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## GEOTECHNICAL INVESTIGATION



**PROPOSED DEVELOPMENT**

**5210 INNES ROAD, OTTAWA, ON**

400 Esna Park Drive, Unit 15  
Markham, ON  
L3R 3K2

Tel: (905) 475-7755  
Fax: (905) 475-7718  
[www.fisherenvironmental.com](http://www.fisherenvironmental.com)

Prepared for:

**Dymon Group of Companies**

Project No. FG 22- 12469

November 30, 2022

Revised August 8, 2023

**Issued to:** Dymon Group of Companies

**Contact:** James Byck, BArch. CET  
Senior Director - Development and Construction  
2-1830 Walkley Road  
Ottawa ON K1H 8K3  
E: [jbyck@dymon.ca](mailto:jbyck@dymon.ca)

**Project Name:** Geotechnical Investigation  
Proposed Development

**Project Address:** 5210 Innes Road, Ottawa, On

**Project Number:** FG 22-12469

**Issued on:** Revised August 8, 2023

**Project Manager:**  
(Primary Contact) Sean Fisher, M.Sc. Eng.,  
Project Manager,  
[sean@fishereng.com](mailto:sean@fishereng.com)



**REPORT PREPARED BY:** Frank Fan, P. Eng.,  
Geotechnical Engineer  
[frank@fishereng.com](mailto:frank@fishereng.com)



**Report Reviewed By:** Rajinder Chahal, P. Eng.,  
Senior Project Engineer  
647.227.8473  
[rajinder@fishereng.com](mailto:rajinder@fishereng.com)



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## **1. INTRODUCTION**

Fisher Engineering Limited (Fisher) was retained by Dymon Group of Companies to carry out a Geotechnical Investigation for the proposed development at the property municipally addressed as 5210 Innes Road, Ottawa, Ontario, hereinafter referred to as the 'Site'.

The purpose of this investigation was to assess subsurface soil and groundwater conditions at the site and provide geotechnical parameters and make recommendations for the design/construction of the proposed new development.

Discussion of the findings and results of the Geotechnical Investigation are in accordance with the general terms of reference. This report was prepared specifically and solely regarding geotechnical aspects of the design & construction for the proposed development as detailed to Fisher at the time of the investigation.

The report was revised to address comments regarding tree planting in sensitive marine clay (Section 14).

## **2. SITE AND PROJECT DESCRIPTIONS**

### **Site Settings**

The site is located at the southeast corner of the intersection of Innes Road and Trim Road in Ottawa, and is bounded by Innes Road to the north, industrial properties to the east & south and Trim Road to the west, beyond which are commercial properties.

The subject property, which was vacant and covered with grass during the investigation, has an approximate area of 12,986m<sup>2</sup>, is square.

### **Topography**

The site is fairly flat and is approximately 0.6 to 1.0m below the adjacent roadways (Innes Road and Trim Road). Ground surface elevations vary from approximately 87.67m to 88.01m asl based on the topographic survey plan provided to Fisher.

### **Proposed Development**

Site Plans, prepared by DCA- A Group of Architect, dated June 7, 2023, provided to Fisher during the current investigation show the proposed development consisting of a 3-storey, 18m high self- storage building with no underground levels. The proposed building will be located in the centre of the property with a footprint of 5,585.69m<sup>2</sup>. Finished Floor Elevation (FFE) was given as 89.38m asl.

### **3. PREVIOUS SITE INVESTIGATION**

Fisher previously conducted a geotechnical investigation, for a proposed building with a footprint of 2159m<sup>2</sup> which was to be located at the northwestern portion of the property. During the investigation, three (3) boreholes, BH1, BH2 and BH3, were advanced to depths of 18.3m to 25.32m below prevailing grade using dynamic cone penetration tests. A geotechnical report was submitted under FE-P 21-10993, dated March 19, 2021.

### **4. FIELD AND LABORATORY WORK**

Subsurface soil exploration for the current Geotechnical Investigation was conducted concurrent with drilling for a Hydrogeological Investigation on September 20 - 23, 2022 and consisted of six (6) boreholes, BH101 to BH106, advanced to depths of 6.55m to 32.33m (corresponding elevations from 81.12m to 55.45m asl). Site Plan with borehole locations is presented in Appendix A.

A track mounted drill rig, equipped with solid stem augers/mud rotary, supplied by Terra Firma Environmental Services, was used for all drilling work.

The subsurface soils were sampled generally at regular intervals of depth using a split-spoon sampler following the procedure as detailed in the ASTM Standard specification D1586 for the Standard Penetration Test. Field tests to determine engineering parameters of the soil were carried out during drilling, which included Standard Penetration Tests (SPT). Sampling in the two (2) deep holes, BH101 and BH106, was carried out at depth of 9.14m to 24.41m and 32.33m respectively, covering elevations of 63.43m to 55.45m asl.

All recovered soil samples were placed in clear, sealable plastic bags in the field and transported to the Fisher Engineering laboratory for further examination, characterization and laboratory analyses.

Monitoring wells were installed in the boreholes, except BH3, to depth of 6.10m below prevailing grade on completion of drilling. Groundwater conditions were observed during and on completion of drilling.

#### **Laboratory Analyses**

Seven (7) representative soil samples from BH1, BH2 and BH3 were selected and submitted to Fisher Environmental laboratory for moisture content analyses during the initial geotechnical investigation. Six (6) samples from BH102, BH103 and BH104 were submitted for grain size, moisture and hydrometer

analyses. The laboratory results, which are presented in Appendix C, are consistent with the field description for subsurface soils discussed in Section 4.0.

The soil samples recovered during the current investigation will be stored at the Fisher Engineering laboratory for a period of thirty (30) days after submitting this report and will be discarded thereafter unless otherwise instructed by the client.

### Site Survey

Elevations at borehole/monitoring well locations were established by interpolating from a topographic survey plan, by Annis, O'Sullivan, Vollebakk Ltd, dated November 10, 2021, which was provided to Fisher during the investigation.

## 5. SUBSOIL CONDITIONS

Details of subsoil conditions encountered at borehole locations are shown in Appendix B – Log of Boreholes and are summarized as follows:

- FILL/TOPSOIL** – A layer of dark brown clayey silt / topsoil was encountered in BH1 and BH3 to depth of 0.61m and was underlain by brown to greyish brown silty clay fill to maximum depth of 1.22m bgs. The encountered fill layers were moist, except in BH2, where the upper 0.60m was wet. SPT 'N' values were generally from 1 to 4 blows per 300mm penetration in the upper section of organic fill/topsoil changing to 9 to 11 blows per 300mm penetration in the lower section consisting of clayey silt. Moisture content in the lower section ranged from 34 to 37%. Fill depths/elevations are presented in Table 1.

**Table 1: Fill Depths and Elevations**

| Borehole No.                            | BH101 | BH102 | BH103 | BH104 | BH105 | BH106 | BH1   | BH2   | BH3   |
|-----------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Surface Elevation (m asl)               | 87.84 | 87.67 | 87.94 | 87.96 | 87.90 | 87.78 | 87.90 | 88.00 | 87.85 |
| Depth of Borehole (m)                   | 8.08  | 8.08  | 8.08  | 14.18 | 13.72 | 8.08  | 18.29 | 25.30 | 24.99 |
| Elevation at Bottom of Borehole (m asl) | 79.76 | 79.59 | 79.86 | 73.78 | 74.18 | 79.70 | 69.61 | 62.70 | 62.86 |
| Depth of Fill/topsoil (m)               | n/a   | 1.07  | 0.91  | 0.91  | 0.69  | n/a   | 1.22  | 1.07  | 1.22  |
| Elevation at Bottom of Fill (m asl)     |       | 86.60 | 87.03 | 87.05 | 87.21 |       | 86.68 | 86.93 | 86.63 |

- **SILTY CLAY to CLAY** – Brown to grey silty clay to clay deposits were encountered in all boreholes below the fill / organic topsoil. Standard penetration test (SPT) was advanced to 6.55m bgs in these layers with SPT 'N' values ranging from 14 to 0 blows per 300mm penetration and generally 0 to 4 blows at 2.5m indicating a very soft to stiff consistency. Moisture content ranged from 43 to 73% from the samples obtained in the section.

DCPT was advanced at depths below which SPT ended in BH1 to BH3. The very soft (hammer falling under its own weight) to stiff silty clay/ clay deposits likely extend to depths of approximately 17.70m in BH1, 23.80m in BH2 and 18.30m in BH3 with DCPT values generally less than 15 blows per 300mm penetration. DCPT values at greater depths were generally greater than 40 blows per 300mm penetration indicating that the soils may contain clayey silt and /or silty/gravelly sand/crushed rock seams/layers or changed to boulder tills in this zone.

Sampling /SPT testing were carried out in BH101 and BH106 below depth of 9.0m. The very soft to soft clay deposits encountered extended to depths of 18.29m in BH101 & 27.43m in BH 106.

- **CLAY WITH GRAVEL** - Grey, wet, soft clay with, layers of gravelly sand and pieces of rock, was encountered in BH101 below the soft clay, extending to approximate depth of 22.86m bgs.
- **GRAVELLY SAND** - Grey, wet, very dense gravelly sand, with pieces of crushed rock, was encountered below the soft clay/depth of 27.43m in BH106 extending to approximate depth of 31.39m bgs.
- **CRUSHED ROCK MATERIAL** – Grey, dry, crushed rock material with some clay/silt was encountered in BH101 and BH106 below the clayey gravelly sand extending to respective termination depths of 24.41m and 32.33m bgs. SPT 'N' values ranged from 26 to auger refusal at over 100 blows per 300mm indicating a very stiff to hard/very dense condition.
- **BEDROCK** - Refusal to auguring was encountered at depths of 24.41m and 32.33m in BH101 and BH106 respectively. Based on information available on the geological data for BH (ID 616330, drilled on the property across Trim Road) bedrock was encountered at depth of 39m.

Shear Wave Velocity measurements for Seismic Site Class determination were carried out by Geophysics GPR International Inc. on behalf of Fisher and a report submitted dated May 5, 2021. Based on the shear wave measurements, presented in Appendix D, the Median MASW Shear-Wave Velocity Sounding are:

- i. less than 110 to 160 m/s from 0 to 21m,
- ii. 200 to 250 m/s from 21 to 24m,
- iii. 300 to 360 m/s from 24m to 40m and
- iv. 1720 m/s below 40m.

The results indicate soft to stiff soils up to 40m depth and hard rock below.

Based on the preceding information we consider that refusal to auguring in BH101 and BH106 may be due to block/chunk of crushed rock/boulders. Bedrock is likely present around depth of 40m as indicated by shear wave velocity data.

To confirm bedrock depth, rock coring will be required, which may require also coring through obstructions/boulders etc.

## 6. GROUNDWATER CONDITIONS

Monitoring wells were installed in BH101, BH102, BH104, BH105 and BH106 during the field investigation and groundwater conditions observed during and on completion of drilling. Groundwater levels in the open boreholes were measured at 3.55m and 4.88m in BH103 and BH104 while BH102 and BH105 were dry. Boreholes BH101 and BH106 were drilled using mud rotary and consequently standing water levels on completion could not be ascertained. Groundwater levels measured on October 6, 2022 ranged from 1.72m to 2.39m bgs as detailed in Table 2. Details pertaining to groundwater are contained in the accompanying hydrogeological investigation report which was conducted by Fisher. Both reports should be read in conjunction when designing the subsurface portion of the building.

**Table 2: Groundwater Depths and Elevations**

| Monitoring Well No.               |                 | BH(MW)101        | BH(MW)102 | BH103 | BH(MW)104 | BH(MW)105 | BH(MW)106        | BH1   | BH2   | BH3   |
|-----------------------------------|-----------------|------------------|-----------|-------|-----------|-----------|------------------|-------|-------|-------|
| Surface Elevation (m asl)         |                 | 87.84            | 87.67     | 87.94 | 87.96     | 87.90     | 87.78            | 87.90 | 88.00 | 87.85 |
| Depth of Well, m bgs              |                 | 6.10             | 6.10      | n/a   | 6.10      | 6.10      | 6.10             | n/a   | n/a   | n/a   |
| Elevation at well base, m asl     |                 | 81.74            | 81.57     |       | 81.86     | 81.80     | 81.68            |       |       |       |
| Depth of BH, m bgs                |                 | 24.41            | 6.55      | 6.55  | 6.55      | 6.55      | 32.33            | 18.29 | 25.30 | 24.99 |
| Elevation at borehole base, m asl |                 | 63.43            | 81.12     | 81.39 | 81.41     | 81.35     | 55.45            | 69.61 | 62.70 | 62.86 |
| In open borehole on Completion    | GW level, m bgs | n/a - mud rotary | Dry       | 3.55  | 4.88      | Dry       | n/a - mud rotary | 5.49  | 1.52  | 0.61  |
|                                   | GW Ele, m asl   |                  |           | 84.39 | 83.08     |           |                  | 82.41 | 86.48 | 87.24 |
| 6-Oct-22                          | GW level, m bgs | 1.92             | 1.74      | n/a   | 2.07      | 2.09      | 2.36             | n/a   | n/a   | n/a   |
|                                   | GW Ele, m asl   | 85.92            | 85.93     |       | 85.89     | 85.81     | 85.42            |       |       |       |

It should be noted that groundwater levels are subject to seasonal fluctuations. Groundwater levels measured in October are not necessarily representative of seasonal highwater levels at the site.

## 7. FOUNDATION CONSIDERATIONS

It was understood that the proposed development will consist of a 3-storey self-storage building with no underground levels. Finished ground floor elevation (FGFE) is proposed at 87.75m asl.

Subsurface stratigraphy consists of surficial fill overlying a thick layer of native, very soft to stiff, generally very soft to soft clayey deposit below 2.5m extending to approximate depth of 18.59m & 27.50m below prevailing grade in BH101 & BH102 respectively. Drilling was terminated in hard clay/rock material and very dense sand in BH101 & BH106 at depths of 24.41m & 32.33m respectively (63.43m and 55.45m asl).

According to MASW Shear-Wave velocity measurements, possibly hard rock is present at 40m bgs with a velocity value over 1700m/s.

### 7.1 Shallow Foundations

#### 7.1.1 Conventional Strip /Spread Footings

Based on subsoil conditions observed during the investigation, native soils, within feasible shallow foundation depths, are not competent to support conventional spread/strip footings for the expected/anticipated large loads from the proposed building.

Table 3 presents a reference of approximate depths/elevations for conventional footings, along with corresponding bearing resistance for limit states design (SLS and ULS).

**Table 3: Foundation Design for Conventional Footings**

| Building/Borehole    |       |                            | Elevation at BH surface (m asl) | Approx depth of footings at or below |       | Bearing Resistance |              |
|----------------------|-------|----------------------------|---------------------------------|--------------------------------------|-------|--------------------|--------------|
|                      |       |                            |                                 | m bgs                                | m asl | at SLS (kPa)       | at ULS (kPa) |
| Proposed Development | BH1   | With no underground levels | 87.90                           | 1.35                                 | 86.55 | 50                 | 60           |
|                      | BH2   |                            | 88.00                           | 1.35                                 | 86.65 | 50                 | 60           |
|                      | BH4   |                            | 87.85                           | 1.50                                 | 86.35 | 100                | 120          |
|                      | BH102 |                            | 87.67                           | 1.20                                 | 86.47 | 50                 | 60           |
|                      | BH103 |                            | 87.94                           | 1.10                                 | 86.84 | 50                 | 60           |
|                      | BH104 |                            | 87.96                           | 1.10                                 | 86.86 | 50                 | 60           |
|                      | BH105 |                            | 87.90                           | 1.00                                 | 86.90 | 50                 | 60           |

**Notes:**

1. In Ottawa Region, all perimeter and exterior foundation elements or interior foundation elements in unheated areas should be provided with a minimum of 1.5m earth cover for frost protection.
2. Based on the subsurface investigation, the existing native silty clay/clay below 2.5m was in a very soft condition hence footings may experience excessive overall/differential settlements depending on the size of footing, thickness of the crust, surcharge loading due to grade raise and founding depths.
3. Footings must be founded on native soils and are subject to further site inspection.

**7.1.2 Raft Foundation**

A raft foundation would need to be sufficiently rigid so that the loads would be uniformly distributed over the entire building footprint. Total and differential settlement would be critical in controlling the design of the raft foundation.

Based on the subsurface investigation, the existing thick, very soft to soft clayey soils extend to depths of 18.29m to 27.43m below prevailing grades. Consequently, a raft slab foundation would be susceptible to significant long-term settlement in the high moisture soft to very soft clayey soils and differential settlements caused by inconsistency in depths/composition of soft stratum.

**It is therefore concluded that it is not feasible or practical for the proposed building to be supported by a raft foundation alone.**

**7.2 Deep Foundations**

Based on the subsurface soil conditions, piled foundations with structural cap/beam system are recommended. The piles could be used to transfer the structural loads through the soft clayey soils and would be founded into more competent bearing soils at further depths. Based on the results of deeper boreholes, depths with different bearing resistances may be utilized as outlined in the following sections.

**7.2.1 Piles Founded into Very Dense Overburden Soils**

A suitable pile foundation may be concrete filled steel pipe piles (driven closed-ended) or H-piles, with the pile end bearing founding into overburden soils at depths below 19m (area covered by BH101) to 28m (area covered by BH106).

For preliminary design purposes 245mm diameter steel piles, or H-piles with similar structural resistance, may be considered. Axial resistance of 750 kN at SLS and factored resistance of 1000 kN ULS may be used.

Due to variation in the composition of very dense/hard overburden soils from gravelly sand/clay to crushed rock, their variable depths below grades and potential variation in their thicknesses; behaviour of piles/pile groups supported in the overburden soils may vary and each pile may have to be tested by suitable method to ensure their load carrying capabilities.

It should be noted that bedrock surface could not be positively confirmed during this investigation as rock coring was not carried out. Refusal to auguring at depths of 24.41m in BH101 and 32.33m in BH106 may be due to the presence of chunks/blocks of hard rock and driven piles may puncture through it & extend deeper to hard rock. We consider that the opinion of piling contractors familiar with the subject area should be sought. Few test piles may have to be driven/tested initially to confirm the feasibility/suitability of this option.

#### **7.2.2 Piles Founded into Bedrock**

Based on the site Shear Wave Velocity measurements, the MASW wave velocity is greater than 1700m/s below 40.0m indicating hard rock.

We recommend that the abovementioned steel pipe piles or H-piles be driven practically to refusal into hard bedrock for higher bearing support. Factored geotechnical resistance of 1500 kN may be used for design.

The ULS factored geotechnical resistance of the pile should be equal to or greater than the structural resistance if the piles are driven into the bedrock using an appropriate design/set criterion with a hammer of sufficient energy.

#### **7.2.3 Lateral Loading Resistance**

Resistance to lateral loading could be derived from the soil resistance in front of the piles.

Based on the subsoil conditions and relative long length of piles, fully or partial battered piles may be required to mobilize lateral load resistance.

Geotechnical parameters presented in Table 4 may be used for the design of resistance to lateral loads.

Group action for lateral loading should be considered when pile spacing in the direction of loading is less than 8 pile diameters by reducing the coefficient of lateral subgrade reaction with the relevant reduction factor.

**Table 4: Geotechnical parameters**

| Soil Property                          | Firm to Stiff Clayey Soils 0 - 3.0m | Very Soft to Soft Clayey Soils 3.0-18.3m (BH1), 3.0-27.4m (BH6) | Very Stiff Clayey Soils 18.3-22.9m (BH1) | Very Dense Sand 27.4-31.4m (BH6). |
|----------------------------------------|-------------------------------------|-----------------------------------------------------------------|------------------------------------------|-----------------------------------|
| Total Unit weight (kN/m <sup>3</sup> ) | 17.0                                | 15.5                                                            | 18.0                                     | 20                                |
| Undrained Shear Strength (Su kPa)      | 30-60                               | 10-20                                                           | 50-80                                    | 150-200                           |

#### 7.2.4 Drilled Cast -in -Place Concrete Caisson (CFAs)

Alternatively, drilled caissons, to be founded into sound bedrock, may be used. The caissons should be socketed into the rock to at least 1.5 times their design diameter.

