presence of cap rock, weathered rock and fissures should be expected at founding levels. Therefore, it is imperative that the surface of the exposed bedrock at the underside of the footings be examined by a geotechnical engineer and any fractured bedrock zones or fissured removed/cleaned prior

to casting of the footings. In areas of previous underground installations (pump island, tanks, underground sewer), all fill will have to be removed to surface of the bedrock and the excavation backfilled using engineered fill prepared as discussed in detail in the main body of the report. This condition applies also to the location of the building at 5938 Hazeldean Road which will be demolished for the construction of the residential blocks.

The basement and garage floor slabs of the proposed structures may be constructed as slabs-on-grade set on a bed of 300 mm of clear stone set over bedrock or engineered fill. Perimeter drainage system is required for the proposed townhouse blocks.

Excavations at the site in the overburden may be undertaken as open-cut provided they are cut back at a slope of 1H to 1V. Excavation of the bedrock would require the use of line drilling and blasting technique and may be undertaken with near vertical sides. Vibrations should be monitored during construction to prevent damage to adjacent structures and services. A pre-condition survey of all the structures and services situated within proximity of the site will be required prior to commencement of construction and during the excavation of the bedrock.

Seepage of surface and sub-surface water into the excavations should be anticipated. It should be possible to collect the water entering the excavation in perimeter ditches and to remove it by pumping from sumps.

The subject site has been classified as **Class C** for seismic site response in relation to Section 4.1.8.4 of the 2012 Ontario Building Code (OBC 2012). A higher site class for the site may be obtained if a shear-wave measurement is completed at the site.

The pavement structure for the subdivision roadways and driveways of the subdivision are presented in Table V of the report.

Due to the presence of shallow bedrock and variability of the bedrock elevations throughout the site, it is highly recommended that an additional test pit investigation should be undertaken in order to collect additional data on the elevations of the bedrock throughout the site. This should be completed prior to finalizing the design and tendering of the project.

The above and other related considerations are discussed in greater detail in the report.

Table of Contents

	Page
Executive Summary	EX-i
1 Introduction	1
2 Background Information	2
3 Site Description	3
4 Procedure	4
5 Site and Soil Description	5
5.1 Topsoil.....	5
5.2 Overburden	5
5.3 Refusal to Auger/Backhoe Refusal	6
5.4 Groundwater Table	7
6 Grade Raise	9
7 Foundation Considerations	10
8 Floor Slabs and Drainage Requirements	12
9 Pipe Bedding Requirement	13
10 Lateral Earth Pressure against Basement Walls	14
11 Excavations	15
12 Seismic Site Classification	16
12.1 Liquefaction Potential.....	16
12.2 Seismic Classification	16
13 Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes	17
14 Subdivision Roads and Driveways	18
15 General Comments	20

List of Tables

	Page
Table I: Summary of Lab Test Results on Soil Samples	6
Table II: Summary of Bedrock Depth and Elevation in Boreholes and Test Pits.....	6
Table III: Results of Unconfined Compression Tests on Rock Samples	7
Table IV: Summary of Groundwater Measurements in Boreholes	8
Table V: Recommended Pavement Structure Thicknesses	18

List of Figures

- Figure 1: Site Location Plan
- Figure 2: Borehole and Test Pit Location Plan
- Figures 3 - 19: Borehole and Test Logs
- Figures 20 - 21: Grain-size Analyses
- Figures 22 - 29: Photographs of Bedrock Cores

1 Introduction

A geotechnical investigation was undertaken for the proposed new residential development to be located at the site encompassing the two properties registered by the street addresses of 5924 and 5938 Hazeldean Road in the City of Ottawa, Ontario (Site, Figure 1). This work was authorized by Mr. Carmine Zayoun of Hazeldean Crossing Inc.

The most recent project development plans call for the development of the subject site with twelve (12) residential townhouses blocks of two (2) to ten (10) units with associated underground services, main roadway and surface parking facilities.

The investigation was undertaken to:

- Establish the subsurface soil/bedrock and groundwater conditions at the borehole and test pits locations;
- Classify the site for Seismic Site Response in accordance the requirements of the 2012 Ontario Building Code (OBC), and comment on the liquefaction potential of the subsurface soils;
- Establish the grade-raise restrictions at the site;
- Make recommendations regarding the most suitable type of foundations, founding depth, Serviceability Limit State (SLS) bearing pressure and Ultimate Limit State (ULS) factored geotechnical resistance of the founding strata for the proposed residential blocks;
- Discuss slab-on-grade construction and permanent drainage requirements;
- Discuss excavations and dewatering requirements;
- Comment on backfilling requirements and suitability of on-site soils for backfilling purposes; and
- Recommend pavement structures for the proposed subdivision roadways and parking area.

The comments and recommendations given in this report are based on the assumption that the above-described design concept will proceed to construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2 Background Information

A geotechnical report was prepared for 5924 Hazeldean Road property by John D. Paterson & Associates Ltd., now Paterson Group (Paterson), under report S6287 and dated August 11, 1994 was provided to EXP as reference material. The report was prepared for a proposed multi-storey office building with underground parking on the southern half of the site, and a single-storey, basementless strip plaza on the north side of the site.

A total of nine (9) test pits were previously excavated by Paterson, which were distributed throughout the site. The report indicates that the bedrock to be at Elevation 112.20 m to 113.56 m.

3 Site Description

The subject site encompasses the two properties registered by the street addresses of 5924 and 5938 Hazeldean Road, are located at the southwest corner of the intersection of Hazeldean Road and Victor Street, City of Ottawa, Ontario (Figure 1).

The property at 5924 Hazeldean Road is currently an unoccupied and undeveloped lot and has an area of 0.49 hectares. It is legally described as Concession 11 Part of Lot 26, Corner; Hazeldean Rd & John St. The property identification number is 044620476. .

The property at 5938 Hazeldean Road is a 0.4 hectare parcel of land, which was previously occupied by a service station.. It is legally described as Concession 11 Part of Lot 25, Registered Plan 4R-10078; Parts 1 & 2. The property identification number is 044620475. Currently, a one-storey building occupies the property, which will be demolished as part of the proposed development. It is also understood that the underground tanks as well as the pump islands were removed and decommissioned from this property about ten (10) years ago and the excavation backfilled with sand.

Ground surface elevations at the site slopes in the easterly direction with elevations ranging from 115.36 m to 114.90 m along the western boundary to 113.37 m to 112.62 along the eastern boundary.

4 Procedure

The fieldwork for the geotechnical investigations was completed in stages, i.e. between February 20 and March 13, 2019, and comprised the drilling of 13 boreholes (BH 1A to 3A and BH 1 to BH-11) using a CME-55 track/truck-mounted drill and the excavation of three test pits (TP-1A to TP-3A) using a rubber-tired backhoe to refusal/termination depths ranging between 0.1 m to 6.4. The fieldwork was supervised on a full-time basis by representatives of EXP.

The elevations and elevations of the boreholes and test pits locations were established in the field by representatives of EXP and refer to the geodetic datum and are presented on Site Plan, Figure No. 2.

Standard penetration tests samples were performed in the overburden in the boreholes at 0.75 m depth intervals and the soil samples retrieved by split-barrel sampler to refusal depth. Below the refusal depth, Borehole Nos. 1A to 3A, 3 to 5 and 9 to 11 were cased and advanced further using washboring and coring techniques and NQ-size core barrel to termination depths of 4.6 m to 6.4 m. During bedrock coring, a careful record of any sudden drops of the drill rods, colour of wash water and wash water return was kept. In the test pits, representative grab samples were collected from each soil stratigraphy encountered.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. Similarly, the rock cores were logged, placed in core boxes and identified. On completion of the fieldwork, all the soil samples and rock cores were transported to the EXP laboratory in the City of Ottawa, Ontario where they were visually examined by a geotechnical engineer and borehole logs prepared. The engineer also assigned the laboratory testing, which consisted of performing natural moisture content on all soil samples and grain-size analysis tests on selected soil samples. In addition, unconfined compressive strength, were completed on selected rock samples.

Water levels were measured in the open boreholes on completion of drilling operations. In addition, 19 mm slotted standpipe was installed in Borehole No. 1A whereas 37 mm monitoring wells were installed in Borehole Nos. 1 to 5 and 9 to 11, 2A and 3A for long-term monitoring and sampling of the groundwater table. The installation was completed in accordance with EXP standard practice and is documented on the respective borehole logs. The test pits were backfilled upon completion of the fieldwork.

5 Site and Soil Description

A detailed description of the geotechnical conditions encountered in the thirteen boreholes and three test pits are given on the borehole and test pit logs, Figures 3 to 19 inclusive. The borehole and test pit logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the location where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted. Boreholes and test pits were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

A review of Figures 3 to 19 inclusive indicates the site to be underlain by shallow deposit of overburden overlying bedrock.

5.1 Topsoil

A 20 mm to 130 mm topsoil was contacted at the location of Borehole 2A to 3A and in TP 1A to 3A. The topsoil extends to the surface of the bedrock in Test Pit 1A to 3A (Elevations 113.2 m and 113.9 m).

5.2 Overburden

The topsoil in Borehole No. 2A, 3A and from the ground surface in Borehole 1 to 11, fill comprising of sand to silty sand and gravel was contacted and extended to surface of the bedrock or to refusal to augers contacted at depths of 0.8 m to 3.6 m (Elevations 111.3 m to 114.3 m). It should be noted that the deeper depth of the sand fill contacted in Borehole Nos. 1, 2 and 11 are located in the areas where underground storage tanks were located at the 5938 Hazeldean site. These tanks were removed soe ten (10) years back and the area backfilled with sand. Therefore, the relatively deeper fill encountered at the locations of Borehole Nos. 1, 2 and 11 should be considered as localized to this area only.

