SHAD & ASSOCIATES INC.

April 10, 2021
**Ref. No.: T21841-A**

**White Squadron Development Corporation & 2076828 Ontario Limited**
433 Steeles Ave. E., Suite #110
Milton, Ontario
L9T 8Z4

Attention: **Ms. Karen Ford, Vice President**
**Mr. Bartosz Lopat, Project Coordinator**

RE: **PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT**
**WHITE SQUADRON-RENAISSANCE WEST PROPERTY**
**NORTHEAST CORNER, TRAFALGAR ROAD & BRITANNIA ROAD WEST**
**MILTON, ONTARIO**

Please find enclosed the preliminary Geotechnical Investigation Report prepared for the above-mentioned project. We will be glad to discuss any questions arising from this work.

We thank you for giving us this opportunity to be of service to you.

Sincerely,
**Shad & Associates Inc.**

H. Shad

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Principal

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# PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT
# WHITE SQUADRON-RENAISSANCE WEST PROPERTY
# NORTHEAST CORNER, TRAFALGAR ROAD & BRITANNIA ROAD WEST
# MILTON, ONTARIO

Submitted to:

**White Squadron Development Corporation**
**&**
**2076828 Ontario Limited**

433 Steeles Ave. E., Suite #110
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Attention:

**Ms. Karen Ford, Vice President**
**Mr. Bartosz Lopat, Project Coordinator**

Submitted by:

Shad & Associates Inc.
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## 1.0 INTRODUCTION

Shad & Associates Inc. was retained by White Squadron Development Corporation & 2076828 Ontario Limited to carry out a preliminary geotechnical investigation for the White Squadron and Renaissance properties located north of Britannia Road West, between Trafalgar Road and Eighth Line, in Milton, Ontario, as shown in Figure 1. This report is prepared to cover the White Squadron-Renaissance West part of the investigation and the findings for the Renaissance East part of the work will be submitted separately.

According to the preliminary and conceptual information provided to us, we understand that the development at the White Squadron-Renaissance West site may generally consist of residential dwellings with one level of basement with associated underground services, paved roads, a stormwater management pond, a school and a park. However, we also understand that some highrise structures of 8 to 20 storeys with two to three levels of underground parking as well as some midrise structures of 8 to 10 storeys with one to two levels of underground parking may also be constructed on the southwest and southeast parts of the site, close to Britannia Road. It should however be noted that the exact project details were not available for our review at the time of preparation of this report.

The geotechnical investigation was completed in accordance with Shad Proposal P21752-Revised dated February 17, 2021, authorized by the Client on February 18, 2021.

The purpose of this geotechnical investigation was to obtain some information about the existing subsurface conditions at the site by means of a number of boreholes. Based on our interpretation of the data obtained, recommendations are provided on the geotechnical aspects of design at the site.

This report contains the findings of our geotechnical investigation together with our recommendations and comments. These recommendations and comments are based on factual information and are intended only for use by the design engineers.

We recommend on-going liaison with Shad & Associates Inc. during the design and construction phases of the project to ensure that the recommendations in this report are applicable and/or correctly interpreted and implemented. Also, any queries concerning the geotechnical aspects of the proposed project should be directed to Shad & Associates Inc. for further elaboration and/or clarification.

## 2.0 INVESTIGATION PROCEDURES

The fieldwork was performed on March 11 to 18, 2021 and consisted of drilling and sampling altogether twenty-two boreholes (Boreholes 1 to 22), generally down to depths ranging from approximately 5.0 to 8.1 m below the existing ground surface. However, in an attempt to also obtain some preliminary subsurface information for the potential midrise and highrise structures, five of the boreholes (i.e., Boreholes 16 to 19 and 22) located close to the southwest and southeast parts of the site, were extended deeper, down to depths ranging from about 15.6 to 19.9 m below existing grade. The borehole locations were staked out on site and surveyed by R-PE Surveying Limited, O.L.S., who also provided us with their geodetic ground surface elevations. The borehole locations are shown in Figure 2.

The boreholes were advanced using solid and hollow stem continuous flight augers, with a track-mounted power auger drilling rig, under the full-time supervision of experienced geotechnical personnel from Shad & Associates Inc. Samples were taken at 0.76 to 1.5 m intervals for the full depth of the investigation and Standard Penetration Tests (SPT) were performed in accordance with ASTM D1586. This consists of freely dropping a 63.5 kg (140 lbs) hammer a vertical distance of 0.76 m (30 inches) to drive a 51 mm (2 inches) diameter o.d. split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m (12 inches) is recorded as SPT 'N' value of the deposit and this gives an indication of the consistency or the relative density of the layer. Furthermore, where the soil consistency permitted, the undrained shear strength of the relatively weaker clayey deposits was measured in-situ by means of field vane tests.

Upon completion of boreholes, the collected samples were transported to our Soil Laboratory for further examination and laboratory testing. Soil laboratory testing consisting of moisture content determination, Gradation Analysis (Sieve and Hydrometer) and Atterberg Limits (Liquid and Plastic Limits) were performed on selected representative soil samples. The results of the in-situ and laboratory tests are presented on the corresponding Record of Borehole Sheets. The Gradation Analysis curves are shown in Enclosure A.

It should be noted that samples obtained during this investigation will be stored in our Soil Laboratory for three months and will be disposed thereafter.

## 3.0 SUB-SURFACE CONDITIONS

Based on the subsurface conditions encountered at the boreholes, below the surficial topsoil and/or fill, and occasional near-surface silty clay to clayey silt layers, the site is generally underlain by glacial till deposits, predominantly consisting of a cohesive silty clay to clayey silt till overlying a silty sand to sandy silt till at lower elevations. However, at the deeper boreholes, some silty sand, sand till, till-shale and highly weathered shale were also contacted.

The stratigraphic units and groundwater conditions are briefly summarized below. For more detailed information, reference should be made to the Record of Borehole Sheets.

### 3.1 Topsoil and/or Fill

Topsoil and/or fill was contacted at all boreholes, generally extending down to depths ranging from approximately 0.3 to 0.8 m below existing ground surface. However, at Boreholes 2, 10, 11, 14, 17 and 19, the topsoil and fill were noted to extend deeper, down to about 1.1 m below existing grade. The existing fill is believed to be generally the result of the agricultural use of the lands.

It should be noted that the thickness and quality of topsoil and fill may vary significantly in between and beyond the borehole locations. Considering this, the limited diameter of the auger hole and the time of fieldwork, it is recommended that allowance be made for possible variations when making construction estimates.

## 3.2 Clayey Silt to Silty Clay, Silty Sand and Sand

The topsoil and fill at Boreholes 1, 3, 12 to 14 and 16 were underlain by non-glacial deposits of near-surface clayey silt to clayey silt, that extended down to depths ranging from approximately 1.7 to 2.4 m below existing ground surface. This deposit was again contacted at a deeper elevation at Borehole 19, extending from about 13.1 to 14.0 m below grade.

Standard Penetration Tests were carried out at the site and the recorded 'N'-values within the clayey silt to silty clay were found to range from 11 to 28 blows/0.3 m penetration, with a lower value of 7 blows/0.3 m measured at immediately below the fill at Borehole 12. Based on these results, the non-glacial cohesive deposit is generally stiff to very stiff. Representative samples from this layer were also tested for natural moisture content determination and the results were 19 and 25%. Considering these results and the visual and tactile examination of the recovered soil samples, the clayey silt to silty clay is generally damp to moist.

Layers of non-glacial silty sand to sandy silt and sand deposits were contacted at the deeper Boreholes 16 to 19, interbedded within the till deposits below a depth of about 10.0 below existing ground surface. The recorded 'N'-values within these deposits ranged widely from 20 to more than 50, indicating a compact to very dense, but generally compact to dense relative density. Representative samples from these deposits were also tested for moisture content and the results were found to range from 10 to 24%. Based on these results and the visual and tactile examination of the recovered soil samples, the silty sand to sandy silt and sand layers were generally moist to wet or wet.

## 3.3 Silty Clay to Clayey Silt Till

Silty clay till and/or clayey silt till with trace to some sand and sand seams/interbedding is the predominant soil type at most boreholes at the site. The cohesive glacial till was contacted at immediately below the surficial topsoil, fill or the near-surface silty clay to clayey silt and extended down to depths ranging from approximately 4.8 to 7.8 m below existing ground surface at Boreholes 1, 8 to 10, 16 to 19 and 22 and down to the completion of the remaining boreholes. The clayey till was again contacted at lower elevations at Boreholes 16 to 18, extending from an average depth of 8.8 to 10.1 m below existing grade.

The measured SPT 'N'-values measured within the cohesive silty clay to clayey silt till ranged widely, generally from 8 to more than 30 blows/0.3 m, indicating a stiff to hard, but generally stiff to very stiff consistency. However, occasional lower values of down to 4 blows/0.3 m were also measured at lower elevations in Boreholes 3, 8 to 10, 17 and 18, indicating a firm consistency, where the soil color was also noted to change to grey. The consistency of the relatively weaker layer was further confirmed by performing Field Vane tests and the undrained shear strength of the deposit was measured to range from 60 to 75 kPa with Sensitivity Factors of 2.7 to 2.8, indicating a medium sensitivity soil. Selected samples from the clayey till deposits were also tested for Natural Moisture Content and the results were found to generally range from 11 to 19% with occasional higher values of up to 26% measured at immediately below the fill or the near-surface silty clay to clayey silt layer or where the soil color was noted to change to grey. Considering these results as well as visual and tactile examination of the recovered soil samples, the clayey silt to silty clay till is generally damp or damp to moist and occasionally moist.

Selected samples from the silty clay to clayey silt till with some sand were tested for Gradation

Analysis (Sieve Analysis and Hydrometer) as well as Atterberg Limits. The results are summarized below and they are presented on Record of Boreholes and Enclosure A.

| | **BH 3 S4** | **BH 5 S5** | **BH 8 S6** | **BH 10 S8** | **BH 12 S5** | **BH 16 S4** |
|---|---|---|---|---|---|---|
| **Gravel (%)** | 9 | 3 | 3 | 3 | 7 | 4 |
| **Sand (%)** | 23 | 19 | 17 | 13 | 20 | 18 |
| **Silt (%)** | 41 | 38 | 35 | 51 | 50 | 53 |
| **Clay (%)** | 27 | 40 | 45 | 33 | 23 | 25 |
| **Liquid Limit (%)** | 26 | 33 | 32 | 35 | 25 | 33 |
| **Plastic Limit (%)** | 17 | 16 | 18 | 22 | 13 | 19 |
| **Plasticity Index (%)** | 9 | 17 | 14 | 13 | 12 | 14 |

Considering the above results, the clayey till deposit has low plasticity.

It should be noted that due to the nature of their formation, cobbles and boulders should be expected to occur within the glacial deposits.

### 3.4 Silty Sand to Sandy Silt Till & Sand Till

Silty sand to sandy silt till deposits were contacted near the completion of Boreholes 1 and 8 to 10 as well as below a depth of about 6.2 m below existing ground surface at Borehole 22. These deposits were also encountered intermittently below the silty clay to clayey silt till at the deeper Boreholes 16 to 19, interbedded with other deposits, extending down to depths ranging from about 16.9 to 17.7 m below existing grade.

The recorded ‘N’-values within the silty sand to sandy silt till deposits ranged widely from 17 to more than 50 blows/0.3 m penetration, indicating a compact to very dense relative dense. However, the deposit was noted to be generally dense to very dense at deeper elevations. Samples from these deposits were also tested for Natural Moisture Content determination and the results were found to range from 8 to 14%. Considering these results as well as the visual and tactile examination of the recovered soil samples, the silty sand to sandy silt till deposits were predominantly damp or damp to moist and occasionally moist.

Representative samples from the silty sand to sandy silt till deposits were tested for Gradation Analysis. The results are summarized below and they are presented on Record of Boreholes and Enclosure A.

| | **BH 17 S8** | **BH 17 S12** | **BH 19 S14** |
|---|---|---|---|
| **Gravel (%)** | 7 | 5 | 10 |
| **Sand (%)** | 37 | 29 | 56 |
| **Silt (%)** | 53 | 59 | 34* |
| **Clay (%)** | 3 | 7 | - |

*Total silt and clay content.

A similar deposit but in the form of a sand till was contacted interbedded between the silty sand to sandy silt till layers at Boreholes 18 and 19, extending from approximately 14.0 to 15.5 m and 14.7 to 16.2 m below existing ground surface, respectively. The deposit was noted to be compact to very dense and moist to wet with recorded 'N'-values of 28 to more than 50 blows/0.3 m and measured moisture content values of 8 to 12%.

As mentioned previously, the occurrence of cobbles and boulders should always be expected when working in glacial till deposits.

## 3.5 Till-Shale Complex and Highly Weathered Shale

A mixture of till-shale and/or highly weathered shale was contacted at the deeper Boreholes 16 to 19, at depths ranging from approximately 16.9 to 17.7 m below existing ground surface. The recorded 'N'-values in these deposits were well in excess of 50 blows/0.3 m penetration indicating a very dense/hard condition.

It should however be noted that the quality and depth of the till-shale complex and the highly weathered shale was inferred from the boreholes rather than proven by rock coring or test pitting.

## 3.6 Groundwater Conditions

Groundwater conditions were monitored during and upon the completion of drilling as well as by installing standpipe piezometers or monitoring wells in some boreholes. The results are summarized below:

**Table 1: Measured Groundwater Data**

| Borehole | Existing Ground Surface Elevation (m) | Measured Groundwater Depth / Elevation (m) | | |
|---|---|---|---|---|
| | | Upon Borehole Completion | Mar.27, 2021 | Apr.3, 2021 |
| 1 | 187.3 | Dry | 2.3 / 185.0 | 2.1 / 185.2 |
| 2 | 187.5 | Dry | 3.6 / 183.9 | 3.0 / 184.5 |
| 3 | 187.3 | Dry | N/A | N/A |
| 4 | 186.9 | Dry | Dry | Dry |
| 5 | 187.3 | Dry | N/A | N/A |
| 6 | 187.4 | Dry | 1.9 / 185.5 | 1.8 / 185.6 |
| 7 | 187.3 | Dry | 2.1 / 185.2 | 1.8 / 185.5 |
| 8 | 186.7 | 7.2 / 179.5 | 3.9 / 182.8 | 3.8 / 182.9 |
| 9 | 186.5 | 7.3 / 179.2 | N/A | N/A |
| 10 | 186.1 | Dry | 3.0 / 183.1 | 2.9 / 183.2 |
| 11 | 186.9 | Dry | N/A | N/A |
| 12 | 187.3 | 4.3 / 183.0 | 1.9 / 185.4 | 1.9 / 185.4 |
| 13 | 186.9 | Dry | N/A | N/A |
| 14 | 187.0 | Dry | N/A | N/A |
| 15 | 186.7 | Dry | 3.1 / 183.6 | 2.6 / 184.1 |
| 16 | 186.6 | N/A | N/A | N/A |
| 17 | 186.4 | N/A | 6.5 / 179.9 | 6.9 / 179.5 |

| | | | | |
|---|---|---|---|---|
| 18 | 186.8 | N/A | 8.1 / 178.7 | 8.1 / 178.7 |
| 19 | 186.6 | N/A | N/A | N/A |
| 20 | 186.4 | Dry | 1.3 / 185.1 | 1.4 / 185.0 |
| 21 | 186.8 | Dry | 4.1 / 182.7 | 4.4 / 182.4 |
| 22 | 186.9 | N/A | 5.7 / 181.2 | 5.7 / 181.2 |

Considering the above information and the soil color change from brown to grey, we are of the opinion that the long-term groundwater level at the site should be below a depth of about 2.4 m below the existing ground surface. However, as noted within the boreholes, occasional sand seams/interbedding were generally noted within the till deposits that are under some minor hydrostatic pressure, resulting in groundwater level measurements closer to surface.

It should be pointed out that the groundwater levels at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events. Furthermore, a perched water condition may also exist at the site due to the presence of fill overlying the relatively less permeable clayey deposits.

## 4.0 DISCUSSION AND RECOMMENDATIONS

According to the preliminary and conceptual information provided to us, we understand that the development at the White Squadron-Renaissance West site may generally consist of residential dwellings with one level of basement with associated underground services, paved roads, a stormwater management pond, a school and a park. However, we further understand that some highrise structures of 8 to 20 storeys with two to three levels of underground parking as well as some midrise structures of 8 to 10 storeys with one to two levels of underground parking may also be constructed on the southwest and southeast parts of the site, close to Britannia Road. It should however be noted that the exact project details were not available for our review at the time of preparation of this report.

Considering the above details, the following discussion and recommendations are provided.

### 4.1 Site Grading

The development of the site will require clearing and stripping of all topsoil and organic rich fill. Since most areas are proposed to be developed for settlement sensitive structures, it is recommended that all fill be placed as engineered fill to provide competent subgrade. Prior to placement of engineered fill, all the surficial topsoil and any fill containing excessive organic matters should be stripped from planned fill areas to expose the inorganic subgrade. The exposed subgrade should then be proof-rolled with a suitably heavy roller to identify weak areas. Any weak or excessively wet zones identified during proof-rolling should be sub-excavated and replaced with compacted competent material to establish stable and uniform conditions. Prior to placement of engineered fill, the subgrade should be inspected and approved by a geotechnical engineer. Reference should be made to Section 4.4 for recommendations regarding engineered fill placement.

Provided the above recommendations are followed, and all topsoil and compressible materials are stripped or sub-excavated, the existing deposits are not considered to be highly compressible and long-term settlements should be minimal.

## 4.2 Foundations For the Low Rise Structures

Based on the subsurface conditions encountered at the borehole locations, our recommendations for spread footing depths and allowable soil bearing pressures for the low rise structures are given in the following Table 2.

**Table 2: Recommended Soil Bearing Capacity Values**

| Borehole | Depth Below Existing Grade (m) | Recommended Geotechnical Reaction at SLS (kPa)** | Factored Geotechnical Resistance at ULS (with a Geotechnical Resistance Factor of |
|---|---|---|---|
| BH 1 | ± 0.9 to 3.0 | 125 | 185 |
| BH 2 | ± 1.1 to 1.5<br>± 1.5 to 2.4<br>± 2.5 to 3.0 | 125<br>150<br>100 | 185<br>225<br>150 |
| BH 3 | ± 0.9 to 1.7<br>1.8 to 2.4<br>2.5 to 3.0 | 100<br>150<br>70 | 150<br>225<br>100 |
| BH 4 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 200<br>150 | 300<br>225 |
| BH 5 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 200<br>150 | 300<br>225 |
| BH 6 | ± 0.9 to 3.0 | 150 | 225 |
| BH 7 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 200<br>150 | 300<br>225 |
| BH 8 | ± 0.8 to 2.4<br>± 2.5 to 3.0 | 200<br>100 | 300<br>150 |
| BH 9 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 150<br>100 | 225<br>150 |
| BH 10 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 150<br>100 | 225<br>150 |
| BH 11 | ± 1.1 to 2.4<br>± 2.5 to 3.0 | 200<br>125 | 300<br>185 |
| BH 12 | ± 1.8 to 3.0 | 100 | 150 |
| BH 13 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 150<br>100 | 225<br>150 |

| | | | |
|---|---|---|---|
| BH 14 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 200<br>125 | 300<br>185 |
| BH 15 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 200<br>125 | 300<br>185 |
| BH 16 | ± 1.1 to 2.4<br>± 2.5 to 3.0 | 200<br>100 | 300<br>150 |
| BH 17 | ± 1.1 to 2.4<br>± 2.5 to 3.0 | 200<br>125 | 300<br>185 |
| BH 18 | ± 0.9 to 1.7<br>± 1.8 to 2.4<br>± 2.5 to 3.0 | 100<br>200<br>150 | 150<br>300<br>225 |
| BH 19 | ± 1.1 to 2.4<br>± 2.5 to 3.0 | 150<br>125 | 225<br>185 |
| BH 20 | ± 1.1 to 2.4<br>± 2.5 to 3.0 | 150<br>100 | 225<br>150 |
| BH 21 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 150<br>100 | 225<br>150 |
| BH 22 | ± 0.9 to 2.4<br>± 2.5 to 3.0 | 150<br>125 | 225<br>185 |

Note: If the footings are to be placed below the recommended depths, our office should be informed for additional confirmation before design.

The minimum footing sizes, footing thickness, excavations and other footing requirements should be designed in accordance with the latest edition of the Ontario Building Code.

The footing subgrade should be inspected and evaluated by the Geotechnical Engineer prior to concreting to ensure that the footings are founded on competent subgrade capable of supporting the recommended design pressure.

Design frost penetration depth for the general area is 1.2 m. Therefore, a permanent soil cover of 1.2 m or its thermal equivalent is required for frost protection of foundations. All exterior footings and footings beneath unheated areas should have at least 1.2 m of earth cover or equivalent synthetic insulation for frost protection.

Where necessary, the stepping of the footings at different elevations should be carried out at an angle no steeper than 2 horizontal (clear horizontal distance between footings) to 1 vertical (difference in elevation) and no individual footing step should be greater than 0.6 m and may have to be as low as 0.3 m if weaker soils are encountered.

For footings designed and constructed in accordance with the above criteria, total and differential settlements should be less than 25 mm and 15 mm, respectively. These values are usually within tolerable limits for most types of structures.

## 4.3 Earthquake Considerations

In conformance to the Criteria in Table 4.1.8.4.A of the Ontario Building Code (OBC 2012), considering the recommended footing inverts in Table 2, the subject site is classified as Site Class "D-Stiff Soil". The four values of the Spectral Response Acceleration Sa (T) for the different periods and the peak ground acceleration (PGA) as well as the design values of $F_a$ and $F_v$ for the project site should be calculated in accordance to the code.

## 4.4 Engineered Fill

Depending on the proposed grades for the site, engineered fill may be required to replace the existing topsoil and fill as well as to raise the site grades for the possible support of footings and floor slabs. Engineered fill could be placed after stripping all topsoil, any soils containing excessive organics and otherwise unsuitable soils, within an area extending at least 2.5 m beyond the perimeter of the footprint of the proposed structure. Engineered fill would then be suitable to support the foundations including the slab provided that the following criteria are strictly followed. Engineered fill may also be carried out to raise the existing grades below proposed roads.

The following placement procedure is recommended.

(i) The areal extent of engineered fill should be controlled by proper surveying techniques to ensure that the top of the engineered fill extends a minimum of 2.5 m beyond the perimeter of the buildings to be supported. Where the depth of engineered fill exceeds 1.5 m, this horizontal distance of 2.5 m beyond the perimeter of the building should be increased by at least 1.0 m for each 1.0 m depth of fill.

(ii) The area to receive the engineered fill should be stripped of any topsoil, fill and other compressible, weak and deleterious materials. After stripping, the entire area should be inspected and approved by the geotechnical engineer. Spongy, wet or soft/loose spots should be sub-excavated to stable subgrade and replaced with compactable approved soil, compatible with subgrade conditions, as directed by the geotechnical engineer.

(iii) The fill material should be placed in thin layers not exceeding approximately 200 mm when loose. Oversize particles (cobbles and boulders) larger than 120 mm should be discarded, and each fill layer should be uniformly compacted with heavy compactors, suitable for the type of fill used, to at least 98% of its Standard Proctor Maximum Dry Density.

(iv) The on-site inorganic soils are generally acceptable for use as engineered fill, provided they are not contaminated with the overlying organic rich deposits and any organic inclusions are removed. Depending on the construction season, the on-site soils may require some reconditioning, wetting or drying.