In this case, factored geotechnical toe-bearing resistance of 2000 kPa at ULS may be used for caisson bearing design. Average factored shaft resistance of 30 kPa may be used for shaft resistance calculations.

However, considering the depth of bedrock, the volume of concrete required and spoil for disposal they may not be viable economically.

#### 7.2.5 Deep Foundation Installation Discussion

It should be noted that for end-bearing piles, founded on or within bedrock, SLS condition generally do not govern the design as settlement of the pile founded in the bedrock is less than required for SLS.

- For group pile installation, the piles should be driven no closer than three pile widths/diameters centre to centre.
- Pile termination or set criteria will be dependent on the type of pile driving hammer, helmet, selected pile and pile length. Relaxation of the piles following the initial set would result from several processes, including: the dissipation of negative excess pore water pressures in the overburden, the driving of adjacent piles and weathered bedrock conditions. Provisions must be

made for restriking all the piles to design set criteria within 24 to 48 hours. If the criteria is not achieved during restriking, then those piles should be driven to design set criteria and the process should be repeated for the subject piles.

- Wall and/or base plate thicknesses should be sufficient to endure driving stresses to overcome obstructions and anticipated hard set. Pipe piles render themselves for visual observations in regards to any pile damage or bending. Specialized pile/foundation contractors familiar with the area should be consulted/retained for the piling operations.
- PDA testing and CASE method estimates of the installed piles should be carried out by the contractor at an early stage to verify both the transferred energy from the pile driving equipment and the load carrying capacity of the piles. Test piles should have sufficient structural capacity/stronger pile sections to sustain the proof load which will be twice the design factored geotechnical resistance.
- Static load testing could be carried out, rather than PDA testing, to confirmed the ULS geotechnical resistance of the piles.
- As the bedrock surface was not confirmed by rock coring and according to shear wave velocity measurements it appears it may be around depth of 40m, it is harder to decide regarding the feasible/practical design factored geotechnical resistance and pile depths. Depths of driven piles are anticipated to vary significantly across the site. For shallow depth, or hung-up piles, their capacities may have to be confirmed by appropriate field testing. Alternatively, a pre-determined depth may be selected and pre auguring carried out as required.
- Piling operations should be inspected on a full-time basis by geotechnical personnel to monitor the pile locations and plumbness, initial sets, penetrations on restrike, and check the integrity of the piles following installation.

## **8. CORROSION AND CEMENT TYPE**

Two soil samples from BH3 and BH4 at depths of 1.52m to 1.98m were submitted to Fisher Environmental laboratories for chemical analyses related to potential sulphate attack on buried concrete. The laboratory results are presented in Appendix C.

Sulphate concentration in the soil sample is 13.4mg/kg and 24.0 mg/kg or 0.00134% and 0.0024%. According to CSA-A23. 1-09 Table 3, the results indicate negligible degree of exposure to sulphate attack.

Chloride contents in the samples were <10 ug/g or <0.001% indicating negligible impact on exposed ferrous metals. pH levels of 7.84 (BH3) and 7.81 (BH4) are within the expected range for subsurface soils (5-11).

## **9. EARTHQUAKE CONDITIONS**

The 2012 OBC Subsection 4.1.8 stipulates that a building should be designed to meet the requirements of the Earthquake Load and Effects. Site Classification for Seismic Site Response (Table 4.1.8.4.A) was determined from the soil shear wave average velocity or Standard Penetration Resistance ( $N_{60}$ ) and/or the undrained shear strength ( $S_u$ ) of the soils within upper 30m.

The Site Classification for Seismic Site Response was established/determined on the basis of MASW Vs 30 values. As shown in Appendix D, Vs30 = 158.0m /s and as set out in Table 4.1.8.4 A of the OBC, the subject Site may be designated as “Class E”.

The terms, which are relevant to the geotechnical conditions at the Site, are acceleration- based Site coefficient  $F_a$  and velocity – based Site coefficient  $F_v$  and are detailed in Subsection 4.1.8 of the 2012 OBC.

## **10. EXCAVATION AND BACKFILL**

No major problems would be encountered for the anticipated depth of excavation for footings/slab on grade/caps/structural beam installation and underground utilities. All excavation must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA).

Based on the subsurface investigation, the subsoils within the expected depth of excavation below the fill / organic topsoil consisted of firm to stiff silty clay to 2.5m bgs and can be classified as Type 3 soils in

accordance with the Occupational Health and Safety Act (OHSA). The very soft silty clay/clay below 3.66m may be classified as Type 4 soils.

For open cut above 2.5m, the sides of slopes would need to be cut back at an inclination no steeper than 1 horizontal to 1 vertical (1H:1V). For slopes which are unsupported in the long-term, flatter side slopes may be required.

Groundwater levels were observed between 1.72m and 2.39m bgs on October 6, 2022 during the investigation. Groundwater seepage from fill layers or more permeable interbedded seams may be encountered in some local areas during excavation. No significant volume of water is expected and excavation for shallow foundation /piles cap installation should be in a 'dry' condition. Seepage, if any, may be handled by pumping from sump pits within the excavation area.

Materials to be used for backfill in service trenches should be suitable for compaction, i.e., free of organics and with moisture content within 2 percent of the optimum moisture value. The backfill material should be compacted in lifts of no more than 200mm in thickness and to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD) in the upper 1.0m from road subgrade or in settlement sensitive areas. Beyond these zones, a 95% SPMDD compaction criterion is considered acceptable.

Additionally, onsite excavated fill materials and native soils may be used as backfill in service trenches, provided that the excavated materials are free of organic soils /construction debris and are of suitable moisture content.

The local soils are dominated by clayey soils with high moisture content and can easily be lumped. To be used as backfill, some moisture must be removed and the soil maintained within optimum moisture content before breaking into small pieces and used as engineered fill under supervision.

For backfill against subsurface walls/footings/grade beams/pile caps and slab on grade construction of buildings, it is recommended that backfill materials consist of Granular Class 'B' aggregates.

## 11. SLAB ON GRADE AND PERMANENT DRAINAGE

For the subject site with proposed building with no basement, slab on grade may be constructed on native undisturbed silty clay and, or engineered fill. The native clayey soils above depth of 2.5m were generally in a firm to stiff condition.

For preliminary design, for slab on grade resting on the native silty clay, subgrade reaction modulus (K) value of 7500 kN/m<sup>3</sup> may be used. It should be noted that long-term consolidation settlement of the slab-on-grade will depend on the intensity and duration of the loading. Heavy loads for longer durations will result in increase in the stresses imparted to soft/very soft clays encountered below depth of 2.5m and induce consolidation settlements. If heavily loaded floor slab-on-grade is required, a raft slab supported by piles should be used.

For slab on grade construction, the prepared subgrade must be proof-rolled prior to placing upper layers of granular material. Any soft spots revealed during proof-rolling should be sub-excavated and backfilled with suitable granular materials, compacted to 98% SPMDD.

Engineered fill materials, compaction quality and finished subgrade proof-rolling should be supervised and inspected by engineering staff from Fisher. Engineered fill must be placed in layers of no more than 200mm and compacted to 98% SPMDD.

For backfill against the subsurface walls/grade beams and footings/pile caps it is recommended that backfill materials should consist of Granular Class 'B' aggregates.

Upon completion of foundation work, the floor slab should rest on a well compacted bed of 19mm clear stones at least 300mm thick. The stone bed would act as a barrier and prevent capillary rise of moisture from the subgrade to the floor slab.

Permanent drainage may not be required, provided that the exterior ground surface is 200mm lower than the building floor slab and should be sloped away from building perimeter walls.

Elevator shaft, if any, should be designed as a 'water tight' structure. Lower loading area/decks should be installed with perimeter sub-drainage and diverted to positive outlet.

## **12. UNDERGROUND UTILITIES**

Pipe bedding and backfill material specifications and compaction criteria for water and sewer services should be in accordance with the pipe designer's recommendations and/or local municipal requirements.

If the excavation is deeper than 1.2m, the excavation sides should be sloped in accordance with requirements of OHSA. If this condition cannot be met, a temporary shoring system or trench box should be introduced.

For the subject site, it is expected that underground services/ sewer pipes would be founded over native silty clay. Granular Class 'A' aggregate is generally considered well suited to be used as pipe bedding material. However, it should be noted that the recommended type of bedding is to be placed on undisturbed subgrade above the groundwater level. If the construction methods will disturb the subgrade i.e. piping, existing footing, boulder removal etc. or existence of excess hydrostatic pressure, then higher-class bedding may have to be used combined with a geotextile. In some areas, localized dewatering may be required.

Trench backfill should be uniformly compacted to a density that minimizes the risk of long-term settlement. Selected on-site excavated native soils is considered suitable for re-use in trench backfilling, provided that organics/construction debris are sorted out and material are not allowed to be wet. Moisture content should be maintained within the optimum moisture content of 2%.

In normal sewer construction practice, the problem of road settlement largely occurs adjacent to manholes, catch basins and service crossings. In these areas, granular materials are generally required for backfill and compaction.

The backfill in the upper 1.0m from road subgrade or in settlement sensitive areas should be placed in maximum 200mm thick lifts and compacted to 98% SPMDD. Beyond these zones, a 95% SPMDD compaction criterion is considered acceptable.

## **13. PAVEMENT DESIGN**

Associated pavement for driveways and parking will be developed on the site. Pavement structures can be constructed on the native soils, engineering fill, or possibly fill materials from the site, subject to design grade and further onsite inspection.

Prior to the construction of asphalt pavement, topsoil, organic soils and construction debris must be removed. The exposed base should be proof-rolled and supervised/approved by geotechnical personnel. Any soft

spongy spots detected during proof-rolling should be sub-excavated and replaced with suitable materials in maximum 300mm thick lifts and compacted to 98% of SPMDD. The placement of engineering fill, if any, should be supervised and inspected by engineering staff from Fisher.

The finished subgrade must be contoured/graded and finally proof-rolled and approved by Fisher before placing the upper granular materials.

Granular materials will be used in construction of asphalt pavement base. Compaction for granular bases should reach 100% of Standard Proctor Maximum Dry Density.

Perforated pipe subdrains should be provided at subgrade level extending from the catch basins for a distance of at least 3-5m in four orthogonal directions, or longitudinally where parallel to a curb. Typical flexible pavement designs are presented in Table 5.

**Table 5: Typical flexible pavement designs are as follows:**

| Layer                   | Heavy Duty | Medium Duty |
|-------------------------|------------|-------------|
| Asphaltic Concrete      | 40 mm HL3  | 40 mm HL3   |
|                         | 65 mm HL8  | 50 mm HL8   |
| 19 mm Crushed Limestone | 150 mm     | 150 mm      |
| Granular B Sub-base     | 350 mm     | 200 mm      |

Pavement structure thicknesses should also meet the minimum local/municipal/regional Pavement Design Standards for the proposed development.

The asphalt material should meet the OPSS requirements for specified grade and be compacted to at least 92% of their MRD.

The above pavement designs are based on the current revealed the subsoils conditions, depending on the actual conditions of the pavement subgrade at the time of construction, it could be necessary to increase the thickness of the subbase and /or to place a woven geotextile beneath the granular base.

#### **14. TREE PLANTATION**

On-site silty clay/clays are sensitive in nature and are susceptible to volume change/shrinkage upon withdrawal of water by some trees. Hence high-water demand trees should not be planted closer to structures than the anticipated height of the trees.

Please refer to the City of Ottawa guidelines for tree planting in sensitive marine clay soils for industrial/commercial developments.

#### **15. GENERAL COMMENTS**

This report is limited in scope to those items specifically referenced in the text. The discussions and recommendations presented in this report are intended only as guidance for the named client, their design engineers and those directly involved in the implementation and regulation of the project.

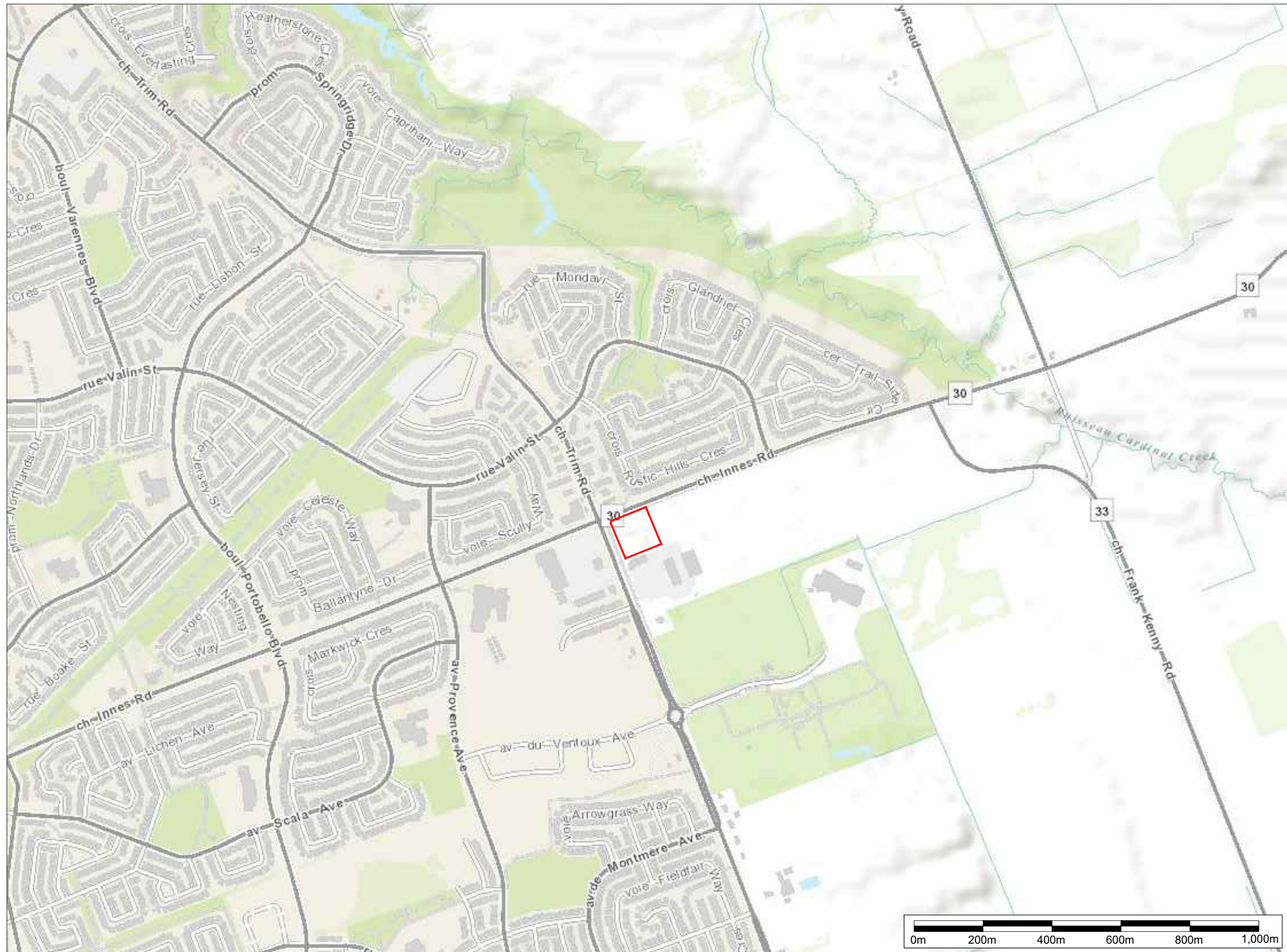
The information on which these recommendations are based is subject to confirmation by engineering personnel at the time of construction.

Localized variations in the subsoil conditions, and particularly the fill material, may be present between and beyond the boreholes on which the recommendations are made and will have to be verified during construction. As more specific subsurface information becomes available during excavations on the subject Site, this report should be updated.

Contractors bidding on or undertaking the work should decide on their own investigations, as well as their own interpretations of the factual borehole results. This concern specifically applies to the classification of the subsurface soils and the potential reuse of these soils on/off Site.

Contractors must draw their own conclusions as to how the near surface and subsurface conditions may affect them.

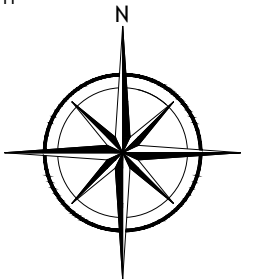
## **APPENDIX A – SITE AND LOCATION PLANS**



400 Esna Park Dr., #15  
Markham, Ontario  
L3R 3K2

Tel: 905 475-7755  
Fax: 905 475-7718

NORTH



LEGEND

— SITE BOUNDARY

PROJECT NAME AND ADDRESS  
**GEOTECHNICAL &  
HYDROGEOLOGICAL  
INVESTIGATIONS**  
5210 Innes Road,  
Ottawa, ON

FIGURE A1:

SITE LOCATION PLAN

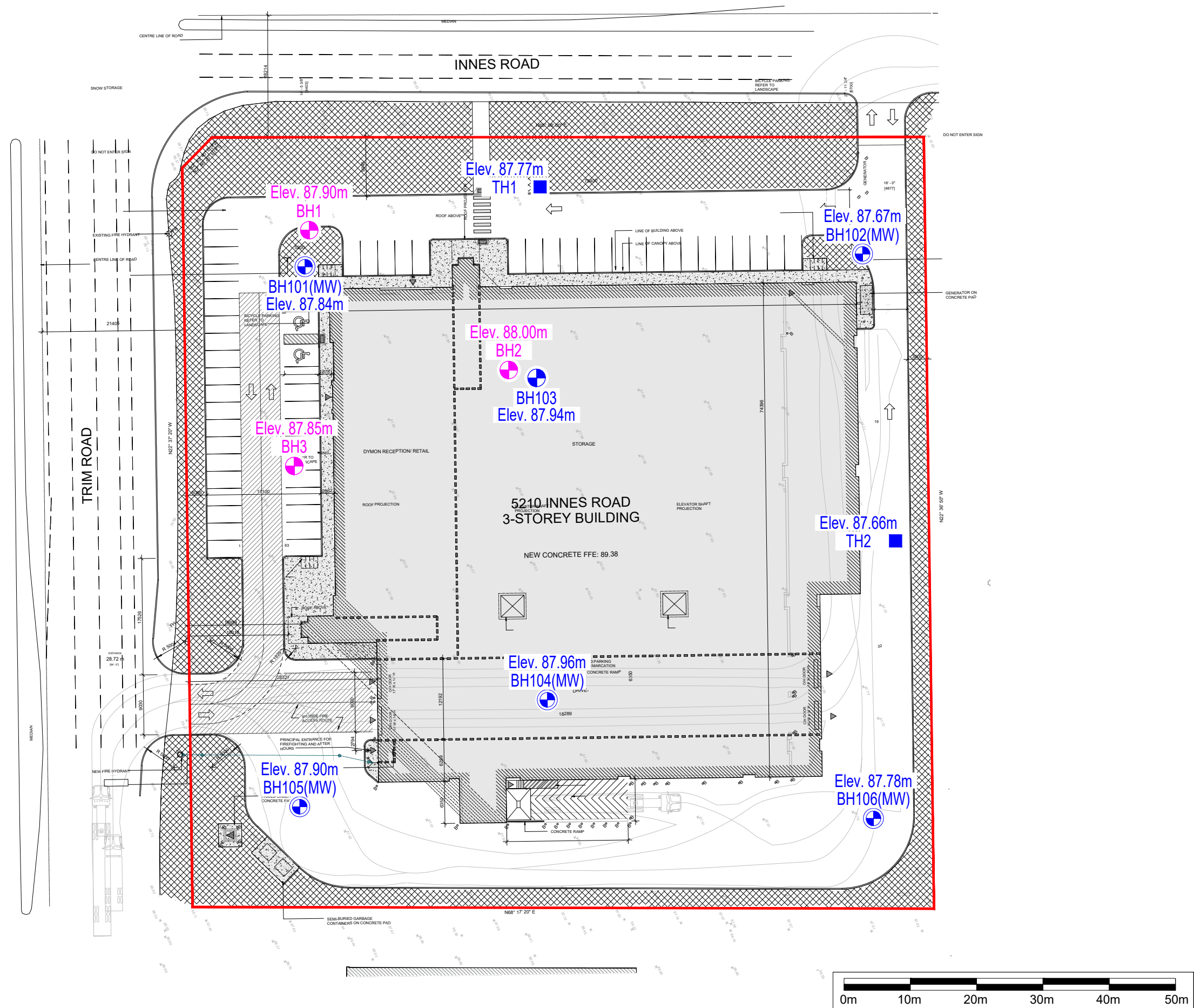
PROJECT NO.  
FE-P 22-12469/70

DATE  
6 October 2022

SCALE  
AS SHOWN

SHEET NO.