Locally at the location of Test Pit No. 3, the fill is underlain by silty sand till, which extends to the surface of the bedrock contacted at a depth of 0.9 m , i.e. 112.6 m.

The natural moisture content of the overburden ranged between 3 to 16 percent.

Grain-size analyses performed on two samples of the overburden are presented in Figure Nos. 20 and 21. A review of these figures revealed a fill composition of 52 to 53 percent gravel, 23 to 24 sand and 22 to 25 silt and clay as summarized in Table I below.

Table I: Summary of Lab Test Results on Soil Samples				
Test Pit No.	Sample Depth (m)	Composition		
		Gravel (%)	Sand (%)	Silt and Clay (%)
BH 3A	0-0.6	53	23	25
TP 3A	0.3-0.9	53	24	22

5.3 Refusal to Auger/Backhoe Refusal

Refusal to auger or to backhoe bucket was met in all boreholes/test pits at depths ranging between 0 and 3.6 m below the existing ground surface (Elevation 111.3 m to 114.3 m). The inferred depth and elevation of the bedrock at the location of the boreholes and test pits is summarized in Table II below.

Table II: Summary of Bedrock Depth and Elevation in Boreholes and Test Pits			
Borehole or Test Pit No.	Ground Surface Elevation (m)	Bedrock Depth (m)	Bedrock Elevation (m)
BH 1A	112.63	0	112.6
BH 2A	113.69	0.9	112.8
BH 3A	113.06	0.2	112.9
TP-1A	113.3	0.1	113.2
TP-2A	114.02	0.1	113.9
TP-3A	113.53	0.9	112.6
BH-01*	114.92	3.6	111.3
BH-02*	114.88	3.5	111.4
BH-03	114.82	1.7	113.2
BH-04	114.97	1.7	113.4
BH-05	114.56	1.1	113.5
BH-06	114.86	1.3	113.6
BH-07	114.95	1.2	113.8
BH-08	115.06	0.8	114.3
BH-09	115.22	1.5	113.7
BH-10	115.08	1.1	114.0
BH-11*	114.92	3.2	111.7

Borehole Nos. 1, 2 and 11 were located in previous tank excavation; therefore, the relatively lower bedrock depths contacted at these locations must be considered as localized to this area only.

Washboring and core drilling techniques used to advance further in Borehole Nos. 1A to 3A, 3 to 5 and 9 to 11 revealed that refusal was met on sandstone bedrock.

A review of the rock cores confirm that sandstone is the predominant bedrock at the site, with some interbedded limestone and occasional shaley partings.

A total Core Recovery (TCR) and Rock Quality Designation (RQD) of 97 to 100 percent and 0 to 98 percent respectively were obtained when core drilling the bedrock. On this basis, the bedrock quality within the depth investigated may be classified as very poor to excellent. However, the upper levels of the bedrock was found to be heavily fractured and weathered in the upper levels.

A total of twelve (12) rock samples were selected for unconfined compressive strength testing and the test results are presented in Table III. A review of the test results indicates a bedrock with compressive strength ranging between 97 MPa and 169 MPa. Based on these values, the rock can be classified with respect to intact strength as "very strong", (Canadian Foundation Engineering Manual, 4th edition, 2006). The unit weight of the bedrock ranged between 2634 kg/m³ and 2718 kg/m³.

Table III: Results of Unconfined Compression Tests on Rock Samples			
Borehole No. RUN No.	Depth (m)	Compressive Strength (MPa)	Unit Weight of Bedrock (kg/m³)
BH 2A – Run 1	1.2 – 1.4	163	2702
BH 2A – Run 1	1.8 – 1.9	144	2710
BH 2A – Run 2	3.3 – 3.5	97	2718
BH 3A – Run 1	0.8 – 1.0	114	2703
BH 3A – Run 2	1.4 – 1.6	112	2725
BH 3 – Run 2	2.0 – 2.2	124	2669
BH 3 – Run 3	2.9 – 3.1	158	2678
BH 3 – Run 4	4.3 – 4.5	101	2649
BH 4 – Run 2	2.5 – 2.7	140	2639
BH 5 – Run 2	2.3 – 2.5	169	2650
BH 9 – Run 2	2.9 – 3.1	112	2634
BH 10 – Run 2	1.7 – 1.9	121	2654

Photographs of the recovered bedrock cores are presented in Figures Nos. 22 to 30.

5.4 Groundwater Table

Water level observations were made in the boreholes and test pits upon completion of the field work and in monitoring wells and standpipes installed in Borehole Nos. 1A to 3A 1 to and 9 to 11. Latest readings collected on February 22 and on April 25, 2019 are presented in Table IV.

Table IV: Summary of Groundwater Measurements in Boreholes				
Monitoring Well ID	Ground Elevation (MASL)	Date of Last Reading	Depth to Water (m)	Elevation of Groundwater (m)
BH-1A	112.63	February 22, 2019	1.47	111.16
BH-2A	113.69	February 22, 2019	3.29	110.40
BH-3A	113.06	February 22, 2019	3.10	109.98
BH-01*	114.92	April 25, 2019	2.54	112.42
BH-02*	114.88	April 25, 2019	2.70	112.18
BH-03	114.82	April 25, 2019	3.42	111.42
BH-04	114.97	April 25, 2019	3.11	111.87
BH-05	114.56	April 25, 2019	3.30	111.26
BH-09	115.22	April 25, 2019	2.49	112.72
BH-10	115.08	April 25, 2019	3.11	111.98
BH--11	114.92	April 25, 2019	2.69	112.22

A review of Table IV indicated the groundwater table to be at depths of 1.47 to 3.42 m below the ground surface, i.e. Elevation 112.42 m to 109.98 m.

Water levels observations were made in the exploratory boreholes at the times and under the conditions stated in the scope of services. These data were reviewed and EXP's interpretation of them discussed in the text of the report. Note that fluctuations in the level of the groundwater may occur due to seasonal variation such as precipitation, snowmelt, rainfall activities, and other factors not evident at the time of measurement and therefore may be at a higher level during wet weather periods.

6 Grade Raise

The investigation has revealed that the undisturbed portion of the site contains a shallow deposit of overburden ranging in thickness between 0 and 1.7 m underlain by sandstone bedrock.

Based on the geotechnical findings and proposed grading plan, a grade raise of up to 2 m is considered at the site and is considered acceptable from a geotechnical point of view.

7 Foundation Considerations

The investigation has revealed that the geotechnical conditions at the site are well suited to construction of two-storey townhome blocks with one basement level on bedrock or on engineered fill. Footings shouldn't be founded partly on the bedrock and partly on the engineered without a provision of a transition zone or additional reinforcement.

Review of the available grading plan and results of the boreholes and test pits investigation indicates that the proposed residential blocks will be founded at the surface of the bedrock or in the bedrock. Therefore, excavation of the bedrock to varying depths for the construction of the footings is expected throughout the site.

Since the residential blocks are expected to be founded on bedrock, factored geotechnical resistance at ULS will govern the design. Footings designed to bear on the surface or in the bedrock below any weathered or fractured zones may be designed for a bearing pressure at ULS of 250 KPa. Since the bedrock in most of the site is present at shallow depth, the presence of cap rock, weathered rock and fissures should be expected in the upper levels of the bedrock. Therefore, it is imperative that the surface of the exposed bedrock at the underside of the footings be examined by a geotechnical engineer and any fractured bedrock zones or fissures removed/cleaned prior to casting of the footings. Filling of the cleaned fissures with concrete and addition of rebar across any large fissures may be required and can be best established in the field by qualified geotechnical engineers or senior technicians.

In areas of the previous tank excavation and area, which was backfilled with sand, all the sand fill should be removed and the area backfilled with engineered fill comprising of OPSS 1010 Granular B Type II placed in 300 mm lifts and each lift compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) in accordance with ASTM D-698-12e2. Additional reinforcement or structural joints will be required in areas where the founding medium changes from bedrock to engineered fill, which will be in the case for Blocks 8 and 9. This also applies to the location of the building at 5938 Hazeldean Road which will be demolished for the construction of the residential blocks. All fill and construction rubbles should be removed down the bedrock surface and the area backfilled with engineered fill as described above.

A minimum of 1.2 m of earth cover should be provided to the footings of a heated structure founded on bedrock to protect them from damage due to frost penetration. The frost cover should be increased to 1.5 m for unheated structures.

All footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces can support the design bearing pressure and that the footing beds have been properly prepared as described above.

The recommended bearing pressures have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with

respect to conditions between boreholes and test pits when foundation construction is underway. The interpretation between boreholes and test pits and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

8 Floor Slabs and Drainage Requirements

The basement and garage floor slabs of the proposed two-storey townhouse blocks may be constructed as slab-on-grade provided they are set on beds of well compacted 19 mm clear stone at least 300 mm thick placed on bedrock or on well compacted engineered fill. The clear stone would prevent the capillary rise of moisture to the floor slab. Adequate saw cuts should be provided in the floor slab to control cracking.

It is anticipated that perimeter drains would be required for the proposed residential blocks with basement. The perimeter drains may consist of 100 mm diameter perforated pipe wrapped with filter cloth (sock) and set on the footings and surrounded with 150 mm of 19 mm clear stone and properly outletted. The subsurface walls should be adequately damp proofed.

The finished exterior grade should be sloped away from the buildings to prevent surface ponding of water close to the exterior walls.

9 Pipe Bedding Requirement

It is recommended that the bedding for the underground services including material specification, thickness of cover material and compaction requirements conform to the local requirements of the municipality and/or Ontario provincial Standard Specification and Drawings (OPSS and OPSD).

For guidance, the pipe bedding may consist of 150 mm of OPSS 1010 Granular A for services founded on bedrock. The bedding material should be also placed along the sides and on top of the pipes to provide a minimum cover of 300 mm. The bedding, spring line and cover should be compacted to at least 95 percent the Standard Proctor Maximum Dry Density (SPMDD).