(v) Full-time geotechnical inspection and quality control (by means of frequent field density and laboratory testing) are necessary for the construction of a certifiable engineered fill. Compaction procedures and efficiency should be controlled by a qualified geotechnical technician.

(vi) The engineered fill should not be frozen and should be placed at a moisture content within 2% of the optimum value for compaction. The engineered fill should not be performed during winter months when freezing ambient temperatures occur persistently or intermittently.

The allowable soil bearing pressure is 150 kPa for footings supported by at least 1.0 m of engineered fill constructed in accordance with the above recommendations. We also recommend that the footing subgrade be evaluated by the geotechnical engineer prior to placing the formwork.

It is recommended to increase the rigidity of foundations of structures erected over engineered fill, and this is generally achieved by making the footings at least 0.5 m wide and adding nominal reinforcing to the footings and foundation walls. This measure helps to bridge over eventual weak spots in the fill.

All footings should have at least 1.2 m of earth cover or equivalent artificial insulation for frost protection.

For footings designed and constructed in accordance with the above criteria, total and differential settlements should be less than 25 mm and 15 mm, respectively. These values are usually within tolerable limits.

## 4.5 Excavating and Dewatering

All excavations should be carried out in accordance with the Ontario Health and Safety Regulations. The soils to be excavated can be classified as follows:

| | |
|---|---|
| -Topsoil / Fill,<br>Compact to Dense Silty Sand, Sand, Sand Till (below Groundwater level) | Type 4 |
| - Firm to Stiff Silty Clay to Clayey Silt, Silty Clay to Clayey Silt Till,<br>Compact to Very Dense Silty Sand to Sandy Silt Till (below groundwater level) | Type 3 |
| -Very Stiff Silty Clay to Clayey Silt, Very Stiff to Hard Silty Clay to Clayey Silt Till,<br>Dense to Very Dense Silty Sand to Sandy Silt Till (above groundwater level)<br>Till-Shale, Highly Weathered Shale | Type 2 |

Accordingly, a side slope of 1H:1V is required for excavations in accordance with the Ontario Health and Safety Regulations. However, in Type 2 soils, the bottom 1.2 m of excavations could be kept near vertical. Near the surface and below the groundwater level in silty sand to sand layers as well as the silty sand to sandy silt till especially where sand and silt seams/pockets/interbedding were encountered, flatter side slopes would be required. We would recommend that any excavations below the groundwater level into the wet silty sand and sand layers should only proceed after advance dewatering. However, the need for this should be further assessed at the time of construction.

Stockpiles of excavated materials should be kept at least 5.0 m from the edge of the excavation to avoid slope instability. Care should also be taken to avoid overloading of any existing underground services/utilities by stockpiles.

Based on the subsurface conditions encountered at the boreholes, we anticipate the house footings to be placed within a depth of 2.5 m below proposed ground surface and therefore no major dewatering problems are anticipated, although some dewatering may have to be carried out for excavations due to surface runoff or from any perched water within the fill or groundwater seepage from sand and silt seams/pockets/interbedding within the native deposits. We are of the opinion that these should be minor and manageable by pumping from temporary sumps protected against erosion, if required. Such sumps should be dug outside the footprint of the building to minimize disturbance to the footing grade.

No major excavation difficulties are foreseen but allowance should be made for boulders and cobbles which occur randomly in glacial deposits.

## 4.6 Basement Slab Construction

Concrete basement floor slab may be built on properly prepared subgrade or engineered fill. If the existing fill is left underneath the basement slab, long-term settlement and/or cracks may occur. The existing fill materials should be removed and replaced with compacted engineered fill in order to support the basement floor slab. For engineered fill subgrade, Section 4.4 should be followed.

Underneath the slabs, a 150 mm thick base course consisting of 20 mm size clear stone or OPSS Granular A should be placed to improve the support for the floor slab and function as a drainage layer. This base course should be compacted with vibratory equipment to a uniform high density. If the subgrade is wet, the clear stone or OPSS Granular A base should be separated from the subgrade by an approved filter fabric (e.g., non-woven geotextile, with FOS of 75 - 150 µm, Class II).

## 4.7 Backfill, Perimeter Drainage and Basement Floor Drainage

The basement walls of the buildings should be backfilled with granular material placed in 125 mm thick loose lifts that can be compacted with light equipment to avoid damaging the basement walls. Heavy compaction equipment should not be operated along basement walls, especially when the walls are unsupported at their top. The backfill should not be over-compacted to avoid damage to basement walls. Due to its high permeability, the granular material will permit quick drainage of water to perimeter drains, but in order to reduce the quantity of water percolating into the backfill, the uppermost 0.5 m of the backfill should consist of clayey soils.

Due to their rigidity and unyielding character, basement walls should be designed for the at-rest earth pressure condition calculated in accordance with the Canadian Foundation Engineering Manual, 4th Edition. The following parameters may be adopted:

Coefficient of lateral earth pressure = 0.45
Bulk unit weight of retained soils = 21 kN/m$^3$

We recommend that for basements, a permanent drainage system consisting of weeping tiles, damp-proofing and an underfloor granular drainage layer as indicated in Section 4.6 be installed. Weeping tiles should be installed along the perimeter of the buildings to prevent accumulation of water in the backfill and possible dampness of floor slabs. Furthermore, considering the relatively high groundwater conditions encountered at the site which is believed to be due to the presence of sand seams/pockets/interbedding within the till deposits which are under some hydrostatic pressure, the need for any additional subfloor drainage system should be further assessed at the time of footing subgrade inspection. The weeping tile system should be installed to provide a positive discharge to a non-frost susceptible sump or outlet. The weeping tiles should be surrounded by a designed graded granular filter or wrapped with an approved geotextile to prevent migration of fines into the system.

The upper 0.5 m of backfill should consist of a relatively impermeable clayey soil, which will minimize the ingress of surface water. The site should be graded for drainage away from foundations. A minimum cross fall of three percent (3%) immediately adjacent to foundations is recommended to allow for some settlement and promote good surface drainage.

## 4.8 Sewers and Watermain

We assume that the depth of sewer and watermain pipes will not exceed 4 m below existing grades. The following discussion is based on this assumption.

### 4.8.1 Trenching

Trench excavations should be carried out as per the Safety Regulations of the Province of Ontario. The boreholes show that within the assumed depth of 4.0 m below existing ground surface for sewers and watermain, below the existing topsoil and fill, the trenches will be predominantly dug through the firm to very stiff silty clay clayey silt and/or firm to hard, but generally stiff to very stiff silty clay to clayey silt till deposits. These deposits are classified in Section 4.5 in accordance with the Ontario Health and Safety Regulations. Within these soils, the side slopes of excavations are expected to be temporarily stable at 1H:1V, although within the very stiff silty clay to clayey silt and very stiff to hard silty clay to clayey till deposits, the bottom 1.2 m of the trench walls could be excavated close to vertical. Flatter slopes would be required in surficial layers and if the excavations are extended deeper into the groundwater level in the silty sand to sandy silt till, especially where sand and silt seams/pockets/interbedding are encountered. Trench boxes or equivalent designed for the specific site conditions may be used to limit the extent of the excavation, if required.

Groundwater seepage within the glacial deposits should be minor and manageable by gravity drainage and pumping from filtered sumps. However, increased seepage may occur from surface runoff, perched water and if the excavation is extended deeper into the silty sand to sandy silt till, especially from the sand seams/pockets/interbedding within the glacial deposits, which may require a series of sumps and pumps. We recommend that once the pipe inverts are finalized and before the commencement of the site servicing operation, the groundwater conditions to be further assessed by test pitting in order to ensure that the most effective temporary dewatering methodology is selected. In no case should the pipes be placed on dilated or disturbed subsoil.

Attention is called to the possible presence of cobbles and/or boulders that may be encountered during the excavation in the glacial till deposits.

Normal excavation equipment will be suitable for making trenches within soils in which the proposed underground services will be installed. The terms describing the consistency (firm, stiff, very stiff, hard) and relative density (compact, dense, very dense) of soil strata give an indication of the effort needed for excavation.

### 4.8.2 Bedding

The boreholes showed that the sewer pipes will be predominantly laid within stiff to very stiff silty clay to clayey silt or stiff to hard but generally very stiff to hard silty clay to clayey silt till which are considered to be suitable to support the pipes. The recommended minimum thickness of granular bedding for normal Class ‘B’ Type of bedding (i.e., compacted granular bedding material – OPSD-802) below the invert is 150 mm. However, the thickness of the bedding may have to be increased depending on the pipe diameter or if wet or weak subgrade conditions are encountered.

### 4.8.3 Backfill

Based on the visual and tactile examination of the soil samples, the inorganic on-site excavated soils could be re-used as backfill in service trenches. The moisture contents at the time of construction should be at or near optimum. The clayey soils will likely be excavated in cohesive chunks and blocks and will be difficult to handle and compact. For use as backfill, the soils will have to be reduced to be smaller than 100 mm in size and placed in thin layers. The clayey soils will have to be compacted using heavy equipment suitable for these soils that may be difficult to operate in the narrow confines of the trenches. Unless the clayey materials are properly reduced in sizes, all organics and debris removed and compacted in sufficiently thin lifts, post-construction settlements could occur. The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture content, and each layer should be compacted to at least 95% Standard Proctor Maximum Dry Density. This value should be increased to at least 98% within 0.6 m of the road subgrade surface.

The excavated soils may require reconditioning (e.g., wetting or drying) prior to reuse. The on-site excavated soils should not be used in confined areas (e.g., around catch-basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of good backfill together with an appropriate frost taper would be preferable in confined areas. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc., should not be used for backfilling.

We recommend that frost tapers be provided at backfilled trenches to ensure gradual transition from the frost-free materials to the frost susceptible natural soil, otherwise differential frost heaving may occur. Frost taper would not be necessary if the backfill material can be matched within the frost zone (i.e., within about 1.2 m depth below the pavement surface) with subgrade-type material.

## 4.9 Pavement Thickness

### 4.9.1 Pavement Structure

The glacial and non-glacial deposits of silty clay to clayey silt or properly placed engineered fill may be used as subgrade. Using good engineering and construction practice, the minimum pavement structure provided in Table 3 may be used as per the Town of Milton standards.

**Table 3: Recommended Minimum Pavement Structure**

| Pavement Structure | Compaction | Local - Residential (mm) |
|---|---|---|
| HL-3 Asphaltic Concrete<br>HL-8 Asphaltic Concrete | 97% Marshall Density | 40<br>50 |
| Granular 'A' Base | 100% | 150 |
| Granular 'B' Sub-base | 100% | 300 |

NOTE: HL-3 and HL-8 asphaltic concrete to conform to OPSS Form 1150 and 310.

To ensure the longevity of the pavement, the roadbed should be well drained at all times. We recommend that full-length perforated sub-drain pipes of 150 mm diameter be installed along both sides of the roads, below the roadbed level, to ensure effective drainage. The sub-drain pipes should be surrounded by 20 mm size clear stone drainage zone of minimum 150 mm thickness, which should have non-woven geotextile (Terrafix 270R or approved equal) wraparound to minimize infiltration of fines in pipes which would reduce their effectiveness.

The granular materials should be compacted as per American Society for Testing and Material's Number D698. The placing, spreading and rolling of the asphalt should be in accordance with Ontario Provincial Standard Specifications Form 310, or equivalent.

Construction traffic over exposed subgrade materials should be minimized, and temporary construction hauling routes should be established. If these routes coincide with future paved areas, adequately reinforced haul roads (increased thickness of granular base, use of geo-fabrics, etc.) should be constructed to reduce disturbance to the subgrade soils. These provisions are particularly important if the construction is scheduled during wet and cold seasons.

### 4.9.2 Construction Comments

In order to provide a durable pavement structure, the following pavement construction method is recommended.

The subgrade should be adequately prepared to receive the sub-base course. Any disturbed and wet subgrade materials should be removed and the top of the subgrade should then be inspected and approved, by proof-rolling, by qualified geotechnical personnel. Cavities created by the removal of unsuitable materials should be backfilled with approved, inorganic fill materials similar to the existing subgrade material. All new fill should be placed in maximum 200 mm loose lifts within ±2% of its optimum moisture content, and each lift compacted with suitable equipment to minimum 95% Standard Proctor Maximum Dry Density, before placing the next lift.

The uppermost zones of the roadfill, within 600 mm of the roadbed, should be compacted to minimum 98% Standard Proctor Maximum Dry Density. If construction of the roadfill is carried out in wet weather, the thickness of the sub-base course should be increased.

Special attention should be paid to proper grading of the subgrade surface. Depressions and undulations should be eliminated and, to permit quick drainage, the subgrade surface should be sloped towards ditches, sub-drains and/or catch-basins.

### 4.10 Stormwater Management Pond

Based on the preliminary and conceptual information provided to us, we understand that Stormwater Management Pond 10 will be constructed on the middle part along the west side of the property. Boreholes 8, 9 and 10 are located within or in close proximity to the proposed pond footprint. Based on the subsurface conditions encountered at these boreholes, below the surficial topsoil and/or fill, depending on the pond bottom invert elevation, the excavation for the pond should generally occur within a firm to hard silty clay to clayey silt till. However, if the pond is extended deeper, some compact to dense sandy silt till could also be encountered. The highest groundwater level at these boreholes were measured at depths ranging from approximately 2.9 to 7.3 m below existing ground surface.

We recommend the groundwater conditions to be further assessed by test pitting before final design. Furthermore, the stability of the pond walls should be analyzed once the design details are confirmed.

Based on the subsurface conditions encountered at the boreholes, if the pond base and walls are formed within the sandy silt till, a suitable liner would be required to minimize surface water infiltration and groundwater exfiltration. This liner may be constructed with clay. The clay should be inorganic and consist of a minimum 60% fines (silt and clay) by weight passing No.200 sieve (0.074 mm). A minimum of 20% of clay (0.002 mm or smaller) is required. The clay should also have a plasticity index of not less than 15%, a liquid Limit of not less than 30% and not greater than 60%, and a plastic limit of not less than 11% and not greater than 30%. The laboratory tests performed on samples collected from the on-site silty clay to clayey silt till have indicated that the clayey till deposit could potentially be used to function as the pond liner, but depending on the source location, the plasticity characteristic of the clayey deposit should be further confirmed by additional sampling and laboratory testing. The clay liner should be at least 0.6 m thick when compacted and this should be confirmed once the pond excavation is complete. The liner should extend at least 1 m above the sandy silt till level. The clayey fill should be placed in loose lifts (each not exceeding 125 mm thick) and compacted to at least 98% of the material's SPMDD value. Alternatively, a synthetic liner can be considered.

Furthermore, considering the presence of sand seams/interbeddings within the native glacial deposits, we would recommend that any seepage from these permeable zones should be properly captured. Based on their extent, this could be carried out through the use of filtered subdrain systems connected to a frost-free outlet. The surface of the sand seams should then be plugged with at least 0.6 m of compacted clay. This option and its appropriate design should be further assessed during construction when the pond subgrade is exposed. Full-time qualified geotechnical engineering supervision should be provided during the excavation and construction of the pond to ensure that adequate protective measures are taken when necessary.

Anti-seepage collars should be installed for the outlet works that direct flow out of the SWM pond as these outlets are subject to hydraulic heads directly from the pond. The provision of anti-seepage collars would increase the seepage path along the outlet works and therefore reduce the quantity of potential seepage.

## 4.11 Proposed Midrise and Highrise Structures

According to the preliminary and conceptual information provided to us, we understand that some highrise structures of eight to twenty storeys with two to three levels of underground parking may be constructed near the southwest corner of the site, near Boreholes 16 to 19. Considering these, the excavation for the underground parking may be 6 to 10 m deep. We further understand that eight to ten storey midrise structures with one to two levels of underground parking may be constructed near the southeast end of the site. For these structures, which may be near Borehole 22, the excavation for the underground parking may extend 3 to 6 m below existing ground surface. It should however be noted that the exact project details were not available for our review at the time of preparation of this report.

Based on the subsurface conditions encountered at Boreholes 16 to 19 and 22, below some surficial topsoil and fill, the site is predominantly underlain by firm to hard, but generally very stiff to hard silty clay to clayey silt till, down to a depth of about 6.2 to 7.8 m below existing ground surface. The clayey deposit was then generally underlain by glacial and occasional non-glacial deposits of silts and sands and clays that extended down to the completion of Borehole 22 at approximately 15.6 m below existing ground surface, and down to depths ranging from about 16.9 to 17.7 m below grade at the remaining boreholes where they were in turn underlain by till-shale and/or highly weathered shale. The highest groundwater level measured at the boreholes was found to generally range from 5.7 to 8.1 m below existing ground surface. It should however be noted that the groundwater levels would fluctuate seasonally and can be expected to be somewhat higher during the spring months.

Considering the above information and based on the available conceptual details, the following discussion and recommendations are provided. These should be considered as general in nature and will need to be reviewed and finalized once the proposed structural details and site grades are known. These information are based on factual data obtained from the site and are intended for use by the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

### 4.11.1 Foundation Considerations

Based on the borehole information, the following options are considered to support the potential buildings:

1. Footings on Native Soils
    - Conventional Footings
    - Mat Foundation
2. Continuous Flight Auger Cast Piles
3. Drilled Caissons

#### 4.11.1.1 Footings on Native Soils

Based on the subsurface conditions encountered at the five deeper boreholes drilled at the site for the potential 8 to 20 storey buildings, our recommendations for soil bearing pressures at various depths are summarised in Table 4.

**Table 4: Recommended Soil Bearing Capacity Values For Midrise and Highrise Structures**

| Borehole | Depth Below Existing Grade (m) | Recommended Geotechnical Reaction at SLS (kPa)** | Factored Geotechnical Resistance at ULS (with a Geotechnical Resistance Factor of 0.5), (kPa)** |
|---|---|---|---|
| BH 16 | ± 3.0 to 3.1 | 100 | 150 |
| | ± 3.2 to 6.2 | 50 | 75 |
| | ± 6.3 to 7.8 | 100 | 150 |
| | ± 7.9 to 10.8 | 200 | 300 |
| | ± 10.9 to 15.2 | 350 | 525 |
| | ± 15.3 to 16.8 | 750 | 1,125 |
| | ± 16.9 to 18.2 | 1,000 | 1,500 |
| BH 17 | ± 3.0 to 3.2 | 125 | 185 |
| | ± 3.3 to 7.8 | 75 | 115 |
| | ± 7.9 to 12.1 | 300 | 450 |
| | ± 12.2 to 15.5 | 1,000 | 1,500 |
| | ± 15.6 to 16.9 | 1,500 | 2,250 |
| BH 18 | ± 3.0 to 3.3 | 150 | 225 |
| | ± 3.4 to 4.7 | 100 | 150 |
| | ± 4.8 to 7.6 | 50 | 75 |
| | ± 7.7 to 12.3 | 200 | 300 |
| | ± 12.4 to 14.2 | 350 | 525 |
| | ± 14.3 to 18.2 | 400 | 600 |
| | ± 18.3 to 18.6 | 1,000 | 1,500 |
| BH 19 | ± 3.0 to 3.2 | 125 | 185 |
| | ± 3.3 to 6.4 | 75 | 115 |
| | ± 6.5 to 7.8 | 150 | 225 |
| | ± 7.9 to 11.0 | 500 | 750 |
| | ± 11.1 to 15.5 | 200 | 300 |
| | ±15.6 to 16.7 | 300 | 400 |
| | ± 16.8 to 18.6 | 1,000 | 1,500 |
| BH 22 | ± 3.0 to 3.3 | 125 | 185 |
| | ± 3.4 to 6.2 | 75 | 115 |
| | ± 6.3 to 7.6 | 200 | 300 |
| | ± 7.7 to 13.9 | 400 | 600 |
| | ± 14.0 to 14.1 | 800 | 1,200 |

Note: If the footings are to be placed below the recommended depths, our office should be informed for additional confirmation before design.

Considering the presence of relatively weaker deposits at the shallow and intermediate depths, for the mid-rise structures, consideration may be given to the use of ground improvement techniques, such as use of Rammed Aggregate Piers to support the loads from the columns and walls. Aggregate Piers are patented construction techniques and the specialist contractor should be consulted for a feasibility assessment.

Assuming a depth of 3 m excavation for each level of underground parking, the parking slab for the one, two and three levels of underground parking would be 3, 6 and 9 m below existing ground surface, respectively. Considering this, for the mat foundation option, the mat design could be carried out using Recommended Geotechnical Reaction at SLS values of 50 kPa for the one and two storey underground parking structures, and 200 kPa for the three storey underground parking structures. These correspond to Factored Geotechnical Resistance at ULS (with a Geotechnical Resistance Factor of 0.5) of 75 kPa and 300 kPa, respectively. The recommended coefficient of vertical subgrade reaction (Ks) of 15,000 kPa/m for the structures with one and two levels of underground parking and 30,000 kPa/m for the structures with three levels of underground parking. These values should be further confirmed once the invert details are available.

It should be noted that the above recommended values are based on founding the foundation on undisturbed native soils.

All founding conditions must be inspected by this office prior to placing concrete. All footings exposed to seasonal freezing conditions must have at least 1.2 m of soil cover for frost protection or equivalent thermal insulation against frost action.

It should be noted that the silty and sandy soils at the base of the footings can be easily disturbed by construction machinery and foot traffic or lose their strength in contact with surface water. We that an allowance to be made for placing a 50 mm thick skim coat of concrete on the founding subgrade immediately after its approval, to prevent its disturbance by construction activities and from ground and surface water, where necessary.

With two and three levels of underground parking, excavations will penetrate into the water table. Positive dewatering such as well points, or eductors or deep wells would be required, especially if the excavations are extended down into the moist to wet silty sand and sand layers, and the groundwater level must be lowered to at least 1.0 m below the footing bases prior to excavation for the footing installation. The project dewatering consultant should review the borehole information and provide guidance regarding the need and therefore the design and construction of the effective dewatering system.

#### 4.11.1.2 Continuous Flight Auger Cast Piles (CFA Piles)

With two to three levels of underground parking, as an alternative, CFA piles could be considered to support the structures. Using CFA piles, positive dewatering will be required in the area of deep excavation such as sumps and elevator pits.

Auger cast piling are installed by drilling continuous flight, hollow-stem augers through the overburden soils to a pre-determined depth. After drilling, a non-shrink fluid such as Portland Cement grout is pumped through the hollow stem augers under pressure and exist at the tip of the augers. Grouting continues as the augers are slowly withdrawn, producing a cylindrical, cast-in-place concrete pile. A pile of this type will drive its primary support from friction.

Auger cast piling constructed for the use in supporting the proposed buildings should have a minimum diameter of 400 mm and a minimum embedment depth of 8 m. For piling of this size and embedment, a skin friction value of 60 kPa in compression below a depth of about 8.0 m below existing ground surface, could be used to assess the number and depth of the required piling. A typical CFA pile having 500 mm diameter and embedded length of 10 m can support a load of 1200 kN in compression at the Serviceability Limit States (SLS) and a Factored Geotechnical Resistance of 1,800 kN at the Ultimate Limit States (ULS). The actual skin friction and/capacity of piles will need to be confirmed by a pile load test. The capacity of the test pile will be assessed by multiplying the resistance factor of 0.6 in compression with the test load.

Pile subject to uplift and lateral loads should be properly reinforced. We further recommend that piling be installed at a minimum centre to centre spacing of three times the pile diameter. Note, during the installation of CFA piles, full-time monitoring will be required to confirm the depth of piles and monitor grouting pressure to avoid discontinuities in the concrete. The success of the CFA piles foundation is dependent on the installation techniques and experience of the contractor.