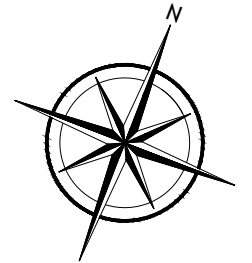
**A1**



400 Esna Park Dr., #15  
Markham, Ontario  
L3R 3K2

Tel: 905 475-7755  
Fax: 905 475-7718

NORTH



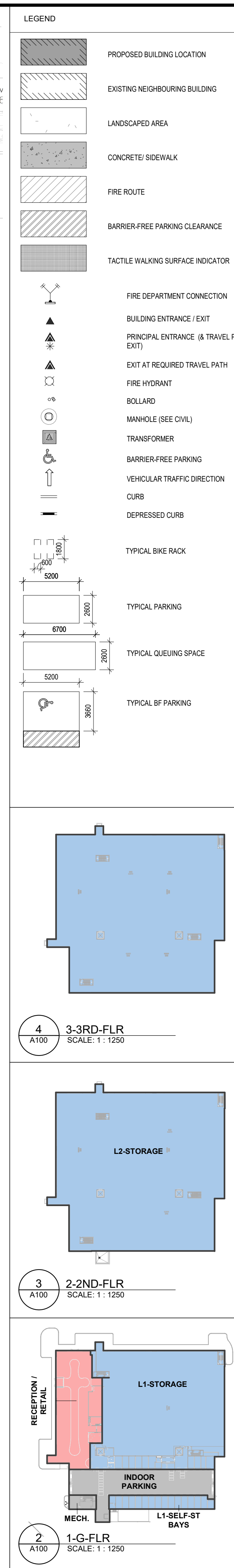
#### LEGEND

- SITE BOUNDARY
- EXISTING BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION
- BOREHOLE LOCATION
- TEST HOLE LOCATION

PROJECT NAME AND ADDRESS  
**GEOTECHNICAL &  
HYDROGEOLOGICAL  
INVESTIGATIONS**  
5210 Innes Road,  
Ottawa, ON

FIGURE A2:  
**SITE PLAN WITH BOREHOLES /  
MONITORING WELL AND  
TEST HOLE LOCATIONS**

|                                 |                        |
|---------------------------------|------------------------|
| PROJECT NO.<br>FE-P 22-12469/70 | SHEET NO.<br><b>A2</b> |
| DATE<br>6 October 2022          |                        |
| SCALE<br>AS SHOWN               |                        |



GENERAL SITE PLAN NOTES:

**TOPOGRAPHICAL INFORMATION:**

PART OF LOT 1  
CONCESSION 8  
GEOGRAPHIC TOWNSHIP OF CUMBERLAND  
CITY OF OTTAWA

SURVEY BY: ANNIS, O'SULLIVAN, VOLLEBECK Ltd.

SITE AND BUILDING DATA:

SITE AREA

|                     |                        |                          |
|---------------------|------------------------|--------------------------|
| NEW BUILDING AREA   | 5585.69 m <sup>2</sup> | 60123.90 ft <sup>2</sup> |
| NEW BUILDING HEIGHT | 14.4M                  |                          |

(1\*)

GROSS BUILDING AREA (1)

16681.61 m<sup>2</sup>

181496.87 ft<sup>2</sup>

(2\*)

GROSS FLOOR AREA (2)

15077.06 m<sup>2</sup>

162288.12 ft<sup>2</sup>

(\*) SEE GROSS BUILDING AREA NOTES BELOW

GENERAL NOTES:

1. FOR PAVED SURFACES, GRADING, SITE SERVICING, DRAINAGE EROSION AND SEDIMENT CONTROL, REFER TO CIVIL DRAWINGS.

2. FOR PLANNING DETAILS, REFER TO LANDSCAPE DRAWINGS.

GROSS BUILDING AREA:

1. (ONTARIO BUILDING CODE DEFINITION): THE TOTAL AREA OF ALL FLOORS ABOVE GRADE MEASURED BETWEEN THE OUTSIDE SURFACES OF EXTERIOR WALLS.

2. \* GROSS FLOOR AREA (CITY OF OTTAWA ZONING BYLAW):  
DEFINITION FOR THE PURPOSE OF DETERMINING PARKING REQUIREMENTS: GROSS LEASABLE FLOOR AREA MEANS THE TOTAL FLOOR AREA DESIGNED FOR TENANT OCCUPANCY AND EXCLUSIVE USE, MEASURED FROM THE INTERIORS OF OUTSIDE WALLS EXCLUDING FLOOR AREA OCCUPIED BY PARTY WALLS AND EXCLUDING INTERIOR PARKING / LOADING (DRIVE THRU).

3. FLOOR AREA OCCUPIED BY SHARED MECHANICAL SERVICE AND ELECTRICAL EQUIPMENT THAT SERVE THE BUILDING, (BY-LAW 2008-326)

4. COMMON HALLWAYS; CORRIDORS; STAIRWELLS; ELEVATOR SHAFTS AND OTHER VOIDS; STEPS AND LANDINGS; (BY-LAW 2008-326)

5. BICYCLE PARKING; MOTOR VEHICLE PARKING OR LOADING FACILITIES; COMMON LAUNDRY, STORAGE AND WASHROOM FACILITIES THAT SERVE THE BUILDING OR TENANTS;

6. COMMON STORAGE AREAS THAT ARE ACCESSORY TO THE PRINCIPAL USE OF THE BUILDING, (BY-LAW 2008-326)

7. COMMON AMENITY AREA AND PLAY AREAS ACCESSORY TO A PRINCIPAL USE ON THE LOT, AND (BY-LAW 2008-326) LIVING QUARTERS FOR A CARETAKER OF THE BUILDING.

ZONING:

ZONING DESIGNATIONS (PART 10):  
GM ZONE

ZONING PROVISIONS

|                                     |      |
|-------------------------------------|------|
| MINIMUM LOT WIDTH (m):              | N/A  |
| MINIMUM LOT AREA (m <sup>2</sup> ): | N/A  |
| MINIMUM FRONT YARD SETBACK:         | 10 m |
| MINIMUM REAR YARD SETBACK:          | 10 m |
| MINIMUM INTERIOR SIDE YARD SETBACK: | 3 m  |
| MINIMUM CORNER SIDE YARD SETBACK:   | 6 m  |

BUILDING HEIGHT

|                     |      |
|---------------------|------|
| MAXIMUM (GM ZONES): | 18 m |
| PROPOSED:           | 14 m |

LANDSCAPING (SECTION 110):

REQUIRED FRONT AND CORNER SIDE YARDS TO BE LANDSCAPED, EXCEPT FOR DRIVEWAYS CROSSING THE FRONT OR CORNER SIDE YARD LEADING TO PARKING AREA

|                       | PARKING LOT AREA       | MIN. LANDSCAPE ALLOWED | LANDSCAPING PROVISION % |
|-----------------------|------------------------|------------------------|-------------------------|
| LANDSCAPING / PARKING | 5300.00 m <sup>2</sup> | 15%                    | 39.96 %                 |

VEHICLE PARKING (SECTION 101):

WAREHOUSE (0.8/100m) FIRST 5000m<sup>2</sup>:

(5,000/100m<sup>2</sup>) x 0.8 = 40

WAREHOUSE (0.4/100m) AFTER 5000m<sup>2</sup>:

((11,080/100m<sup>2</sup>) x 0.4 = 45

MINIMUM REQUIRED: 85

NUMBER PROVIDED: (\*) SEE AMENDMENT AS PART OF ZONING BY-LAW AMENDMENT

PARKING FOR THE PHYSICALLY DISABLED (PARKING BYLAW 2003-50, SECTION 122):

|                   |                                  |
|-------------------|----------------------------------|
| MINIMUM REQUIRED: | 3 No. [1x TYPE 'A' 12x TYPE 'B'] |
| NUMBER PROVIDED:  | 3 No. [1x TYPE 'A' 12x TYPE 'B'] |

(\*) PARKING PROVIDED:

| PARKING TYPE:                     | No. |
|-----------------------------------|-----|
| SITE 2X2.6                        | 49  |
| PARK-BF-5-2X3.4-TYPE-A            | 1   |
| SITE 2 SITE BARR. FREE BAY TYPE A | 2   |
| PARK-BF-5-2X2.6-TYPE-B            | 1   |
| 3 BARR. FREE BAY TYPE B           | 2   |
| PARKING TOTAL.....                | 52  |

LOADING BAY AREA

PARKING TYPE:

No.

LOAD-3-66\*6.7M

LOAD-BARR.-FREE

1

LOAD-2-6\*6.7M

LOAD.-QUEING-BAY

6

LOADING BAY PARKING TOTAL.....

7

BICYCLE PARKING (SECTION 111):

1 PER 2000m<sup>2</sup> (WAREHOUSE)

MINIMUM REQUIRED: 9

NUMBER PROVIDED: 10

LOADING ZONE (SECTION 113):

MINIMUM REQUIRED: 2

NUMBER PROVIDED: 1\* (\*) SEE AMENDMENT AS PART OF ZONING BY-LAW AMENDMENT

GROSS FLOOR AREA (GFA) - INTERIOR LOADING

|                        |                       |                         |
|------------------------|-----------------------|-------------------------|
| INT. LOADING & PARKING | 882.58 m <sup>2</sup> | 9500.05 ft <sup>2</sup> |
|------------------------|-----------------------|-------------------------|

GROSS FLOOR AREA (GFA) - EXCL-INTERIOR LOADING

|                               |                         |                           |
|-------------------------------|-------------------------|---------------------------|
| 1. GFA- RECEPTION / RETAIL    | 1029.14 m <sup>2</sup>  | 11077.61 ft <sup>2</sup>  |
| 1.0- GFA- MECH.               | 47.50 m <sup>2</sup>    | 511.26 ft <sup>2</sup>    |
| 1-0. GFA- SELF-ST. @-DR- AISL | 295.05 m <sup>2</sup>   | 3175.87 ft <sup>2</sup>   |
| 1-1.5 GFA- MECH. (+ MEZZ.)    | 58.75 m <sup>2</sup>    | 632.35 ft <sup>2</sup>    |
| 1-3. GFA- SELF-ST.            | 13846.62 m <sup>2</sup> | 148691.02 ft <sup>2</sup> |
| GFA-TOTAL                     | 15077.06 m <sup>2</sup> | 162288.12 ft <sup>2</sup> |

GENERAL NOTES

1.

DO NOT SCALE DRAWINGS; ONLY FIGURED DIMENSIONS ARE TO BE USED. WHERE DOUBT EXISTS, FILE REQUEST FOR INTERPRETATION AND REQUEST CLARITY.

2.

IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO VERIFY DIMENSIONS ON SITE; REPORT DISCREPANCIES TO THE ARCHITECT PROMPTLY.

3.

GENERAL CONTRACTOR TO TAKE INTO ACCOUNT CONSTRUCTION TOLERANCE; GENERAL CONTRACTOR TO COORDINATE THE WORK OF DIFFERENT TRADES TO COMPLY WITH DESIGN INTENT.

4.

ALL WORK DESCRIBED IN THESE DRAWINGS AND SPECIFICATIONS ARE TO COMPLY WITH THE CURRENT EDITION OF THE ONTARIO BUILDING CODE (2010) INCLUDING MOST RECENT AMENDMENTS.

5.

DRAWINGS AND SPECIFICATIONS ARE COMPLEMENTARY AND ARE TO BE READ TOGETHER.

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A diagram illustrating the orientation of the site plan. It shows two arrows originating from a point labeled "project north". One arrow points upwards and slightly to the left, labeled "actual north". The other arrow points downwards and slightly to the right, also labeled "project north". This indicates a magnetic declination correction.

ISSUE RECORD

| No. | Description            | Date       |
|-----|------------------------|------------|
| 1   | Issue for Review       | 2022-12-22 |
| 2   | Issue for SPA          | 2023-02-06 |
| 3   | Issue for Review       | 2023-04-12 |
| 4   | Issue for SPA - Update | 2023-06-07 |
|     |                        |            |
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CLIENT

DYMON SELF-STORAGE

2-1830 WALKLEY ROAD, OTTAWA, ON  
(T) 613-247-0888

CONSULTANTS

FOTENN PLANNING + DESIGN

223 MCLEOD STREET, OTTAWA ON  
PLANNING & URBAN DESIGN  
(T) 613-730-5709

D B LONG GRAY ENGINEERING INC.

700 L B POINT CIR, GLOUCESTER, ON.  
CIVIL ENGINEER  
(T) 613-425-8044

TACT ARCHITECTURE INC.

680R COLLEGE STREET (REAR LANE) TORONTO ON.  
DESIGN ARCHITECT  
(T) 416-516-1949

BRUMAR ENGINEERING SERVICES LTD

25-120 WEST BEAVER CREEK RD., RICHMOND HILL, ON  
MECHANICAL CONSULTANTS  
(T) 905-717-7798

HUDDSON ENGINEERING

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DCA

A GROUP of ARCHITECTS

201-1339 WELLINGTON ST. W | OTTAWA ON K1V 3B8  
WWW.ARCHITECTSDCA.COM      613.725.2294

PROJECT TITLE

DYMON 5210 INNES ROAD

DRAWING TITLE

SITE PLAN

| DATE<br>APRIL 2022    | DRAWN<br>SD    | JOB NO. | DRAWING NO. |
|-----------------------|----------------|---------|-------------|
| SCALE<br>As indicated | REVIEWED<br>TD | 3465    | A100        |

ARCHITECTURAL

## **APPENDIX B – LOG OF BOREHOLES**



## LOG OF BOREHOLE

NO. BH101(MW) SHEET. 1 of 3

PROJECT NO.: FE-P# 22-12469/70

PROJECT NAME: GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Mud Rotary

DRILLING DATE: 21 September, 2022

[illegible]





## LOG OF BOREHOLE

NO. BH101(MW) SHEET. 3 of 3

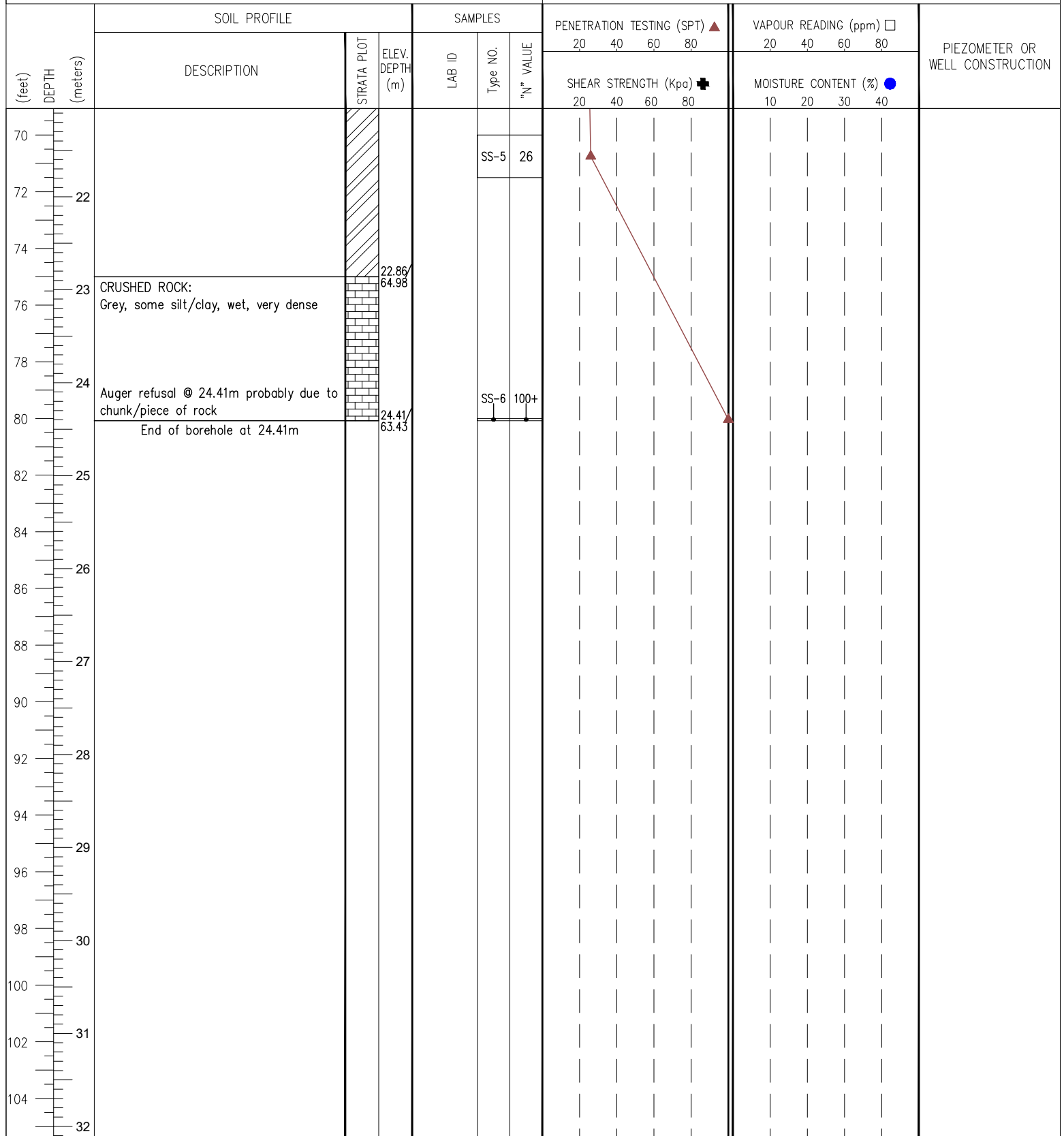
PROJECT NO.: FE-P# 22-12469/70

PROJECT NAME: GEOTECHNICAL &amp; HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Mud Rotary

DRILLING DATE: 21 September, 2022



Groundwater Depth (m): on completion: N/A, Mud Rotary, on 6 October 2022: 1.92m

DRAWN: D.C.

LOGGED: J.Y.

CHECKED: C.W.