10 Lateral Earth Pressure against Basement Walls

The subsurface walls should be backfilled with free draining material, such as OPSS 1010 for Granular B, Type II and equipped with a perimeter drainage system to prevent the buildup of hydrostatic pressure behind the walls. The walls will be subjected to lateral static and dynamic (seismic) earth forces.

For design purposes, the lateral static earth thrust against the subsurface walls may be computed from the following equation:

$$P = K_0 H (q + \frac{1}{2} \gamma H)$$

where P = lateral earth thrust acting on the subsurface wall; kN/m

K_0 = lateral earth pressure coefficient for 'at rest' condition for Granular B Type II backfill material = 0.5

γ = unit weight of free draining granular backfill; Granular B = 22 kN/m³

H = Height of backfill adjacent to foundation wall, m

q = surcharge load, kPa

The lateral seismic thrust may be computed from the equation given below:

$$\Delta P_E = 0.32 \gamma H^2$$

where ΔP_E = resultant thrust due to seismic activity; kN/m

γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m³

H = height of backfill behind wall, (m)

The ΔP_E value does not take into account the surcharge load. The resultant load should be assumed to act at 0.6 H from the bottom of the wall.

11 Excavations

Excavations for the construction of the residential blocks and underground services is expected to require the removal of the bedrock throughout the majority of the site.

Excavations at the site must comply with the latest version of Ontario Occupational Health and Safety Act, Ontario Regulations 213/91 (January 11, 2014), i.e. excavation in the overburden should be cut back at a slope of 1H to 1V.

Excavation of the bedrock may be undertaken with near vertical sides and would require the use of line drilling and blasting techniques. To prevent any damage to the surrounding structures and services, the blasting operations would have to be carefully planned and closely monitored. It is recommended that the blasting contractor should retain the services of a blast specialist to provide him with a blasting plan. The contractor should have a licensed blaster on site always during the blasting and a vibration engineer on retainer. A condition survey of all the structures near the site should be undertaken prior to commencement of the excavation work. Vibration monitoring should be carried out during blasting operations. Vibrations should be monitored at property boundaries and should be limited so that there will be no damage to the existing structures or services.

Water inflow into the excavation should be expected. However, it should be possible to adequately handle this inflow by collecting the water in perimeter ditches and pumping from properly filtered sumps. It is possible that additional localized sumps may be required in areas where the seepage is more extensive.

12 Seismic Site Classification

12.1 Liquefaction Potential

The investigation has revealed that the residential blocks will be founded on bedrock.

Based on the results of the investigation, there is no liquefaction potential of the subsurface soil during a seismic event.

12.2 Seismic Classification

Based on the subsurface conditions, the site is classified as **Class C for seismic site response** in accordance with Section 4.1.8.4 of the 2012 Ontario Building Code (ONBC 2012).

A higher site class will likely be obtained if a shear-wave velocity testing is completed at the site.

13 Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

The material to be excavated from the site will comprise of topsoil and small quantity of heterogenous fill, silty sand and sand. The overburden may be re-used in for general grading purposes in the general area of the site provided it is free of organics and cobbles and boulders. Topsoil should be removed and discarded.

It is anticipated that the majority of the material required for backfilling purposes will need to be imported and should preferably conform to the following specifications:

- Engineering fill under footing and basement floor and in the previous tank area/pump island – OPSS 1010 Granular B Type II placed in 300 mm thick lifts and compacted to 100 percent of the SPMDD under footings and to 98 percent of the SPMDD under the basement floors;
- Backfilling against exterior basement walls – OPSS 1010 Granular B Type II, placed in 300 mm thick lifts and compacted to 95 percent of the SPMDD;
- Trench backfill and fill placement to subgrade level for pavement – OPSS 1010 Select Subgrade Material (SSM), free of organics, debris and with a natural moisture content within 2 percent of the optimum moisture content. It should be placed in 300 mm thick lifts compacted to minimum 95 percent of the SPMDD.

14 Subdivision Road and Parking Area

The subgrade at the site is expected to be bedrock or engineered fill comprising of material conforming to OPSS 1010 Select Subgrade Material (SSM). Pavement structure thicknesses required for the subdivision streets and driveways were computed and are shown on Table V. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination, textural classification of the soil samples and functional design life of 18 to 20 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table V: Recommended Pavement Structure Thicknesses				
Pavement Layer	Compaction Requirements	Driveways	Subdivision Roadways	
			Surface Parking	Heavy Duty/Fire-Route
Asphaltic Concrete (PG 58-34)	92 to 97% MRD	50 mm HL3	65mm – SP12.5 OR HL3	40 mm SP12.5 OR HL3 50 mm SP19 OR HL8
Granular A Base (crushed limestone)	100% SPMDD*	150 mm	150 mm	150 mm
Granular B Sub-base, Type II	100% SPMDD*	300 mm	300 mm Overburden 200 mm Bedrock	400 mm Overburden 300 mm Bedrock
SPMDD* Standard Proctor Maximum Dry Density, ASTM-D698 MRD denotes Maximum Relative Density, ASTM D2041 Asphaltic Concrete in accordance with OPSS 1150/ 1151				

Additional comments on the construction of parking area are as follows:

1. As part of the subgrade preparation for the areas to be paved, the subdivision roadways should be stripped of topsoil and other obviously unsuitable material down to subgrade level. The exposed area should be proof rolled with a vibratory roller. Any soft areas detected should be sub-excavated and replaced with approved imported material conforming to OPSS 1010 for Select subgrade Material (SSM). Fill required to raise the grades to design elevations should conform to OPSS 1010 SSM and should be placed in 300 mm lifts and each lift compacted to 95 percent of the SPMDD.
2. The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. As a minimum, subdrains stubs should be installed at the catchbasin. This will ensure no water collects in the granular course, which could result in pavement failure during

the spring thaw. The location and extent of sub drainage required within the paved areas should be reviewed by this office in conjunction with the proposed site grading.

3. To minimize the problems of differential movement between the pavement and catch basins/manhole due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS Granular B, Type II material. Weep holes should be provided in the catch basins/manholes to facilitate drainage of any water that may accumulate in the granular fill.
4. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 2 percent) to provide effective surface drainage towards catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.
5. Transition zone should be provided in areas where subgrade changes from overburden to bedrock. EXP can provide additional recommendation in areas where this case arises;
6. The granular materials used for pavement construction should conform to OPSS 1010 for Granular A and Granular B, Type II and should be compacted to 100 percent of the SPMDD (ASTM D698-12 e2). The asphaltic concrete used, and its placement should meet OPSS 1150/1151 and 310/313 requirements. It should be compacted to 92 to 97 percent of the maximum relative density in accordance with ASTM D2041.

It is recommended that EXP be retained to review the final pavement structure design and drainage plans prior to construction to ensure that they are consistent with the recommendations of this report.

15 General Comments

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes and test pits required to determine the localized underground conditions, especially bedrock elevations between boreholes and test pits affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretation of the factual borehole and test pit results to draw their own conclusions as to how the subsurface conditions may affect them.

The information contained in this report is not intended to reflect on environmental aspects of the soils and groundwater. Should specific information be required, including for example, the presence of pollutants, contaminants or other hazards in the soil, additional testing may be required.

Due to the presence of shallow bedrock and variability of the bedrock elevations throughout the site and limitation of the fieldwork completed to date, it is highly recommended that an additional test pit investigation should be undertaken at the site to collect additional data on the bedrock elevations prior to finalizing the design and tendering of the project.

We trust that this information is satisfactory for your purposes. Should you have any questions, please contact this office.

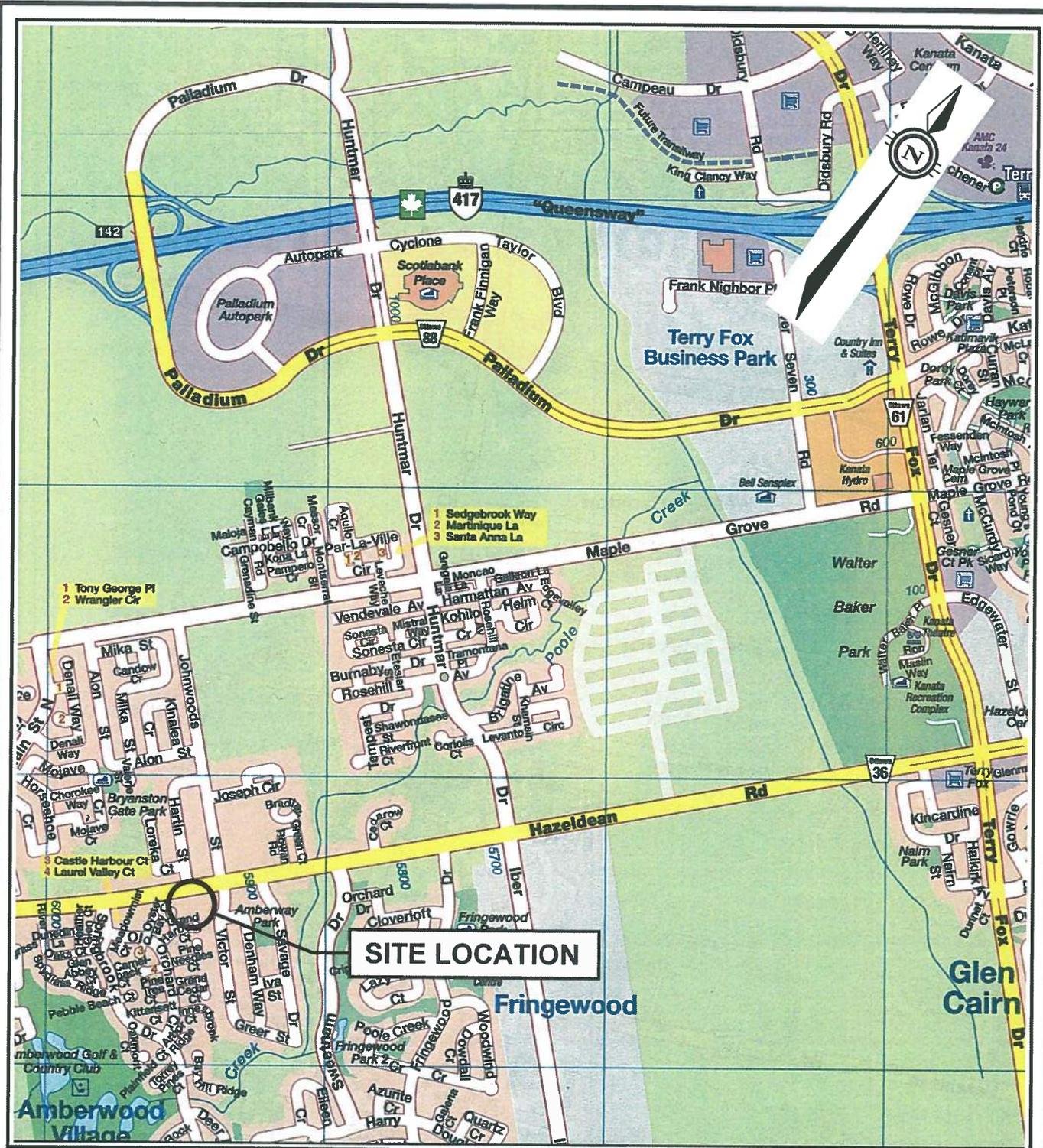
EXP Services Inc.