Considering the presence of water bearing silty sand and difficult conditions to achieve dry base for conventional drilled caissons, the use of CFA piles could be considered for the building with two to three levels of underground parking levels, based on a geotechnical consideration.

Pile caps exposed to seasonal freezing conditions should be provided with at least 1.2 m of earth cover or equivalent thermal insulation against frost action.

#### 4.11.1.3 Drilled Caissons

Considering the extent of the potential midrise and highrise structures as well as the relatively weaker deposits encountered at shallow to intermediate depths, and the presence of better bearing deposits at lower elevations, drilled caissons could be considered to support the structures. Assuming the caissons to extend at least 3 times their diameter into the very stiff to hard silty clay/clayey silt till and/or into dense to very dense silty sand to sandy silt till, sand till and silty sand, the bearing pressures and the corresponding depths are presented in Table 5.

**Table 5: Soil Bearing Capacity Values for Caissons**

| Borehole | Recommended Geotechnical Reaction at SLS (kPa) | Factored Geotechnical Resistance at ULS (kPa) | Foundation Depth Below Existing Ground |
|---|---|---|---|
| BH 16 | 400<br>700<br>1,500 | 600<br>1,050<br>2,250 | ± 9.1 to 10.6<br>± 10.7 to 15.2<br>± 15.3 to 17.7 |
| BH 17 | 550<br>1,000<br>1,500 | 825<br>1,500<br>2,250 | ± 9.1 to 12.1<br>± 12.2 to 13.6<br>± 13.7 to 15.4 |
| BH 18 | 350<br>600<br>700<br>800<br>1,500 | 525<br>900<br>1,050<br>1,200<br>2,250 | ± 9.1 to 12.2<br>± 12.3 to 14.0<br>± 14.0 to 15.2<br>± 15.3 to 18.3<br>± 18.3 to 19.0 |

| | | | |
|---|---|---|---|
| BH 19 | 450<br>500<br>1,500 | 675<br>750<br>2,250 | ± 9.1 to 15.5<br>± 15.6 to 17.1<br>± 17.2 to 18.6 |
| BH 22 | 500<br>800<br>1,000 | 750<br>1,200<br>1,500 | ± 7.6 to 9.4<br>± 9.5 to 13.7<br>± 13.8 to 14.2 |

Temporary liners will be required to help in preventing the soil from caving as well as to control water seepage into the caisson holes. Special drilling techniques such as the use of oversized liners may be required. All caisson bases must be properly cleaned, proven and confirmed by our office. Considering the presence of moist to wet silty sand/sandy silt/sand and moist to wet sand till that may form the founding levels of the caissons, the project hydrogeologist/dewatering consultant should be consulted for any dewatering needs to ensure that the wet layers are stable during the installation of the caissons.

Concrete being placed into the caissons should have a slump of about 150 mm since it may not be practical to vibrate the concrete at depth. However, if the liners are being vibrated in and out of the holes, then normal slump concrete could likely be used.

The recommended resistance at SLS allows for up to 25 mm of total settlement.

All foundations exposed to ambient outside temperatures must have a minimum of 1.2 m of soil cover or equivalent to protect against frost heave. Experience suggests that the temperature in the unheated underground parking levels two or more below grade with normal ventilation provisions is not as severe as the ambient open air condition. For these, we would recommend that the cover for the perimeter and the internal footings may be reduced to 0.6 m and 0.9 m, respectively. At locations adjacent to the ventilation shafts, a frost cover of 1.2 m is recommended.

### 4.11.2 Earthquake Considerations

In conformance to the Criteria in Table 4.1.8.4.A of the Ontario Building Code (OBC 2012), considering the recommended footing inverts below the underground parking structure, the subject site is classified as Site Class "D-Stiff Soil". The four values of the Spectral Response Acceleration Sa (T) for the different periods and the peak ground acceleration (PGA) as well as the design values of $F_a$ and $F_v$ for the project site should be calculated in accordance to the code.

### 4.11.3 Earth Pressure on Walls

The foundation walls should be designed to resist the unbalanced lateral earth pressure, hydrostatic pressure, as well as the lateral loads from any surcharge loadings. The following equation can be used to calculate the lateral pressure P acting on the retaining wall:

$$P= K [\gamma(h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

Where: P: the horizontal Pressure at depth (m)
K: the coefficient of lateral earth pressure,
K=0.3 for the earth pressure coefficient is considered applicable
$\gamma$: the bulk unit weight of backfill, 22 kN/$m^3$
h: total depth of excavation

$h_w$: the depth below the water level, m
$\gamma_w$: the unit weight of water, 9.8 kN/$m^3$
$\gamma'$: the submerged unit weight of the overburden soils ($\gamma$- 9.8) kN/$m^3$
q: surcharge loads, kN/$m^2$

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, the above equation can be simplified to:

$$P= K [\gamma h + q]$$

To ensure that there is no hydrostatic pressure acting on the walls, where the structure is made directly against a shored excavation, drainage is normally provided by forming a drainage cavity with prefabricated drains core material covering the excavation face and designed to discharge collected water into a perimeter/underfloor drainage system. Where the structure is built by open excavation methods, in order to eliminate the effects of the hydrostatic pressure, free-draining backfill such as Granular 'B' (OPSS 1010) is used.

### 4.11.4 Elevator Pits

It is anticipated that the elevator pits at underground parking P2 and especially P3 finish floor level will generally be installed in the glacial and non-glacial deposits of silts and sands below the water table. Drainage systems at the base level of the elevator pits are not recommended, due to loss of fines. The elevator pits can be designed as water-tight structures and the water pressure on the pit walls should be considered, assuming the water table at the level of the lowest adjacent parking floor.

### 4.11.5 Floor Slab and Permanent Drainage

The lowest garage floor can be constructed as slab on grade, provided all disturbed, softened or loose native soils are removed and the base thoroughly proofrolled. Any fill required to raise the grade can consist of inorganic soils similar to the surrondings, placed in shallow lifts and compacted to 98% of the material's Standard Proctor Maximum Dry Density value (SPMDD).

Underneath the slab, a 300 mm thick base course consisting of 20 mm size clear stone or OPSS Granular 'A' should be placed to improve the support for the floor slab and function as a drainage layer. This base course should be compacted with vibratory equipment to a uniform high density. If the subgrade is wet, the clear stone or OPSS Granular A base should be separated from the subgrade by an approved filter fabric (e.g. non-woven geotextile, with FOS of 75 - 150 µm, Class II).

To assist in maintaining dry basements and prevent seepage, it is recommended that exterior grades around the buildings be sloped away at a 2% gradient or more, for a distance of at least 1.2 metres. Provision of nominal subfloor drainage is required in conjunction with the perimeter drainage of the structure, to collect and remove the water that infiltrates at the building perimeter and under the floor. Perimeter and subfloor drainage are required throughout the below grade areas.

Foundation walls must be damp-proofed in conformance to Section 5.8.2 of the Ontario Building Code (2012). Prefabricated drainage composites, such as Miradrain 2000 (Mirafi) or Terradrain 200 (Terrafix), should be incorporated between the shoring wall or soil face and the cast-in-place concrete foundation wall to make a drained cavity. Drainage from the cavity must be collected at the base of the wall in non-perforated pipes and conveyed directed to the sumps. The flow to the building storm water sump from the subfloor drainage will be governed largely by the building perimeter drainage collection during rainfall and runoff events.

The drainage system is a critical structural element since it keeps water pressure from acting on the basement floor slab or on the foundation wall. As such, the pump that ensures the performance of this system must have a duplexed pump arrangement for 100% redundancy and these pumps must be on emergency power. The size of the pump should be adequate to accommodate the anticipated groundwater and storm event flows. The project hydrogeological engineer must be consulted to address anticipated groundwater flow into the buildings.

### 4.11.6 Excavations, Dewatering & Backfill

All excavations should be carried out in accordance with the Ontario Health and Safety Regulations. The soils to be excavated were classified and they were presented in Section 4.5.

Accordingly, a side slope of 1H:1V is required for excavations in accordance with the Ontario Health and Safety Regulations. However, in Type 2 soils, the bottom 1.2 m of excavations could be kept near vertical. Near the surface and below the groundwater level in the silty sand to sandy silt till, especially where silt and silty sand layers/interbedding were encountered, flatter side slopes would be required. We would recommend that any excavations below the groundwater level into the wet silty sand and sand layers should only proceed after advance dewatering.

Stockpiles of excavated materials should be kept at least 10.0 m from the edge of the excavation to avoid slope instability. Care should also be taken to avoid overloading of any existing underground services/utilities by stockpiles.

Based on the subsurface conditions encountered at the boreholes, below the fill layer, excavation for the underground parking structure that may extend to about 9 m below the existing grade, should generally encounter silty clay to clayey silt till at higher elevations underlain by silty sand till to sandy silt till, sand till with occasional layers of clayey silt and silty sand. The overburden soils could be removed by conventional excavation equipment. However, cobbles and boulders may be encountered when working in the glacial till layers.

Groundwater control during excavation within the native glacial and non-glacial deposits of the clayey silt and silty clay could be handled as required by pumping from properly constructed and filtered sump pumps located within the excavation. However, increased seepage should be expected from surface runoff, perched water within the fill as well as when the excavation is extended to below the groundwater level within the silty sand till to sandy silt till and sand till, especially down into moist to wet silty sand. The moist to wet silty sand would require advance dewatering. The groundwater level should be lowered one meter below the lowest excavation depth. We would recommend the subsurface conditions and the groundwater levels to be reviewed by the Project Hydrogeologist / dewatering consultant to ensure that the most effective dewatering program is selected.

The excavated soils are not considered to be free draining. The backfill under floor slabs and against the subsurface walls, where applicable, must be free draining granular fill, preferably conforming to the Ontario Provincial Standard Specification for granular base course, Granular B.

It should be noted that the excavated soils are subject to water content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface or be covered with tarpaulins to minimize moisture uptake.

### 4.11.7 Shoring Design

A shoring system should be designed to protect adjacent structures and services. The fourth edition of Foundation Engineering Manual should be referred for the design of the shoring system.

It should be noted that groundwater and cobbles/boulders will be encountered during soldier pile/caisson construction, and the contractor must be prepared to deal with boulders and water seepage into the caisson shafts without undue delays. Specifically, the shoring contractor may experience difficulties during the drilling of the till-shale and highly weathered shale, if encountered.

The geotechnical parameters, which are considered to be applicable for the design, as follows:

Active earth pressure coefficient, Ka=0.5 for the walls in areas where structures or sensitive services are being supported

Active earth pressure coefficient, Ka=0.3 for the remaining areas

Bulk unit weight of soil= 22 kN/$m^3$

Passive earth pressure coefficient in native soils=3

Angle of internal friction: natural soil=30 degrees

Any surcharge loads must be included in the lateral pressure calculations.

If construction of earth anchors is considered:

Bond values of 25 kPa for depths down to 7.5 m below existing ground surface and 50 kPa below this depth are suggested for gravity poured anchors. These values depend on the anchor installation methods and grouting procedures and must be confirmed by field loading tests. Therefore, the bonding value is arbitrary since the contractor’s installation procedures will assess the actual soil to concrete bond value. Hence the contractor must decide on a capacity and confirm its availability. Gravity poured concrete can result in low bond values while pressure grouted anchors will give higher values and produce a more satisfactory anchor. The anchors must be of a length that meets the Canadian Foundation Manual recommendations. It is important to note that the minimum length lies beyond the 45+0.15H line drawn from the base of the soldier pile and the overall stability of the system must be checked at each anchor level. All anchors must be tested as indicated in the Foundation Manual, 4th Edition.

The soldier piles should be installed in pre-augered holes taken below the deepest excavation. If construction of an anchor is not an option, soldier pile should be extended at least 3 m below the base of the excavation. The holes should be filled with concrete below the excavation level and half bag mixed above the base of the excavation. The concrete strength must be specified by the shoring designer.

Safe net bearing value of soldier pile caissons base,

-assuming clean dry hole:

| | |
|---|---|
| Above 7.5 m below existing ground surface: | 100 to 200 kPa |
| Below 7.5 m below existing ground surface: | 400 kPa |

-assuming a slurry procedure and tremie concrete:

| | |
|---|---|
| Above 7.5 m below existing ground surface: | 75 to 150 kPa |
| Below 7.5 m below existing ground surface: | 300 kPa |

The top 1 m at excavation level should be ignored when calculating the horizontal resistance of the soil. Temporary liners and slurry method will be required below the water table to help prevent the sand from caving during the installation period. Positive measures may be required to prevent loss of soil through the spaces between the lagging boards. This could probably be achieved by placing well-graded sand and gravel behind the lagging boards or by installing a geotextile filter fabric cloth.

Alternatively, raker footings can be used to support the shoring. Raker footings can be designed for a net bearing value of 50 to 150 kPa above a depth of 7.5 m below existing grade and 200 to 400 kPa below. The actual value will depend on the depth of the footing. Rakers must be prestressed to help in minimizing the movements of the shoring.

Adhesion on the buried caisson shaft or behind the shoring system must be neglected when designing this shoring system.

Movement of the shoring system is inevitable. The magnitude of this movement can be controlled by sound construction practices and it is anticipated that the horizontal movement will be in the range of 0.1% to 0.25% H, where H is the depth of the excavation. The horizontal and vertical movements should be monitored during construction to ensure satisfactory performance of the shoring system.

### 4.11.8 Pavement Thickness

For the proposed roads over the concrete deck, our recommendations for the pavement structure is provided in Table 6.

### Table 6: Recommended Pavement Thickness Over the Parking Structure

| Pavement Structure | Compaction | Light Duty (mm) | Heavy Duty (mm) |
|---|---|---|---|
| HL-3 Asphaltic Concrete<br>HL-8 Asphaltic Concrete | 97% Marshall Density | 40<br>50 | 50<br>85 |
| Granular 'A' Base | 100 % | 150 | 150 |
| Free-Draining and Grading Sand Layer | - | 100 | 100 |

**NOTE: HL-3 and HL-8 asphaltic concrete to conform to OPSS Form 1150 and 310.**

The above pavement make-up should be placed over the asphaltic protection board over waterproofing membrane. Proper drainage should be provided to ensure a well-drained pavement structure.

## 5.0 CLOSURE

The attached Report Limitations are an integral part of this report.

We recommend that once the project details are known and before final design, we should be given the opportunity to review and provided any additional recommendations that may be required.

It is recommended that a programme of geotechnical/material inspection and testing be carried out during the construction phase of the project to confirm that the conditions exposed in the excavations are consistent with those encountered in the boreholes and the design assumptions, and to confirm that the various project specifications and materials requirements are being met.

Sincerely,
**Shad & Associates Inc.**

S. Chong

LICENSED PROFESSIONAL ENGINEER
H. SHAD
PROVINCE OF ONTARIO

H. Shad

Stephen Chong, P. Eng.
Senior Engineer

Houshang Shad, Ph.D., P. Eng.
Principal

# FIGURES

Figure 1: Site Location Plan
Figure 2: Borehole Location Plan

**CLIENT:**
White Squadron Development Corporation
& 2076828 Ontario Limited

**SHAD & ASSOCIATES INC.**
GEOTECHNICAL, ENVIRONMENTAL AND MATERIALS ENGINEERS
83 Citation Drive, Unit 9
Vaughan, Ontaruio, L4K 2Z6
Tel: (905) 760-5566
Fax: (905) 760-5567

SHAD & ASSOCIATES INC.

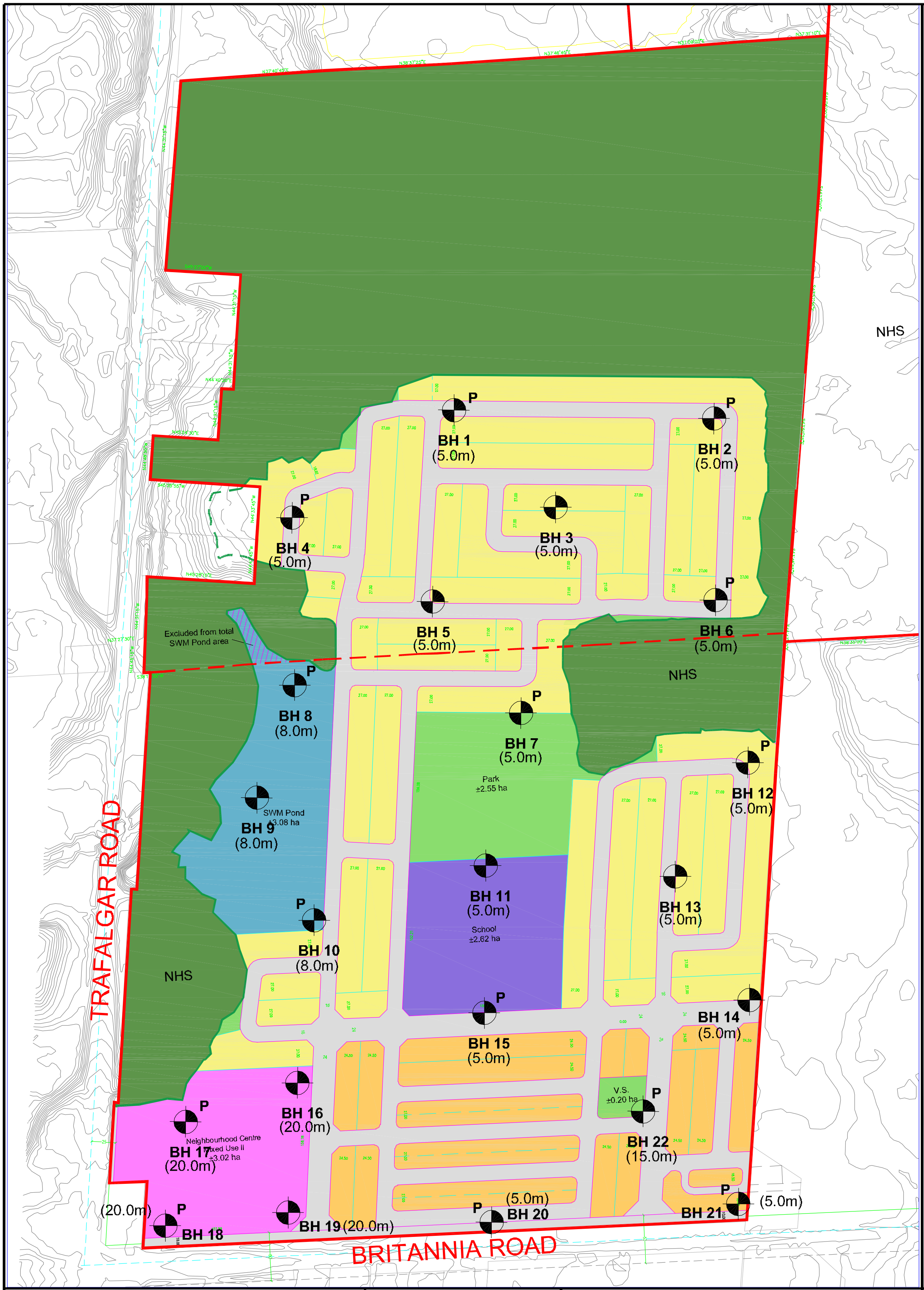
**Drawn By:** R.H.
**Checked By:** H.S.
**Datum:** -
**Projection:** -
**Scale:** N.T.S.

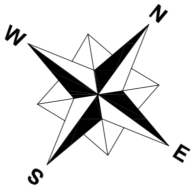
**TITLE:**

# SITE LOCATION PLAN

**PROJECT:**
**Preliminary Geotechnical Investigation**
**White Squadron & Renaissance West**
**Proposed Residential Subdivision**
Trafalgar Road & Britannia Road, Milton, Ontario

Date: April, 2021
Project No.: **T21841-A**
Figure No.: **1**





## LEGEND:

BH 1

⊕ Borehole Locations

## NOTES:

1. Borehole locations are approximate.
2. Drawing not to scale.
3. The drawing should be read in conjunction with the associated report by Shad & Associates Inc., T21841-A

**CLIENT:**
**White Squadron Development Corp.**
**& 2076828 Ontario Limited**

**SHAD & ASSOCIATES INC.**
GEOTECHNICAL, ENVIRONMENTAL AND MATERIALS ENGINEERS
83 Citation Drive, Unit 9
Vaughan, Ontario, L4K 2Z6
Tel: (905) 760-5566
Fax: (905) 760-5567

SHAD & ASSOCIATES INC.

| | |
|---|---|
| Drawn By: | R.H. |
| Checked By: | H.S. |
| Datum: | - |
| Projection: | - |
| Scale: | N.T.S. |

**TITLE:**

**Borehole Location Plan**

**PROJECT:** **Preliminary Geotechnical Investigation**
**White Squadron & Renaissance West**
**Proposed Residential Subdivision**
Trafalgar Road & Britannia Road
Milton, Ontario

| | |
|---|---|
| Date: | April 2021 |
| Project No.: | T21841-A |
| Figure No.: | 2 |

# RECORD OF BOREHOLES

## Record of Boreholes (Boreholes 1 to 22)
## Explanation of Borehole Logs

# RECORD OF BOREHOLE 1

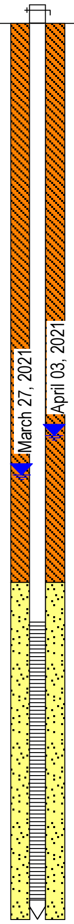
**Project No.:** T21841 **CLIENT:** Mattamy Development Corporation **ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021 **LOCATION:** Trafalgar Road, Milton **COMPILED BY:** R.H.

**DATUM:** Geodetic **BOREHOLE TYPE:** Solid Stem **CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | "N" VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 187.3 | | Ground Surface | | | | | | | | | | |
| | 0 | **Topsoil** | | 1 | SS | 30 | 5 | | | 20<br>20 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 187.0 | | brown<br>**Sandy Silt Fill**<br>some clay, occ. topsoil<br>damp to moist | | | | | | | | | | |
| 186.6 | 1 | brown, occ. grey<br>**Clayey Silt**<br>occ. oxidized fissures<br>occ. silty sand/sandy silt interbeddings<br>damp to moist, very stiff | | 2 | SS | 46 | 18 | | | 19 | | |
| | 2 | some oxidized fissures, stiff<br>damp | | 3 | SS | 46 | 13 | | | 19 | | |
| 184.8 | | greyish brown<br>**Silty Clay/Clayey Silt Till**<br>trace sand<br>damp, very stiff | | 4 | SS | 46 | 27 | | | 15 | | |
| | 3 | brown, occ. greyish brown<br>some silty sand/sandy silt interbeddings<br>stiff | | 5 | SS | 36 | 13 | | | 19 | | |
| | | damp to moist | | | | | | | | | | |
| | 4 | grey, occ. reddish grey<br>some sand | | | | | | | | 15 | | |
| 182.5 | | grey<br>**Silty Sand/Sandy Silt Till**<br>some clay, some gravel<br>occ. fine to medium sand interbeddings<br>damp, compact | | 6 | SS | 41 | 17 | | | 9 | | |
| 182.3 | 5 | **End of Borehole** | | | | | | | | | | |



Cave-in Depth on Completion: None
Groundwater Depth on Completion: Dry

Measured Groundwater Level in Installed Standpipe Piezometer on:
March 27, 2021: 2.3m
April 03, 2021: 2.1m

# RECORD OF BOREHOLE 2

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

## SOIL PROFILE

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION |
|---|---|---|
| 187.5 | 0 | Ground Surface |
| 187.2 | | **Topsoil** |
| 186.6 | | mottled brown **Sandy Silt Fill** some clay, occ. organic stains damp to moist |
| | 1 | mottled brown, occ. grey **Silty Clay/Clayey Silt Till** occ. silty clay/clayey silt interbeddings moist, stiff |
| | | greyish brown some sand, some oxidized fissures damp, very stiff |
| | | brown |
| | | brown, occ. greyish brown |
| | 3 | damp to moist, stiff |
| | 4 | grey |
| 182.5 | 5 | **End of Borehole** |

## SAMPLES

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) |
|---|---|---|---|---|
| 1 | SS | 46 | 10 | 28<br>23 |
| 2 | SS | 46 | 12 | 26 |
| 3 | SS | 46 | 22 | 16 |
| 4 | SS | 46 | 21 | 16 |
| 5 | SS | 46 | 13 | 14 |
| 6 | SS | 46 | 9 | 17 |

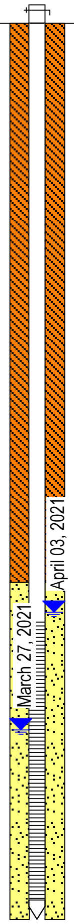
GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: 20 40 60 80 100

WATER CONTENT (%): 5 15 25 35

MONITORING WELL



REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

Ground surface was going through freeze-thaw cycle at the time of fieldwork.