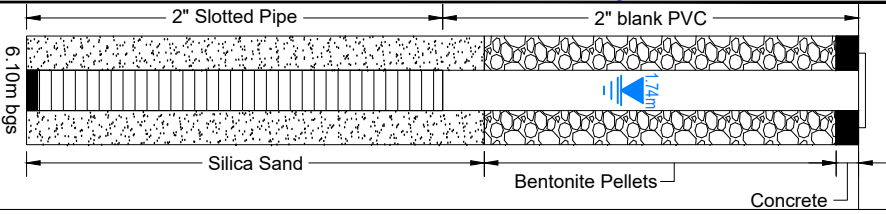
PROJECT NAME: GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Solid Stem

DRILLING DATE: 22 September, 2022

| SOIL PROFILE |                | STRATA PLOT | SAMPLES |          |           | PENETRATION TESTING (SPT) ▼ |  |  |  | VAPOUR READING (ppm) □ |  |  |  | PIEZOMETER OR WELL CONSTRUCTION |  |
|--------------|----------------|-------------|---------|----------|-----------|-----------------------------|--|--|--|------------------------|--|--|--|---------------------------------|--|
| DEPTH (feet) | DEPTH (meters) |             | LAB ID  | Type NO. | "N" VALUE | SHEAR STRENGTH (Kpo) ➕      |  |  |  | MOISTURE CONTENT (%) ● |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
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|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |
|              |                |             |         |          |           |                             |  |  |  |                        |  |  |  |                                 |  |



PROJECT NAME: GEOTECHNICAL &amp; HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Solid Stem

DRILLING DATE: 20 September, 2022

| (feet)<br>DEPTH<br>(meters) | SOIL PROFILE                                                                              |             |                       | SAMPLES   |          |           | PENETRATION TESTING (SPT) ▲ |  |  |  | VAPOUR READING (ppm) □ |  |       |  | PIEZOMETER OR<br>WELL CONSTRUCTION |
|-----------------------------|-------------------------------------------------------------------------------------------|-------------|-----------------------|-----------|----------|-----------|-----------------------------|--|--|--|------------------------|--|-------|--|------------------------------------|
|                             | DESCRIPTION                                                                               | STRATA PLOT | ELEV.<br>DEPTH<br>(m) | LAB ID    | Type NO. | "N" VALUE | 20 40 60 80                 |  |  |  | 20 40 60 80            |  |       |  |                                    |
|                             |                                                                                           |             |                       |           |          |           | SHEAR STRENGTH (Kpa) ➡      |  |  |  | MOISTURE CONTENT (%) ● |  |       |  |                                    |
|                             |                                                                                           |             | 87.94                 |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 0                           | ~4" TOPSOIL                                                                               |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 2                           | FILL:<br>Dark grey silty clay, trace sand, roots,<br>topsoil & topsoil mixed soils, moist |             |                       | 22-9177-3 | SS-1     | 8         |                             |  |  |  |                        |  |       |  |                                    |
| 1                           |                                                                                           |             | 0.91 / 87.03          |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 4                           | SILTY CLAY:<br>Greenish grey, moist, stiff to very soft                                   |             |                       |           | SS-2     | 13        |                             |  |  |  |                        |  |       |  |                                    |
| 6                           |                                                                                           |             |                       | 22-9177-4 | SS-3     | 6         |                             |  |  |  |                        |  | 45.8% |  |                                    |
| 2                           |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 8                           |                                                                                           |             |                       |           | SS-4     | 2         |                             |  |  |  |                        |  |       |  |                                    |
| 10                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 12                          | SILTY CLAY:<br>Grey, moist to wet, very soft                                              |             | 3.35 / 84.59          |           |          | SS-5      | 2                           |  |  |  |                        |  |       |  |                                    |
| 4                           |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 14                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 16                          | Wet @ 4.57m                                                                               |             |                       |           |          | SS-6      | 0                           |  |  |  |                        |  |       |  |                                    |
| 5                           |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 18                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 20                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 6                           |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 22                          | End of borehole at 6.55m                                                                  |             | 6.55 / 81.39          |           |          | SS-7      | 0                           |  |  |  |                        |  |       |  |                                    |
| 7                           |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 24                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 26                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 8                           |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 28                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 9                           |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 30                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 32                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 10                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |
| 34                          |                                                                                           |             |                       |           |          |           |                             |  |  |  |                        |  |       |  |                                    |

Groundwater Depth (m): on completion: 3.55m

DRAWN: D.C.

LOGGED: J.Y.

CHECKED: C.W.



PROJECT NAME: GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Solid Stem

DRILLING DATE: 20 September, 2022

| SOIL PROFILE                                                                                                                          |                              | STRATA PLOT | SAMPLES |          |           | PENETRATION TESTING (SPT) ▴ |                        | VAPOUR READING (ppm) □ |  | PIEZOMETER OR WELL CONSTRUCTION |  |  |  |  |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------------|---------|----------|-----------|-----------------------------|------------------------|------------------------|--|---------------------------------|--|--|--|--|--|--|--|
| DESCRIPTION                                                                                                                           | ELEV. DEPTH (m)              |             | LAB ID  | Type NO. | "N" VALUE | SHEAR STRENGTH (kpo) ▴      | MOISTURE CONTENT (%) ● |                        |  |                                 |  |  |  |  |  |  |  |
| ~4" TOPSOIL<br><br>FILL:<br>Dark grey to reddish brown silty clay, trace sand & roots, moist<br><br>SILTY CLAY:<br>Grey, moist, stiff | 87.90 / 87.80 / 0.10 / 87.21 | 22-9177-7   | SS-1    | 11       |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
| SILTY CLAY:<br>Grey, moist, firm                                                                                                      | 85.46 / 2.44 / 3.14 / 84.76  | 22-9177-8   | SS-3    | 10       |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
| CLAY:<br>Grey, moist, very soft                                                                                                       | 81.35 / 6.55 / 81.35         |             | SS-4    | 6        |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
| End of borehole at 6.55m                                                                                                              | 81.35 / 6.55 / 81.35         |             | SS-5    | 0        |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             | SS-6    | 0        |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             | SS-7    | 0        |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |
|                                                                                                                                       |                              |             |         |          |           |                             |                        |                        |  |                                 |  |  |  |  |  |  |  |

2.09m

2" blank PVC

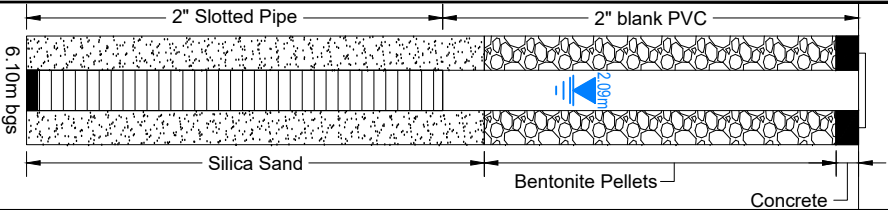
2" Slotted Pipe

Silica Sand

Bentonite Pellets

Concrete

6.10m bgs





## LOG OF BOREHOLE

NO. BH106(MW) SHEET. 1 of 4

PROJECT NO.: FE-P# 22-12469/70

PROJECT NAME: GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Mud Rotary

DRILLING DATE: 22 September, 2022

[illegible]



## LOG OF BOREHOLE

NO. BH106(MW) SHEET. 2 of 4

PROJECT NO.: FE-P# 22-12469/70

PROJECT NAME: GEOTECHNICAL &amp; HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Mud Rotary

DRILLING DATE: 22 September, 2022

| (feet)<br>DEPTH<br>(meters) | SOIL PROFILE                  |             | SAMPLES               |        |          | PENETRATION TESTING (SPT) ▲ |                        |  |  | VAPOUR READING (ppm) □ |                        |  |  | PIEZOMETER OR<br>WELL CONSTRUCTION |  |
|-----------------------------|-------------------------------|-------------|-----------------------|--------|----------|-----------------------------|------------------------|--|--|------------------------|------------------------|--|--|------------------------------------|--|
|                             | DESCRIPTION                   | STRATA PLOT | ELEV.<br>DEPTH<br>(m) | LAB ID | Type NO. | "N" VALUE                   | 20 40 60 80            |  |  |                        | 20 40 60 80            |  |  |                                    |  |
|                             |                               |             |                       |        |          |                             | SHEAR STRENGTH (Kpa) ➤ |  |  |                        | MOISTURE CONTENT (%) ● |  |  |                                    |  |
| 36<br>11                    | CLAY:<br>Grey, wet, very soft |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 38                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 40<br>12                    |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 42                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 44                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 46<br>14                    |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 48                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 50<br>15                    |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 52                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 54                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 56<br>17                    |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 58                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 60<br>18                    |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 62                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 64                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 66<br>20                    |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 68                          |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |
| 70<br>21                    |                               |             |                       |        |          |                             |                        |  |  |                        |                        |  |  |                                    |  |

Groundwater Depth (m): on completion: N/A, Mud Rotary, on 6 October 2022: 2.36m

DRAWN: D.C.

LOGGED: J.Y.

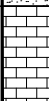
CHECKED: C.W.

PROJECT NAME: GEOTECHNICAL &amp; HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Mud Rotary

DRILLING DATE: 22 September, 2022

| (feet)<br>DEPTH<br>(meters) | SOIL PROFILE                                                                                            |                                                                                     |                       | SAMPLES |          |           | PENETRATION TESTING (SPT) ▲ |  |  |  | VAPOUR READING (ppm) □ |  |  |  | PIEZOMETER OR<br>WELL CONSTRUCTION |  |  |
|-----------------------------|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---------|----------|-----------|-----------------------------|--|--|--|------------------------|--|--|--|------------------------------------|--|--|
|                             | DESCRIPTION                                                                                             | STRATA PLOT                                                                         | ELEV.<br>DEPTH<br>(m) | LAB ID  | Type NO. | "N" VALUE | 20 40 60 80                 |  |  |  | 20 40 60 80            |  |  |  |                                    |  |  |
|                             |                                                                                                         |                                                                                     |                       |         |          |           | SHEAR STRENGTH (Kpa) ➕      |  |  |  | MOISTURE CONTENT (%) ● |  |  |  |                                    |  |  |
| 70                          | CLAY:<br>Grey, wet, very soft                                                                           |   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 72                          |                                                                                                         |                                                                                     |                       | SS-5    | 0        |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 74                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 76                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 78                          |                                                                                                         |   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 80                          |                                                                                                         |                                                                                     |                       | SS-6    | 1        |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 82                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 84                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 86                          |                                                                                                         |  |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 88                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 90                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 92                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 94                          | GRAVELLY SAND:<br>Grey, some clay/silt, pieces of crushed<br>rock, wet, very dense                      |  | 27.43/<br>60.35       |         |          | SS-7      | 100+                        |  |  |  |                        |  |  |  |                                    |  |  |
| 96                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 98                          |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 100                         |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 102                         |                                                                                                         |  |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 104                         |                                                                                                         |                                                                                     |                       | SS-8    | 76       |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 106                         |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 108                         |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 110                         | CRUSHED ROCK:<br>Grey, wet, very dense<br>Auger refusal @ 32.33m probably due to<br>chunk/piece of rock |  | 31.39/<br>56.39       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 112                         |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 114                         |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |
| 116                         |                                                                                                         |                                                                                     |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |  |  |

Groundwater Depth (m): on completion: N/A, Mud Rotary, on 6 October 2022: 2.36m

DRAWN: D.C.

LOGGED: J.Y.

CHECKED: C.W.



## LOG OF BOREHOLE

NO. BH106(MW) SHEET. 4 of 4

PROJECT NO.: FE-P# 22-12469/70

PROJECT NAME: GEOTECHNICAL &amp; HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Mud Rotary

DRILLING DATE: 22 September, 2022

| (feet)<br>DEPTH<br>(meters) | SOIL PROFILE                                                                                                                         |                                                                                   |                       | SAMPLES |          |           | PENETRATION TESTING (SPT) ▲ |  |  |  | VAPOUR READING (ppm) □ |  |  |  | PIEZOMETER OR<br>WELL CONSTRUCTION |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------|---------|----------|-----------|-----------------------------|--|--|--|------------------------|--|--|--|------------------------------------|
|                             | DESCRIPTION                                                                                                                          | STRATA PLOT                                                                       | ELEV.<br>DEPTH<br>(m) | LAB ID  | Type NO. | "N" VALUE | 20 40 60 80                 |  |  |  | 20 40 60 80            |  |  |  |                                    |
|                             |                                                                                                                                      |                                                                                   |                       |         |          |           | SHEAR STRENGTH (Kpa) +      |  |  |  | MOISTURE CONTENT (%) ● |  |  |  |                                    |
| 32                          | CRUSHED ROCK:<br>Grey, wet, very dense<br>Auger refusal @ 32.33m probably due to<br>chunk/piece of rock<br>End of borehole at 32.33m |  | 32.33<br>55.45        |         | SS-9     | 100+      |                             |  |  |  |                        |  |  |  |                                    |
| 33                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 34                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 35                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 36                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 37                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 38                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 39                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 40                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 41                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |
| 42                          |                                                                                                                                      |                                                                                   |                       |         |          |           |                             |  |  |  |                        |  |  |  |                                    |

Groundwater Depth (m): on completion: N/A, Mud Rotary, on 6 October 2022: 2.36m

DRAWN: D.C.

LOGGED: J.Y.

CHECKED: C.W.



LOG OF BOREHOLE NO. BH1 SHEET 1 of 1

PROJECT NO.: FE-P 21-10991

PROJECT NAME: GEOTECHNICAL INVESTIGATION

LOCATION: 5210 Innes Road, Ottawa

DRILLING METHOD: Geo-probe Solid Steam

DRILLING DATE: 8 March 2021

| SOIL PROFILE |                                                                                      |                             | SAMPLES |        | PENETRATION TESTING (SPT) ▲ |                        |    |    | VAPOUR READING (ppm) □ |                        |    |    | PIEZOMETER OR WELL CONSTRUCTION |    |
|--------------|--------------------------------------------------------------------------------------|-----------------------------|---------|--------|-----------------------------|------------------------|----|----|------------------------|------------------------|----|----|---------------------------------|----|
| DEPTH (m)    | DESCRIPTION                                                                          | STRATA PLAT ELEV. DEPTH (m) | TYPE    | NUMBER | % VALUE                     | SHEAR STRENGTH (kPa) ◆ |    |    |                        | MOISTURE CONTENT (%) ○ |    |    |                                 |    |
|              |                                                                                      |                             |         |        |                             | 20                     | 40 | 60 | 80                     | 20                     | 40 | 60 |                                 | 80 |
| 0            | GROUND SURFACE (m asl)                                                               | 87.80                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 1            | FILL:<br>organic silty clay, dark, brown, moist                                      | 88.11/87.59                 | SS      | 1      | 2                           |                        |    |    |                        |                        |    |    |                                 |    |
| 2            |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 3            | FILL:<br>silty clay, trace of rootlets, clayey particles, greyish brown, moist, silt | 88.22/88.86                 | SS      | 2      | 10                          |                        |    |    |                        |                        |    |    |                                 |    |
| 4            |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 5            | SILTY CLAY:<br>greyish brown, moist, firm to soft                                    |                             | SS      | 3      | 7                           |                        |    |    |                        |                        |    |    |                                 |    |
| 6            |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 7            |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 8            |                                                                                      |                             | SS      | 4      | 4                           |                        |    |    |                        |                        |    |    |                                 |    |
| 9            |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 10           |                                                                                      |                             | SS      | 5      | 3                           |                        |    |    |                        |                        |    |    |                                 |    |
| 11           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 12           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 13           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 14           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 15           | Grey clay below 4.57m wet                                                            |                             | SS      | 6      | 1                           |                        |    |    |                        |                        |    |    |                                 |    |
| 16           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 17           | DCPT from 5.33m                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 18           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 19           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 20           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 21           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 22           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 23           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 24           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 25           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 26           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 27           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 28           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 29           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 30           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 31           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 32           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 33           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 34           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 35           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 36           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 37           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 38           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 39           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 40           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 41           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 42           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 43           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 44           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 45           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 46           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 47           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 48           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 49           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 50           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 51           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 52           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 53           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 54           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 55           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 56           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 57           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 58           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 59           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 60           | become harder at 17.69m                                                              |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 61           | End of BH at 18.29m                                                                  |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 62           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 63           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 64           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 65           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 66           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 67           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 68           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 69           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 70           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 71           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 72           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 73           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 74           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 75           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 76           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 77           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 78           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 79           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 80           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 81           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 82           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 83           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 84           |                                                                                      |                             |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |

Groundwater Depth (m): On Completion: 5.49m

PEUW: Drop Under Hammer Weight

LOGGED: ZA

CHECKED: FF

Groundwater Depth (m): On Completion: 5.49m

PEUW: Drop Under Hammer Weight

LOGGED: ZA

CHECKED: FF

PROJECT NAME: GEOTECHNICAL INVESTIGATION

LOCATION: 5210 Innes Road, Ottawa

**DRILLING METHOD:** Geo-probe Solid Steam

DRILLING DATE: 9 March 2021

| SOIL PROFILE |              |                                                    |          |           | SAMPLES |                      | PENETRATION TESTING (SPT) ▲ |    |    | VAPOUR READING (ppm) □ |    |    | PIEZOMETER OR WELL CONSTRUCTION |
|--------------|--------------|----------------------------------------------------|----------|-----------|---------|----------------------|-----------------------------|----|----|------------------------|----|----|---------------------------------|
| DEPTH (m)    | DEPTH (feet) | DESCRIPTION                                        | SPT TYPE | ELEV. (m) | NUMBER  | N <sup>o</sup> VALUE | SHEAR STRENGTH (kPa) ◆      |    |    | MOISTURE CONTENT (%) ○ |    |    |                                 |
|              |              |                                                    |          |           |         |                      | 20                          | 40 | 60 | 80                     | 20 | 40 |                                 |
| 0            | 0            | GROUND SURFACE (m asl)                             |          | 86.00     |         |                      |                             |    |    |                        |    |    |                                 |
| 0.5          | 1            | FILL: silty clay, some rootlets, brown, wet        | SS       | 85.75     | 1       | 1                    |                             |    |    |                        |    |    |                                 |
| 1.5          | 5            | FILL: silty clay, greyish brown, trace of rootlets | SS       | 85.65     | 2       | 11                   |                             |    |    |                        |    |    |                                 |
| 6            | 20           | SILTY CLAY: grey, moist, firm to soft              | SS       |           | 3       | 4                    |                             |    |    |                        |    |    |                                 |
| 10           | 33           | clay below 3.05m<br>very soft below 3.05m          | SS       |           | 4       | 5                    |                             |    |    |                        |    |    |                                 |
| 12           | 39           | DOPT from 3.66m                                    | SS       |           | 5       | 1                    |                             |    |    |                        |    |    |                                 |
| 14           | 46           |                                                    |          | 84.34     |         |                      |                             |    |    |                        |    |    |                                 |
| 16           | 52           |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
| 18           | 59           |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
| 20           | 66           |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
| 22           | 72           |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
| 24           | 79           |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
| 26           | 85           | soft below 7.92m                                   |          | 79.82     | 7       | 2                    |                             |    |    |                        |    |    |                                 |
| 28           | 92           |                                                    |          |           | 8       | 3                    |                             |    |    |                        |    |    |                                 |
| 30           | 98           |                                                    |          |           | 9       | 3                    |                             |    |    |                        |    |    |                                 |
| 32           | 105          |                                                    |          |           | 10      | 3                    |                             |    |    |                        |    |    |                                 |
| 34           | 111          |                                                    |          |           | 11      | 3                    |                             |    |    |                        |    |    |                                 |
| 36           | 118          |                                                    |          |           | 12      | 3                    |                             |    |    |                        |    |    |                                 |
| 38           | 125          |                                                    |          |           | 13      | 3                    |                             |    |    |                        |    |    |                                 |
| 40           | 131          |                                                    |          |           | 14      | 3                    |                             |    |    |                        |    |    |                                 |
| 42           | 138          |                                                    |          |           | 15      | 3                    |                             |    |    |                        |    |    |                                 |
| 44           | 145          |                                                    |          |           | 16      | 4                    |                             |    |    |                        |    |    |                                 |
| 46           | 151          |                                                    |          |           | 17      | 4                    |                             |    |    |                        |    |    |                                 |
| 48           | 158          |                                                    |          |           | 18      | 4                    |                             |    |    |                        |    |    |                                 |
| 50           | 165          |                                                    |          |           | 19      | 4                    |                             |    |    |                        |    |    |                                 |
| 52           | 171          |                                                    |          |           | 20      | 4                    |                             |    |    |                        |    |    |                                 |
| 54           | 178          |                                                    |          |           | 21      | 5                    |                             |    |    |                        |    |    |                                 |
| 56           | 185          |                                                    |          |           | 22      | 4                    |                             |    |    |                        |    |    |                                 |
| 58           | 191          |                                                    |          |           | 23      | 5                    |                             |    |    |                        |    |    |                                 |
| 60           | 198          |                                                    |          |           | 24      | 4                    |                             |    |    |                        |    |    |                                 |
| 62           | 205          |                                                    |          |           | 25      | 5                    |                             |    |    |                        |    |    |                                 |
| 64           | 211          |                                                    |          |           | 26      | 6                    |                             |    |    |                        |    |    |                                 |
| 66           | 218          |                                                    |          |           | 27      | 5                    |                             |    |    |                        |    |    |                                 |
| 68           | 225          |                                                    |          |           | 28      | 5                    |                             |    |    |                        |    |    |                                 |
| 70           | 231          |                                                    |          |           | 29      | 5                    |                             |    |    |                        |    |    |                                 |
| 72           | 238          |                                                    |          |           | 30      | 5                    |                             |    |    |                        |    |    |                                 |
| 74           | 245          |                                                    |          |           | 31      | 6                    |                             |    |    |                        |    |    |                                 |
| 76           | 251          |                                                    |          |           | 32      | 5                    |                             |    |    |                        |    |    |                                 |
| 78           | 258          |                                                    |          |           | 33      | 6                    |                             |    |    |                        |    |    |                                 |
| 80           | 265          |                                                    |          |           | 34      | 5                    |                             |    |    |                        |    |    |                                 |
| 82           | 271          |                                                    |          |           | 35      | 6                    |                             |    |    |                        |    |    |                                 |
| 84           | 278          |                                                    |          |           | 36      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 37      | 6                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 38      | 6                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 39      | 6                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 40      | 6                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 41      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 42      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 43      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 44      | 6                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 45      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 46      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 47      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 48      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 49      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 50      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 51      | 6                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 52      | 7                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 53      | 8                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 54      | 8                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 55      | 6                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 56      | 9                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 57      | 8                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 58      | 6                    |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 59      | 21                   |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 60      | 54                   |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 61      | 61                   |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 62      | 74                   |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 63      | 94                   |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           | 64      | 99m                  |                             |    |    |                        |    |    |                                 |
|              |              | End of BH at 25.30m                                |          | 84.30     |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |
|              |              |                                                    |          |           |         |                      |                             |    |    |                        |    |    |                                 |