Client: Hazeldean Crossing Inc.
Geotechnical Investigation, Proposed Residential Development
5924 and 5938 Hazeldean Road, City of Ottawa, Ontario
OTT-00250806-A0
May 14, 2019

Figures



File name: p:\projects\environmental\2500000a\2500000a\250806-co phase two esa 5938 hazeldean rd\working drawings\phase i dwgs\250806-co fig 1 - 2.dwg
 Last Saved: 4/26/2019 1:31:40 PM
 Last Plotted: 4/30/2019 9:23:31 AM
 Pen Table: from standard, July 01, 2004.ctb
 Plotted by: nugentm

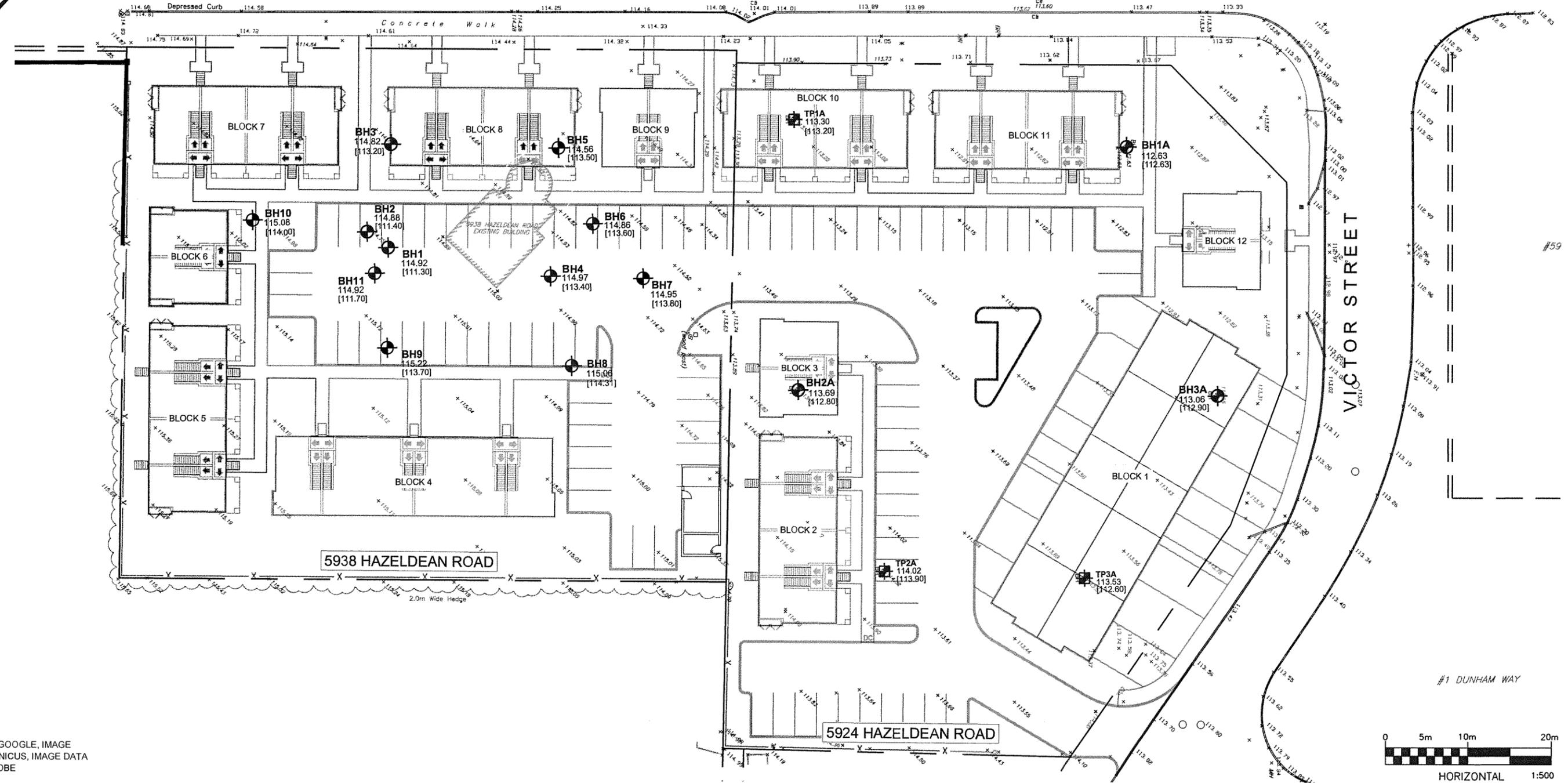


exp Services Inc. www.exp.com
 t: +1.613.688.1899 | f: +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6, Canada

DATE APRIL 2019		CLIENT: HAZELDEAN CROSSING INC.	project no. OTT-00250806-A0
DESIGN C.H.	CHECKED M.G.M.		scale 1:5,000
DRAWN BY M.N.			TITLE: Site Location Plan. 5924-5938 Hazeldean Road, Ottawa, ON
			FIG 1



HAZELDEAN ROAD



MAP DATA ©2018 GOOGLE, IMAGE
 LANDSAT/ COPERNICUS, IMAGE DATA
 ©2018 DIGITALGLOBE

- NOTES:**
1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
 2. SOIL AND ROCK SAMPLES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
 3. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT THE BOREHOLE LOCATIONS.
 4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
 5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
 6. BASE PLAN OBTAINED FROM FMW, JOB NUMBER Z10700, DATED APRIL 9th, 2019

LEGEND

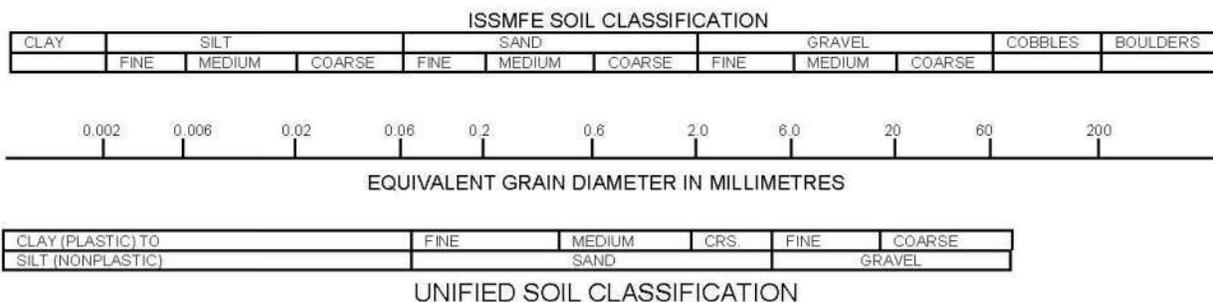
	BH1 114.20	BOLEHOLE NUMBER, LOCATION AND ELEVATION
	TP2 113.20	TEST PIT NUMBER, LOCATION AND ELEVATION
	[113.70]	BEDROCK ELEVATION

<p>exp Services Inc. t: +1.613.688.1899 f: +1.613.225.7337 2650 Queensview Drive, Suite 100 Ottawa, ON K2B 8H6 Canada www.exp.com • BUILDINGS • EARTH & ENVIRONMENT • ENERGY • • INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •</p>		project no. OTT-00250806-A0
		HAZELDEAN CROSSING INC.
scale 1:500	CLIENT:	HAZELDEAN CROSSING INC. BOLEHOLE LOCATION PLAN 5924-5938 HAZELDEAN ROAD, OTTAWA, ON
date APRIL, 2019	TITLE:	
drawn by A.O.		
		FIG 2

File name: p:\projects\geotechnical\2500000\2500000\250806 geo investigation hazeldean zayonto - drawings\250806-co bh.dwg
 Last Saved: 5/22/2019 10:37:12 AM
 Last Plotted: 5/22/2019 10:37:38 AM Plotted by: HewsonJ Pen Table: : trow standard, July 01, 2004.ctb

Notes On Sample Descriptions

- All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



- Fill:** Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.
- Till:** The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole BH 1A



Project No: OTT-00250806-A0

Figure No. 3

Project: Geotechnical Investigation - Proposed Residential Development

Page. 1 of 1

Location: 5924 & 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: February 20, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-75 Trackmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: M.L. Checked by: I.T.