Cave-in Depth on Completion: None
Groundwater Depth on Completion: Dry

Measured Groundwater Level in Installed Standpipe Piezometer on:
March 27, 2021: 3.6m
April 03, 2021: 3.0m

# RECORD OF BOREHOLE 3

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Solid Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100<br>SHEAR STRENGTH kPa ▲ 20 40 60 80 100 ▲ | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| 187.3 | | Ground Surface | | | | | | | | | | |
| | 0 | **Topsoil** | | 1 | SS | 30 | 6 | | | 27<br>22 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 186.9 | | mottled brown<br>**Sandy Silt Fill**<br>occ. rootlets, some organic stains<br>damp to moist | | | | | | | | | | |
| 186.6 | 1 | mottled brown, occ. grey<br>**Clayey Silt**<br>damp to moist, stiff | | 2 | SS | 46 | 11 | | | 22 | | |
| | | some sand seams<br>occ. oxidized fissures<br>occ. silty sand/sandy silt interbeddings<br>very stiff | | 3 | SS | 46 | 16 | | | 22 | | |
| 185.1 | 2 | greyish brown<br>**Silty Clay/Clayey Silt Till**<br>some sand, occ. oxidized fissures<br>damp, very stiff | | 4 | SS | 46 | 20 | | | 15 | | Gradation Analysis & Atterberg Limits, S(4):<br>9 23 41 27<br>LL: 26%<br>PL: 17%<br>PI: 9% |
| | 3 | grey, firm | | 5 | SS | 41 | 7 | | | 14 | | |
| | 4 | damp to moist, stiff | | 6 | SS | 46 | 9 | | | 17 | | |
| | | occ. gravel<br>occ. sand interbeddings, stiff | | 7 | SS | 46 | 10 | | | 18 | | |
| 182.2 | 5 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: Dry | | | | | | | | | | |
| | 6 | | | | | | | | | | | |
| | 7 | | | | | | | | | | | |

# RECORD OF BOREHOLE 4

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

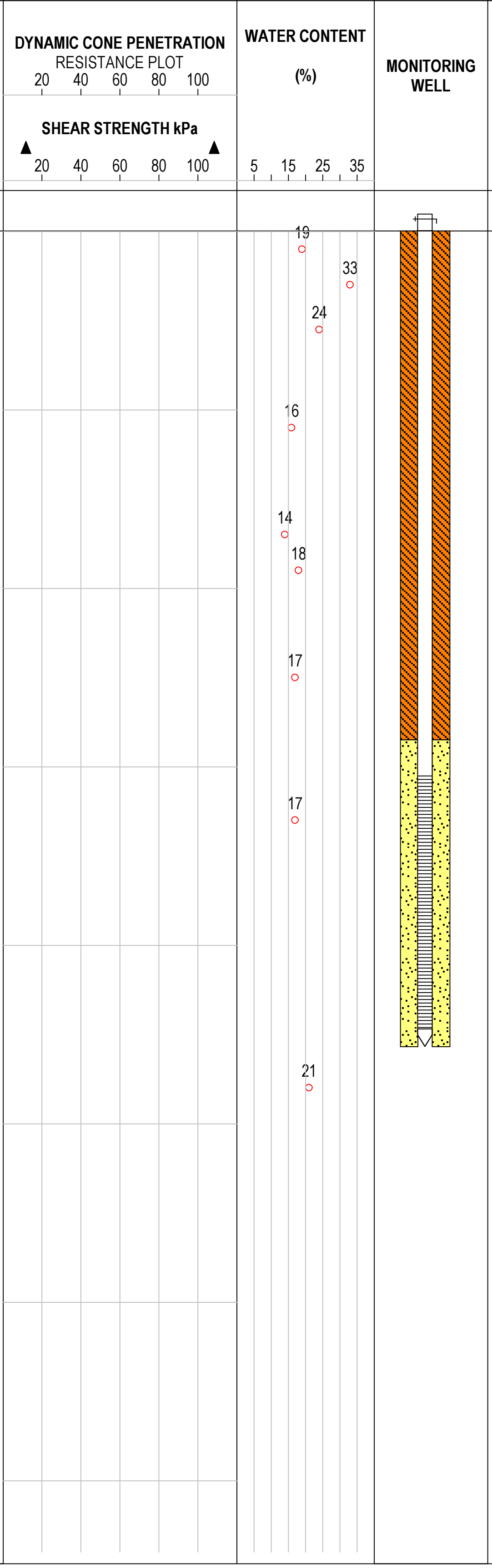
**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|
| 186.9 | | Ground Surface | | | | | |
| 186.8 | 0 | **Topsoil** | | | | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 186.4 | | mottled brown **Silty Sand Fill** some clay, some rootlets, damp to moist | 1 | SS | 46 | 4 | |
| | | brown, occ. grey | | | | | |
| | 1 | greyish brown **Silty Clay/Clayey Silt Till** some oxidized fissures damp, very stiff | 2 | SS | 46 | 23 | |
| | | some sand, damp to moist | 3 | SS | 41 | 23 | |
| | 2 | trace sand seams some oxidized fissures, damp | | | | | |
| | | occ. oxidized fissures | 4 | SS | 46 | 24 | |
| | 3 | some oxidized fissures | 5 | SS | 46 | 19 | |
| | 4 | grey damp to moist, stiff | 6 | SS | 46 | 9 | |
| 181.9 | 5 | **End of Borehole** | | | | | |

Cave-in Depth on Completion: None
Groundwater Depth on Completion: Dry

Measured Groundwater Level in Installed Standpipe Piezometer on:
March 27, 2021: Dry
April 03, 2021: Dry



# RECORD OF BOREHOLE 5

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 187.3 | 0 | Ground Surface | | | | | | | | | |
| 187.1 | | **Topsoil** | | | | | | | 23 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 186.7 | | mottled brown<br>**Ploughed Silty Clay/Clayey Silt Fill**<br>some organic stains, moist | 1 | SS | 46 | 5 | | | 21<br>16 | | |
| | 1 | brown<br>**Silty Clay/Clayey Silt Till**<br>occ. fine sand seams<br>damp, very stiff | 2 | SS | 46 | 22 | | | 17 | | |
| | | brown, occ. reddish grey | 3 | SS | 46 | 29 | | | 15 | | |
| | 2 | occ. oxidized fissures | 4 | SS | 46 | 29 | | | 14 | | |
| | 3 | grey | 5 | SS | 46 | 24 | | | 15 | | Gradation Analysis & Atterberg Limits, S(5):<br>3 19 38 40<br>LL: 33%<br>PL: 16%<br>PI: 17% |
| | 4 | some shale fragments<br>damp to moist, stiff | 6 | SS | 46 | 13 | | | 17 | | |
| 182.3 | 5 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: Dry | | | | | | | | | |
| | 6 | | | | | | | | | | |
| | 7 | | | | | | | | | | |

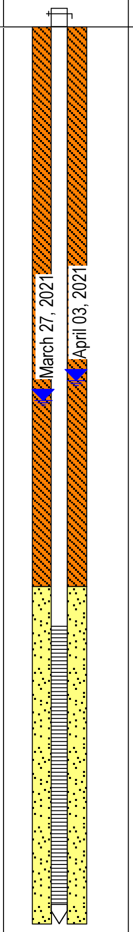
# RECORD OF BOREHOLE 6

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|
| 187.4 | | Ground Surface | | | | | | |
| 187.1 | 0 | **Topsoil** | 1 | SS | 41 | 6 | 31<br>22 | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 186.7 | | brown<br>**Sandy Silt Fill**<br>some clay, some rootlets<br>damp to moist | | | | | | |
| | 1 | mottled brown<br>**Silty Clay/Clayey Silt Till**<br>trace sand<br>occ. clayey silt interbeddings<br>damp to moist, very stiff | 2 | SS | 46 | 15 | 21 | |
| | 2 | greyish brown<br>some oxidized fissures<br>damp | 3 | SS | 46 | 23 | 16 | |
| | | brown | 4 | SS | 46 | 24 | 16 | |
| | 3 | greyish brown<br>occ. sand seams/interbeddings | 5 | SS | 36 | 19 | 14 | |
| | 4 | grey<br>damp to moist, stiff | 6 | SS | 36 | 10 | 15 | |
| 182.4 | 5 | grey, occ. reddish grey | | | | | | |
| | | **End of Borehole** | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH kPa: 20 40 60 80 100



Cave-in Depth on Completion: None
Groundwater Depth on Completion: Dry

Measured Groundwater Level in Installed Standpipe Piezometer on:
March 27, 2021: 1.9m
April 03, 2021: 1.8m

# RECORD OF BOREHOLE 7

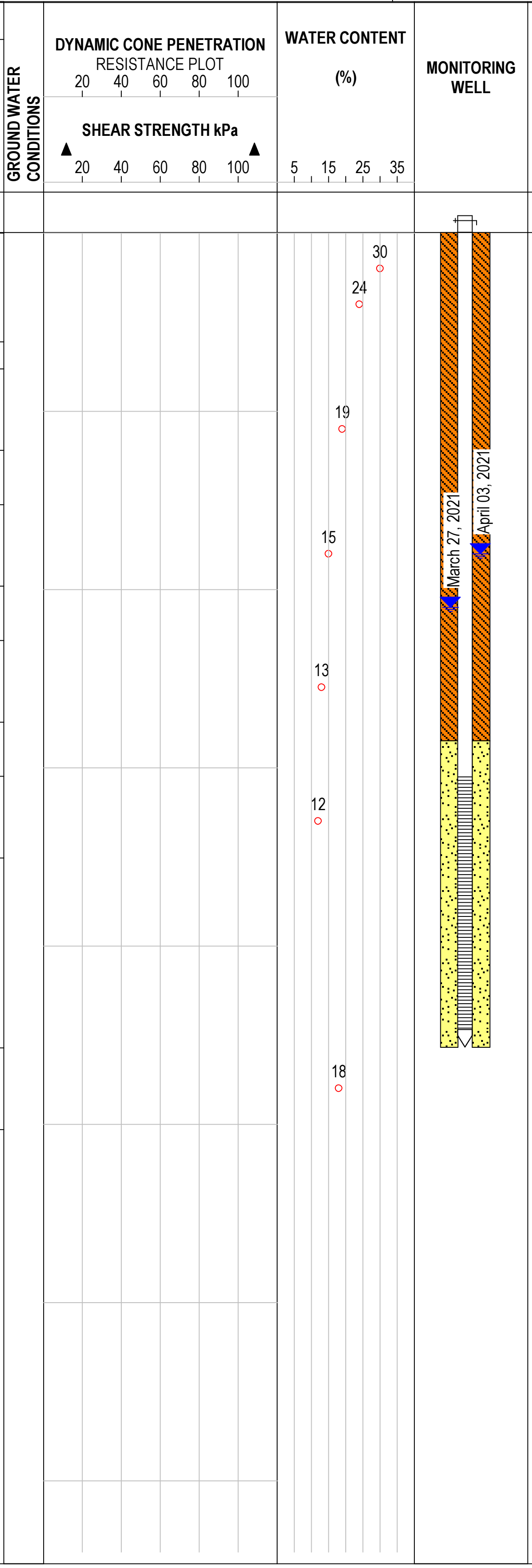
Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.

DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.

DATUM: Geodetic
BOREHOLE TYPE: Solid Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | SAMPLES | | | | WATER CONTENT (%) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | | |
| 187.3 | | Ground Surface | | | | | | |
| | 0 | **Topsoil** | | | | | 30 | Ground surface was going thorugh freeze-thaw cycle at the time of fieldwork. |
| 187.1 | | mottled brown, occ. grey<br>**Silty Clay/Clayey Silt Fill**<br>some organic stains, moist | 1 | SS | 38 | 6 | 24 | |
| 186.8 | | brown<br>**Silty Clay/Clayey Silt Till**<br>some oxidized fissures<br>damp, very stiff | 2 | SS | 46 | 26 | 19 | |
| | 1 | | 3 | SS | 46 | 31 | 15 | |
| | 2 | some shale fragments<br>occ. sand seams/pockets<br>hard | 4 | SS | 46 | 31 | 13 | |
| | 3 | | 5 | SS | 46 | 29 | 12 | |
| | | grey, very stiff | | | | | | |
| | 4 | damp to moist, stiff | 6 | SS | 46 | 13 | 18 | |
| 182.3 | 5 | **End of Borehole** | | | | | | |



**End of Borehole**

Cave-in Depth on Completion: None
Groundwater Depth on Completion: Dry

Measured Groundwater Level in Installed Standpipe Piezometer on:
March 27, 2021: 2.1m
April 03, 2021: 1.8m

# RECORD OF BOREHOLE 8

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

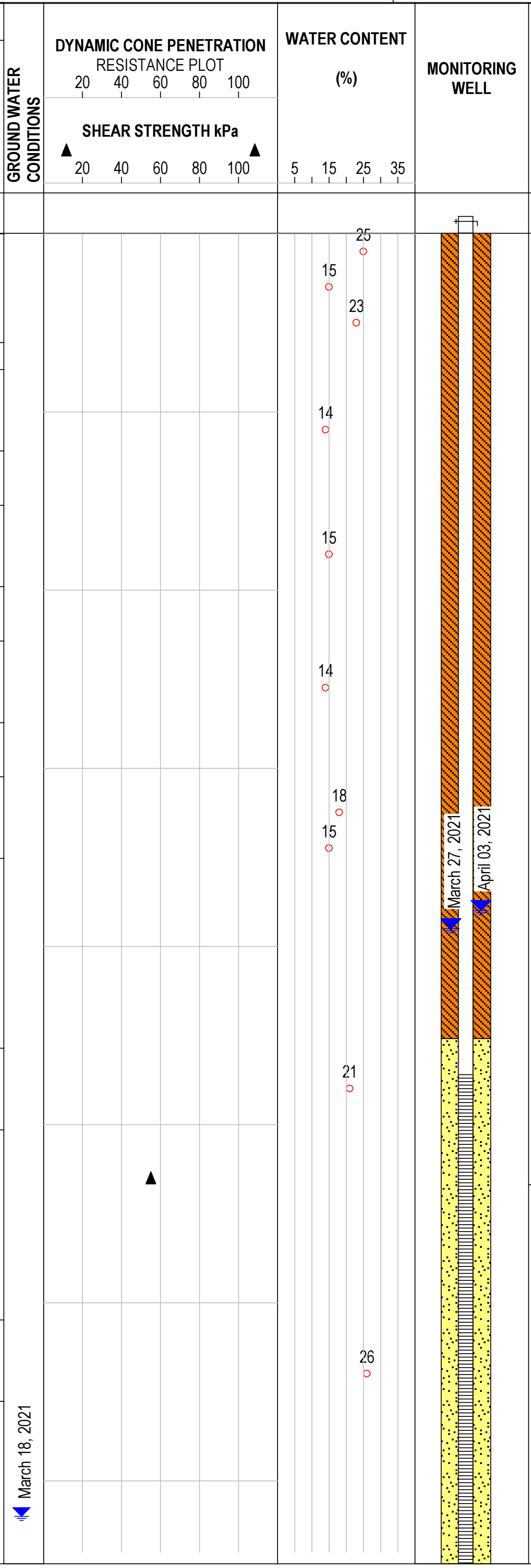
SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

## SOIL PROFILE

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION |
|---|---|---|
| 186.7 | | Ground Surface |
| 186.6 | 0 | **Topsoil** |
| 186.3 | | mottled brown<br>**Sandy Silt Fill**<br>some clay, occ. organic stains<br>damp to moist |
| | | stiff, moist |
| 185.4 | 1 | greyish brown<br>**Clayey Silt Till**<br>some sand<br>damp, very stiff |
| | | brown, occ. grey<br>**Silty Clay/Clayey Silt Till**<br>trace sand, some oxidized fissures<br>damp, hard |
| | 2 | occ. shale fragments |
| | 3 | very stiff |
| | | greyish brown<br>damp to moist |
| | 4 | grey<br>moist, firm |
| | 5 | grey, occ. reddish grey<br>occ. sand seams |
| | 6 | grey, silty clay/clayey silt interbedding |
| 179.6 | 7 | |

## SAMPLES

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES |
|---|---|---|---|
| 1 | SS | 46 | 6 |
| 2 | SS | 46 | 22 |
| 3 | SS | 46 | 32 |
| 4 | SS | 41 | 33 |
| 5 | SS | 41 | 16 |
| 6 | SS | 46 | 6 |
| 7 | SS | 46 | 7 |



## REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

Ground surface was going through freeze-thaw cycle at the time of fieldwork.

Gradation Analysis & Atterberg Limits, S(6):
3 17 35 45
LL: 32%
PL: 18%
PI: 14%

Field Vane Test Undrained Shear Strength,
Su: 75 kPa
Sensitivity Factor. St: 2.7

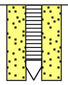
# RECORD OF BOREHOLE 8

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ▲ 20 40 60 80 100 ▲ | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| 178.7 | 8 | grey<br>**Sandy Silt Till**<br>some clay<br>damp to moist, compact | | 8 | SS | 46 | 28 | | | 11<br>○ |  | |
| | 9<br>10<br>11<br>12<br>13<br>14 | **End of Borehole**<br><br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: 7.2m<br><br>Measured Groundwater Level in Installed Standpipe Piezometer on:<br>March 27, 2021: 3.9m<br>April 03, 2021: 3.8m | | | | | | | | | | |

# RECORD OF BOREHOLE 9

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.

DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.

DATUM: Geodetic
BOREHOLE TYPE: Solid Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| ELEVATION (metres) | DEPTH SCALE (metres) | SOIL PROFILE DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | SHEAR STRENGTH kPa | WATER CONTENT (%) | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 186.5 | 0 | Ground Surface | | | | | | | | | |
| | | **Topsoil** | | | | | | | 20 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 186.2 | | mottled brown to brown<br>**Silty Clay/Clayey Silt Till**<br>some organic stains<br>damp to moist, stiff | 1 | SS | 46 | 10 | | | 24 | | |
| | | brown, occ. grey<br>occ. silty clay/clayey silt interbeddings<br>very stiff | 2 | SS | 46 | 18 | | | 24 | | |
| | | brown<br>some sand, some oxidized fissures<br>damp | 3 | SS | 46 | 26 | | | 16 | | |
| | | brown, occ. greyish brown | 4 | SS | 46 | 26 | | | 15 | | |
| | | greyish brown<br>damp to moist, stiff | 5 | SS | 46 | 14 | | | 19 | | |
| | | reddish brown<br>moist, firm | 6 | SS | 46 | 6 | | | 20<br>24 | | |
| | | grey | | | | | | ▲ | | | Field Vane Test Undrained Shear Strength, Su: 70 kPa Sensitivity Factor, St: 2.8 |
| 180.2 | | reddish grey<br>**Sandy Silt Till**<br>some clay<br>damp to moist, compact | 7 | SS | 46 | 10 | March 16, 2021 | | 25<br>14 | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: 20 40 60 80 100

WATER CONTENT (%): 5 15 25 35

# RECORD OF BOREHOLE 9

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100<br>SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%)<br>5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%)<br>GR SA SI CL |
| 178.4 | 8 | grey<br>some sand<br>occ. silty sand/sandy silt till interbeddings<br>dense | | 8 | SS | 46 | 36 | | | 12 | | |
| | | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: 7.3m | | | | | | | | | | |
| | 9 | | | | | | | | | | | |
| | 10 | | | | | | | | | | | |
| | 11 | | | | | | | | | | | |
| | 12 | | | | | | | | | | | |
| | 13 | | | | | | | | | | | |
| | 14 | | | | | | | | | | | |
| | 15 | | | | | | | | | | | |

# RECORD OF BOREHOLE 10

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

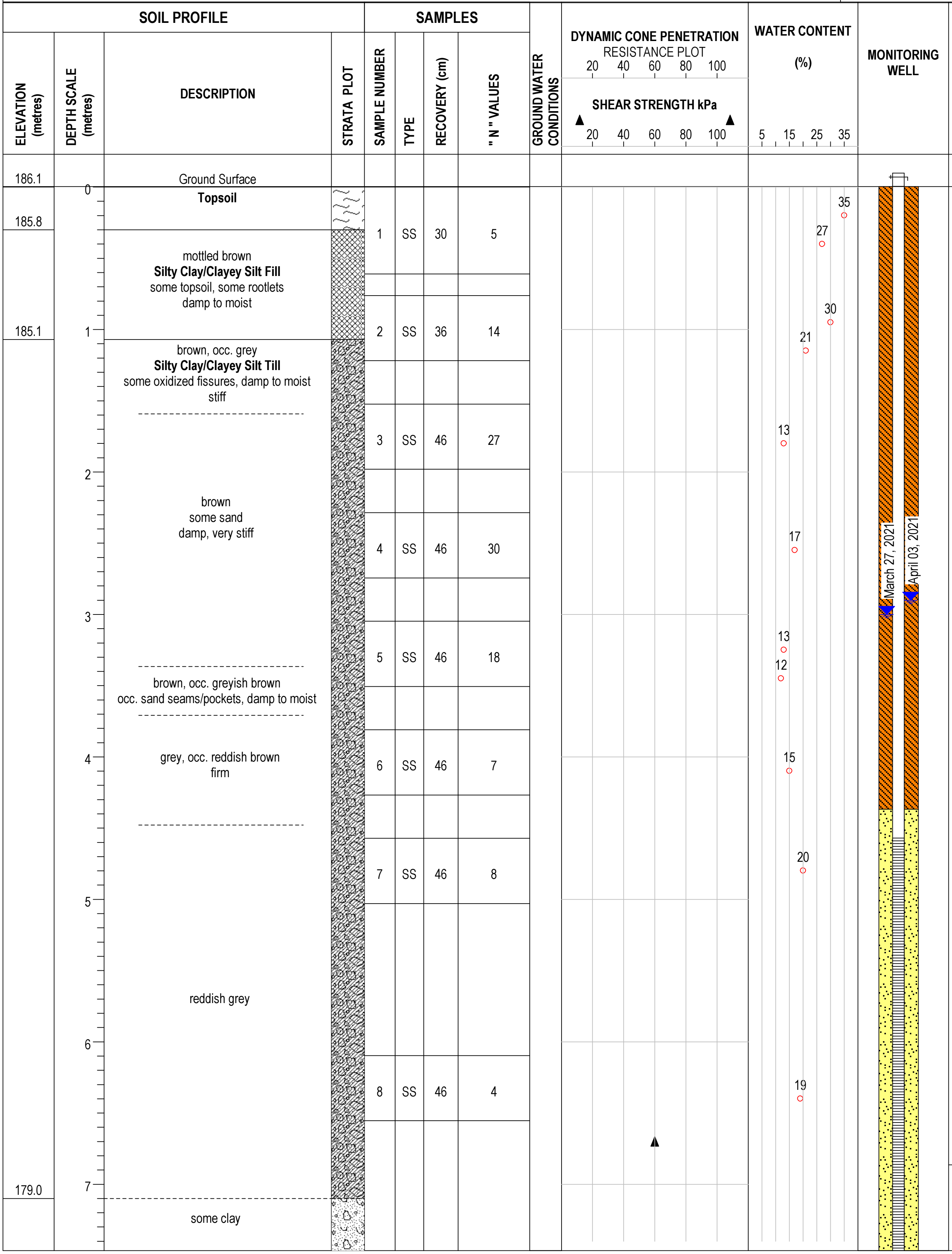
SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

## SOIL PROFILE

| ELEVATION (metres) | DESCRIPTION |
|---|---|
| 186.1 | Ground Surface |
|  | **Topsoil** |
| 185.8 | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>some topsoil, some rootlets<br>damp to moist |
| 185.1 | brown, occ. grey<br>**Silty Clay/Clayey Silt Till**<br>some oxidized fissures, damp to moist<br>stiff |
|  | brown<br>some sand<br>damp, very stiff |
|  | brown, occ. greyish brown<br>occ. sand seams/pockets, damp to moist |
|  | grey, occ. reddish brown<br>firm |
|  | reddish grey |
| 179.0 | some clay |

## SAMPLES

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) |
|---|---|---|---|---|
| 1 | SS | 30 | 5 | 35<br>27 |
| 2 | SS | 36 | 14 | 30<br>21 |
| 3 | SS | 46 | 27 | 13 |
| 4 | SS | 46 | 30 | 17 |
| 5 | SS | 46 | 18 | 13<br>12 |
| 6 | SS | 46 | 7 | 15 |
| 7 | SS | 46 | 8 | 20 |
| 8 | SS | 46 | 4 | 19 |



## REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

Ground surface was going through freeze-thaw cycle at the time of fieldwork.

