12197 Hurontario Street, Brampton, Ontario
And
12211, 12213 & 12231 Hurontario Street, Caledon, Ontario

Type of Document:
Geotechnical Investigation

Project Name:

Proposed Residential Development (Summer Valley)

Project Number:

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1595 Clark Blvd. | Brampton, ON L6T 4V1 | CANADA
t: +1.905.793.9800 | f: +1.905.793.0641 | exp.com

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1. Introduction

This report presents the results of a geotechnical investigation carried out for a proposed Residential Development located at 12197 Hurontario Street, Brampton, Ontario and 12211, 12213 & 12231 Hurontario Street, Caledon, Ontario. The work was authorized by Mr. Anil Datt on behalf of Argo Summer Valley Limited.

The project involves construction of a residential subdivision inclusive of roads, sidewalks, sewers, watermains and single-family dwellings.

The purpose of the geotechnical investigation was to determine the subsurface soil and groundwater conditions at the site and, based on this information, to provide an engineering report with geotechnical recommendations pertaining to the design and construction of the proposed residential development.

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

2. Site Description

The Site is located at the northwest corner of Highwood Road and Hurontario Street and comprised property parcels with municipal addresses: 12197 Hurontario Street, Brampton and 12211, 12213 and 12231 Hurontario Street, Caledon, Ontario.

The Site is irregular in shape and covers an area of approximately 3.6 hectare (8.9 acres). The Site is presently vacant with no development. Based on review of historical aerial images, the Site was previously developed with various buildings for commercial as well as residential use.

Based on the EXP's following remediation report completed for the site, remediation excavation was carried out for the removal of Petroleum Hydrocarbons (PHC) impacted soil as well as soil with elevated Electrical Conductivity (EC) and Sodium Adsorption Ratio (SAR) within two areas of the site.

- "Remediation Report, 12197 Hurontario Street, Brampton, Ontario and 12211, 12213, 12231 and 12233 Hurontario Street, Caledon, Ontario", Project No. MRK-00257876-B0, dated July 29, 2021

Attached Drawing No. 1 – Borehole Location Plan shows the location and dimensions of the two remediation excavation areas.

3. Investigation Procedures / Fieldwork

The fieldwork comprised drilling of six (6) sampled boreholes designated Boreholes BH21-1 to BH21-6. The fieldwork was carried out on December 20 and 21, 2021. All six (6) sampled boreholes were drilled to approximately 8.1 m depth below existing grade at the approximate locations shown on the attached Borehole Location Plan (Drawing No. 1). Prior to the commencement of drilling operations, underground services were cleared to minimize the risk of encountering any such services during the drilling operations.

The locations of the boreholes were established in the field by EXP personnel. The ground surface elevation, as-drilled northing and easting (UTM Zone 17 NAD83 coordinate system) of the boreholes in the geotechnical investigation were established by Sokkia GCS3 GNSS System. The horizontal and vertical positioning accuracies of the instrument are 3 and 5 mm, respectively.

The boreholes were advanced using continuous flight solid stem auger equipment owned and operated by a specialist drilling contractor. Representative samples of the subsurface soils were recovered at regular intervals using conventional 50 mm O.D. split spoon sampling equipment driven in accordance with the procedures of Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils (ASTM D1586).

Water levels were observed in the open boreholes during the course of the fieldwork. In addition, four (4) monitoring wells were installed in Boreholes BH21-1 to BH21-4 for subsequent groundwater level measurement.

The fieldwork was supervised throughout by an EXP's geotechnical technologist who directed the drilling and sampling operations, prepared borehole logs, made groundwater observations during and upon completion of drilling, and processed the recovered samples. All split spoon samples were returned to EXP's Brampton laboratory for further geotechnical testing. In the laboratory, the samples were classified as to their visual and textural characteristics.

The following tests were performed on selected soil samples:

- Moisture content
- Unit weight
- Grain size distribution

The results of natural moisture content and density tests carried out for selected recovered samples are presented on the Log of Borehole sheets.

Results of grain size analysis carried out on four (4) selected recovered samples are included in Appendix C.

4. Subsurface Conditions

The detailed soil profiles encountered in each borehole and the results of geotechnical laboratory testing are indicated on the attached borehole logs (Drawing Nos. 2 through 7) and figures in Appendix A. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change.

Notes on Sample Description (Drawing No. 1A) preceding the borehole logs form an integral part of and should be read in conjunction with this report.