Shear Strength by Vane Test

G W L	S O M E T H I N G S	SOIL DESCRIPTION	Geodetic m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³	
					Shear Strength				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
					20	40	60	80	250	500	750		
		SANDSTONE BEDROCK Some interbedded limestone layers, fine grained, moderate joint spacing, some shale partings, grey (good to excellent quality)	112.63	0									
				1									Run 1
			111.16	2									Run 2
				3									
				4									Run 3
		Borehole Terminated at 4.6 m Depth	108.0										

LOG OF BOREHOLE BH LOGS - 250806 - 5924 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - 19 mm diameter standpipe piezometer installed upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Feb. 22, 2019	1.5	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	0 - 1.5	97	82
2	1.5 - 3.1	100	85
3	3.1 - 4.6	100	90

Log of Borehole BH 2A



Project No: OTT-00250806-A0
 Project: Geotechnical Investigation - Proposed Residential Development
 Location: 5924 & 5938 Hazeldean Road, City of Ottawa, Ontario
 Date Drilled: January 11, 2019
 Drill Type: CME-75 Trackmount
 Datum: Geodetic
 Logged by: M.L. Checked by: I.T.

Figure No. 4
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³
					Shear Strength				250	500	750	
					20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		TOPSOIL ~30 mm	113.69	0								
		FILL Mixture of sand, gravel and silty clay, brown, moist, upper 600 mm frozen	113.6									
		WEATHERED BEDROCK	112.8									
		SANDSTONE BEDROCK Some interbedded limestone layers, some shaly partings, fine grained, moderate joint spacing, several horizontal fractures/seams in the upper 1200 mm, grey, (fair to excellent quality)	112.6	1								
				2								Run 1
				3								Run 2
				4								Run 3
				5								Run 3
		Borehole Terminated at 5.8 m Depth	107.9									

LOG OF BOREHOLE BH LOGS - 250806 - 5924 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:**
- Borehole data requires interpretation by EXP before use by others
 - 32 mm diameter monitoring well installed upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Feb. 22, 2019	3.3	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	1.1 - 2.6	100	60
2	2.6 - 4.2	100	90
3	4.2 - 5.8	100	92

Log of Borehole BH 3A



Project No: OTT-00250806-A0
 Project: Geotechnical Investigation - Proposed Residential Development
 Location: 5924 & 5938 Hazeldean Road, City of Ottawa, Ontario
 Date Drilled: January 11, 2019
 Drill Type: CME-75 Trackmount
 Datum: Geodetic
 Logged by: M.L. Checked by: I.T.

Figure No. 5
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

G W L	S O B H	SOIL DESCRIPTION	Geodetic m	D e p t h	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³
					Shear Strength				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
					20	40	60	80	250	500	750	
		TOPSOIL ~20 mm	113.06	0								
		FILL Gravel and sand, brown, moist, frozen	113.0 112.9									
		SANDSTONE BEDROCK Some interbedded limestone layers, fine grained, moderate joint spacing, fractured and with horizontal seams in upper 1200 mm, some shaly partings, grey (very poor to excellent quality)		1								Run 1
				2								Run 2
			109.98	3								Run 3
				4								Run 3
		Borehole Terminated at 4.7 m Depth	108.4									

LOG OF BOREHOLE BH LOGS - 250806 - 5924 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:**
- Borehole data requires interpretation by EXP before use by others
 - 32 mm diameter monitoring well installed upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Feb. 22, 2019	3.1	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	0.2 - 1.6	100	24
2	1.6 - 3.1	100	87
3	3.1 - 4.7	100	98

Log of Test Pit TP-1A



Project No: OTT-00250806-A0
 Project: Geotechnical Investigation - Proposed Residential Development
 Location: 5924 & 5938 Hazeldean Road, City of Ottawa, Ontario
 Date Drilled: February 12, 2019
 Drill Type: Backhoe
 Datum: Geodetic
 Logged by: M.L. Checked by: I.T.

Figure No. 6
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

G W L	S Y M B O L	SOIL DESCRIPTION	Geodetic m	D e p t h 0	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			N a t u r a l U n i t W t. k N/m ³
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
					50	100	150	200	20	40	60	
		TOPSOIL ~80 mm Topsoil mixed with sand and gravel Refusal to Backhoe Bucket at 0.08 m Depth	113.3 113.2									

LOG OF BOREHOLE BH LOGS - 250806 - 5924 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:**
- Borehole data requires interpretation by EXP before use by others
 - Test Pit Backfiled Upon Completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Test Pit TP-2A



Project No: OTT-00250806-A0
 Project: Geotechnical Investigation - Proposed Residential Development
 Location: 5924 & 5938 Hazeldean Road, City of Ottawa, Ontario
 Date Drilled: February 12, 2019
 Drill Type: Backhoe
 Datum: Geodetic
 Logged by: M.L. Checked by: I.T.

Figure No. 7
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		TOPSOIL ~130 mm Some sand, gravel and rootlets	114.02	0								
		WEATHERED BEDROCK Fractured and weathered bedrock, grey Refusal to Backhoe Bucket at 0.4 m Depth	113.9 113.6									

LOG OF BOREHOLE BH LOGS - 250806 - 5924 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - Test Pit Backfilled Upon Completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Test Pit TP-3A



Project No: OTT-00250806-A0
 Project: Geotechnical Investigation - Proposed Residential Development
 Location: 5924 & 5938 Hazeldean Road, City of Ottawa, Ontario
 Date Drilled: February 12, 2019
 Drill Type: Backhoe
 Datum: Geodetic
 Logged by: M.L. Checked by: I.T.

Figure No. 8
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

G W L	S Y M B O L	SOIL DESCRIPTION	Geodetic m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			S A M P L E S	Natural Unit Wt. kN/m ³
					20	40	60	80	250	500	750		
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		TOPSOIL ~100 mm Some sand, gravel and rootlets	113.53 113.4 113.2	0									
		FILL Silty sand, some gravel and debris, brown, moist											
		SILTY SAND TILL Some gravel, some boulders and cobbles, brown, moist	112.6										
		Refusal to Backhoe Bucket at 0.9 m Depth											

LOG OF BOREHOLE BH LOGS - 250806 - 5924 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - Test Pit Backfilled Upon Completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH 01



Project No: OTT-00250806-A0

Figure No. 9

Project: Geotechnical Investigation. Proposed Residential Development.

Page. 1 of 1

Location: 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: February 15th, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-75 Truckmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: M.L. Checked by: M.M.

Shear Strength by

Shear Strength by

Vane Test

GWL	SOIL DESCRIPTION	Geodetic m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³	
				Shear Strength kPa				250	500	750		
				20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)				
	SAND TO SAND AND GRAVEL FILL Fine to medium grained, some gravel, brown, moist, no odour, upper 600 mm frozen, (loose)	114.92	0	12				0				
			1	6				0				
	SAND FILL Fine grained, trace silt, brown to grey, moist to wet, petroleum odour at 3.0 m depth, (loose to very loose)	113.4	2	4				0				
			2									
		112.42	3	2				0				
			3									
	Auger Refusal at 3.6 m Depth	111.3										

LOG OF BOREHOLE BH LOGS - 250806 (ENV) - 5938 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - A 37 mm diameter monitoring well installed upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.4	-
11 days	3.1	-
26 days	3.0	-
31 days	3.0	-
99 days	2.5	-

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH 02



Project No: OTT-00250806-A0

Figure No. 10

Project: Geotechnical Investigation. Proposed Residential Development.

Page. 1 of 1

Location: 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: February 15th, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-75 Truckmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: M.L. Checked by: M.M.

Shear Strength by

Shear Strength by

Vane Test

Penetrometer Test

G W L	S O B Y L	SOIL DESCRIPTION	Geodetic m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			S O I L T E M P E R A T U R E	Natural Unit Wt. kN/m ³	
					Shear Strength kPa				250	500	750			
					20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)					
		SAND AND GRAVEL TO SAND FILL Fine to medium grained, some gravel, brown, moist, no odour, upper 700 mm frozen, (loose)	114.88	0										
				1	15				0					
		SAND FILL Fine grained, trace silt and gravel, brown to grey, moist to wet, strong petroleum odour at 3.0 m depth, (loose)	113.4	2	6				0					
				3	5				0					
				4	4				0					
		Auger Refusal at 3.5 m Depth	111.4	3	50/Refusal				40					

LOG OF BOREHOLE BH LOGS - 250806 (ENV) - 5938 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - A 37 mm diameter monitoring well installed upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.5	-
11 days	3.1	-
26 days	3.1	-
31 days	3.0	-
95 days	2.7	-

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH 05



Project No: OTT-00250806-A0

Figure No. 13

Project: Geotechnical Investigation. Proposed Residential Development.

Page. 1 of 1

Location: 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: February 20th, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-45 Trackmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: M.L. Checked by: M.M.

Shear Strength by

Shear Strength by

Vane Test

G W L	S O B Y L	SOIL DESCRIPTION	Geodetic m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³	
					Shear Strength				250	500	750		
					20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		SAND AND GRAVEL FILL Trace silt and clay, brown, moist, upper 700 mm frozen, (compact)	114.56	0									
				1									
		SANDSTONE BEDROCK Weathered in the upper 100 mm, some interbedded limestone layers, fine grained, moderate joint spacing, some horizontal seams and fractures, grey to light grey (fair to good quality)	113.5	1									
				2									
				3									
			111.26	4									
				5									
		Borehole Terminated at 4.6 m Depth	110.0	4.6									

LOG OF BOREHOLE BH LOGS - 250806 (ENV) - 5938 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:**
- Borehole data requires interpretation by EXP before use by others
 - A 37 mm diameter monitoring well installed upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	-	-
7 days	3.5	-
31 days	3.9	-
36 days	3.5	-
94 days	3.3	-

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	1.1 - 1.6	88	55
2	1.6 - 3.1	90	68
3	3.1 - 4.6	100	85

Log of Borehole BH 06



Project No: OTT-00250806-A0

Figure No. 14

Project: Geotechnical Investigation. Proposed Residential Development.