Gradation Analysis & Atterberg Limits, S(8):
3 13 51 33
LL: 35%
PL: 22%
PI: 13%

Field Vane Test Undrained Shear Strength, Su: 60 kPa
Sensitivity Factor, St: 2.7

# RECORD OF BOREHOLE 10

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100<br>SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%)<br>5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%)<br>GR SA SI CL |
| 178.1 | 8 | grey<br>**Sandy Silt Till**<br>some clay<br>damp, compact | | 9 | SS | 46 | 21 | | | 11 | | |
| | 9 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: Dry<br>Measured Groundwater Level in Installed Standpipe Piezometer on:<br>March 27, 2021: 3.0m<br>April 03, 2021: 2.9m | | | | | | | | | | |
| | 10 | | | | | | | | | | | |
| | 11 | | | | | | | | | | | |
| | 12 | | | | | | | | | | | |
| | 13 | | | | | | | | | | | |
| | 14 | | | | | | | | | | | |

# RECORD OF BOREHOLE 11

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Solid Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| 186.9 | | Ground Surface | | | | | | | | | |
| | 0 | **Topsoil** | 1 | SS | 46 | 10 | | | 29 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 186.6 | | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>some sand, occ. rootlets<br>damp to moist | | | | | | | 26 | | |
| 186.0 | 1 | brown, occ. grey<br>**Silty Clay/Clayey Silt Till**<br>damp to moist, very stiff | 2 | SS | 46 | 20 | | | 17 | | |
| | 2 | brown<br>some oxidized fissures<br>damp | 3 | SS | 46 | 30 | | | 14 | | |
| | | some sand seams | 4 | SS | 46 | 30 | | | 13 | | |
| | 3 | greyish brown | | | | | | | | | |
| | 4 | grey<br>damp to moist<br>occ. sand seams | 5 | SS | 46 | 18 | | | 17 | | |
| | | damp to moist, stiff | 6 | SS | 46 | 10 | | | 18 | | |
| 181.9 | 5 | **End of Borehole**<br>Cave-in Depth on Completion:None<br>Groundwater Depth on Completion: Dry | | | | | | | | | |
| | 6 | | | | | | | | | | |
| | 7 | | | | | | | | | | |

# RECORD OF BOREHOLE 12

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

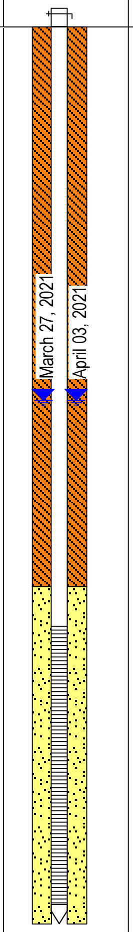
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | WATER CONTENT (%) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|
| 187.3 | | Ground Surface | | | | | | | |
| | 0 | **Topsoil** | | | | | | 28 | |
| 187.0 | | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>some organic stains, damp | 1 | SS | 46 | 5 | | 25 | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 186.6 | 1 | brown<br>**Silty Clay/Clayey Silt**<br>some moist fine sand seams<br>damp to moist, firm | 2 | SS | 30 | 7 | | 25 | |
| 185.6 | 2 | brown<br>**Silty Clay/Clayey Silt Till**<br>some oxidized fissures<br>damp to moist, stiff | 3 | SS | 46 | 11 | | 25 | |
| | | grey<br>some sand seams | 4 | SS | 46 | 14 | | 23 | |
| | 3 | grey, occ. reddish grey<br>some shale fragments<br>damp | 5 | SS | 46 | 11 | | 13 | Gradation Analysis & Atterberg Limits, S(5):<br>7 20 50 23<br>LL: 25%<br>PL: 13%<br>PI: 12% |
| | 4 | reddish brown<br>damp to moist | | | | | | | |
| | | grey<br>damp to moist | 6 | SS | 46 | 10 | March 17, 2021 ▼ | 17 | |
| 182.2 | 5 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: 4.3m<br>Measured Groundwater Level in Installed Standpipe Piezometer on:<br>March 27, 2021: 1.9m<br>April 03, 2021: 1.9m | | | | | | | |
| | 6 | | | | | | | | |
| | 7 | | | | | | | | |

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa 20 40 60 80 100

WATER CONTENT (%) 5 15 25 35

MONITORING WELL



# RECORD OF BOREHOLE 13

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Solid Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100<br>SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| 186.9 | | Ground Surface | | | | | | | | | | |
| 186.8 | 0 | **Topsoil** | | | | | | | | 29 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 186.2 | | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>trace topsoil, trace sand<br>some organic stains, damp | | 1 | SS | 46 | 3 | | | 22 | | |
| | 1 | brown<br>**Silty Clay/Clayey Silt**<br>some fine sand seams<br>damp to moist, very stiff | | 2 | SS | 38 | 19 | | | 22 | | |
| 184.7 | 2 | | | 3 | SS | 38 | 28 | | | 20 | | |
| | | brown<br>**Silty Clay/Clayey Silt Till**<br>some fine sand<br>occ. oxidized fissures<br>damp, very stiff | | 4 | SS | 46 | 24 | | | 15 | | |
| | 3 | brown, occ. grey | | 5 | SS | 38 | 15 | | | 16 | | |
| | 4 | grey<br>damp to moist, stiff | | 6 | SS | 38 | 11 | | | 15 | | |
| 181.9 | | | | 7 | SS | 46 | 11 | | | 17 | | |
| | 5 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: Dry | | | | | | | | | | |
| | 6 | | | | | | | | | | | |
| | 7 | | | | | | | | | | | |

# RECORD OF BOREHOLE 14

**Project No.:** T21841 **CLIENT:** Mattamy Development Corporation **ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021 **LOCATION:** Trafalgar Road, Milton **COMPILED BY:** R.H.

**DATUM:** Geodetic **BOREHOLE TYPE:** Solid Stem **CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

## SOIL PROFILE

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION |
|---|---|---|
| 187.0 | 0 | Ground Surface |
|  |  | **Topsoil** |
| 186.8 |  | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>some organic stains<br>damp |
| 186.1 | 1 | brown<br>**Clayey Silt**<br>occ. sand seams/interbeddings<br>some oxidized fissures<br>damp, very stiff |
| 185.3 | 2 | brown<br>**Silty Clay/Clayey Silt Till**<br>some fine sand seams<br>some oxidized fissures, damp<br>very stiff |
|  |  | greyish brown |
|  | 3, 4 | grey<br>damp to moist, stiff |
| 182.0 | 5 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: Dry |

## SAMPLES

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) |
|---|---|---|---|---|
| 1 | SS | 38 | 3 | 24<br>19 |
| 2 | SS | 46 | 19 | 22<br>19 |
| 3 | SS | 38 | 26 | 19 |
| 4 | SS | 38 | 23 | 15 |
| 5 | SS | 38 | 13 | 20 |
| 6 | SS | 46 | 12 | 17 |

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: 20 40 60 80 100

WATER CONTENT (%): 5 15 25 35

MONITORING WELL

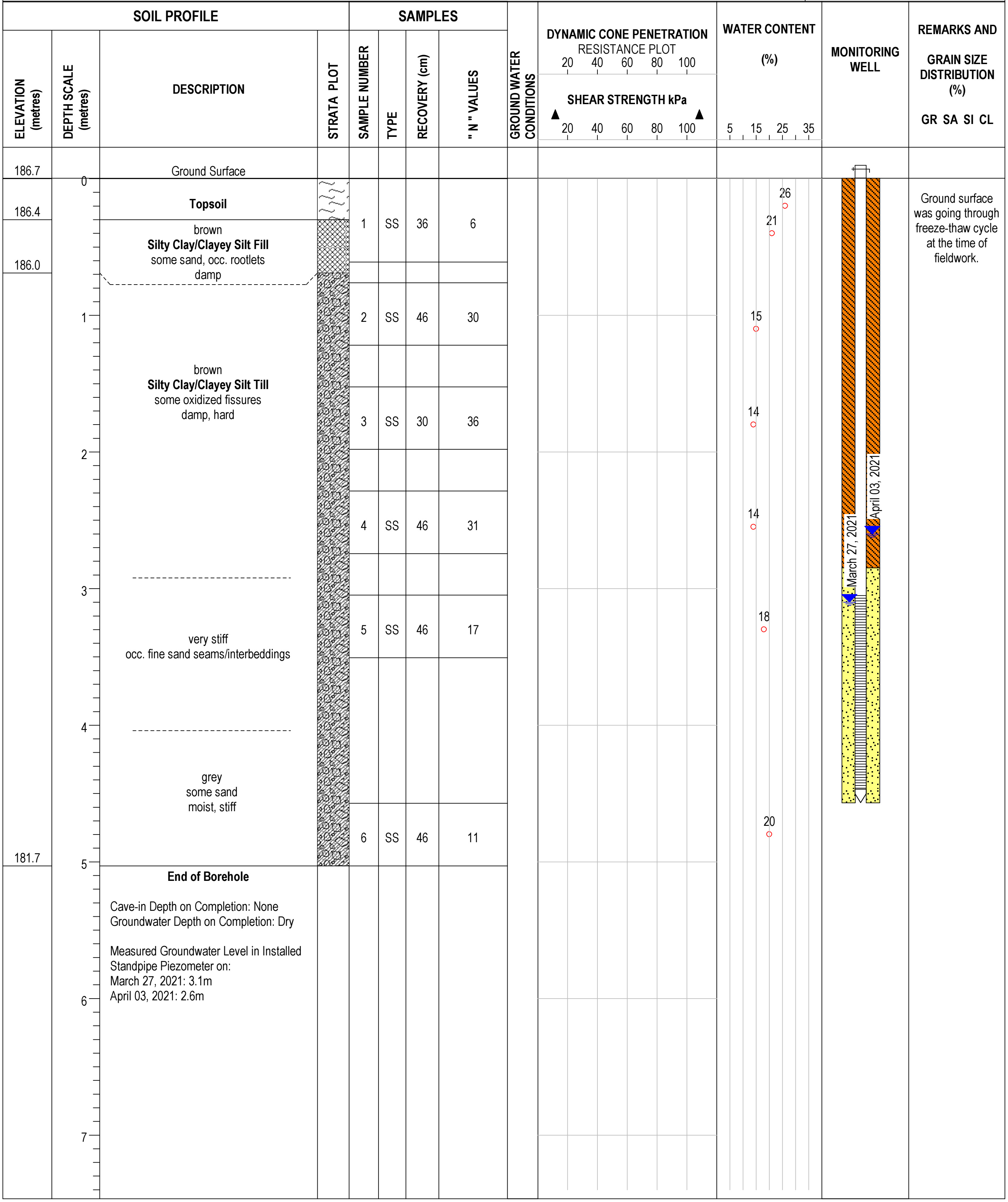
**REMARKS AND GRAIN SIZE DISTRIBUTION (%)**
GR SA SI CL

Ground surface was going through freeze-thaw cycle at the time of fieldwork.

# RECORD OF BOREHOLE 15

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6



| ELEVATION (metres) | DESCRIPTION |
|---|---|
| 186.7 | Ground Surface |
| 186.4 | **Topsoil** |
| 186.0 | brown **Silty Clay/Clayey Silt Fill** some sand, occ. rootlets damp |
|  | brown **Silty Clay/Clayey Silt Till** some oxidized fissures damp, hard |
|  | very stiff occ. fine sand seams/interbeddings |
|  | grey some sand moist, stiff |
| 181.7 | **End of Borehole** |

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) |
|---|---|---|---|---|
| 1 | SS | 36 | 6 | 26<br>21 |
| 2 | SS | 46 | 30 | 15 |
| 3 | SS | 30 | 36 | 14 |
| 4 | SS | 46 | 31 | 14 |
| 5 | SS | 46 | 17 | 18 |
| 6 | SS | 46 | 11 | 20 |

Cave-in Depth on Completion: None
Groundwater Depth on Completion: Dry

Measured Groundwater Level in Installed Standpipe Piezometer on:
March 27, 2021: 3.1m
April 03, 2021: 2.6m

Ground surface was going through freeze-thaw cycle at the time of fieldwork.

# RECORD OF BOREHOLE 16

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Hollow Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 186.6 | 0 | Ground Surface | | | | | | | | | |
| 186.3 | | **Topsoil** | | | | | | | | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 185.9 | | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>occ. rootlets, some organic stains<br>damp | 1 | SS | 30 | 5 | | | 26<br>26 | | |
| 185.3 | 1 | brown, occ. greyish brown<br>**Silty Clay/Clayey Silt**<br>occ. rootlets<br>moist, very stiff | 2 | SS | 41 | 18 | | | 24 | | |
| | | brown, occ. grey<br>**Silty Clay/Clayey Silt Till**<br>some sand, some oxidized fissures<br>damp, very stiff | 3 | SS | 46 | 23 | | | 14 | | |
| | 2 | greyish brown | | | | | | | | | |
| | | brown | 4 | SS | 46 | 30 | | | 14 | | Gradation Analysis & Atterberg Limits, S(4):<br>4 18 53 25<br>LL: 33%<br>PL: 19%<br>PI: 14% |
| | 3 | occ. oxidized fissures | 5 | SS | 46 | 26 | | | 13 | | |
| | 4 | greyish brown, occ. reddish brown<br>damp to moist, firm | 6 | SS | 46 | 7 | | | 18 | | |
| | 5<br>6 | grey<br>silty clay/clayey silt interbedding<br>damp to moist | | | | | | | 24 | | |
| | | | 7 | SS | 46 | 14 | | | 16 | | |
| | 7 | grey, occ. reddish brown<br>damp, stiff | | | | | | | | | |

# RECORD OF BOREHOLE 16

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Hollow Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | SAMPLES | | | | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100<br>SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | | | | | |
| | | | | | | | | | 15 | | |
| 178.8 | 8 | reddish grey<br>**Silty Sand/Sandy Silt Till**<br>damp to moist, compact | 8 | SS | 46 | 22 | | | 11 | | |
| 178.1 | 9 | grey<br>**Clayey Silt Till**<br>some sand<br>occ. sandy silt interbeddings<br>damp, very stiff | 9 | SS | 46 | 23 | | | 11 | | |
| 176.6 | 10<br>11 | grey<br>**Sandy Silt Till**<br>some clay<br>damp, dense | 10 | SS | 46 | 39 | | | 12 | | |
| | 12 | | 11 | SS | 46 | 48 | | | 10 | | |
| | 13 | grey, occ. reddish brown<br>trace clay | 12 | SS | 46 | 37 | | | 11 | | |
| | 14<br>15 | silty fine sand/sandy silt<br>interbedding<br>moist to wet, dense | | | | | | | 22 | | |

# RECORD OF BOREHOLE 16

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Hollow Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100<br>SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| | | reddish grey<br>some clay<br>damp, very dense | | 13 | SS | 25 | 74 | | | 8 | | |
| | 16 | | | | | | | | | | | |
| | 17 | trace clay<br>occ. till-shale interbeddings<br>some shale fragments | | 14 | SS | 10 | 50/10cm | | | 10 | | |
| 169.0 | | | | | | | | | | | | |
| | 18 | reddish brown<br>**Highly Weathered Shale** | | 15 | SS | 3 | 50/5cm | | | 8 | | |
| | 19 | | | | | | | | | | | |
| 166.8 | | **End of Borehole** | | 16 | SS | 3 | 50/5cm | | | 10 | | |
| | 20 | Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: N/A | | | | | | | | | | |
| | 21 | | | | | | | | | | | |
| | 22 | | | | | | | | | | | |

# RECORD OF BOREHOLE 17

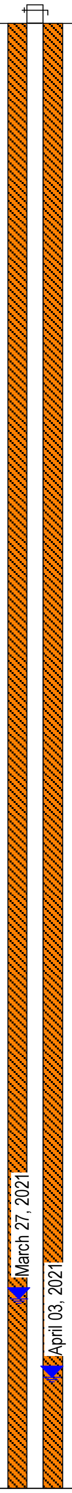
**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Hollow Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | SAMPLES | | | | | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | | | |
| 186.4 | Ground Surface | | | | | | | | |
| | **Topsoil** | 1 | SS | 46 | 5 | | | 25<br>22 | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 185.9 | mottled brown **Silty Clay/Clayey Silt Fill** some rootlets, damp to moist | | | | | | | | |
| 185.5 | brown, occ. grey **Silty Clay/Clayey Silt Till** damp, very stiff | 2 | SS | 36 | 16 | | | 18 | |
| | some sand some oxidized fissures hard | 3 | SS | 41 | 35 | | | 13 | |
| | brown | 4 | SS | 30 | 36 | | | 12 | |
| | brown, occ. greyish brown very stiff | 5 | SS | 36 | 26 | | | 12 | |
| 182.4 | greyish brown **Clayey Silt Till** some sand, occ. shale fragments damp to moist, stiff | 6 | SS | 36 | 11 | | | 16 | |
| | firm | 7 | SS | 46 | 7 | | | 16 | |
| | grey | | | | | | | | |

DEPTH SCALE (metres): 0, 1, 2, 3, 4, 5, 6, 7

MONITORING WELL



# RECORD OF BOREHOLE 17

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Hollow Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

## SOIL PROFILE

| ELEVATION (metres) | DESCRIPTION |
|---|---|
| | reddish grey<br>trace clay<br>damp, dense |
| 177.8 | grey<br>**Silty Clay/Clayey Silt Till**<br>some sand<br>damp |
| 176.2 | grey<br>**Sand and Gravel**<br>some shale fragments<br>moist to wet, dense |
| 174.7 | greyish brown<br>**Sandy Silt Till**<br>trace clay<br>damp, very dense |

DEPTH SCALE (metres): 8, 9, 10, 11, 12, 13, 14

## SAMPLES

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|
| 8 | SS | 46 | 34 | 8 | Gradation Analysis, S(8):<br>7 37 53 3 |
| 9 | SS | 46 | 31 | 10 | |
| 10 | SS | 41 | 32 | 10 | |
| 11 | SS | 10 | 50/13cm | 11 | |
| 12 | SS | 25 | 50/10cm | 8 | Gradation Analysis, S(12):<br>5 29 59 7 |

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: 20 40 60 80 100

WATER CONTENT (%): 5 15 25 35

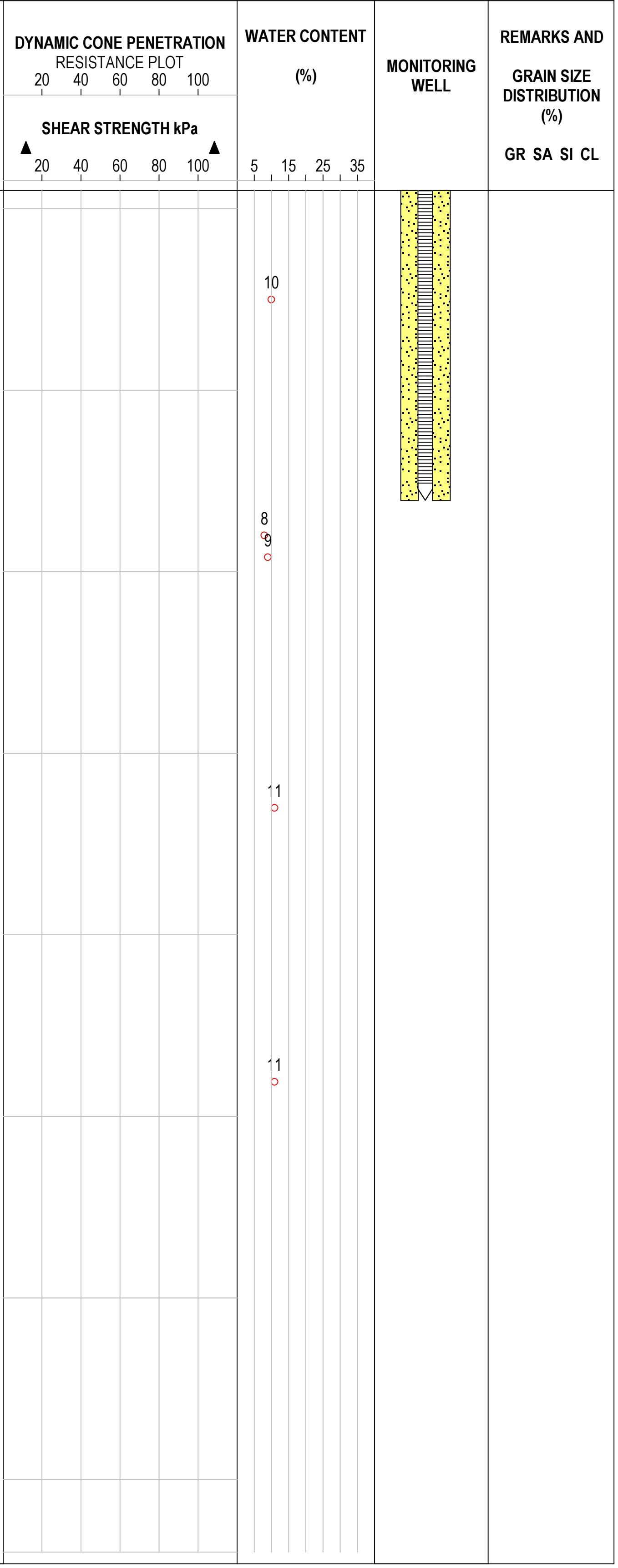
MONITORING WELL

# RECORD OF BOREHOLE 17

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Hollow
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | SAMPLES | | | | | |
|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | WATER CONTENT (%) |
| | 15 | some clay | 13 | SS | 30 | 95/23cm | | 10 |
| 170.8 | 16 | reddish grey<br>**Silty Sand Till**<br>damp to moist, very dense | 14 | SS | 15 | 50/5cm | | 8<br>9 |
| 169.4 | 17 | reddish grey<br>**Till-Shale**<br>damp to moist, very dense | | | | | | |
| 168.7 | 18<br>19 | reddish brown<br>**Highly Weathered Shale** | 15 | SS | 5 | 50/5cm | | 11 |
| | | | 16 | SS | 3 | 50/3cm | | 11 |
| 166.5 | 20<br>21<br>22 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: N/A<br>Measured Groundwater Level in Installed Monitoring Well on:<br>March 27, 2021: 6.5m<br>April 03, 2021: 6.9m | | | | | | |



# RECORD OF BOREHOLE 18

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Hollow Stem
CHECKED BY: H.S.