LOG OF BOREHOLE NO. BH3 SHEET 1 of 1

PROJECT NO.: FE-P 21-10991

PROJECT NAME: GEOTECHNICAL INVESTIGATION

LOCATION: 5210 Innes Road, Ottawa

DRILLING METHOD: Geo-probe Solid Steam

DRILLING DATE: 9 March 2021

| DEPTH (m)<br>(feet) | SOIL PROFILE                                                                 |                                       | SAMPLES |        | PENETRATION TESTING (SPT) ▲ |                        |    |    | VAPOUR READING (ppm) □ |                        |    |    | PIEZOMETER OR WELL CONSTRUCTION |    |
|---------------------|------------------------------------------------------------------------------|---------------------------------------|---------|--------|-----------------------------|------------------------|----|----|------------------------|------------------------|----|----|---------------------------------|----|
|                     | DESCRIPTION                                                                  | STRATA PLAT<br>ELEV. (m)<br>DEPTH (m) | TYPE    | NUMBER | N° VALUE                    | SHEAR STRENGTH (kPa) ◆ |    |    |                        | MOISTURE CONTENT (%) ○ |    |    |                                 |    |
|                     |                                                                              |                                       |         |        |                             | 20                     | 40 | 60 | 80                     | 20                     | 40 | 60 |                                 | 80 |
| 0                   | GROUND SURFACE (m asl)                                                       | 87.85                                 |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 1                   | FILL:<br>organic silty clay, trace of rootlets,<br>bake to dark brown, moist | 88/87.24                              | SS      | 1      | 3                           |                        |    |    |                        |                        |    |    |                                 |    |
| 2                   | FILL:<br>silty clay, trace of rootlets<br>greyish brown, moist               | 87.23/86.63                           | SS      | 2      | 9                           |                        |    |    |                        |                        |    |    |                                 |    |
| 3                   |                                                                              |                                       | SS      | 3      | 9                           |                        |    |    |                        |                        |    |    |                                 |    |
| 4                   |                                                                              |                                       | SS      | 4      | 15                          |                        |    |    |                        |                        |    |    |                                 |    |
| 5                   |                                                                              |                                       | SS      | 5      | 21                          |                        |    |    |                        |                        |    |    |                                 |    |
| 6                   | SILTY CLAY:<br>grey, moist, stiff to very stiff                              |                                       |         | 6      | 19                          |                        |    |    |                        |                        |    |    |                                 |    |
| 7                   |                                                                              |                                       |         | 7      | 19                          |                        |    |    |                        |                        |    |    |                                 |    |
| 8                   |                                                                              |                                       |         | 8      | 18                          |                        |    |    |                        |                        |    |    |                                 |    |
| 9                   |                                                                              |                                       |         | 9      | 14                          |                        |    |    |                        |                        |    |    |                                 |    |
| 10                  |                                                                              |                                       |         | 10     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 11                  |                                                                              |                                       |         | 11     | 11                          |                        |    |    |                        |                        |    |    |                                 |    |
| 12                  |                                                                              |                                       |         | 12     | 9                           |                        |    |    |                        |                        |    |    |                                 |    |
| 13                  |                                                                              |                                       |         | 13     | 8                           |                        |    |    |                        |                        |    |    |                                 |    |
| 14                  |                                                                              |                                       |         | 14     | 7                           |                        |    |    |                        |                        |    |    |                                 |    |
| 15                  |                                                                              |                                       |         | 15     | 6                           |                        |    |    |                        |                        |    |    |                                 |    |
| 16                  |                                                                              |                                       |         | 16     | 6                           |                        |    |    |                        |                        |    |    |                                 |    |
| 17                  |                                                                              |                                       |         | 17     | 5                           |                        |    |    |                        |                        |    |    |                                 |    |
| 18                  |                                                                              |                                       |         | 18     | 6                           |                        |    |    |                        |                        |    |    |                                 |    |
| 19                  |                                                                              |                                       |         | 19     | 7                           |                        |    |    |                        |                        |    |    |                                 |    |
| 20                  |                                                                              |                                       |         | 20     | 7                           |                        |    |    |                        |                        |    |    |                                 |    |
| 21                  |                                                                              |                                       |         | 21     | 9                           |                        |    |    |                        |                        |    |    |                                 |    |
| 22                  |                                                                              |                                       |         | 22     | 9                           |                        |    |    |                        |                        |    |    |                                 |    |
| 23                  |                                                                              |                                       |         | 23     | 10                          |                        |    |    |                        |                        |    |    |                                 |    |
| 24                  |                                                                              |                                       |         | 24     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 25                  |                                                                              |                                       |         | 25     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 26                  |                                                                              |                                       |         | 26     | 11                          |                        |    |    |                        |                        |    |    |                                 |    |
| 27                  |                                                                              |                                       |         | 27     | 10                          |                        |    |    |                        |                        |    |    |                                 |    |
| 28                  |                                                                              |                                       |         | 28     | 10                          |                        |    |    |                        |                        |    |    |                                 |    |
| 29                  |                                                                              |                                       |         | 29     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 30                  |                                                                              |                                       |         | 30     | 11                          |                        |    |    |                        |                        |    |    |                                 |    |
| 31                  |                                                                              |                                       |         | 31     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 32                  |                                                                              |                                       |         | 32     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 33                  |                                                                              |                                       |         | 33     | 13                          |                        |    |    |                        |                        |    |    |                                 |    |
| 34                  |                                                                              |                                       |         | 34     | 14                          |                        |    |    |                        |                        |    |    |                                 |    |
| 35                  |                                                                              |                                       |         | 35     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 36                  |                                                                              |                                       |         | 36     | 13                          |                        |    |    |                        |                        |    |    |                                 |    |
| 37                  |                                                                              |                                       |         | 37     | 11                          |                        |    |    |                        |                        |    |    |                                 |    |
| 38                  |                                                                              |                                       |         | 38     | 11                          |                        |    |    |                        |                        |    |    |                                 |    |
| 39                  |                                                                              |                                       |         | 39     | 14                          |                        |    |    |                        |                        |    |    |                                 |    |
| 40                  |                                                                              |                                       |         | 40     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 41                  |                                                                              |                                       |         | 41     | 12                          |                        |    |    |                        |                        |    |    |                                 |    |
| 42                  |                                                                              |                                       |         | 42     | 13                          |                        |    |    |                        |                        |    |    |                                 |    |
| 43                  |                                                                              |                                       |         | 43     | 13                          |                        |    |    |                        |                        |    |    |                                 |    |
| 44                  |                                                                              |                                       |         | 44     | 15                          |                        |    |    |                        |                        |    |    |                                 |    |
| 45                  |                                                                              |                                       |         | 45     | 16                          |                        |    |    |                        |                        |    |    |                                 |    |
| 46                  |                                                                              |                                       |         | 46     | 14                          |                        |    |    |                        |                        |    |    |                                 |    |
| 47                  |                                                                              |                                       |         | 47     | 14                          |                        |    |    |                        |                        |    |    |                                 |    |
| 48                  |                                                                              |                                       |         | 48     | 15                          |                        |    |    |                        |                        |    |    |                                 |    |
| 49                  |                                                                              |                                       |         | 49     | 17                          |                        |    |    |                        |                        |    |    |                                 |    |
| 50                  |                                                                              |                                       |         | 50     | 18                          |                        |    |    |                        |                        |    |    |                                 |    |
| 51                  |                                                                              |                                       |         | 51     | 16                          |                        |    |    |                        |                        |    |    |                                 |    |
| 52                  |                                                                              |                                       |         | 52     | 17                          |                        |    |    |                        |                        |    |    |                                 |    |
| 53                  |                                                                              |                                       |         | 53     | 19                          |                        |    |    |                        |                        |    |    |                                 |    |
| 54                  |                                                                              |                                       |         | 54     | 66                          |                        |    |    |                        |                        |    |    |                                 |    |
| 55                  |                                                                              |                                       |         | 55     | 56                          |                        |    |    |                        |                        |    |    |                                 |    |
| 56                  |                                                                              |                                       |         | 56     | 52                          |                        |    |    |                        |                        |    |    |                                 |    |
| 57                  |                                                                              |                                       |         | 57     | 51                          |                        |    |    |                        |                        |    |    |                                 |    |
| 58                  |                                                                              |                                       |         | 58     | 45                          |                        |    |    |                        |                        |    |    |                                 |    |
| 59                  |                                                                              |                                       |         | 59     | 47                          |                        |    |    |                        |                        |    |    |                                 |    |
| 60                  |                                                                              |                                       |         | 60     | 58                          |                        |    |    |                        |                        |    |    |                                 |    |
| 61                  |                                                                              |                                       |         | 61     | 37                          |                        |    |    |                        |                        |    |    |                                 |    |
| 62                  |                                                                              |                                       |         | 62     | 36                          |                        |    |    |                        |                        |    |    |                                 |    |
| 63                  |                                                                              |                                       |         | 63     | 65                          |                        |    |    |                        |                        |    |    |                                 |    |
| 64                  |                                                                              |                                       |         | 64     | 36                          |                        |    |    |                        |                        |    |    |                                 |    |
| 65                  |                                                                              |                                       |         | 65     | 36                          |                        |    |    |                        |                        |    |    |                                 |    |
| 66                  |                                                                              |                                       |         | 66     | 42                          |                        |    |    |                        |                        |    |    |                                 |    |
| 67                  |                                                                              |                                       |         | 67     | 29                          |                        |    |    |                        |                        |    |    |                                 |    |
| 68                  |                                                                              |                                       |         | 68     | 46                          |                        |    |    |                        |                        |    |    |                                 |    |
| 69                  |                                                                              |                                       |         | 69     | 64                          |                        |    |    |                        |                        |    |    |                                 |    |
| 70                  |                                                                              |                                       |         | 70     | 42                          |                        |    |    |                        |                        |    |    |                                 |    |
| 71                  |                                                                              |                                       |         | 71     | 43                          |                        |    |    |                        |                        |    |    |                                 |    |
| 72                  |                                                                              |                                       |         | 72     | 34                          |                        |    |    |                        |                        |    |    |                                 |    |
| 73                  |                                                                              |                                       |         | 73     | 55                          |                        |    |    |                        |                        |    |    |                                 |    |
| 74                  |                                                                              |                                       |         | 74     | 43                          |                        |    |    |                        |                        |    |    |                                 |    |
| 75                  |                                                                              |                                       |         | 75     | 67                          |                        |    |    |                        |                        |    |    |                                 |    |
| 76                  |                                                                              |                                       |         | 76     | 46/ F                       |                        |    |    |                        |                        |    |    |                                 |    |
| 77                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 78                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 79                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 80                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 81                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 82                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 83                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 84                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 85                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 86                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 87                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 88                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 89                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 90                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 91                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 92                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 93                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 94                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 95                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 96                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 97                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 98                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 99                  |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 100                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 101                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 102                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 103                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 104                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 105                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 106                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 107                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 108                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 109                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 110                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 111                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 112                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 113                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 114                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 115                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 116                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 117                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 118                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 119                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 120                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 121                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 122                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 123                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 124                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 125                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 126                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 127                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 128                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 129                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 130                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 131                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 132                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 133                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 134                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 135                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 136                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 137                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 138                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 139                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 140                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 141                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 142                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 143                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 144                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 145                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 146                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 147                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 148                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 149                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 150                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 151                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 152                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 153                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 154                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 155                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 156                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 157                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 158                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 159                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 160                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 161                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 162                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 163                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 164                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 165                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |
| 166                 |                                                                              |                                       |         |        |                             |                        |    |    |                        |                        |    |    |                                 |    |



LOG OF BOREHOLE

NO. TH1 SHEET. 1 of 1

PROJECT NO.: FE-P# 22-12469/70

PROJECT NAME: GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Solid Stem

DRILLING DATE: 23 September, 2022

| SOIL PROFILE     |                                  |                 | SAMPLES                      |          |           | PENETRATION TESTING (SP) ▲ |  |  |  | VAPOUR READING (ppm) □ |  |  |  | PIEZOMETER OR WELL CONSTRUCTION                                                            |
|------------------|----------------------------------|-----------------|------------------------------|----------|-----------|----------------------------|--|--|--|------------------------|--|--|--|--------------------------------------------------------------------------------------------|
| DESCRIPTION      | STRATA PLOT                      | ELEV. DEPTH (m) | LAB ID                       | Type NO. | "N" VALUE | SHEAR STRENGTH (Kpa) ➕     |  |  |  | MOISTURE CONTENT (%) ● |  |  |  |                                                                                            |
| Augered to 1.52m |                                  | 87.77           |                              |          |           |                            |  |  |  |                        |  |  |  | <div>2" Slotted Pipe</div> <div>Silica Sand</div> <div>Concrete</div> <div>1.98m bgs</div> |
|                  | SILTY CLAY:<br>Grey, moist, soft |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  | End of test hole at 1.98m        |                 | 1.52 / 86.25<br>1.98 / 85.79 |          | SS-1      | 7                          |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
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|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  |                 |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |
|                  |                                  | </              |                              |          |           |                            |  |  |  |                        |  |  |  |                                                                                            |

Groundwater Depth (m): on completion: Dry

DRAWN: D.C.

LOGGED: J.Y.

CHECKED: C.W.



LOG OF BOREHOLE

NO. TH2 SHEET. 1 of 1

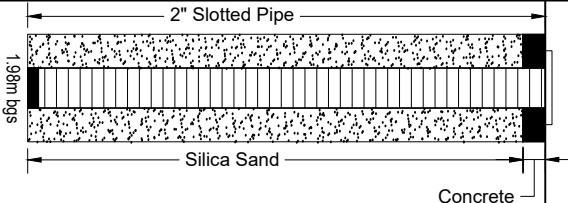
PROJECT NO.: FE-P# 22-12469/70

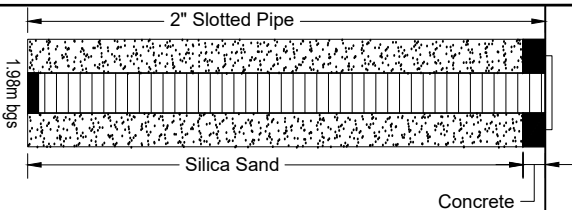
PROJECT NAME: GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATIONS

LOCATION: 5210 Innes Road, Ottawa, ON

DRILLING METHOD: Truck, Solid Stem

DRILLING DATE: 23 September, 2022

| SOIL PROFILE                     |             | SAMPLES         |        |          | PENETRATION TESTING (SP) ▲ |             | VAPOUR READING (ppm) □ |             | PIEZOMETER OR WELL CONSTRUCTION                                                       |
|----------------------------------|-------------|-----------------|--------|----------|----------------------------|-------------|------------------------|-------------|---------------------------------------------------------------------------------------|
| DESCRIPTION                      | STRATA PLOT | ELEV. DEPTH (m) | LAB ID | Type NO. | "N" VALUE                  | 20 40 60 80 | MOISTURE CONTENT (%) ● | 20 40 60 80 |                                                                                       |
| Augered to 1.52m                 |             | 87.66           |        |          |                            |             |                        |             |  |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
| SILTY CLAY:<br>Grey, moist, soft |             | 1.52 / 86.14    |        |          |                            |             |                        |             |                                                                                       |
|                                  |             | 1.98 / 85.68    |        | SS-1     | 6                          |             | 42.8%                  |             |                                                                                       |
| End of test hole at 1.98m        |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |
|                                  |             |                 |        |          |                            |             |                        |             |                                                                                       |



Groundwater Depth (m): on completion: Dry

DRAWN: D.C.

LOGGED: J.Y.

CHECKED: C.W.