Page. 1 of 1

Location: 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: March 13th, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-55 Trackmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: M.L. Checked by: M.M.

Shear Strength by

Shear Strength by

Vane Test

G W L	S O B O L	SOIL DESCRIPTION	Geodetic m	D e p t h	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³	
					20	40	60	80	250	500	750		
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		SAND AND GRAVEL FILL Trace silt and clay, brown, moist, upper 700 mm frozen, no odour or staining.	114.86	0									
				1									
		Auger Refusal at 1.3 m Depth	113.6										

LOG OF BOREHOLE BH LOGS - 250806 (ENVJ) - 5938 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - Borehole backfilled upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH 07



Project No: OTT-00250806-A0

Figure No. 15

Project: Geotechnical Investigation. Proposed Residential Development.

Page. 1 of 1

Location: 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: March 13th, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-55 Trackmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: M.D. Checked by: M.M

Shear Strength by

Shear Strength by

Vane Test

G W L	S O B O L	SOIL DESCRIPTION	Geodetic m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³	
					20	40	60	80	250	500	750		
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		SAND AND GRAVEL FILL Trace silt and clay, brown, moist, upper 700 mm frozen, no odour or staining.	114.95	0									
				1									
		Auger Refusal at 1.2 m Depth	113.8										

LOG OF BOREHOLE BH LOGS - 250806 (ENV) - 5938 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - Borehole backfilled upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH 08



Project No: OTT-00250806-A0

Figure No. 16

Project: Geotechnical Investigation. Proposed Residential Development.

Page. 1 of 1

Location: 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: March 13th, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-55 Trackmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: M.D. Checked by: M.M

Shear Strength by

Shear Strength by

Vane Test

G W L	S O B O L	SOIL DESCRIPTION	Geodetic m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³	
					20	40	60	80	250	500	750		
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		SAND AND GRAVEL FILL Trace silt and clay, brown, moist, upper 700 mm frozen, no odour or staining.	115.06	0									
		Auger Refusal at 0.8 m Depth	114.3										

LOG OF BOREHOLE BH LOGS - 250806 (ENV) - 5938 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - Borehole backfilled upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH 09



Project No: OTT-00250806-A0

Figure No. 17

Project: Geotechnical Investigation. Proposed Residential Development.

Page. 1 of 1

Location: 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: March 13th, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-55 Trackmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: M.D. Checked by: M.M

Shear Strength by

Shear Strength by

Vane Test

G W L	S O M E L	SOIL DESCRIPTION	Geodetic m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³	
					Shear Strength				250	500	750		
					20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		SILTY SAND FILL WITH SOME GRAVEL Brown, moist, upper 700 mm frozen, no odour or staining.	115.22	0									
		WEATHERED BEDROCK OR BOULDERS Grey, gravel and rock pieces.	113.7	1									
		SANDSTONE BEDROCK Some interbedded limestone layers, some shaly partings, fine grained, moderate joint spacing, grey to light grey, (very poor to good quality).	113.5	2									
			112.72	3									Run 1
													Run 2
													Run 3
		Borehole Terminated at 6.0 m Depth	109.2	6									

LOG OF BOREHOLE BH LOGS - 250806 (ENV) - 5938 HAZELDEAN.GPJ TROW OTTAWA.GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - A 37 mm diameter monitoring well installed upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
5 days	2.1	-
73 days	2.5	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	1.5 - 2.9	94	22
2	2.9 - 4.5	100	44
3	4.5 - 6	99	80

Log of Borehole BH 11



Project No: OTT-00250806-A0

Figure No. 19

Project: Geotechnical Investigation. Proposed Residential Development.

Page. 1 of 1

Location: 5924 and 5938 Hazeldean Road, City of Ottawa, Ontario

Date Drilled: March 13th, 2019

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME-55 Trackmount

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: M.D. Checked by: M.M

Shear Strength by

Shear Strength by

Vane Test

G W L	S O B Y L	SOIL DESCRIPTION	Geodetic m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m ³
					Shear Strength				250	500	750	
					20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		SAND AND GRAVEL TO SAND FILL Fine to medium grained, some gravel, brown, moist, no odour, upper 700 mm frozen, (loose)	114.92	0								
				1								
				2								
			112.22									
				3								
		WEATHERED BEDROCK OR BOULDERS Grey, gravel and rock pieces.	111.7									
		SANDSTONE BEDROCK Some interbedded limestone layers, some shaly partings, fine grained, moderate joint spacing, several fractures throughout, grey (fair to good quality).	111.4									
				4								Run 1
				5								Run 2
				6								Run 3
		Borehole Terminated at 6.4 m Depth	108.5									

LOG OF BOREHOLE BH LOGS - 250806 (ENV) - 5938 HAZELDEAN GPJ TROW OTTAWA GDT 5/22/19

- NOTES:
- Borehole data requires interpretation by EXP before use by others
 - A 37 mm diameter monitoring well installed upon completion
 - Field work supervised by an EXP representative.
 - See Notes on Sample Descriptions
 - Log to be read with EXP Report OTT-00250806-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
5 days	3.0	-
73 days	2.7	

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	3.2 - 4.2	73	50
2	4.2 - 5.7	100	66
3	5.7 - 6.4	100	89

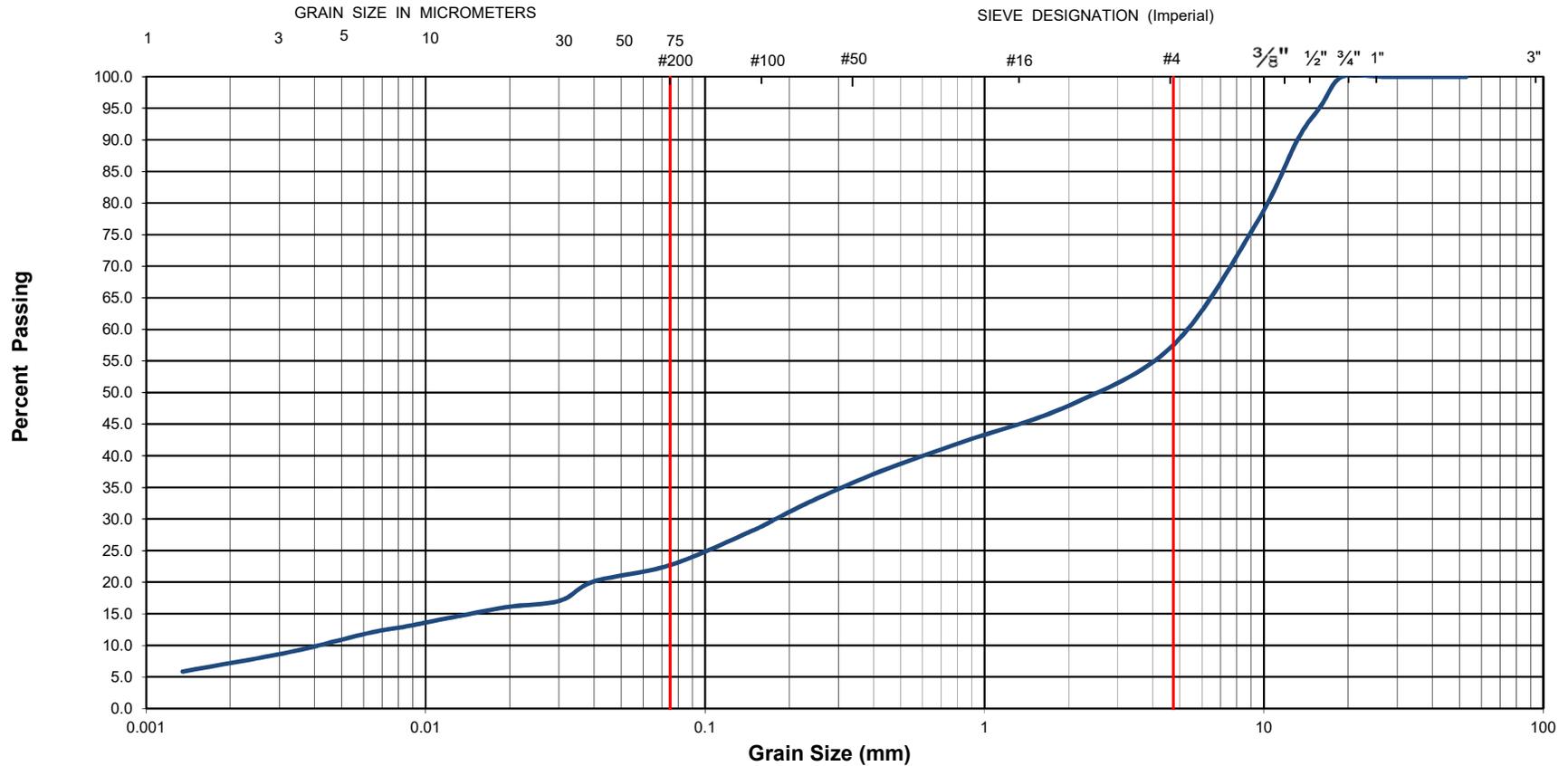


Grain-Size Distribution Curve Method of Test For Particle Size Analysis of Soil ASTM C-136/ASTM D422

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Unified Soil Classification System

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



EXP Project No.:	OTT-00250806-A0	Project Name :	Geotechnical Investigation - Proposed Residential Development		
Client :	Hazeldean Crossing Inc.	Project Location :	5924 Hazeldean Rd, Ottawa		
Date Sampled :	January 11, 2019	Borehole No:	BH 3A	Sample No.: AS1	
Sample Description :	% Silt and Clay	23	% Sand	35	
Sample Description :	Silty Sand & Gravel (SM)			% Gravel	42
Sample Description :				Figure :	20