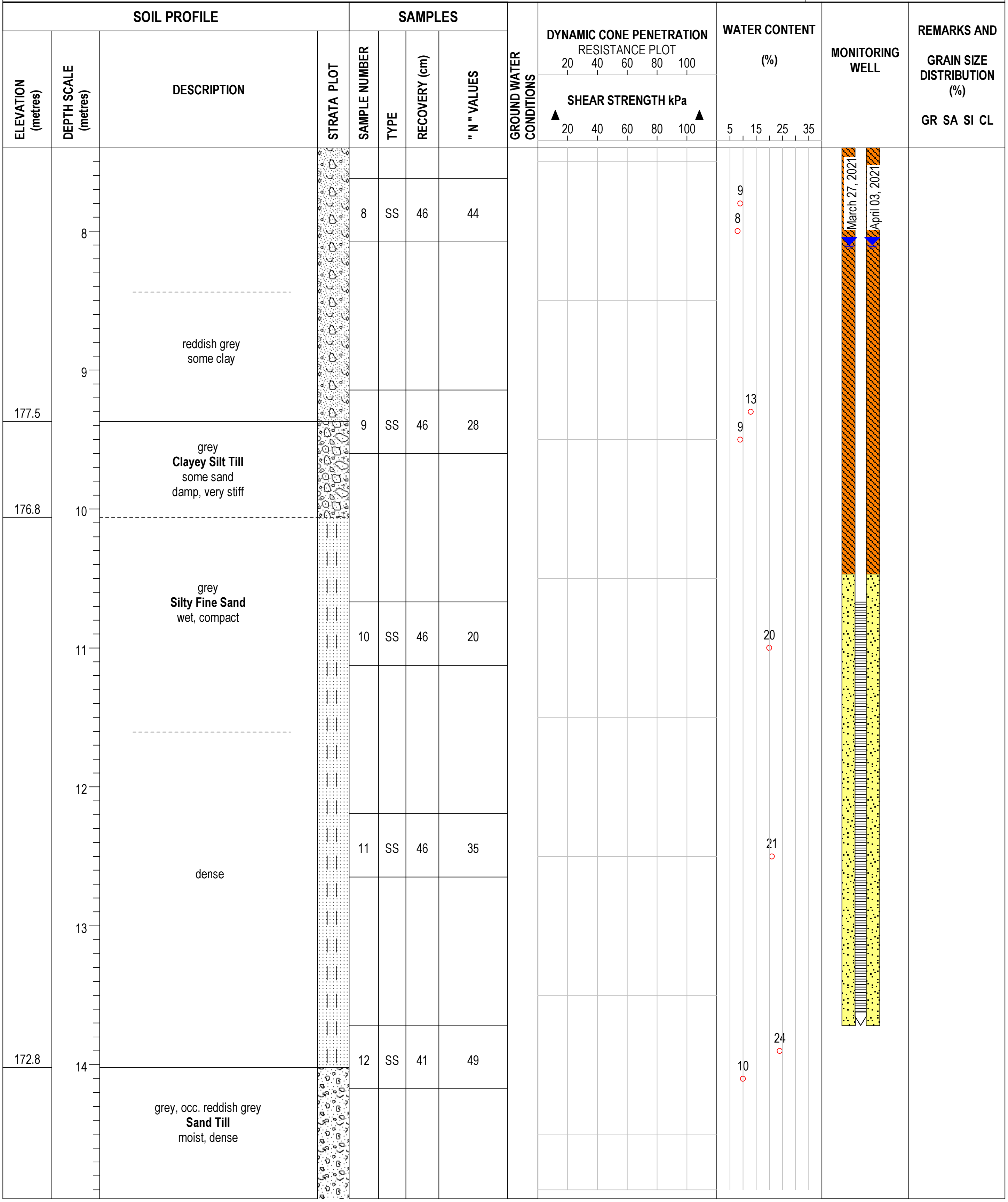
SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| 186.8 | | Ground Surface | | | | | | | | | | |
| 186.7 | 0 | **Topsoil** | | | | | | | | | | |
| 186.4 | | light brown **Silty Sand Fill** trace organic stains, damp to moist | | 1 | SS | 46 | 9 | | | 23<br>19<br>24 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| | 1 | brown, occ. grey **Silty Clay/Clayey Silt Till** some sand damp to moist, stiff | | 2 | SS | 41 | 13 | | | 17 | | |
| | | occ. oxidized fissures occ. shale fragments damp, hard | | 3 | SS | 46 | 33 | | | 13 | | |
| | 2 | brown some oxidized fissures | | | | | | | | | | |
| | | silty sand/sandy silt till interbedding, moist | | 4 | SS | 46 | 30 | | | 12 | | |
| | 3 | occ. silty sand/sandy silt till interbeddings very stiff | | 5 | SS | 46 | 29 | | | 11 | | |
| | 4 | greyish brown | | 6 | SS | 41 | 15 | | | 14 | | |
| | 5 | damp | | | | | | | | | | |
| | 6 | reddish grey to grey damp to moist, firm | | 7 | SS | 46 | 5 | | | 16 | | |
| 179.8 | 7 | grey **Silty Sand/Sandy Silt Till** trace clay, damp, dense | | | | | | | | | | |

# RECORD OF BOREHOLE 18

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Hollow Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6



| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) |
|---|---|---|---|---|---|---|---|
| | 8 | | 8 | SS | 46 | 44 | 9<br>8 |
| | 9 | reddish grey<br>some clay | | | | | |
| 177.5 | | grey<br>**Clayey Silt Till**<br>some sand<br>damp, very stiff | 9 | SS | 46 | 28 | 13<br>9 |
| 176.8 | 10 | grey<br>**Silty Fine Sand**<br>wet, compact | | | | | |
| | 11 | | 10 | SS | 46 | 20 | 20 |
| | 12 | dense | 11 | SS | 46 | 35 | 21 |
| | 13 | | | | | | |
| 172.8 | 14 | grey, occ. reddish grey<br>**Sand Till**<br>moist, dense | 12 | SS | 41 | 49 | 24<br>10 |

# RECORD OF BOREHOLE 18

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Hollow Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100<br>SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| | 15 | | | | | | | | | | | possible cobbles/boulder |
| | | | | 13 | SS | 30 | 99/23cm | | | 8<br>9 | | |
| 171.4 | | reddish brown<br>**Sandy Silt Till**<br>some clay, occ. shale fragments<br>damp, very dense | | | | | | | | | | |
| 170.7 | 16 | grey, occ reddish grey<br>**Sandy Silt**<br>some clayey interbeddings<br>occ. silty sand till interbeddings<br>moist to wet, dense | | | | | | | | | | |
| | 17 | | | 14 | SS | 41 | 41 | | | 24 | | |
| 169.2 | 18 | reddish brown, occ. grey<br>**Till-Shale**<br>damp to moist, very dense | | | | | | | | | | |
| | | | | 15 | SS | 10 | 50/13cm | | | 9 | | |
| | 19 | reddish brown | | | | | | | | | | |
| | | | | 16 | SS | 8 | 50/8cm | | | 10 | | |
| 166.9 | 20 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: N/A<br>Measured Groundwater Level in Installed Monitoring Well on:<br>March 27, 2021: 8.1m<br>April 03, 2021: 8.1m | | | | | | | | | | |
| | 21 | | | | | | | | | | | |
| | 22 | | | | | | | | | | | |

# RECORD OF BOREHOLE 19

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Hollow Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT<br>20 40 60 80 100<br>SHEAR STRENGTH kPa<br>20 40 60 80 100 | WATER CONTENT (%)<br>5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%)<br>GR SA SI CL |
| 186.6 | | Ground Surface | | | | | | | | | | |
| 186.4 | 0 | **Topsoil** | | | | | | | | 29 | | |
| | | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>some sand, occ. topsoil, occ. rootlets<br>damp to moist | | 1 | SS | 46 | 7 | | | 22 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 185.6 | | brown, occ. grey | | | | | | | | 27 | | |
| | 1 | brown, occ. reddish grey<br>**Silty Clay/Clayey Silt Till**<br>some sand<br>damp, very stiff | | 2 | SS | 41 | 16 | | | 19 | | |
| | | | | 3 | SS | 46 | 21 | | | 16 | | |
| | 2 | brown<br>some oxidized fissures<br>occ. silty sand/sandy silt interbeddings | | 4 | SS | 46 | 30 | | | 13 | | |
| | 3 | occ. shale fragments | | 5 | SS | 46 | 29 | | | 13 | | |
| | 4 | | | | | | | | | | | |
| | | grey<br>damp, stiff | | 6 | SS | 15 | 10 | | | 14 | | |
| | 5 | | | | | | | | | | | |
| | 6 | grey, occ. reddish grey<br>damp to moist, very stiff | | 7 | SS | 15 | 15 | | | 16 | | |
| 179.5 | 7 | reddish brown<br>**Silty Sand/Sandy Silt Till**<br>occ. shale fragments<br>damp, very dense | | | | | | | | | | |

# RECORD OF BOREHOLE 19

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Hollow Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

## SOIL PROFILE

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION |
|---|---|---|
| | 8 | |
| | 9 | grey<br>occ. gravel<br>damp to moist |
| | | silty fine sand interbedding<br>moist to wet |
| | 10 | |
| | 11 | occ. clayey zones, occ. sandy zones<br>occ. shale fragments<br>damp |
| | 12 | some clay<br>damp |
| 173.4 | 13 | grey<br>**Silty Clay/Clayey Silt**<br>some sand<br>occ. silty sand/sandy silt till interbeddings<br>damp to moist, very stiff |
| 172.5 | 14 | grey<br>**Silty Fine Sand/Sandy Silt**<br>moist, compact |
| 171.8 | 15 | |

## SAMPLES

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH kPa 20 40 60 80 100
WATER CONTENT (%) 5 15 25 35

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | WATER CONTENT (%) | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|
| 8 | SS | 25 | 59 | | 9 | | |
| 9 | SS | 46 | 54 | | 11<br>16 | | |
| 10 | SS | 46 | 64 | | 14 | | |
| 11 | SS | 46 | 66 | | 9 | | |
| 12 | SS | 46 | 24 | | 25<br>23 | | |

# RECORD OF BOREHOLE 19

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Hollow
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 170.3 | 16 | grey<br>**Sand Till**<br>occ. sand pockets/interbeddings<br>moist to wet, compact | 13 | SS | 30 | 28 | | | 12 | | |
| 168.8 | 17 | reddish brown<br>**Silty Sand Till**<br>damp to moist, very dense | 14 | SS | 15 | 50/5cm | | | 10 | | Gradation Analysis, S(14):<br>10 56 34 |
| | 18 | reddish brown, occ. grey<br>**Till-Shale to Highly Weathered Shale**<br>moist, very dense | 15 | SS | 5 | 50/5cm | | | 10 | | |
| 166.7 | 19 | | 16 | SS | 3 | 50/3cm | | | 12 | | |
| | 20<br>21<br>22 | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: N/A | | | | | | | | | |

# RECORD OF BOREHOLE 20

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.

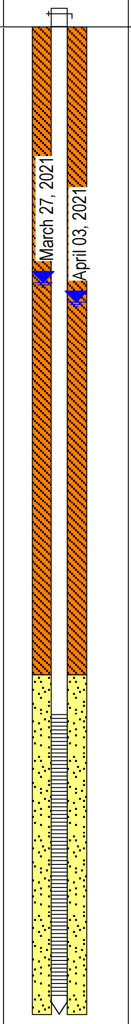
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.

**DATUM:** Geodetic
**BOREHOLE TYPE:** Solid Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH kPa: 20 40 60 80 100
WATER CONTENT (%): 5 15 25 35

| SOIL PROFILE | | | SAMPLES | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | WATER CONTENT (%) | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| 186.4 | | Ground Surface | | | | | | | | |
| 186.1 | 0 | **Topsoil** | 1 | SS | 30 | 4 | | 31 | | Ground surface was going through freeze-thaw cycle at the time of fieldwork. |
| 185.7 | | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>moist | | | | | | 24 | | |
| | 1 | brown, occ. grey<br>**Silty Clay/Clayey Silt Till**<br>some sand, some oxidized fissures<br>occ. fine sand seams/interbeddings<br>damp, very stiff | 2 | SS | 46 | 21 | | 14 | | |
| | | | 3 | SS | 46 | 29 | | 15 | | |
| | 2 | brown | 4 | SS | 46 | 32 | | 16 | | |
| | 3 | grey<br>damp to moist, stiff | 5 | SS | 46 | 14 | | 13<br>14 | | |
| 181.3 | 4 | grey, occ. reddish grey<br>moist | 6 | SS | 46 | 10 | | 15 | | |
| | 5 | **End of Borehole** | | | | | | | | |



Cave-in Depth on Completion: None
Groundwater Depth on Completion: Dry

Measured Groundwater Level in Installed Standpipe Piezometer on:
March 27, 2021: 1.3m
April 03, 2021: 1.4m

# RECORD OF BOREHOLE 21

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Solid Stem
CHECKED BY: H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

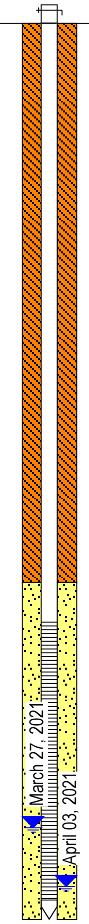
| ELEVATION (metres) | DESCRIPTION | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) |
|---|---|---|---|---|---|---|
| 186.8 | Ground Surface | | | | | |
| 186.5 | **Topsoil** | 1 | SS | 46 | 7 | 25<br>23 |
| 186.1 | mottled brown **Silty Clay/Clayey Silt Fill** some organic stains damp | | | | | |
| | brown, occ. grey **Silty Clay/Clayey Silt Till** occ. silty clay/clayey silt interbeddings damp, very stiff | 2 | SS | 46 | 21 | 20 |
| | occ. silty sand pockets/seams | 3 | SS | 30 | 20 | 16 |
| | brown some oxidized fissures | 4 | SS | 41 | 23 | 15 |
| | damp to moist | 5 | SS | 46 | 15 | 16 |
| 181.8 | grey moist, stiff | 6 | SS | 46 | 8 | 16 |

**End of Borehole**

Cave-in Depth on Completion: None
Groundwater Depth on Completion: Dry

Measured Groundwater Level in Installed Standpipe Piezometer on:
March 27, 2021: 4.1m
April 03, 2021: 4.4m

MONITORING WELL



REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Borehole was moved approximately 10m west from stake due to water ponding.

Ground surface was going through freeze-thaw cycle at the time of fieldwork.

# RECORD OF BOREHOLE 22

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Hollow Stem
CHECKED BY: H.S.

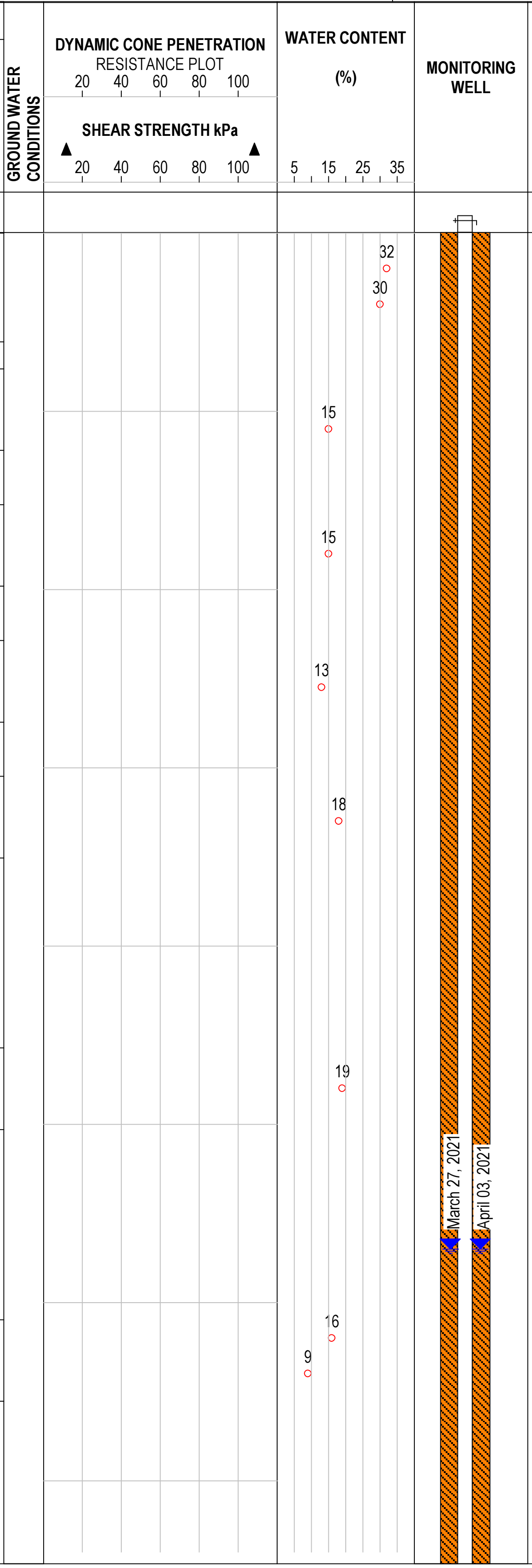
SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

## SOIL PROFILE

| ELEVATION (metres) | DESCRIPTION |
|---|---|
| 186.9 | Ground Surface |
|  | **Topsoil** |
| 186.6 | mottled brown<br>**Silty Clay/Clayey Silt Fill**<br>some organic stains, damp |
| 186.4 | brown<br>**Silty Clay/Clayey Silt Till**<br>trace organic stains<br>occ. shale fragments<br>damp, very stiff |
|  | brown<br>some oxidized fissures<br>hard |
|  | very stiff |
|  | grey<br>damp to moist, stiff |
| 180.7 | grey<br>**Sandy Silt Till**<br>damp, compact |
|  | dense |

## SAMPLES

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES |
|---|---|---|---|
| 1 | SS | 30 | 4 |
| 2 | SS | 20 | 18 |
| 3 | SS | 30 | 27 |
| 4 | SS | 38 | 31 |
| 5 | SS | 46 | 19 |
| 6 | SS | 38 | 9 |
| 7 | SS | 46 | 27 |



DEPTH SCALE (metres): 0 1 2 3 4 5 6 7

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Ground surface was going through freeze-thaw cycle at the time of fieldwork.

# RECORD OF BOREHOLE 22

Project No.: T21841
CLIENT: Mattamy Development Corporation
ORIGINATED BY: R.H.
DATE: March 11-18, 2021
LOCATION: Trafalgar Road, Milton
COMPILED BY: R.H.
DATUM: Geodetic
BOREHOLE TYPE: Hollow Stem
CHECKED BY: H.S.

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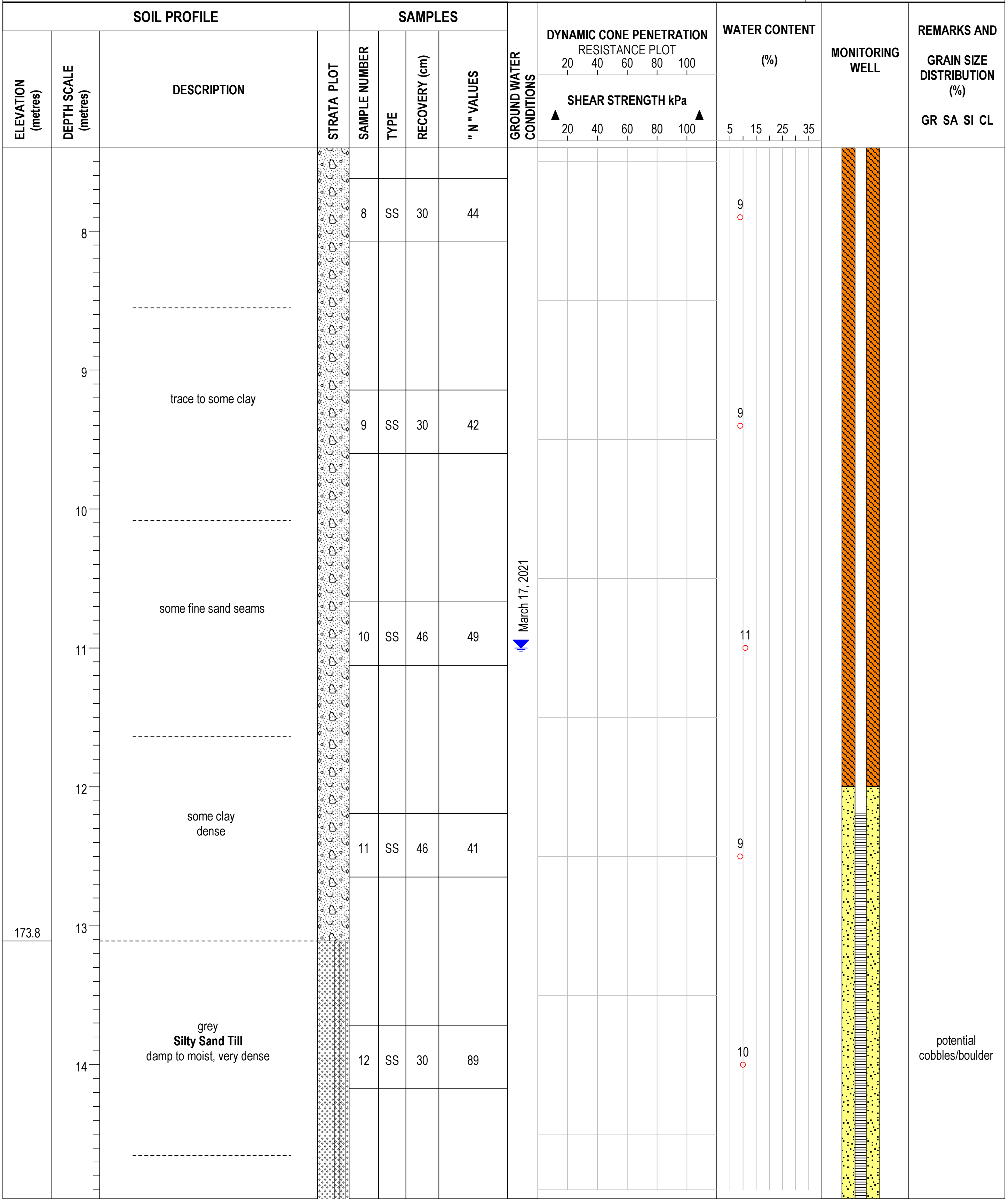


| ELEVATION (metres) | DESCRIPTION | REMARKS AND GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|
| | trace to some clay | |
| | some fine sand seams | |
| | some clay<br>dense | |
| 173.8 | grey<br>**Silty Sand Till**<br>damp to moist, very dense | potential cobbles/boulder |

| SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | WATER CONTENT (%) |
|---|---|---|---|---|
| 8 | SS | 30 | 44 | 9 |
| 9 | SS | 30 | 42 | 9 |
| 10 | SS | 46 | 49 | 11 |
| 11 | SS | 46 | 41 | 9 |
| 12 | SS | 30 | 89 | 10 |

# RECORD OF BOREHOLE 22

**Project No.:** T21841
**CLIENT:** Mattamy Development Corporation
**ORIGINATED BY:** R.H.
**DATE:** March 11-18, 2021
**LOCATION:** Trafalgar Road, Milton
**COMPILED BY:** R.H.
**DATUM:** Geodetic
**BOREHOLE TYPE:** Hollow Stem
**CHECKED BY:** H.S.