## **APPENDIX C – MOISTURE CONTENT**

**Project Name:** Geotechnical Investigation

**F.E. Lab #:** 22-495

**Client:** Dymon Group of Companies

**Date Sampled:** 20-Sep-2022

**Project ID:** 22-12470

**Date Received:** 26-Sep-2022

**Location:** 5210 Innes Road

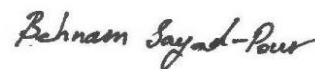
**Date Reported:** 18-Oct-2022

Ottawa, Ontario

## Certificate of Analysis

| Analyses                    | Matrix | Quantity | Testing Date | Method Reference |
|-----------------------------|--------|----------|--------------|------------------|
| Moisture Content            | Soil   | 6        | 26-Sep-22    | ASTM D2216       |
| Grain Size (Sieve Analysis) | Soil   | 0        | N.A.         | LS-602           |
| Grain Size (Hydrometer)     | Soil   | 5        | 12-Oct-22    | LS-702           |
| Atterberg test              | Soil   | 0        | N.A.         | LS-703/704       |

Authorized by:



Behnam Sayad Pour Zanjani

Geo-Lab Supervisor

## Certificate of Analysis

|                            |                  |                            |                  |
|----------------------------|------------------|----------------------------|------------------|
| <b>Analysis Requested:</b> | Moisture Content | <b>Sample Description:</b> | 6 Soil Sample(s) |
|----------------------------|------------------|----------------------------|------------------|

|                             |           |           |           |           |           |           |
|-----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>Sample Info</b>          | BH2 SS3   | BH3 SS3   | BH4 SS2   | BH4 SS3   | BH4 SS4   | TH1       |
| <b>Sample Depth (m)</b>     | 1.53-1.98 | 1.53-1.98 | 0.76-1.22 | 1.53-1.98 | 2.29-2.75 | 1.53-1.98 |
| <b>Moisture Content (%)</b> | 48.2      | 45.8      | 35.5      | 44.9      | 58.9      | 47.3      |

|                             |           |  |  |  |  |  |
|-----------------------------|-----------|--|--|--|--|--|
| <b>Sample Info</b>          | TH2       |  |  |  |  |  |
| <b>Sample Depth (m)</b>     | 1.53-1.98 |  |  |  |  |  |
| <b>Moisture Content (%)</b> | 42.8      |  |  |  |  |  |

## Certificate of Analysis

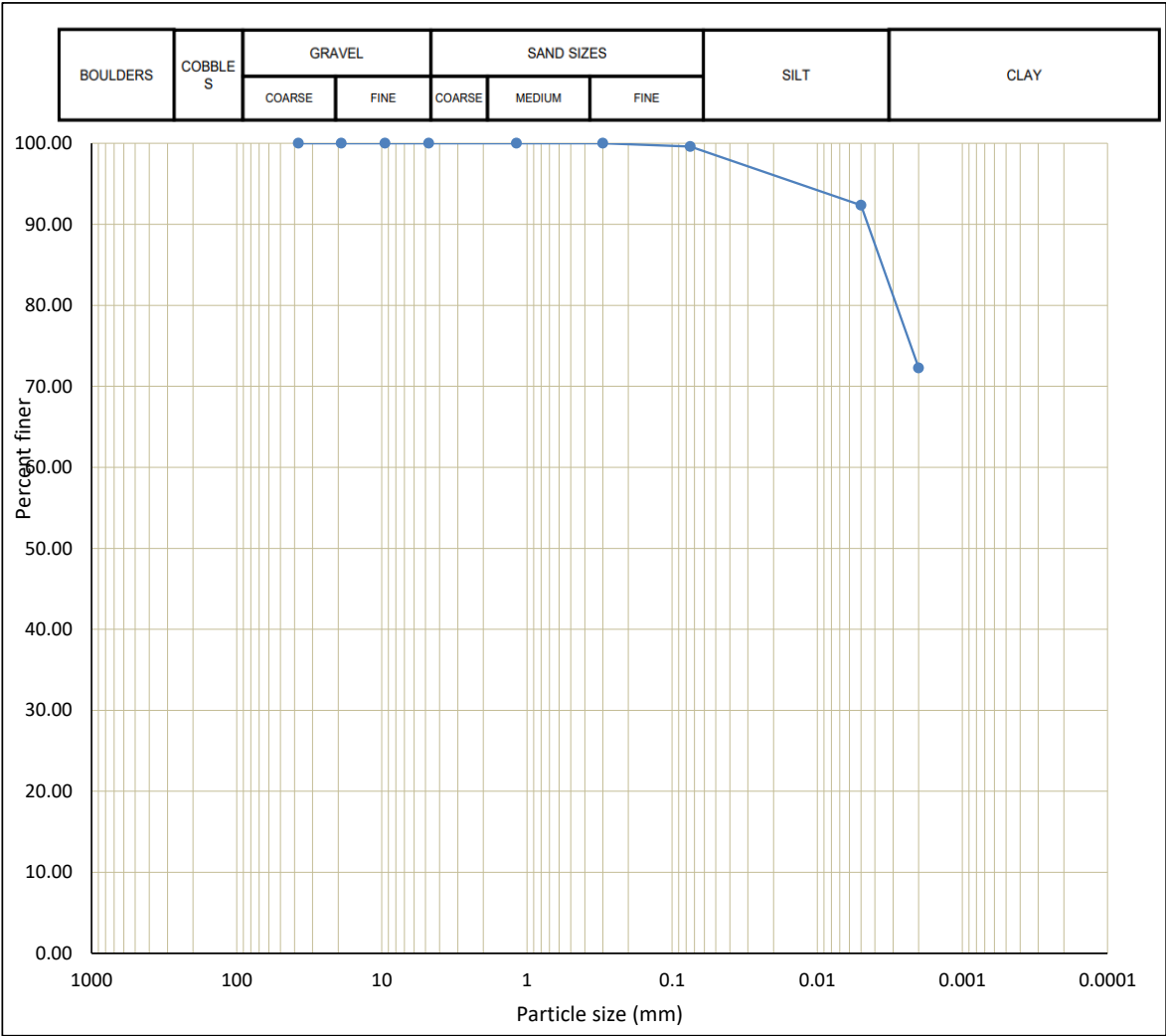
|                            |                         |
|----------------------------|-------------------------|
| <b>Analysis Requested:</b> | Grain Size (Hydrometer) |
| <b>Sample Description:</b> | 5 Soil Sample(s)        |

| <b>Sample Info</b>      | <b>22-508<br/>BH2 SS3</b> | <b>22-509<br/>BH3 SS3</b> | <b>22-510<br/>BH4 SS2</b> | <b>22-511<br/>TH1</b> | <b>22-512<br/>TH2</b> |  |
|-------------------------|---------------------------|---------------------------|---------------------------|-----------------------|-----------------------|--|
| <b>Sample Depth (m)</b> | <b>1.53-1.98</b>          | <b>1.53-1.98</b>          | <b>0.76-1.22</b>          | <b>1.53-1.98</b>      | <b>1.53-1.98</b>      |  |
| <b>Grain Size (%)</b>   |                           |                           |                           |                       |                       |  |
| > 19mm                  | 0.0                       | 0.0                       | 0.0                       | 0.0                   | 0.0                   |  |
| 9.5mm-19mm              | 0.0                       | 0.0                       | 0.0                       | 0.0                   | 0.0                   |  |
| 4.75mm-9.5mm            | 0.0                       | 0.0                       | 0.0                       | 0.0                   | 0.0                   |  |
| 1.18mm-4.75mm           | 0.0                       | 0.0                       | 0.0                       | 0.0                   | 0.0                   |  |
| 300um-1.18mm            | 0.0                       | 0.2                       | 0.0                       | 0.0                   | 0.0                   |  |
| 75um-300um              | 0.4                       | 0.6                       | 0.6                       | 0.4                   | 0.2                   |  |
| 5um-75um                | 7.2                       | 9.7                       | 15.1                      | 10.8                  | 11.9                  |  |
| 2um-5um                 | 20.1                      | 15.9                      | 14.2                      | 14.8                  | 15.4                  |  |
| <2um                    | 72.3                      | 73.6                      | 70.1                      | 74.0                  | 72.5                  |  |
| <b>Clay</b>             | <b>72</b>                 | <b>74</b>                 | <b>70</b>                 | <b>74</b>             | <b>72</b>             |  |
| <b>Silt</b>             | <b>27</b>                 | <b>26</b>                 | <b>29</b>                 | <b>26</b>             | <b>27</b>             |  |
| <b>Sand</b>             | <b>0</b>                  | <b>1</b>                  | <b>1</b>                  | <b>0</b>              | <b>0</b>              |  |
| <b>Gravel</b>           | <b>0</b>                  | <b>0</b>                  | <b>0</b>                  | <b>0</b>              | <b>0</b>              |  |

Grain Size Distribution

Sample ID: 22-508 BH2 SS3 1.53-1.98

Gravel: 0%      Sand: 0%      Silt: 27%      Clay: 72%

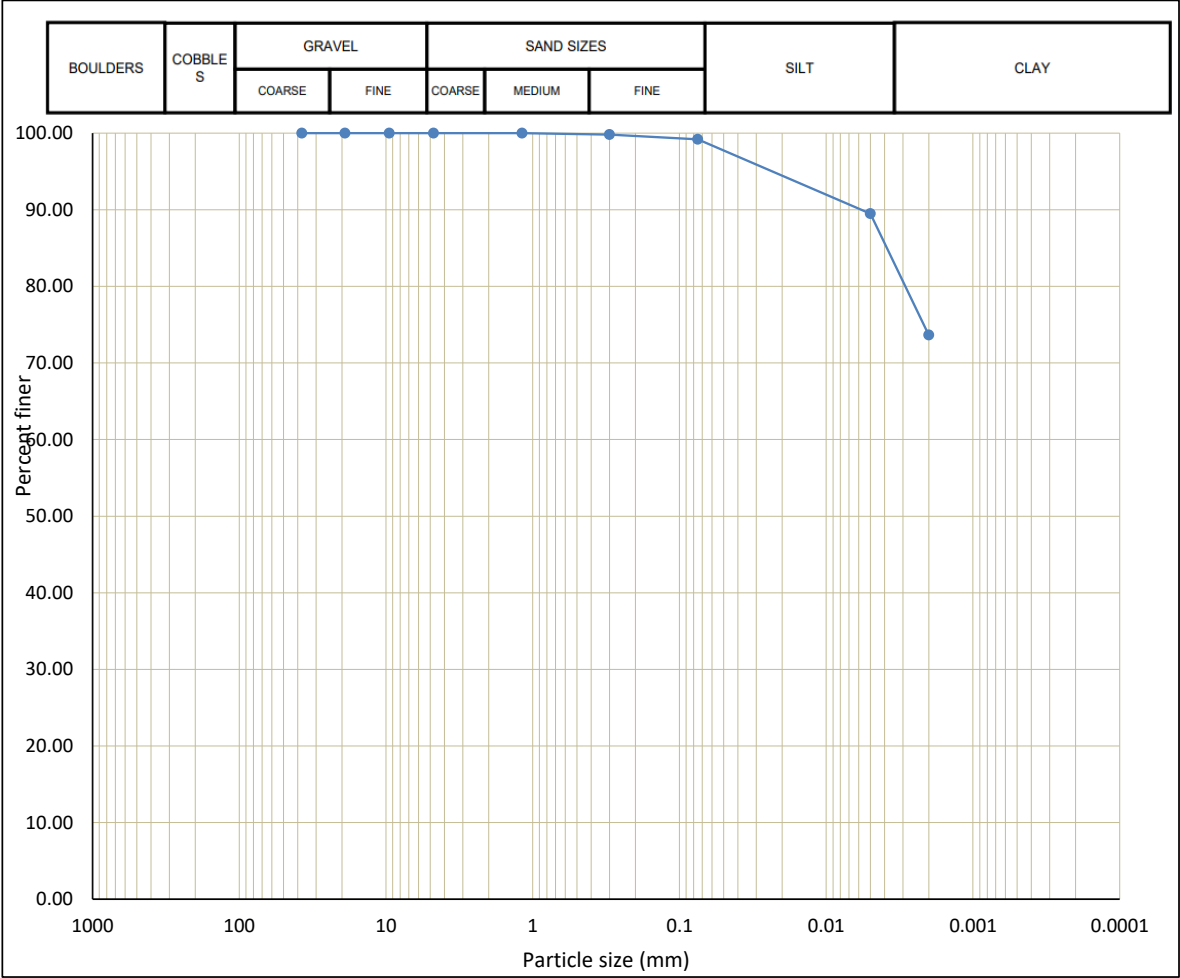


| Sample ID: 22-508 BH2 SS3 1.53-1.98 |            |             |
|-------------------------------------|------------|-------------|
| Diameter                            | Weight (%) | Grain Size  |
| >4.75mm                             | 0.0        | Gravel      |
| 1.18mm-4.75mm                       | 0.0        | Coarse Sand |
| 300um-1.18mm                        | 0.0        | Medium Sand |
| 75um-300um                          | 0.4        | Fine Sand   |
| 5um-75um                            | 7          | Silt        |
| 2um-5um                             | 20         |             |
| <2um                                | 72         | Clay        |

Grain Size Distribution

Sample ID: 22-509 BH3 SS3 1.53-1.98

Gravel: 0%      Sand: 1%      Silt: 26%      Clay: 74%



| Sample ID: 22-509 BH3 SS3 1.53-1.98 |            |             |
|-------------------------------------|------------|-------------|
| Diameter                            | Weight (%) | Grain Size  |
| >4.75mm                             | 0.0        | Gravel      |
| 1.18mm-4.75mm                       | 0.0        | Coarse Sand |
| 300um-1.18mm                        | 0.2        | Medium Sand |
| 75um-300um                          | 0.6        | Fine Sand   |
| 5um-75um                            | 10         | Silt        |
| 2um-5um                             | 16         |             |
| <2um                                | 74         | Clay        |

## Grain Size Distribution

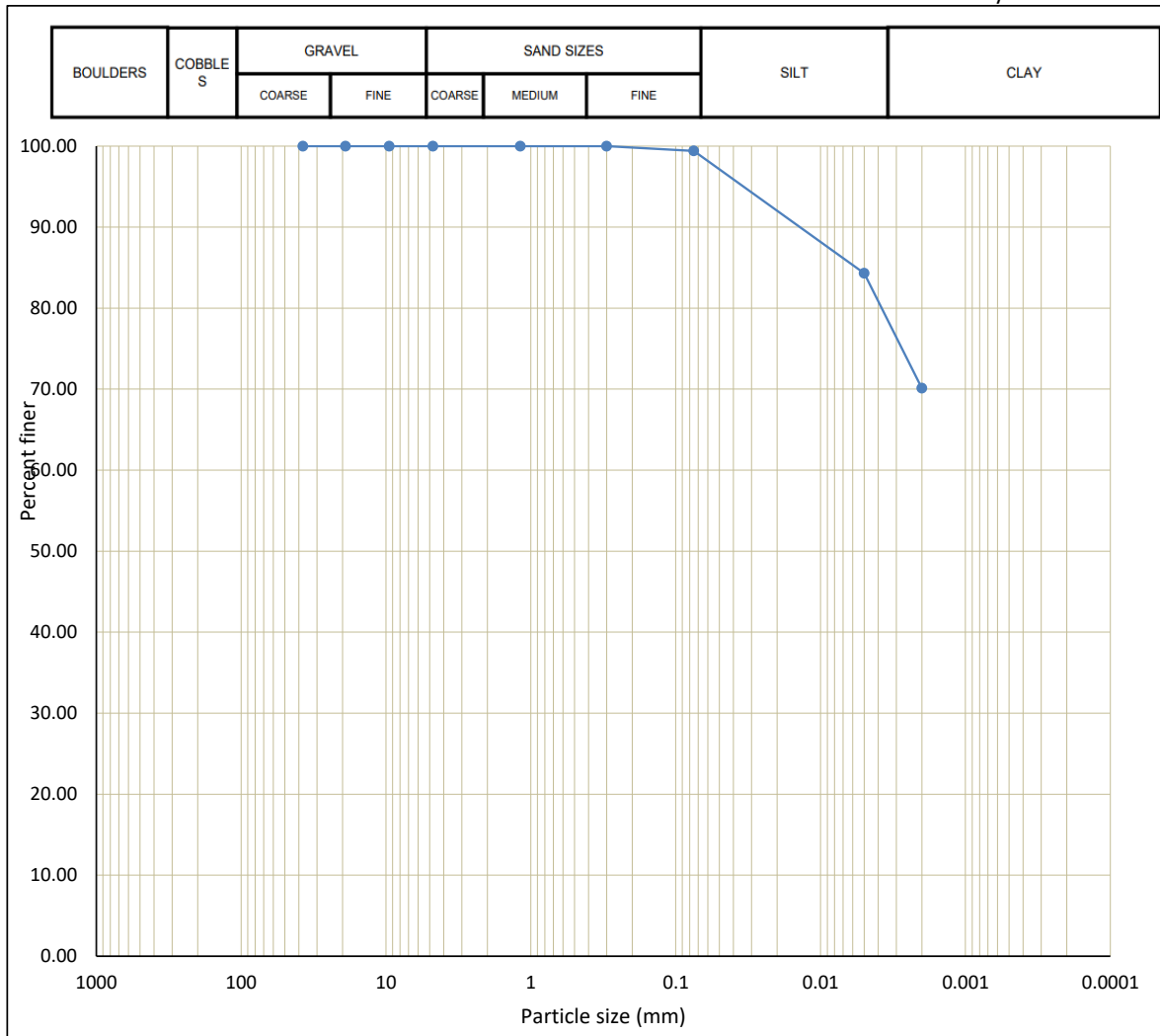
Sample ID: 22-510 BH4 SS2 0.76-1.22

Gravel: 0%

Sand: 1%

Silt: 29%

Clay: 70%



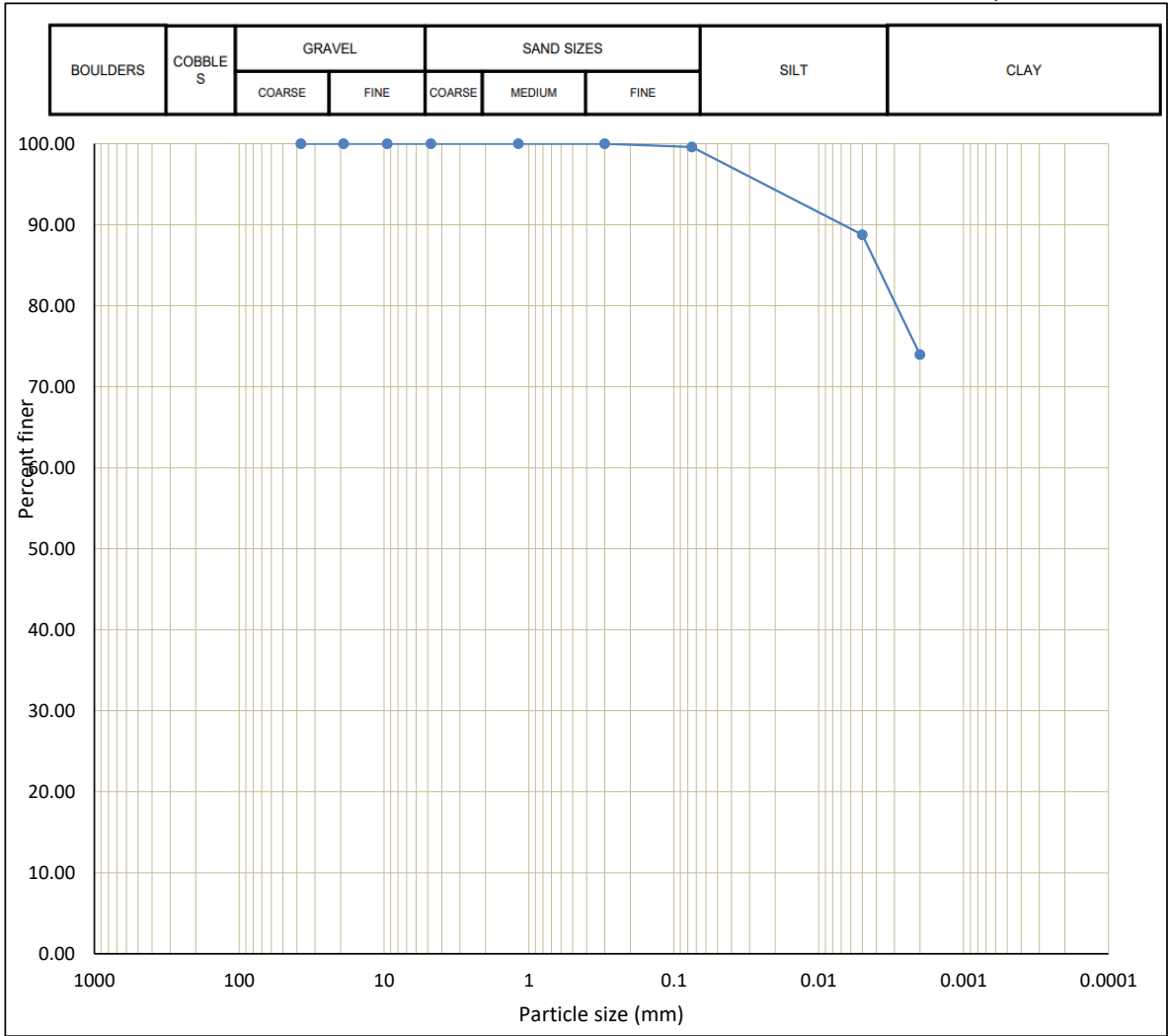
| Sample ID: 22-510 BH4 SS2 0.76-1.22 |            |             |
|-------------------------------------|------------|-------------|
| Diameter                            | Weight (%) | Grain Size  |
| >4.75mm                             | 0.0        | Gravel      |
| 1.18mm-4.75mm                       | 0.0        | Coarse Sand |
| 300um-1.18mm                        | 0.0        | Medium Sand |
| 75um-300um                          | 0.6        | Fine Sand   |
| 5um-75um                            | 15         | Silt        |
| 2um-5um                             | 14         |             |
| <2um                                | 70         | Clay        |