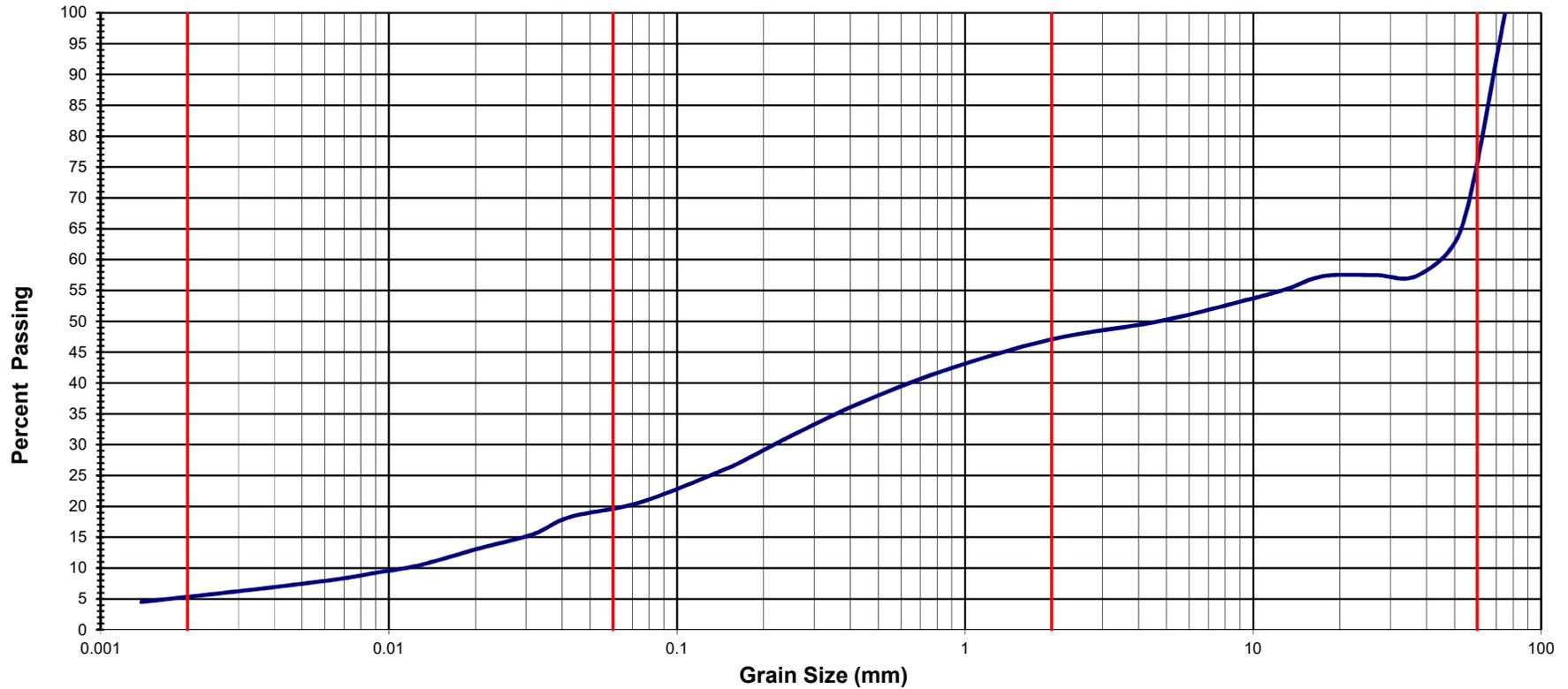


**Grain-Size Distribution Curve
Method of Test for Particle Size Analysis of Soil
ASTM C-136/ASTM D-422**

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL		
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse



EXP Project No.:	OTT-00250806-A0	Project Name :	Geotechnical Investigation - Proposed Residential Development					
Client :	Hazeldean Crossing Inc.	Project Location :	5924 Hazeldean Rd, Ottawa					
Date Sampled :	February 12, 2019	Borehole No:	TP 3A	Sample No.:	S2	Depth (m) :	0.3-0.9	
Sample Composition:	% Clay:	5	% Silt:	18	% Sand:	24	% Gravel:	53
Sample Description :	Sandy Gravel, some Silt, trace Clay					Figure :	21	

DRY BEDROCK CORES



WET BEDROCK CORES

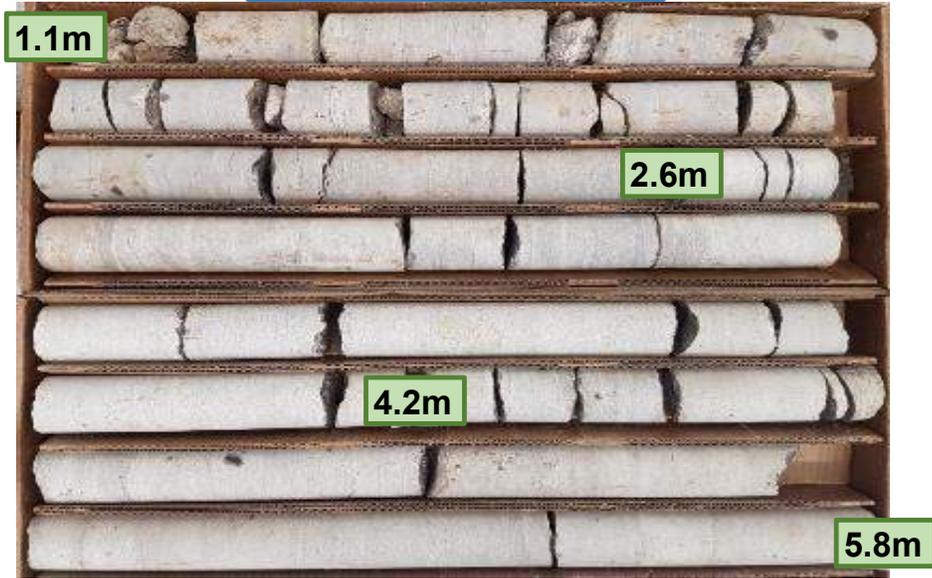


exp Services Inc.
 t: +1.613.688.1899 | f: +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6
 Canada
www.exp.com

- BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no. BH 1A	core runs Run 1: 0 m - 1.5m Run 2: 1.5m - 3.1m Run 3: 3.1m - 4.6m	PROJECT PROPOSED RESIDENTIAL DEVELOPMENT 5924 & 5938 HAZELDEAN RD, OTTAWA, ON	project no. OTT-00250806-A0
date cored Feb 20, 2019		ROCK CORE PHOTOGRAPHS	FIG 22

DRY BEDROCK CORES



WET BEDROCK CORES



exp Services Inc.

t +1.613.688.1899 | f +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6
 Canada

www.exp.com

- BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no. BH 2A	core runs Run 1: 1.1m - 2.6m Run 2: 2.6m - 4.2m Run 3: 4.2m - 5.8m	PROJECT PROPOSED RESIDENTIAL DEVELOPMENT 5924 & 5938 HAZELDEAN RD, OTTAWA, ON	project no. OTT-00250806-A0
date cored Jan 11, 2019		ROCK CORE PHOTOGRAPHS	FIG 23

DRY BEDROCK CORES



WET BEDROCK CORES



exp Services Inc.
 t +1.613.688.1899 | f +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6
 Canada
www.exp.com

- BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no. BH 3	core runs Run 1: 1.7m - 2.0m Run 2: 2.0m - 2.7m Run 3: 2.7m - 4.2m Run 4: 4.2m - 4.8m	PROJECT PROPOSED RESIDENTIAL DEVELOPMENT 5924 & 5938 HAZELDEAN RD, OTTAWA, ON	project no. OTT-00250806-C0
date cored Feb 15, 2019		ROCK CORE PHOTOGRAPHS	FIG 24

DRY BEDROCK CORES



WET BEDROCK CORES



exp Services Inc.

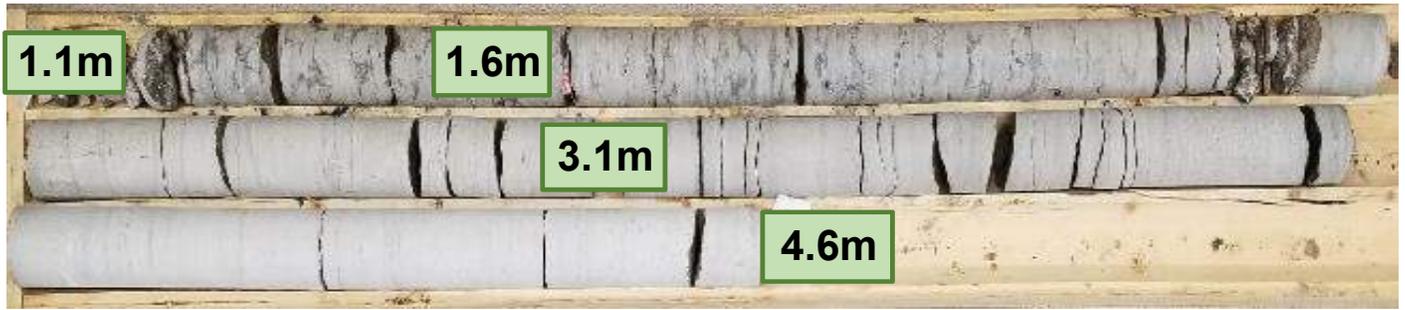
t +1.613.688.1899 | f +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6
 Canada

www.exp.com

- BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no. BH 4	core runs Run 1: 1.7m - 2.0m Run 2: 2.0m - 3.1m Run 3: 3.1m - 4.7m	PROJECT PROPOSED RESIDENTIAL DEVELOPMENT 5924 & 5938 HAZELDEAN RD, OTTAWA, ON	project no. OTT-00250806-C0
date cored Feb 19, 2019		ROCK CORE PHOTOGRAPHS	FIG 25