SHAD & ASSOCIATES INC.
83 Citation Dr, Unit 9,
Vaughan, Ontario, L4K 2Z6

| SOIL PROFILE | | | | SAMPLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEVATION (metres) | DEPTH SCALE (metres) | DESCRIPTION | STRATA PLOT | SAMPLE NUMBER | TYPE | RECOVERY (cm) | " N " VALUES | GROUND WATER CONDITIONS | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100<br>SHEAR STRENGTH kPa ▲ 20 40 60 80 100 ▲ | WATER CONTENT (%) 5 15 25 35 | MONITORING WELL | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| | 15 | reddish grey<br>some shale fragments<br>occ. clayey zones<br>moist | ▨ | 13 | SS | 38 | 91/23cm | | | 10 | | |
| 171.3 | | **End of Borehole**<br>Cave-in Depth on Completion: None<br>Groundwater Depth on Completion: N/A<br>Measured Groundwater Level in Installed Monitoring Well on:<br>March 27, 2021: 5.7m<br>April 03, 2021: 5.7m | | | | | | | | | | |
| | 16 | | | | | | | | | | | |
| | 17 | | | | | | | | | | | |
| | 18 | | | | | | | | | | | |
| | 19 | | | | | | | | | | | |
| | 20 | | | | | | | | | | | |
| | 21 | | | | | | | | | | | |
| | 22 | | | | | | | | | | | |

# EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. It should be noted that materials, boundaries and conditions have been established only at the borehole locations at the time of investigation and are not necessarily representative of subsurface conditions elsewhere across the site. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

## GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

## SOIL LITHOLOGY

### *Elevation and depth*

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

### *Lithology Plot*

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

### *Description*

This column gives a description of the soil stratums, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the following classification and terminology (Ref. Unified Soil Classification System):

The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows (Ref. Canadian Foundation Engineering Manual):

| Compactness of Cohesionless Soils | SPT N-Value |
|---|---|
| Very loose | 0 to 4 |
| Loose | 4 to 10 |
| Compact | 10 to 30 |
| Dense | 30 to 50 |
| Very Dense | > 50 |
| | |

| Consistency of Cohesive Soils | SPT N-Value | Undrained Shear Strength | |
|---|---|---|---|
| | | kPa | psf |
| Very soft | 0 to 2 | 0 to 12 | 0 to 250 |
| Soft | 2 to 4 | 12 to 25 | 250 to 500 |
| Firm | 4 to 8 | 25 to 50 | 500 to 1000 |
| Stiff | 8 to 15 | 50 to 100 | 1000 to 2000 |
| Very stiff | 15 to 30 | 100 to 200 | 2000 to 4000 |
| Hard | > 30 | Over 200 | Over 4000 |

### *Soil Sampling*

Sample types are abbreviated as follows:

| | | | | | |
|---|---|---|---|---|---|
| SS | Split Spoon | TW | Thin Wall Open (Pushed) | RC | Rock Core |
| AS | Auger Sample | TP | Thin Wall Piston (Pushed) | WS | Washed Sample |

Additional information provided in this section includes sample numbering, sample recovery and numerical testing results.

### *Field and Laboratory Testing*

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

### *Instrumentation Installation*

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section. Water levels, if measured during fieldwork, are also plotted. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors.

### *Comments*

This column is used to describe non-standard situations or notes of interest.

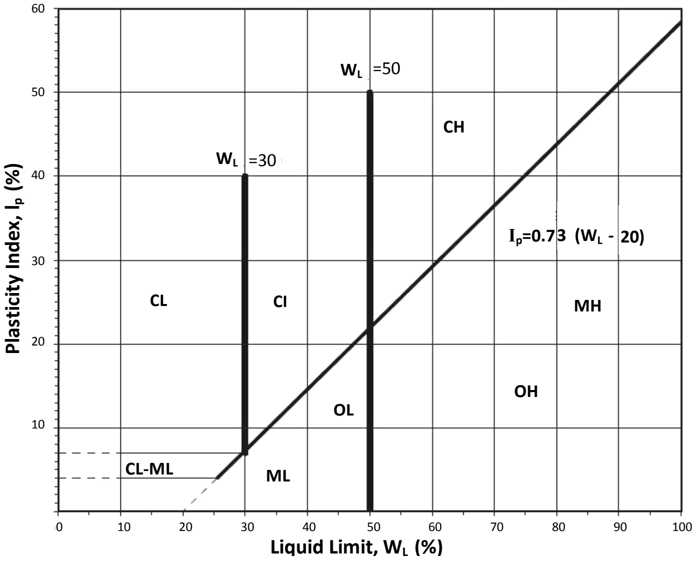
## MODIFIED * UNIFIED CLASSIFICATION SYSTEM FOR SOILS

*The soil of each stratum is described using the Unified Soil Classification System (Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S Army. Vol. 1 March 1953.) modified slightly so that an inorganic clay of "medium plasticity" is recognized.

| MAJOR DIVISION | | | GROUP SYMBOL | TYPICAL DESCRIPTION | LABORATORY CLASSIFICATION CRITERIA |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm) | GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm | CLEAN GRAVELS (TRACE OR NO FINES) | GW | WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES | $C_u = \frac{D_{60}}{D_{10}} > 4;\ C_C = \frac{(D_{30})^2}{D_{10} \text{ x } D_{60}} = 1 \text{ to } 3$ |
| | | | GP | POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES | NOT MEETING ABOVE REQUIREMENTS |
| | | DIRTYGRAVELS (WITH SOME OR MORE FINES) | GM | SILTY GRAVELS, GRAVEL-SAND- SILT MIXTURES | ATTERBERG LIMITS BELOW "A" LINE OR P.I. MORE THAN 4 |
| | | | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES | ATTERBERG LIMITS BELOW "A" LINE OR P.I. MORE THAN 7 |
| | SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm | CLEAN SANDS (TRACE OR NO FINES) | SW | WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES | $C_u = \frac{D_{60}}{D_{10}} > 6;\ C_C = \frac{(D_{30})^2}{D_{10} \text{ x } D_{60}} = 1 \text{ to } 3$ |
| | | | SP | POORLY GRADED GRAVELS, GRAVEL- SAND MIXTURES, LITTLE OR NO FINES | NOT MEETING ABOVE REQUIREMENTS |
| | | DIRTY SANDS (WITH SOME OR MORE FINES) | SM | SILTY SANDS, SAND-SILT MIXTURES | ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 4 |
| | | | SC | CLAYEY SANDS, SAND-CLAY MIXTURES | ATTERBERG LIMITS BELOW "A" LINE OR P.I MORE THAN 7 |
| FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm) | SILTS BELOW “A” LINE NEGLIGIBLE ORGANIC CONTENT | $W_L < 50\%$ | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY | CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW) |
| | | $W_L < 50\%$ | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS | |
| | CLAY ABOVE “A” LINE NEGLIGIBLE ORGANIC CONTENT | $W_L < 30\%$ | CL | INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS | |
| | | $30\% < W_L < 50\%$ | CI | INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS | |
| | | $W_L < 50\%$ | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS | |
| | ORGANIC SILTS & CLAYS BELOW “A” LINE | $W_L < 50\%$ | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY | WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G SF IS A MIXTURE OF SAND WITH SILT OR CLAY |
| | | $W_L < 50\%$ | OH | ORGANIC CLAYS OF HIGH PLASTICITY | |
| HIGH ORGANIC SOILS | | | Pt | PEAT AND OTHER HIGHLY ORGANIC SOILS | STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE |

| SOIL COMPONENTS | | | | | |
|---|---|---|---|---|---|
| FRACTION | U.S STANDARD SIEVE SIZE | | | DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS | |
| | | PASSING | RETAINED | PERCENT | DESCRIPTOR |
| GRAVEL | COARSE | 76 mm | 19 mm | 35-50<br>20-35<br>10-20<br>1-10 | AND<br>Y/EY<br>SOME<br>TRACE |
| | FINE | 19 mm | 4.75 mm | | |
| SAND | COARSE | 4.75 mm | 2.00 mm | | |
| | MEDIUM | 2.00 mm | 425 µm | | |
| | FINE | 425 µm | 75 µm | | |
| FINES (SILT OR CLAY BASED ON PLASTICITY) | | 75 µm | | | |
| OVERSIZED MATERIAL | | | | | |
| ROUNDED OR SUBROUNDED: COBBLES 76 mm TO 200 mm<br>BOULDERS > 200 mm | | | | NOT ROUNDED:<br>ROCK FRAGMENTS > 76 mm<br>ROCKS> 0.76 CUBIC METRE IN VOLUME | |

**Plasticity Chart for Soil Passing 425 Micron Sieve**



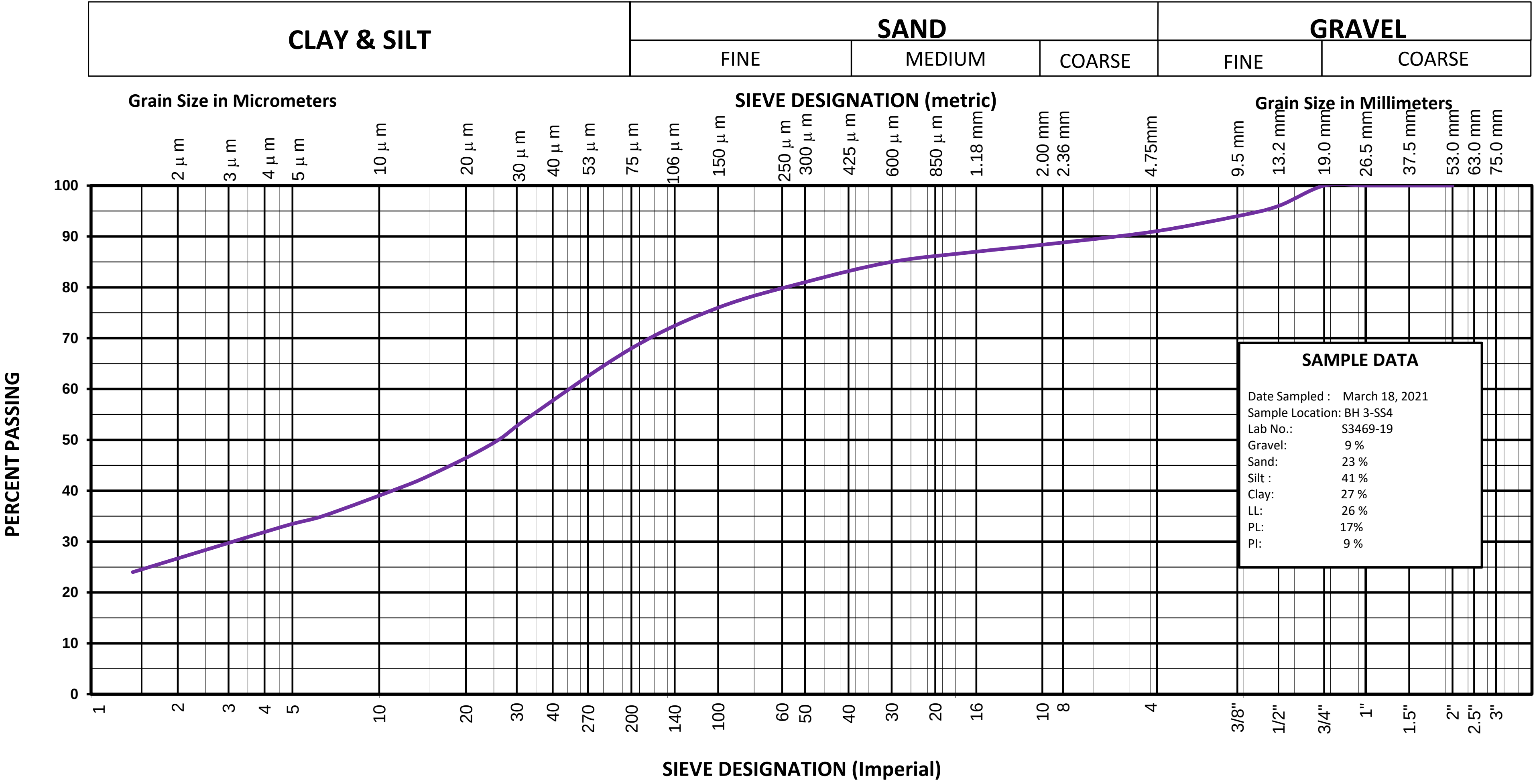
Note 1: Soils are classified and described according to their engineering properties and behavior.

Note 2: The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual ( 3rd Edition, Canadian Geotechnical Society, 1992)

# ENCLOSURES

## Enclosure A: Laboratory Test Results

# UNIFIED SOIL CLASSIFICATION SYSTEM



**SAMPLE DATA**

Date Sampled : March 18, 2021
Sample Location: BH 3-SS4
Lab No.: S3469-19
Gravel: 9 %
Sand: 23 %
Silt : 41 %
Clay: 27 %
LL: 26 %
PL: 17%
PI: 9 %

| | | | |
|---|---|---|---|
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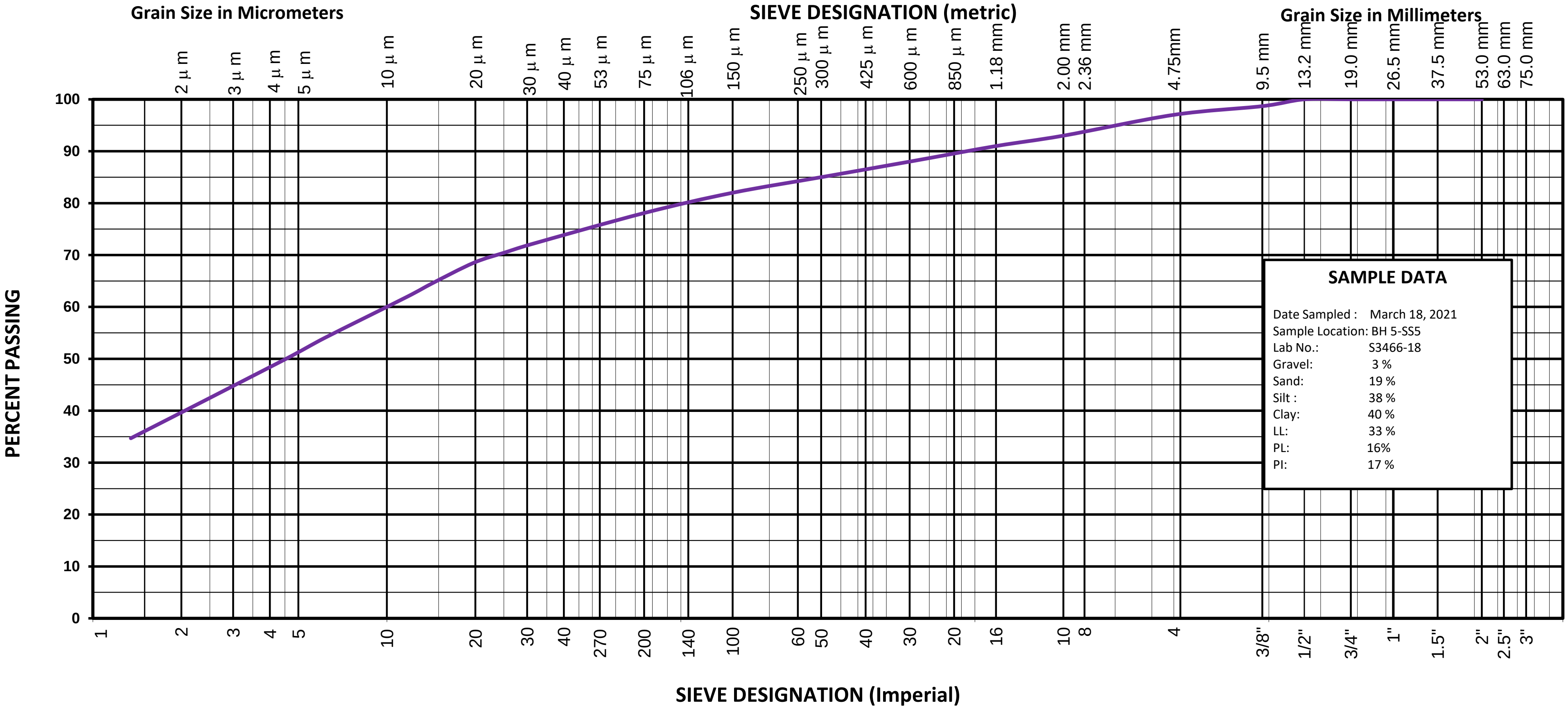
| | | **Client:**<br>**Mattamy Development Corporation** | |

# UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | SAND | | | GRAVEL | |
|---|---|---|---|---|---|
| | FINE | MEDIUM | COARSE | FINE | COARSE |



**SAMPLE DATA**

Date Sampled : March 18, 2021
Sample Location: BH 5-SS5
Lab No.: S3466-18
Gravel: 3 %
Sand: 19 %
Silt : 38 %
Clay: 40 %
LL: 33 %
PL: 16%
PI: 17 %

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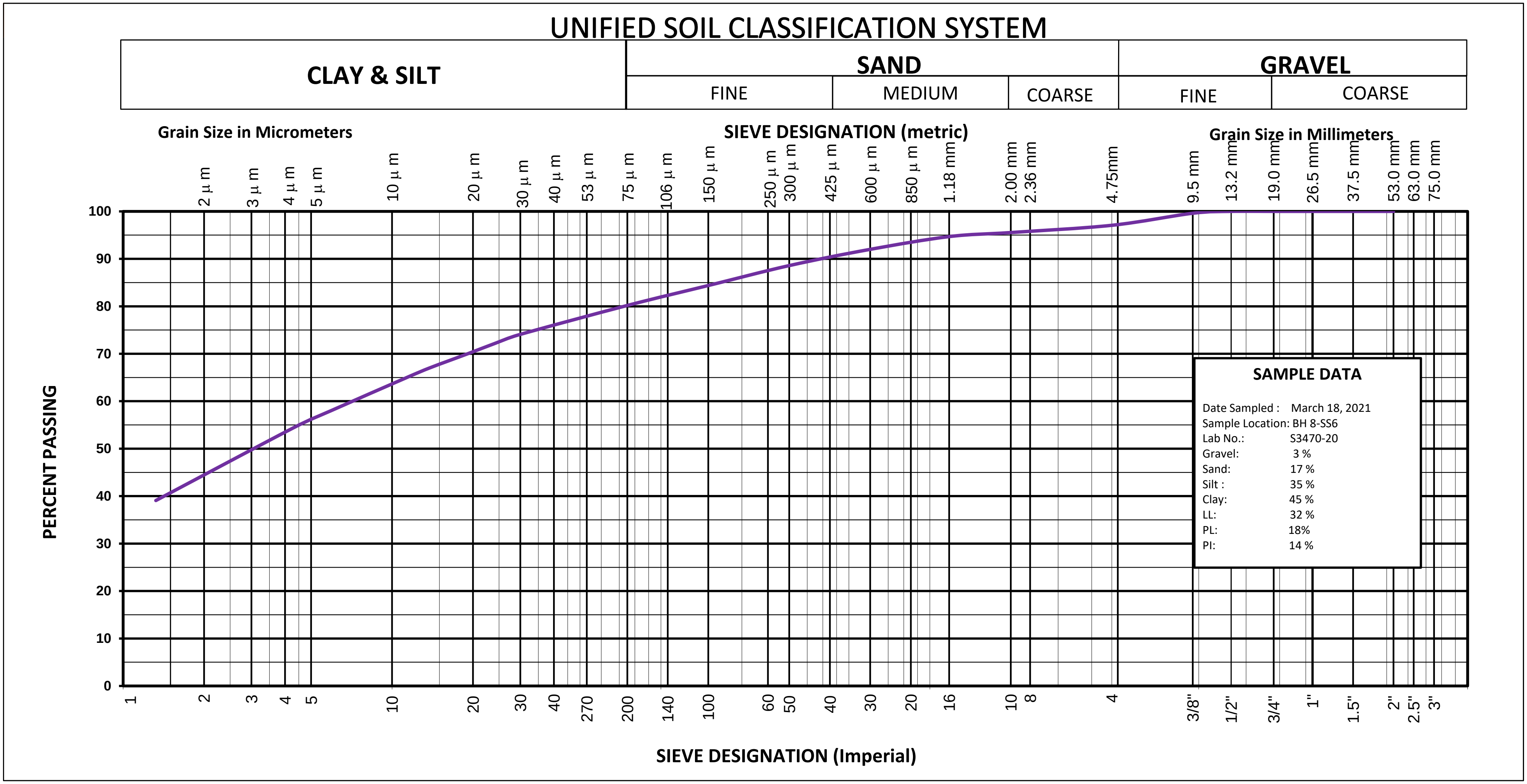
**GRAIN SIZE ANALYSIS**

**Project :** Proposed Residential Subdivision

**Project No.:** T21841

**Client:** Mattamy Development Corporation



**SAMPLE DATA**

Date Sampled : March 18, 2021
Sample Location: BH 8-SS6
Lab No.: S3470-20
Gravel: 3 %
Sand: 17 %
Silt : 35 %
Clay: 45 %
LL: 32 %
PL: 18%
PI: 14 %