## Grain Size Distribution

Sample ID: 22-511 TH1 1.53-1.98

Sand: 0%

Clay: 74%



| Sample ID: 22-511 TH1 1.53-1.98 |                   |                   |
|---------------------------------|-------------------|-------------------|
| <i>Diameter</i>                 | <i>Weight (%)</i> | <i>Grain Size</i> |
| >4.75mm                         | 0.0               | Gravel            |
| 1.18mm-4.75mm                   | 0.0               | Coarse Sand       |
| 300um-1.18mm                    | 0.0               | Medium Sand       |
| 75um-300um                      | 0.4               | Fine Sand         |
| 5um-75um                        | 11                | Silt              |
| 2um-5um                         | 15                |                   |
| <2um                            | 74                | Clay              |

## Grain Size Distribution

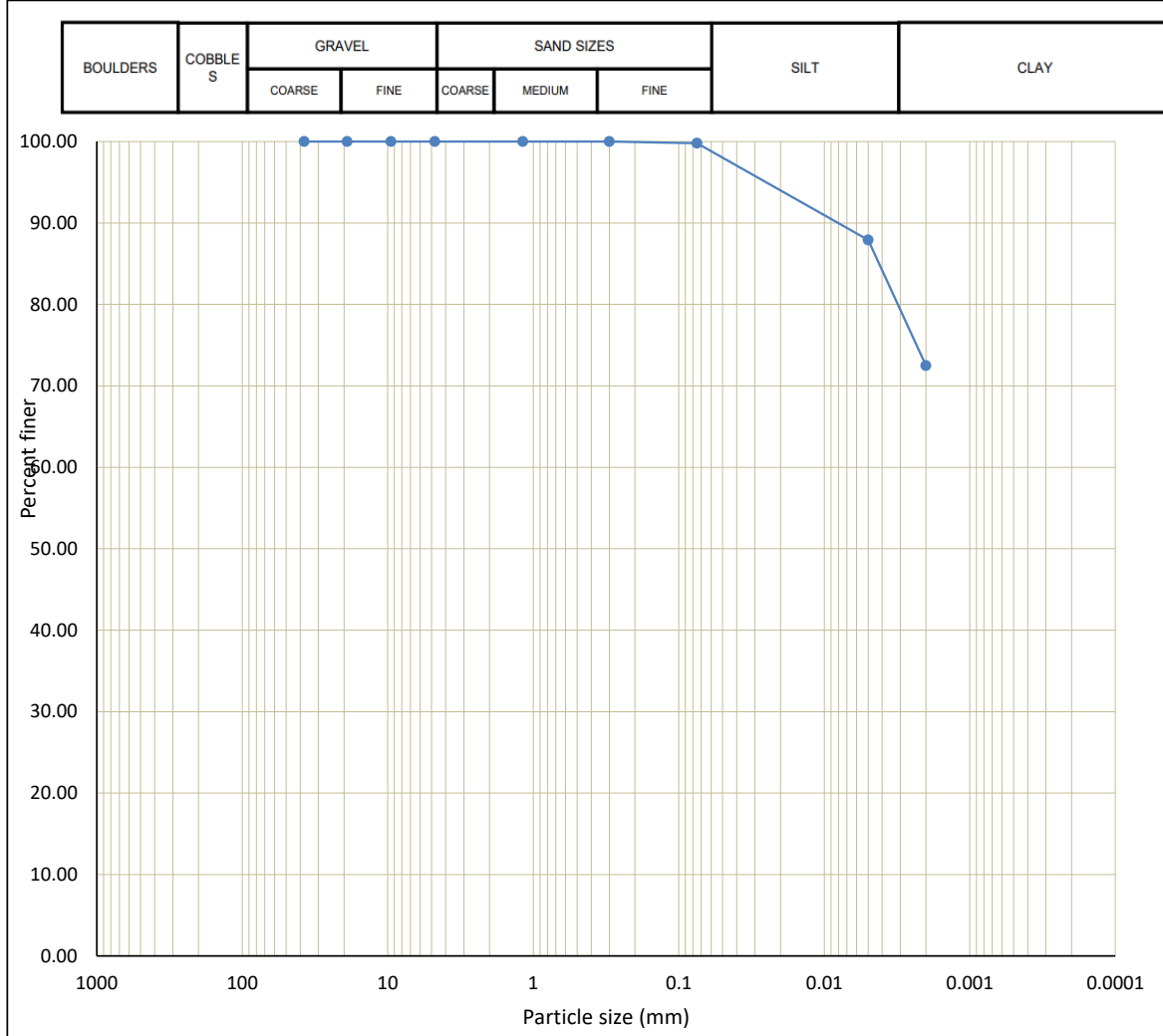
Sample ID: 22-512 TH2 1.53-1.98

Gravel: 0%

Sand: 0%

Silt: 27%

Clay: 72%



| Sample ID: 22-512 TH2 1.53-1.98 |            |             |
|---------------------------------|------------|-------------|
| Diameter                        | Weight (%) | Grain Size  |
| >4.75mm                         | 0.0        | Gravel      |
| 1.18mm-4.75mm                   | 0.0        | Coarse Sand |
| 300um-1.18mm                    | 0.0        | Medium Sand |
| 75um-300um                      | 0.2        | Fine Sand   |
| 5um-75um                        | 12         | Silt        |
| 2um-5um                         | 15         | Clay        |
| <2um                            | 72         |             |

LAB JOB No:

**Standard Laboratory Request Form: Chain of Custody**

Page 1 of 1
**CLIENT INFORMATION**

Name:  
Contact:  
Address: 5210 INNES

Email:

Fax:

Phone:

Fax results ☐  
Email results ☒
**PROJECT INFORMATION**

Project Name: 5210 INNES

Project ID: 77-12470

Sampled By:

**TURNAROUND TIME (TAT): Check ONE if all samples are the same/or see below.**

STD - Standard (5-7 bus. days)

3D - Three-Day (72 hrs.)

Standard Charge

+25%

**SURCHARGES MAY APPLY**  
Custom quotations (if applicable) will be reflected on final billing.  
CALL for: Emergencies, Bulk Quotes, or other Questions.

Reg. Business Hrs.  
9am to 5pm  
Samples received after 2pm are considered next day orders.

**BILLING INFORMATION**

Purchase Order No:

Verbal Authorization:

Credit Card Type (e.g. MC/Visa/AMEX...):

Credit Card #:

Expiry Date:

| LAB<br>SAMPLE ID | CLIENT'S SAMPLE ID<br>AND DESCRIPTION | SAMPLING<br>DATE/TIME | SAMPLE<br>MATRIX | CONTAINER<br>NO. and<br>TYPE | TAT<br>(Above) | ANALYSIS REQUESTED (Check or Specify) |                   |            |                     |         |  |  |  |  |  | NOTES |
|------------------|---------------------------------------|-----------------------|------------------|------------------------------|----------------|---------------------------------------|-------------------|------------|---------------------|---------|--|--|--|--|--|-------|
|                  |                                       |                       |                  |                              |                | Moisture<br>Content                   | Sieve<br>Analysis | Hydrometer | Atterberg<br>Limits | Proctor |  |  |  |  |  |       |
| 1                | MH2 5'-6.5'                           | · Sep 20              | Soil             | bag                          | STD            | ✓                                     | ✗                 | ✓          |                     |         |  |  |  |  |  |       |
| 2                | MH4 2.5'-4'                           | ↓                     | Soil             | bag                          | ↓              | ↓                                     | ✗                 | ✓          |                     |         |  |  |  |  |  |       |
|                  | 5'-6.5'                               | ↓                     | Soil             | bag                          | ↓              | ↓                                     | ✗                 |            |                     |         |  |  |  |  |  |       |
|                  | 10'-11.5'                             | ↓                     | Soil             | bag                          | ↓              | ↓                                     | ✗                 |            |                     |         |  |  |  |  |  |       |
| 3                | MH3 5'-6.5'                           | ↓                     | Soil             | bag                          | ↓              | ↓                                     |                   | ✓          |                     |         |  |  |  |  |  |       |
| 4                | TH1 5'-6.5'                           | ↓                     | Soil             | bag                          | ↓              | ↓                                     |                   | ✓          |                     |         |  |  |  |  |  |       |
| 5                | TH2 5'-6.5'                           | ↓                     | Soil             | bag                          | ↓              | ↓                                     |                   | ✓          |                     |         |  |  |  |  |  |       |
|                  |                                       |                       |                  |                              |                |                                       |                   |            |                     |         |  |  |  |  |  |       |
|                  |                                       |                       |                  |                              |                |                                       |                   |            |                     |         |  |  |  |  |  |       |
|                  |                                       |                       |                  |                              |                |                                       |                   |            |                     |         |  |  |  |  |  |       |

**Relinquished by:**

Name: (print) JAMAL, Clive  
Signature:   
Date & Time: Sep 26  
Method of Shipment: by hand

**Client's Comments:**
**Regulatory Requirements:**

OPSS Reg.

**Purpose for sampling:**

Road Base  
Road Subbase  
Subgrade  
Backfill

Engineering Fill  
Soil Classification  
Other

**Received by (Internal):**

Name:

Date &amp; Time:

**Arrival Temperature °C:**

Laboratory Remarks:



# FISHER ENVIRONMENTAL LABORATORIES

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FAX: 905 475-7718  
www.fisherenvironmental.com

**Client:** Dymon Group of Companies

**Address:**

**Tel.:**

**Email:**

**Attn.:**

**F.E. Job #:** 21-6138

**Project Name:** Geotechnical

**Project ID:** FE-P 21-10991

**Date Sampled:** 8, 9-Mar-2021

**Date Received:** 10-Mar-2021

**Date Reported:** 17-Mar-2021

**Location:** 5210 Innes Road

Ottawa, ON

## Certificate of Analysis

| Analyses         | Matrix | Quantity | Date<br>Extracted | Date Analyzed | Lab SOP                    | Method<br>Reference |
|------------------|--------|----------|-------------------|---------------|----------------------------|---------------------|
| Moisture Content | Soil   | 7        | N/A               | 12-Mar-21     | Support<br>Procedures F-99 | Carter (1993)       |

Fisher Environmental Laboratories is accredited by CALA (the Canadian Association for Laboratory Accreditation Inc.) for specific parameters as required by Ontario Regulation 153/04. All analytical testing has been performed in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act published by Ontario Ministry of the Environment.

**Authorized by:**

Roger Lin, Ph. D., C. Chem.  
Laboratory Manager



## Certificate of Analysis

|                            |                  |
|----------------------------|------------------|
| <b>Analysis Requested:</b> | Moisture Content |
| <b>Sample Description:</b> | 7 Soil Sample(s) |

| Parameter                   | 21-6138-1<br>BH1<br>0.75-1.35m | 21-6138-2<br>BH1<br>2.25-2.85m | 21-6138-3<br>BH1<br>4.55-5.15m | 21-6138-4<br>BH2<br>1.50-2.10m | 21-6138-5<br>BH2<br>3.00-3.60m | 21-6138-6<br>BH3<br>0.75-1.35m |
|-----------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| <b>Moisture Content (%)</b> | 37                             | 44                             | 73                             | 48                             | 68                             | 34                             |

| Parameter                   | 21-6138-7<br>BH3<br>2.25-2.85m |  |  |  |  |  |
|-----------------------------|--------------------------------|--|--|--|--|--|
| <b>Moisture Content (%)</b> | 43                             |  |  |  |  |  |

## QA/QC Report

| Parameter                   | Blank | RL  | LCS          | AR     | Duplicate | AR   |
|-----------------------------|-------|-----|--------------|--------|-----------|------|
|                             |       |     | Recovery (%) |        | RPD (%)   |      |
| <b>Moisture Content (%)</b> | <0.1  | 0.1 | 100          | 70-130 | 4.0       | 0-20 |

**LEGEND:**

RL - Reporting Limit

LCS - Laboratory Control Sample

AR - Acceptable Range

RPD - Relative Percent Difference



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www.fisherenvironmental.com

**Client:** Dymon Group of Companies

**Address:**

**Tel.:**

**Email:**

**Attn.:**

**F.E. Job #:** 22-9178

**Project Name:** Geotechnical & Hydrogeotechnical

**Project ID:** FE-P 22-12470

**Date Sampled:** 23-Sep-2022

**Date Received:** 26-Sep-2022

**Date Reported:** 3-Oct-2022

**Location:** 5210 Innes Road

Ottawa, ON

## Certificate of Analysis

| Analyses | Matrix | Quantity | Date<br>Extracted | Date Analyzed | Lab SOP        | Method<br>Reference     |
|----------|--------|----------|-------------------|---------------|----------------|-------------------------|
| pH       | Soil   | 2        | 26-Sep-22         | 26-Sep-22     | pH-EC-SAR F-16 | SW-846, 9045D           |
| Chloride | Soil   | 2        | N/A               | 28-Sep-22     | Chloride F-20  | SM 4500-Cl-E            |
| Sulphate | Soil   | 2        | 26-Sep-22         | 28-Sep-22     | Sulphate F-21  | SM 4500-SO <sub>4</sub> |

Fisher Environmental Laboratories is accredited by CALA (the Canadian Association for Laboratory Accreditation Inc.) for specific parameters as required by Ontario Regulation 153/04. All analytical testing has been performed in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act published by Ontario Ministry of the Environment.

Authorized by:

*Lin Ronggen*

Ronggen (Roger) Lin  
Laboratory Manager



## Certificate of Analysis

|                            |                        |
|----------------------------|------------------------|
| <b>Analysis Requested:</b> | pH, Sulphate, Chloride |
| <b>Sample Description:</b> | 2 Soil Sample(s)       |

| Parameter           | 22-9178-1<br>BH3<br>1.52-1.98m | 22-9178-2<br>BH4<br>1.52-1.98m |  |  |  | Soil Standards * |
|---------------------|--------------------------------|--------------------------------|--|--|--|------------------|
| <b>pH (pH unit)</b> | 7.85                           | 7.81                           |  |  |  | (5-11) 5-9       |

\* Surface soil pH value from 5 - 9, Sub-surface soil pH value from 5-11.

## QA/QC Report

| Parameter           | LCS                                  | AR        | Duplicate | AR   |  |  |
|---------------------|--------------------------------------|-----------|-----------|------|--|--|
|                     | <b>Absolute Difference (pH Unit)</b> |           |           |      |  |  |
| <b>pH (pH unit)</b> | 7.10                                 | 6.90-7.20 | 0.16      | <0.3 |  |  |

**LEGEND:**

LCS - Laboratory Control Sample

AR - Acceptable Range

## Certificate of Analysis

|                            |                             |                  |  |  |  |  |
|----------------------------|-----------------------------|------------------|--|--|--|--|
| <b>Analysis Requested:</b> | pH, Sulphate, Chloride      |                  |  |  |  |  |
| <b>Sample Description:</b> | 2 Soil Sample(s)            |                  |  |  |  |  |
| <b>Parameter</b>           | <b>22-9178-1</b>            | <b>22-9178-2</b> |  |  |  |  |
|                            | BH3                         | BH4              |  |  |  |  |
|                            | 1.52-1.98m                  | 1.52-1.98m       |  |  |  |  |
|                            | <i>Concentration (µg/g)</i> |                  |  |  |  |  |
| <b>Chloride in Soil</b>    | <10                         | <10              |  |  |  |  |

< result obtained was below RL (Reporting Limit).

## QA/QC Report

| Parameter               | Blank  | RL | LCS          | AR     | MS           | AR     |
|-------------------------|--------|----|--------------|--------|--------------|--------|
|                         | (µg/g) |    | Recovery (%) |        | Recovery (%) |        |
| <b>Chloride in Soil</b> | <10    | 10 | 99           | 70-130 | 89           | 70-130 |

| Parameter               | Duplicate | AR   |  |  |  |  |
|-------------------------|-----------|------|--|--|--|--|
|                         | RPD (%)   |      |  |  |  |  |
| <b>Chloride in Soil</b> | 0.4       | 0-20 |  |  |  |  |

**LEGEND:**

RL - Reporting Limit

LCS - Laboratory Control Sample

MS - Matrix Spike

AR - Acceptable Range

RPD - Relative Percent Difference

## Certificate of Analysis

|                            |                        |
|----------------------------|------------------------|
| <b>Analysis Requested:</b> | pH, Sulphate, Chloride |
| <b>Sample Description:</b> | 2 Soil Sample(s)       |

| Parameter               | 22-9178-1<br>BH3<br>1.52-1.98m | 22-9178-2<br>BH4<br>1.52-1.98m |  |  |  |  |
|-------------------------|--------------------------------|--------------------------------|--|--|--|--|
| <b>Sulphate (mg/kg)</b> | 13.4                           | 24.0                           |  |  |  |  |

## QA/QC Report

| Parameter       | Blank   | RL | LCS/Spike    | AR     | Duplicate | AR   |
|-----------------|---------|----|--------------|--------|-----------|------|
|                 | (mg/kg) |    | Recovery (%) |        | RPD (%)   |      |
| <b>Sulphate</b> | <1      | 1  | 96           | 70-130 | 7.4       | 0-30 |

**LEGEND:**

RL - Reporting Limit

LCS - Laboratory Control Sample

AR - Acceptable Range

RPD - Relative Percent Difference



## **APPENDIX D – SHEAR WAVE TESTS RESULTS**



May 6, 2021

Dymon Group of Companies  
2-1830 Walkley Road  
Ottawa, Ontario K1H 8K3

Attn: James Byck  
Email: [jbyck@dymon.ca](mailto:jbyck@dymon.ca)

**Re: Shear Wave Velocity Sounding - Proposed New Development,  
5210 Innes Road, Ottawa, Ontario  
Fisher Project #: FE-P-21-10991**

---

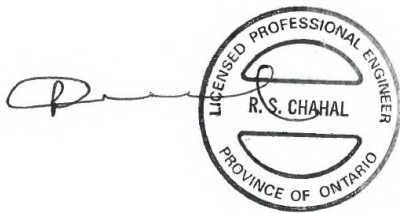
We enclose the report prepared by Jean-Luc Arsenault, M.A.Sc., P.Eng., of Geophysics GPR International Inc. documenting the results of shear-wave velocity sounding at the above noted site.

The sounding/survey was performed on April 26, 2021. Shear wave velocity measurements were recommended in order to determine/confirm the Site Class for the building design at the subject site and/or the approximate depth of bedrock.

Average Vs values determined through MASW method varied from 100m/s to 200m/s in upper 20m, 200m/s to 400m/s in 20m to 40m depth range with an overall average Vs30 of 158m/s. The above Sounding indicate that sound bedrock is located at the approximate depth of 40m below grade. We recommend that few deeper boreholes be carried out to determine the subsurface conditions down to the bedrock level to determine liquification potential or presence of very soft/sensitive clays etc.

The above average shear wave velocity measurement (Vs30) of 158m/s also confirm that Site Class 'E' be used for the building design purposes.