DRY BEDROCK CORES



WET BEDROCK CORES



exp Services Inc.

t +1.613.688.1899 | f +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6
 Canada

www.exp.com

- BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no. BH 5	core runs Run 1: 1.1m - 1.6m Run 2: 1.6m - 3.1m Run 3: 3.1m - 4.6m	PROJECT PROPOSED RESIDENTIAL DEVELOPMENT 5924 & 5938 HAZELDEAN RD, OTTAWA, ON	project no. OTT-00250806-A0
date cored Feb 20, 2019		ROCK CORE PHOTOGRAPHS	FIG 26

DRY BEDROCK CORES



WET BEDROCK CORES

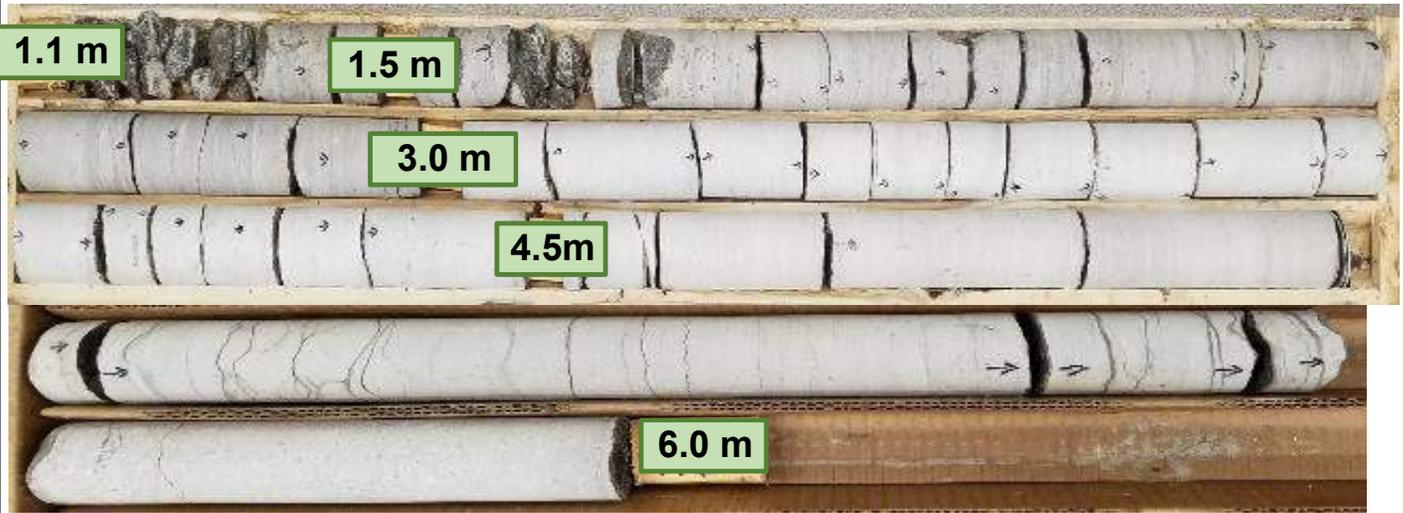


exp Services Inc.
 t +1.613.688.1899 | f +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6
 Canada
www.exp.com

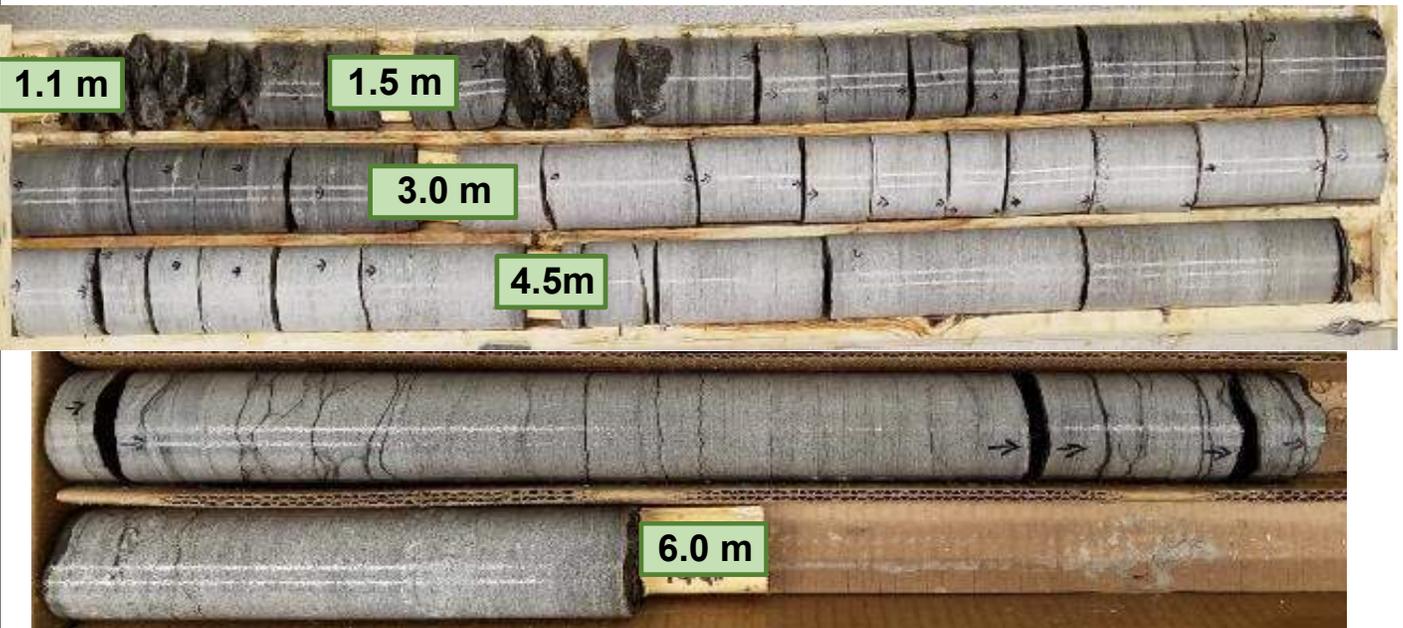
- BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no. BH 9	core runs Run 1: 1.5 - 2.9m Run 2: 2.9m - 4.5m Run 3: 4.5m - 6.0m	PROJECT PROPOSED RESIDENTIAL DEVELOPMENT 5924 & 5938 HAZELDEAN ROAD, OTTAWA, ON	project no. OTT-00250806-A0
date cored Mar 13, 2019		ROCK CORE PHOTOGRAPHS	FIG 27

DRY BEDROCK CORES



WET BEDROCK CORES



exp Services Inc.

t +1.613.688.1899 | f +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6
 Canada

www.exp.com

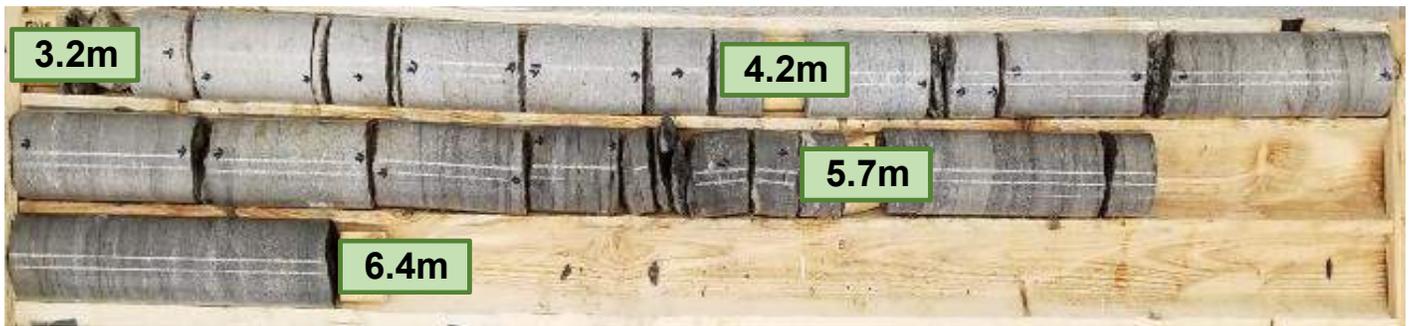
- BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no. BH 10	core runs Run 1: 1.1m - 1.5m Run 1.5 m - 3.0m	PROJECT PROPOSED RESIDENTIAL DEVELOPMENT 5924 & 5938 HAZELDEAN RD, OTTAWA, ON	project no. OTT-00250806-A0
date cored Mar 13, 2019	Run 3.0m - 4.5m Run 4.5 m - 6 m	ROCK CORE PHOTOGRAPHS	FIG 28

DRY BEDROCK CORES



WET BEDROCK CORES



exp Services Inc.

t +1.613.688.1899 | f +1.613.225.7337
 2650 Queensview Drive, Suite 100
 Ottawa, ON K2B 8H6
 Canada

www.exp.com

- BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no. BH 11	core runs Run 1: 3.2m - 4.2m Run 2: 4.2m - 5.7m Run 3: 5.7m - 6.4m	PROJECT PROPOSED RESIDENTIAL DEVELOPMENT 5924 & 5938 HAZELDEAN RD, OTTAWA, ON	project no. OTT-00250806-A0
date cored Mar 13, 2019		ROCK CORE PHOTOGRAPHS	FIG 29

EXP Services Inc.

Client: Hazeldean Crossing Inc.
Geotechnical Investigation, Proposed Residential Development
5924 and 5938 Hazeldean Road, City of Ottawa, Ontario
OTT-00250806-A0
May 14, 2019

List of Distribution

Report Distributed To:

Hazeldean Crossing Inc.- Carmine Zayoun; carmine.zayoun@gmail.com
EXP Infrastructure Division - Mr. Bruce Thomas. Bruce.thomas@exp.com
Jaime Posen, MCIP RPP- Fotenn - posen@fotenn.com