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**Project No.:** **T21841**

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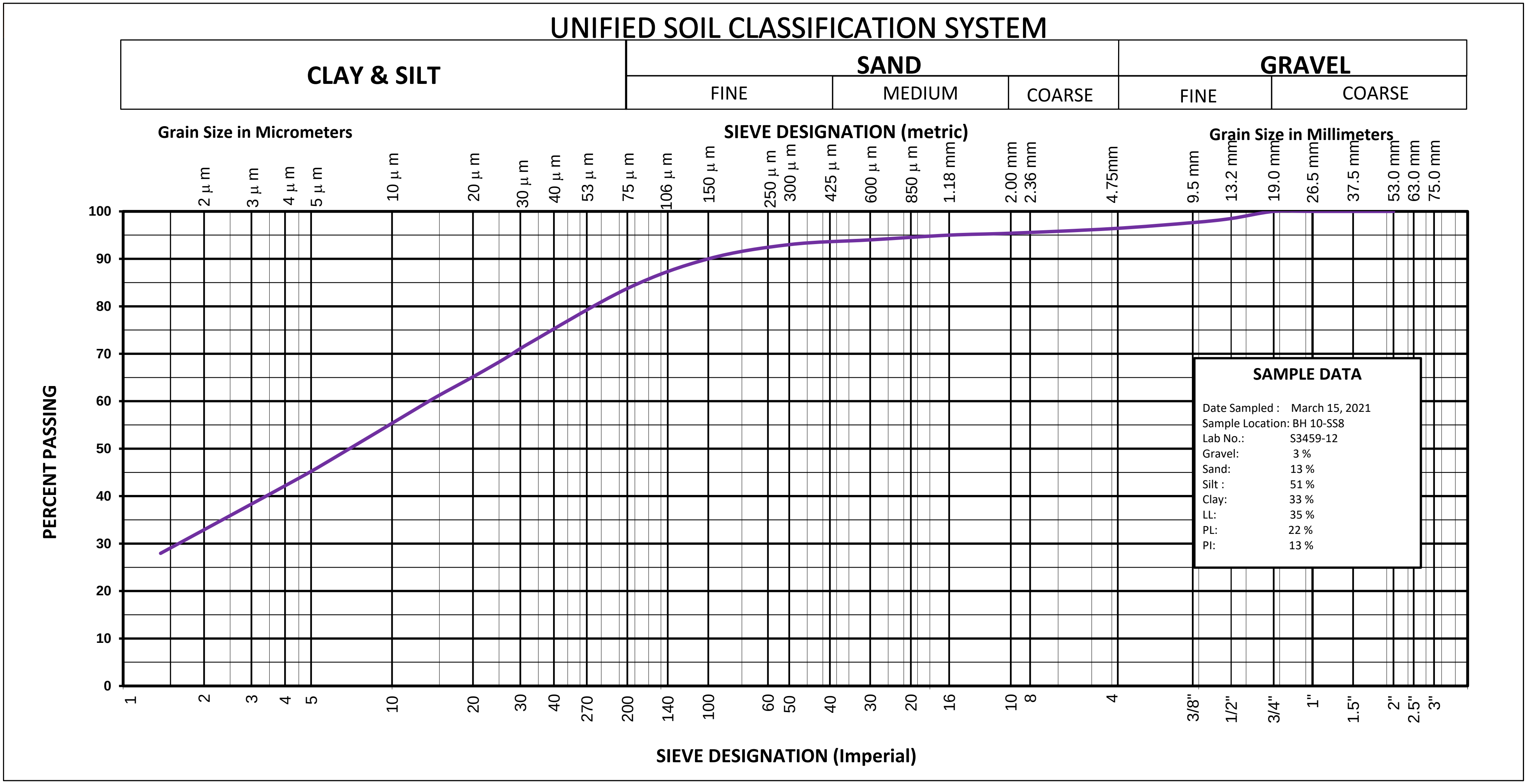

**SAMPLE DATA**

Date Sampled : March 15, 2021
Sample Location: BH 10-SS8
Lab No.: S3459-12
Gravel: 3 %
Sand: 13 %
Silt : 51 %
Clay: 33 %
LL: 35 %
PL: 22 %
PI: 13 %

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**GRAIN SIZE ANALYSIS**

**Project :**

**Proposed Residential Subdivision**

**Project No.:**

**T21841**

**Client:**

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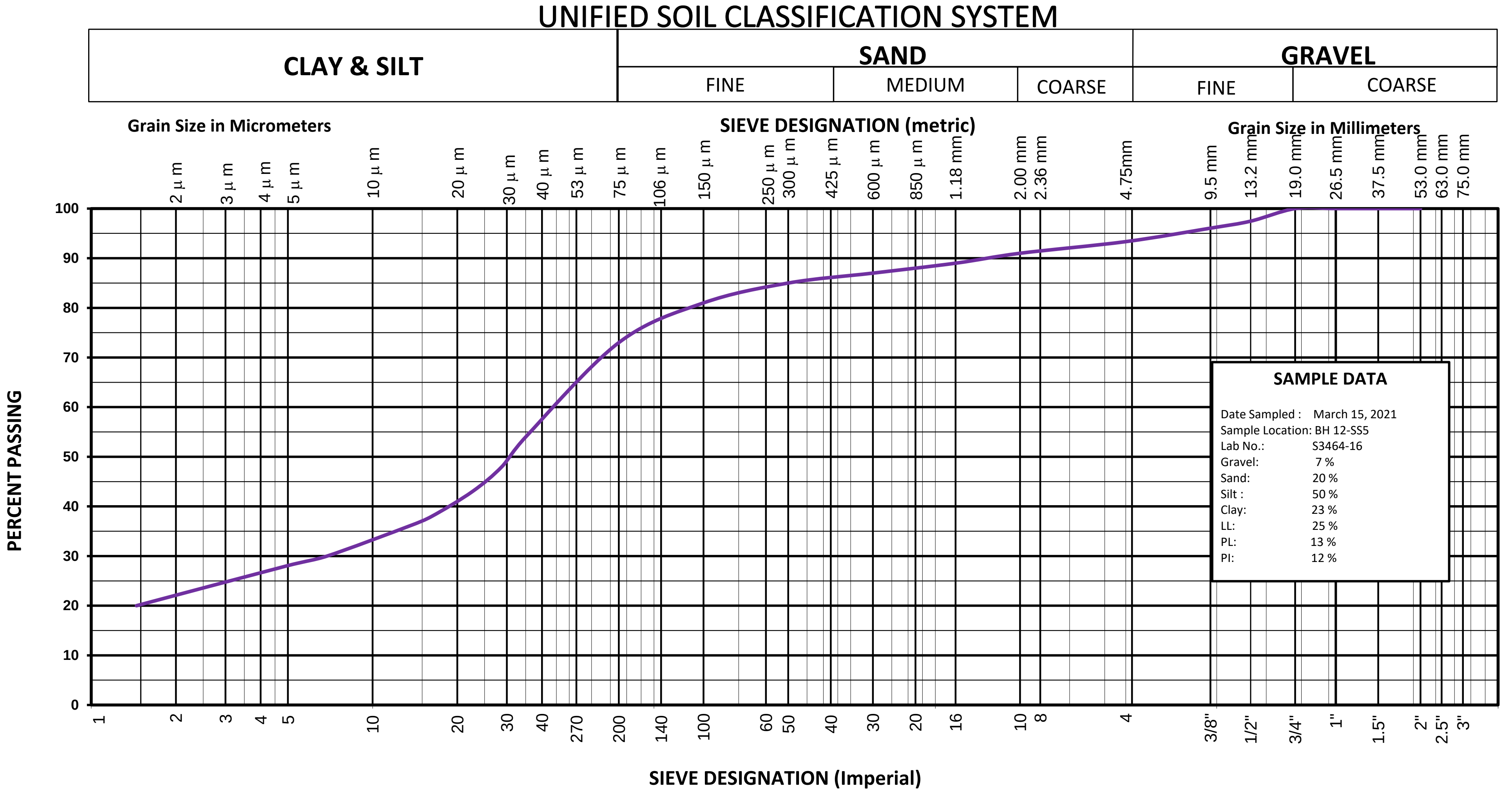

**SAMPLE DATA**

Date Sampled : March 15, 2021
Sample Location: BH 12-SS5
Lab No.: S3464-16
Gravel: 7 %
Sand: 20 %
Silt : 50 %
Clay: 23 %
LL: 25 %
PL: 13 %
PI: 12 %

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**GRAIN SIZE ANALYSIS**

**Project :**

**Proposed Residential Subdivision**

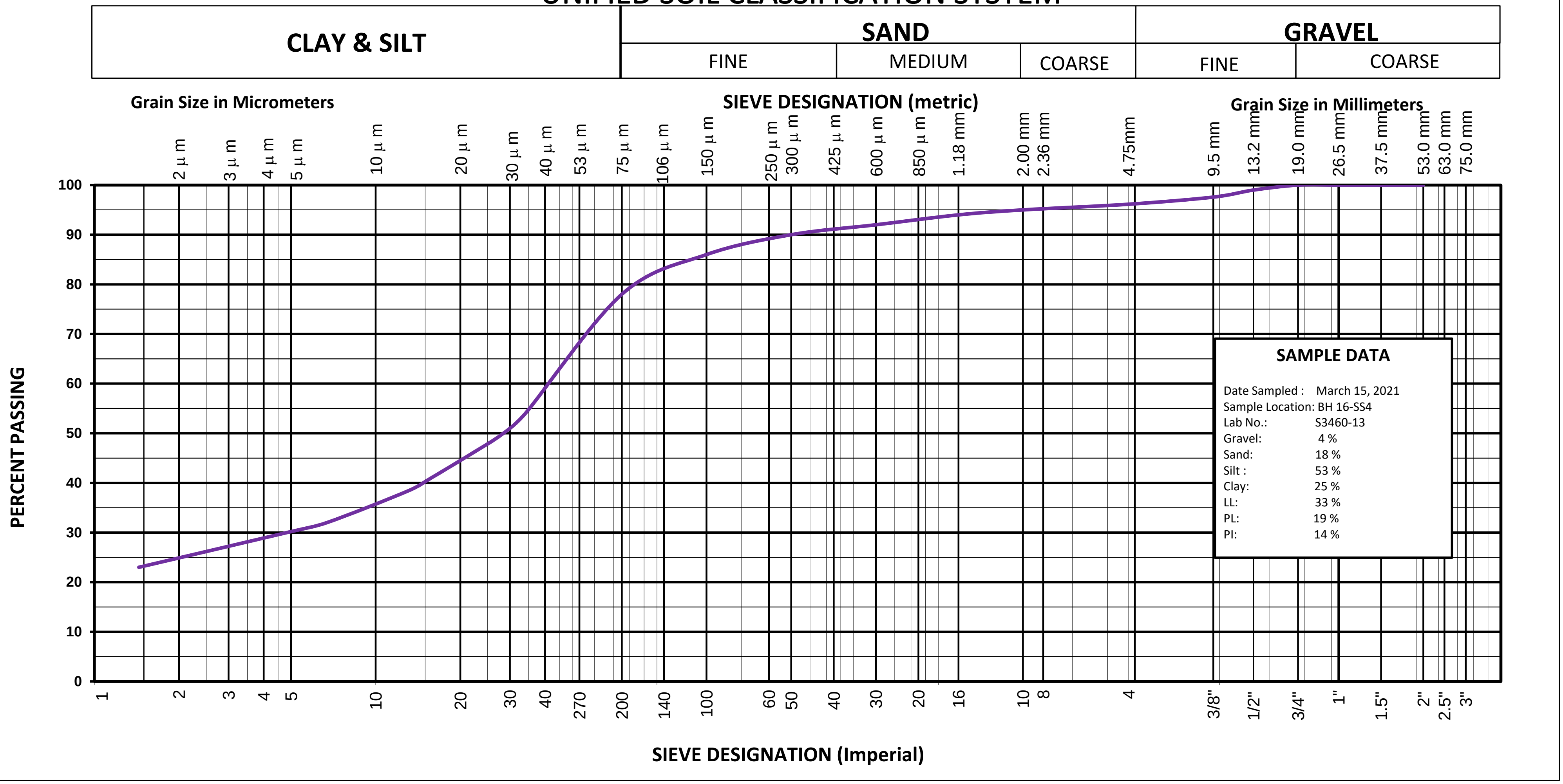
**Project No.:**

**T21841**

**Client:**

**Mattamy Development Corporation**

# UNIFIED SOIL CLASSIFICATION SYSTEM



**SAMPLE DATA**

Date Sampled : March 15, 2021
Sample Location: BH 16-SS4
Lab No.: S3460-13
Gravel: 4 %
Sand: 18 %
Silt : 53 %
Clay: 25 %
LL: 33 %
PL: 19 %
PI: 14 %

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**GRAIN SIZE ANALYSIS**

**Project :** **Proposed Residential Subdivision**

**Project No.:** **T21841**

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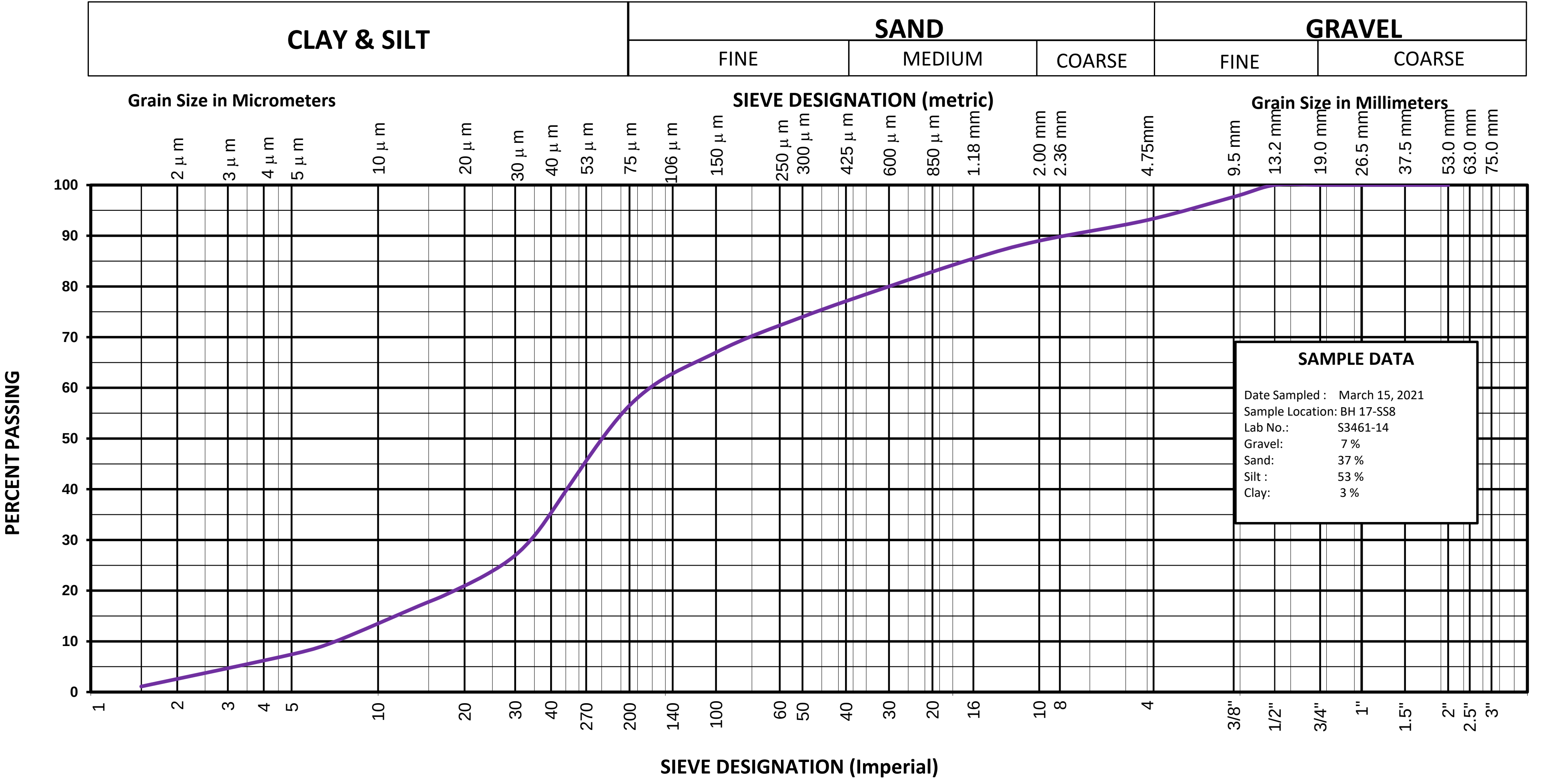
# UNIFIED SOIL CLASSIFICATION SYSTEM



**SAMPLE DATA**

Date Sampled : March 15, 2021
Sample Location: BH 17-SS8
Lab No.: S3461-14
Gravel: 7 %
Sand: 37 %
Silt : 53 %
Clay: 3 %

| | | | |
|---|---|---|---|
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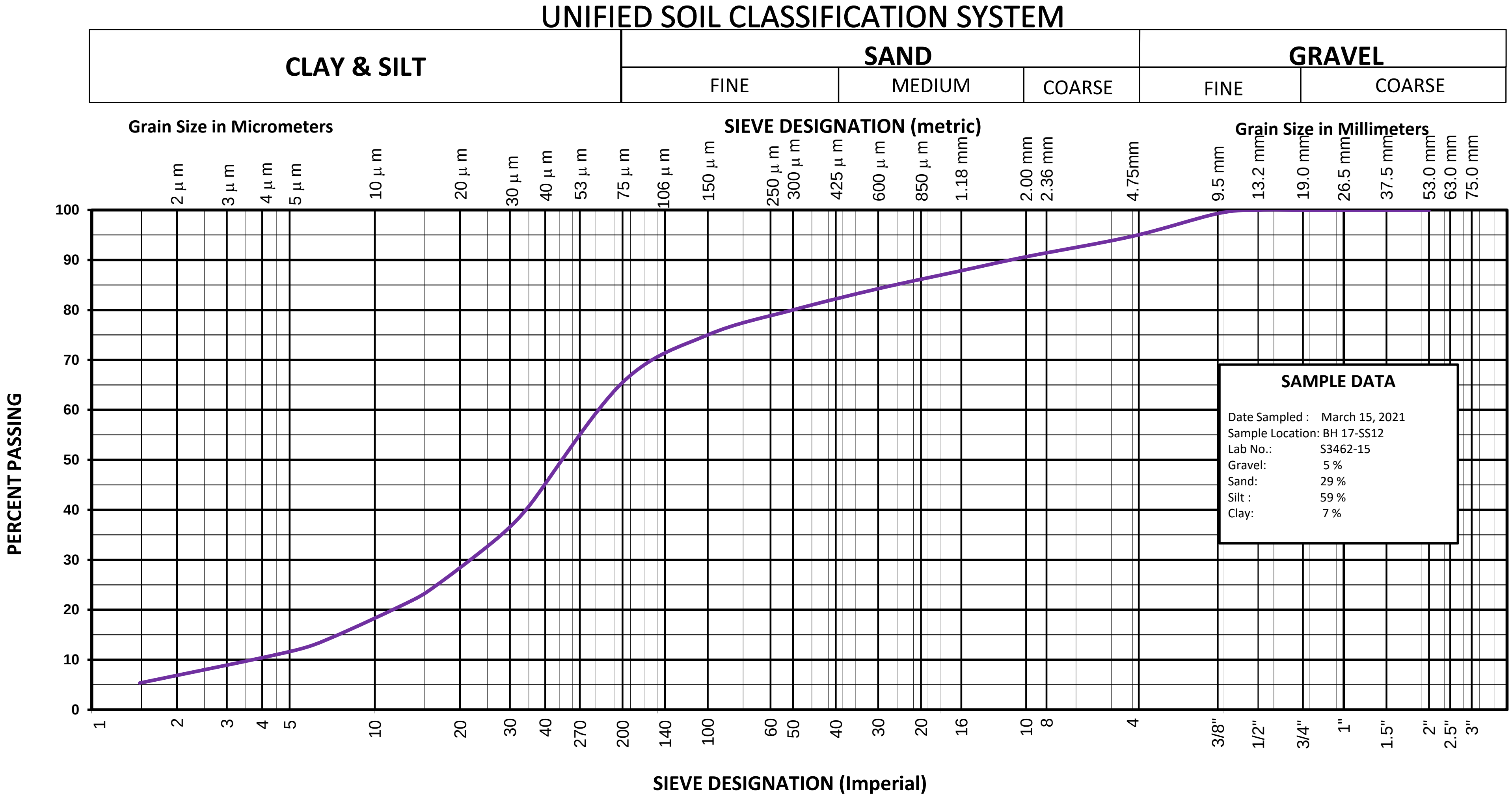

**SAMPLE DATA**

Date Sampled : March 15, 2021
Sample Location: BH 17-SS12
Lab No.: S3462-15
Gravel: 5 %
Sand: 29 %
Silt : 59 %
Clay: 7 %

| | | | |
|---|---|---|---|
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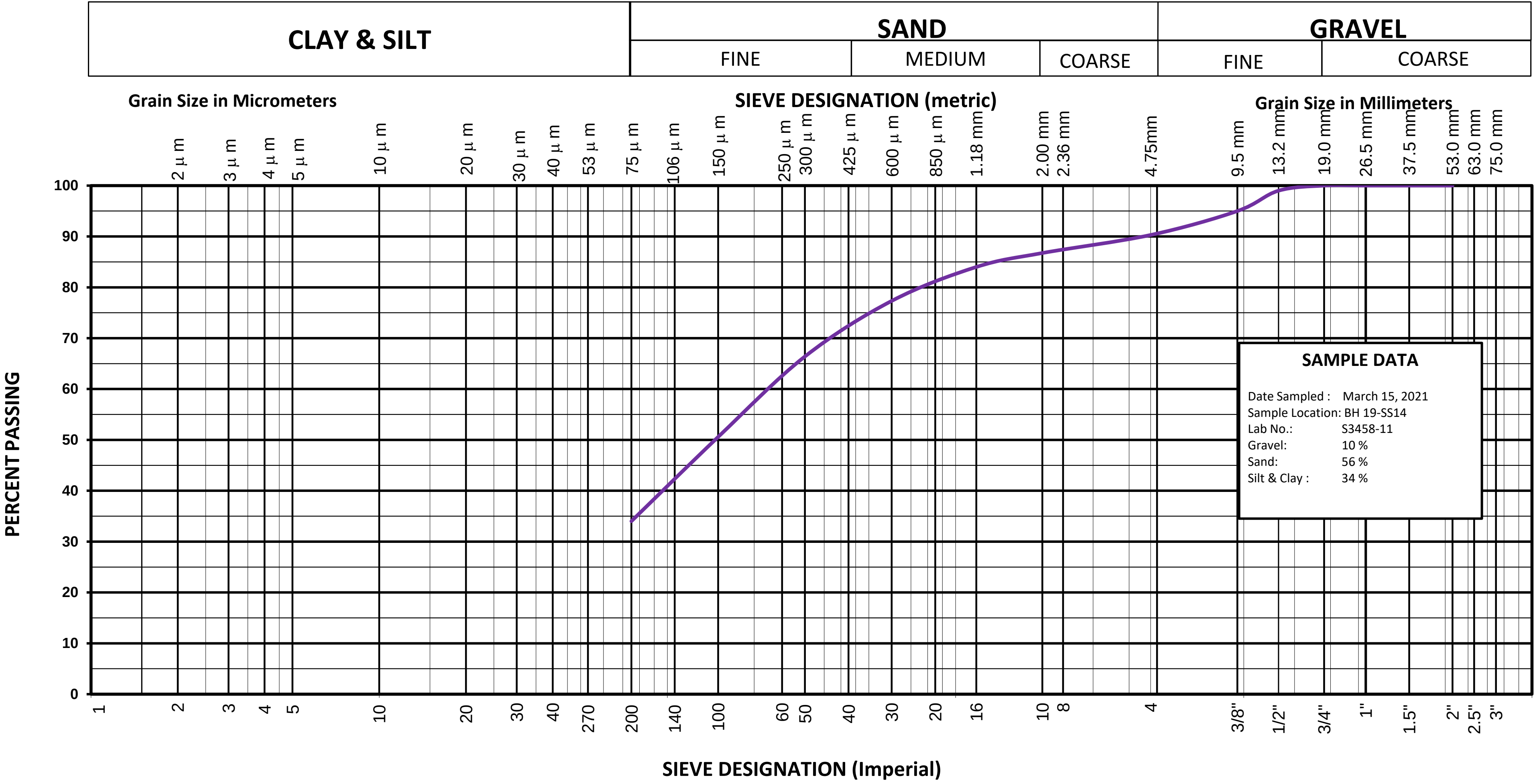
| | | **Client:**<br>**Mattamy Development Corporation** | |

# UNIFIED SOIL CLASSIFICATION SYSTEM



**SAMPLE DATA**

Date Sampled : March 15, 2021
Sample Location: BH 19-SS14
Lab No.: S3458-11
Gravel: 10 %
Sand: 56 %
Silt & Clay : 34 %

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SHAD & ASSOCIATES INC.

## GRAIN SIZE ANALYSIS

**Project :** Proposed Residential Subdivision

**Project No.:** T21841

**Client:** Mattamy Development Corporation