**Fisher Engineering Limited**



---

Rajinder Chahal, P. Eng.  
Senior Project Engineer  
Mobile: 647.227.8473  
[rajinder@fisherenvironmental.com](mailto:rajinder@fisherenvironmental.com)



**GEOPHYSICS GPR INTERNATIONAL INC.**

100 – 2545 Delorimier Street    Tel. : (450) 679-2400  
Longueuil (Québec)    Fax : (514) 521-4128  
Canada J4K 3P7    info@geophysicsgpr.com  
www.geophysicsgpr.com

May 5<sup>th</sup>, 2021

Transmitted by email: [Sean@fisherenvironmental.com](mailto:Sean@fisherenvironmental.com)

Our Ref.: GPR-21-02934-02

Mr. Sean Fisher, M.Sc.  
Project manager  
Fisher Environmental Ltd.  
15 - 400 Esna Park Dr.  
Markham ON K1J 9G2

**Subject:    Shear Wave Velocity Sounding for the Site Classe Determination**  
**Innes Road and Trim Road, Ottawa (ON)**

[Project: FE-P 21-10991]

Dear Sir,

Geophysics GPR International inc. has been mandated by Fisher Environmental Ltd. to carry out seismic shear wave surveys on a vacant field located at the east corner of Innes Road and Trim Road, in Ottawa (ON). The geophysical investigation used the Multi-channel Analysis of Surface Waves (MASW), the Spatial AutoCorrelation (SPAC), and the seismic reflection methods to determine the Site Class.

The surveys were carried out on April 26<sup>th</sup>, 2021, by Mr. Dominic Dérap, tech. geoph. and Mr. Timothy Ward, tech. Figure 1 shows the regional location of the site and Figure 2 illustrates the location of the seismic spreads. Both figures are presented in the Appendix.

The following paragraphs briefly describe the survey design, the principles of the testing methods, and the results presented in tables and graphs.

## MASW PRINCIPLE

The *Multi-channel Analysis of Surface Waves* (MASW) and the *SPatial AutoCorrelation* (SPAC or MAM for *Microtremors Array Method*) are seismic methods used to evaluate the shear wave velocities of subsurface materials through the analysis of the dispersion properties of the Rayleigh surface waves (“ground roll”). The MASW is considered an “active” method, as the seismic signal is induced at known location and time in the geophones’ spread axis. Conversely, the SPAC is considered a “passive” method, using the low frequency “signals” produced far away. The method can also be used with “active” seismic source records. The dispersion properties are expressed as a change of phase velocities with respect to frequencies. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. The inversion of the Rayleigh wave dispersion curve yields a shear wave ( $V_s$ ) velocity depth profile (sounding). Figure 3 schematically outlines the basic operating procedure for the MASW method.

Figure 4 illustrates an example of one of the MASW/SPAC records, the corresponding spectrogram analysis and resulting 1D  $V_s$  model. The SPAC method allows deeper  $V_s$  soundings, but generally with a lower resolution for the surface portion. Its dispersion curve can then be merged with the one of higher frequency from the MASW to calculate a more complete inversion.

## INTERPRETATION

The main processing sequence involved data inspection and edition when required; spectral analysis (“phase shift” for MASW, and “cross-correlation” for SPAC); picking the fundamental mode; and 1D inversion of the MASW and SPAC shot records using the SeisImagerSW™ software. The data inversions used a nonlinear least squares algorithm.

In theory, all the shot records for a given seismic spread should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation, local surface seismic velocities variations, and/or dipping of overburden layers or rock. In general, the precision of the calculated seismic shear wave velocities ( $V_s$ ) is of the order of 15% or better.

More detailed descriptions of these methods are presented in *Shear Wave Velocity Measurement Guidelines for Canadian Seismic Site Characterization in Soil and Rock*, Hunter, J.A., Crow, H.L., et al., Geological Surveys of Canada, General Information Product 110, 2015.



## SURVEY DESIGN

The main seismic acquisition spread used a geophone spacing of 4.0 metres, with 24 geophones. A shorter seismic spread, with geophone spacing 1.0 metre, was centered on the main one, and was dedicated to the near surface materials. The seismic records counted 4096 data, sampled at 1000  $\mu$ s for the MASW surveys, and 50  $\mu$ s for the seismic refraction. The records included a pre-triggered portion of 10 ms. A stacking procedure was also used to improve the Signal / Noise ratio for the seismic records.

The seismic records were produced with a seismograph Terraloc PRO2 (from ABEM Instrument), and the geophones were 4.5 Hz. An 8 kg sledgehammer was used as the energy source with impacts being recorded off both ends of the seismic lines.

The shear wave depth sounding can be considered as the average of the bulk area within the geophone spread, especially for its central half-length.

## RESULTS

From seismic reflection (NMO using  $V_s$ ), four reflectors were calculated at 20, 25, 30 and 42 metres deep. From seismic resonance ( $V_p$ ), four equivalent reflectors were calculated at 18, 24, 33 and 40 metres deep. The deepest reflector could reasonably be associated to the rock. These results were used as initial parameters for the basic geophysical model, prior to the MASW dispersion curves modeling and inversions.

The MASW calculated  $V_s$  results are illustrated at Figure 5. The Table 1 shows the  $V_s$  values calculated between the surface and the rock.

The  $\bar{V}_{s30}$  value results from the harmonic mean of the shear wave velocities, from the surface to 30 metres deep. It is calculated by dividing the total depth of interest (30 metres) by the sum of the time spent in each velocity layer from the surface down to 30 metres, as:

$$\bar{V}_{s30} = \frac{\sum_{i=1}^N H_i}{\sum_{i=1}^N H_i / V_i} \quad | \quad \sum_{i=1}^N H_i = 30 \text{ m}$$

(N: number of layers;  $H_i$ : thickness of layer "i";  $V_i$ :  $V_s$  of layer "i")

Thus, the  $\bar{V}_{s30}$  value represents the seismic shear wave velocity of an equivalent homogeneous single layer response, between the surface and 30 metres deep.



The calculated  $\bar{V}_{S30}$  value of the actual site is 158.0 m/s (cf. Table 2), corresponding to the Site Class “E”. It must be noted that very low seismic velocities were calculated for the clayey materials, from approximately 1.5 to 12 metres deep. Some low seismic velocities were also calculated from the surface to approximately 1.5 metres deep, and from approximately 12 to 21 metres deep.



## CONCLUSION

Geophysical surveys were carried out on a vacant field located east of the intersection of Innes Road and Trim Road, in Ottawa (ON), to identify the Site Class. The seismic surveys used the MASW and the SPAC analysis, and the seismic reflection method to calculate the  $\bar{V}_{S30}$  value. Its calculation is presented at Table 2.

The  $\bar{V}_{S30}$  value of the actual site is 158 m/s, corresponding to the Site Class “E” ( $\bar{V}_{S30} < 180$  m/s), as determined through the MASW and SPAC methods, Table 4.1.8.4.A of the NBC, and the Building Code, O. Reg. 332/12. It must be noted that very low to low seismic values were calculated from the surface to approximately 21 metres deep. A geotechnical assessment of the corresponding materials should be produced for the potential of liquefaction, the clay degree of sensitivity, and possibly other critical parameters.

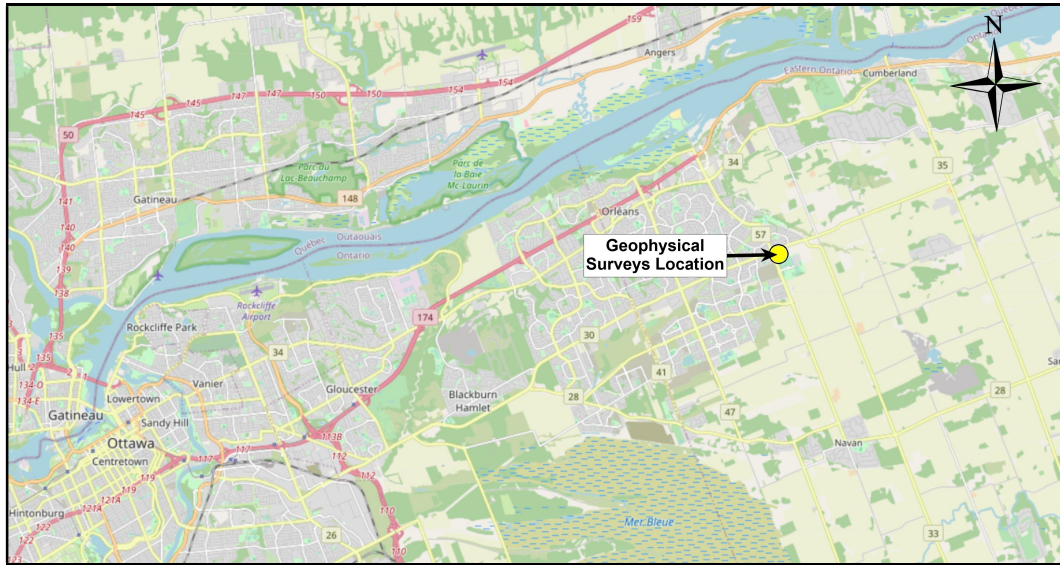
It must also be noted that other geotechnical information gleaned on site; including the presence of liquefiable soils, very soft clays, high moisture content etc. (cf. Table 4.1.8.4.A of the NBC) can supersede the Site classifications provided in this report based on the  $\bar{V}_{S30}$  value.

The  $V_s$  values calculated are representative of the in-situ materials and are not corrected for the total and effective stresses.

Hoping the whole to your satisfaction, we remain yours truly.

Jean-Luc Arsenault, M.A.Sc., P.Eng.  
Senior Project Manager



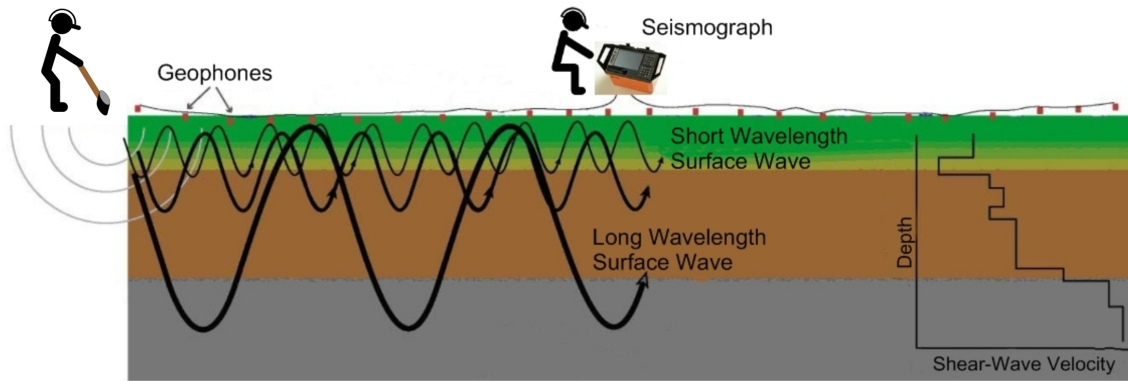


**Figure 1: Regional location of the Site**  
 (source: *OpenStreetMap*©)

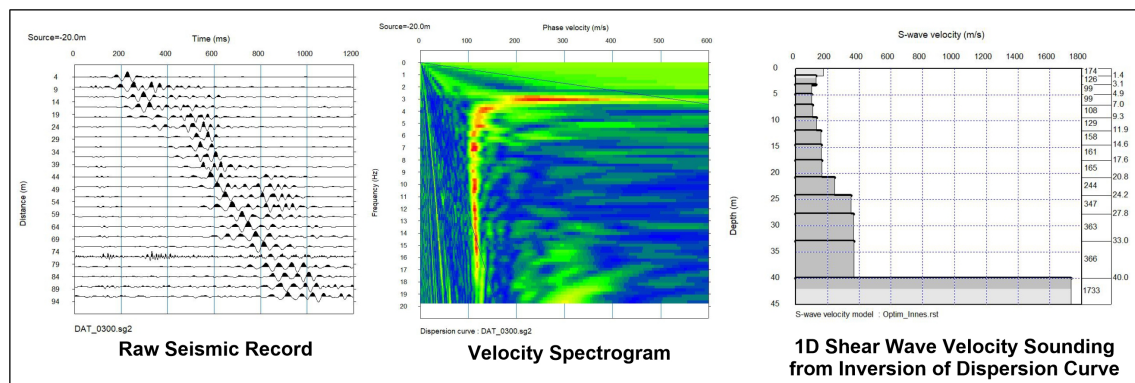


**Figure 2: Location of the Seismic Lines**  
 (source: *Google Earth*™)



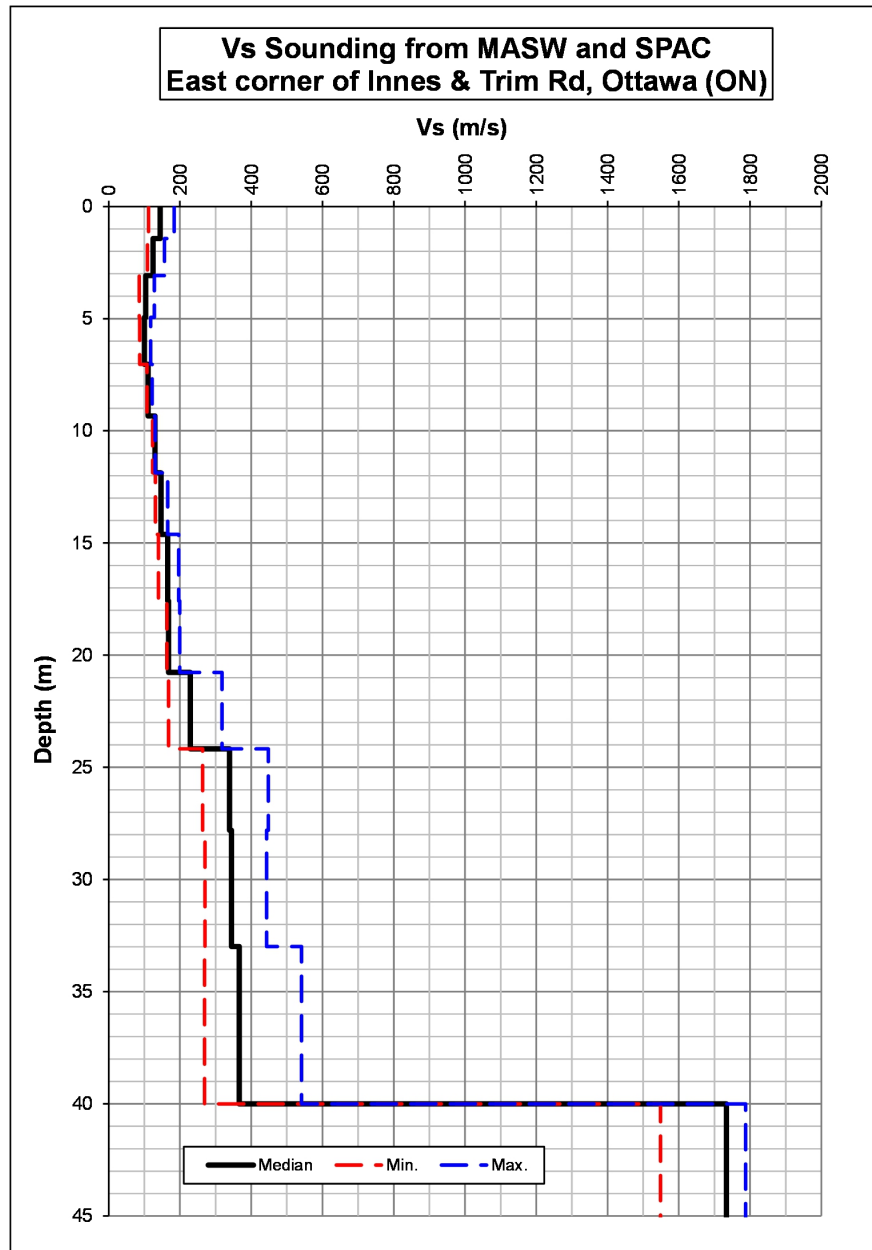


**Figure 3: MASW Operating Principle**



**Figure 4: Example of a MASW/SPAC record, Rayleigh wave Velocity - Frequency Dispersion Curve and resulting 1D Shear Wave Velocity Model**





**Figure 5: MASW Shear-Wave Velocity Sounding**



**TABLE 1**  
**Calculated  $V_s$  values**

| Depth (m) |       | $V_s$ (m/s) |        |        |
|-----------|-------|-------------|--------|--------|
| from      | to    | Min.        | Median | Max.   |
| 0         | 1.43  | 111.5       | 144.7  | 183.6  |
| 1.43      | 3.08  | 108.7       | 124.3  | 156.5  |
| 3.08      | 4.95  | 85.7        | 104.0  | 128.3  |
| 4.95      | 7.03  | 87.1        | 100.4  | 118.0  |
| 7.03      | 9.34  | 107.6       | 110.4  | 122.0  |
| 9.34      | 11.87 | 123.0       | 129.9  | 130.7  |
| 11.87     | 14.62 | 131.0       | 147.0  | 165.6  |
| 14.62     | 17.58 | 139.5       | 165.6  | 196.5  |
| 17.58     | 20.77 | 163.2       | 167.7  | 199.7  |
| 20.77     | 24.18 | 168.2       | 228.9  | 318.0  |
| 24.18     | 27.80 | 263.4       | 339.3  | 447.8  |
| 27.80     | 32.98 | 270.1       | 344.4  | 443.0  |
| 32.98     | 40.00 | 269.0       | 366.6  | 541.2  |
| 40.0      | plus  | 1548.3      | 1733.6 | 1787.5 |

**TABLE 2**  
 **$V_{S30}$  Calculation for the Site Class (actual site)**

| Depth | Vs    |        |       | Thickness                    | Cumulative Thickness | Delay for Med. Vs | Cumulative Delay | Vs at given Depth |
|-------|-------|--------|-------|------------------------------|----------------------|-------------------|------------------|-------------------|
|       | Min.  | Median | Max.  |                              |                      |                   |                  |                   |
| (m)   | (m/s) | (m/s)  | (m/s) | (m)                          | (m)                  | (s)               | (s)              | (m/s)             |
| 0     | 111.5 | 144.7  | 183.6 | Grade Level (April 26, 2021) |                      |                   |                  |                   |
| 1.43  | 108.7 | 124.3  | 156.5 | 1.43                         | 1.43                 | 0.009875          | 0.009875         | 144.7             |
| 3.08  | 85.7  | 104.0  | 128.3 | 1.65                         | 3.08                 | 0.013258          | 0.023133         | 133.0             |
| 4.95  | 87.1  | 100.4  | 118.0 | 1.87                         | 4.95                 | 0.017971          | 0.041104         | 120.3             |
| 7.03  | 107.6 | 110.4  | 122.0 | 2.09                         | 7.03                 | 0.020788          | 0.061893         | 113.6             |
| 9.34  | 123.0 | 129.9  | 130.7 | 2.31                         | 9.34                 | 0.020911          | 0.082804         | 112.8             |
| 11.87 | 131.0 | 147.0  | 165.6 | 2.53                         | 11.87                | 0.019464          | 0.102268         | 116.0             |
| 14.62 | 139.5 | 165.6  | 196.5 | 2.75                         | 14.62                | 0.018695          | 0.120963         | 120.8             |
| 17.58 | 163.2 | 167.7  | 199.7 | 2.97                         | 17.58                | 0.017914          | 0.138877         | 126.6             |
| 20.77 | 168.2 | 228.9  | 318.0 | 3.19                         | 20.77                | 0.019001          | 0.157878         | 131.6             |
| 24.18 | 263.4 | 339.3  | 447.8 | 3.41                         | 24.18                | 0.014881          | 0.172759         | 139.9             |
| 27.80 | 270.1 | 344.4  | 443.0 | 3.63                         | 27.80                | 0.010687          | 0.183446         | 151.6             |
| 30    |       |        |       | 2.20                         | 30.00                | 0.006382          | 0.189828         | 158.0             |

|                                   |                         |
|-----------------------------------|-------------------------|
| <b><math>V_{S30}</math> (m/s)</b> | <b>158.0</b>            |
| <b>Class</b>                      | <b>E <sup>(1)</sup></b> |

- (1) Conditional to geotechnical assessment results of the materials associated with the very low to low seismic velocity values, for the potential of liquefaction, the clay degree of sensitivity, and/or other critical parameters.