The stratigraphy encountered at the site, as revealed in the boreholes, generally comprises surficial topsoil followed by fill underlain by native deposit of sandy silt till and clayey silt till.

The following is a brief description of the subsurface conditions encountered during the current investigation.

4.1 Soil Conditions

Topsoil

Approximately 120 mm thick layer of topsoil was encountered from ground surface in boreholes BH21-1, BH21-2, BH21-5 and BH21-6.

It should be noted that the topsoil quantity should not be established from the information provided at the borehole locations only. If required, a more detailed analysis which involves shallow test pits should be carried out to accurately quantify the amount of topsoil to be removed for construction purpose.

Fill

Fill was encountered from ground surface in boreholes BH21-3 and BH21-4 and underlies the topsoil layer in remaining boreholes. The fill extends to depths of approximately 1.0 to 2.5 m below existing grade. The fill generally appeared to be reworked on-site material with the except of near surface fill comprising sandy silt to silty sand with some sand and gravel pockets in Boreholes BH21-3 and BH21-4. Moisture contents in the fill ranged from approximately 8 to 27% indicating moist to wet conditions.

Sandy Silt Till

Sandy silt till exists below the fill in Boreholes BH21-1, BH21-2, BH21-4 and BH21-6. The sandy silt till extends to depths of approximately 4.2 to 8.1 m. The sandy silt till contains some clay, trace gravel and occasional oxidized zones. At depths between 6.0 to 6.6 m below grade, a wet silty sand layer was noted within the till in Borehole BH21-6 and a silt layer was noted in Borehole BH21-1. Borehole BH21-6 was terminated in sandy silt till at depth of 8.1 m below grade. The sandy silt till is generally brown in colour changing to grey below 4.5 m in Borehole BH21-6. The sandy silt till exists in a compact to dense state of compactness. Moisture contents in the sandy silt till were recorded between approximately 9 and 17% indicating moist conditions.

The presence of cobbles and boulders should always be anticipated in the glacial till deposits, owing to their mode of deposition.

Clayey *Silt Till*

Clayey silt till exists below the sandy silt till in Boreholes BH21-1, BH21-2, BH21-4, and below the fill in Boreholes BH21-3 and BH21-5. Boreholes BH21-1 to BH21-5 in were terminated in the clayey silt till at approximately 8.1 m depth. The clayey silt till contains trace sand and trace gravel. The clayey silt till generally grey below 4.5 m depth. The consistency of the clayey silt till varies with depth and varies from one borehole location to another and generally assessed to be stiff to hard. Moisture contents in the clayey silt till were recorded between approximately 10 and 23% indicating moist to very moist conditions.

The presence of cobbles and boulders should always be anticipated in the glacial till deposits, owing to their mode of deposition.

Grain size analyses were carried out in the geotechnical laboratory on four (4) selected samples. The test results are summarized in the following table and are included in Appendix C of this report.

Sample ID	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH 21 -1 SS5	6.8	27.1	45.8	20.3
BH 21 -2 SS5	7.2	28.7	44.9	19.2
BH 21 -4 SS4	6.2	32.0	44.0	17.8
BH 21 -6 SS7	6.9	46.1	37.7	9.3

4.2 Groundwater Conditions

Groundwater conditions were observed in the open boreholes during the course of the fieldwork as well as in the monitoring wells installed in Boreholes BH21-1 to BH21-4 for subsequent groundwater measurements.

Upon completion of drilling, free groundwater was observed in all boreholes at depth ranged between 7.0 to 8.0 m except BH21-1 which remained dry. After an elapsed time of 22 to 23 days, groundwater was measured at depths ranged between approximately 1.6 to 6.5 m below grade (~Elevation 257.9 to 251.3 m) in the monitoring well installed in Boreholes BH21-1 to BH21-4.

Based on the information observed in the boreholes, the groundwater may be trapped within the remediated backfills or originates from the more pervious seams within the glacial till deposits. The groundwater elevations may not reflect stabilized conditions. Groundwater elevations are also subject to seasonal fluctuations.

The monitoring wells were installed in general accordance with the Ontario Water Resources Act- R.R.O. 1990, Regulation 903 – Amended to O. Reg. 128/03 by CSD, by a licensed well contractor. When the use of the monitoring well is no longer required, they must be decommissioned in accordance with the procedure outlined in the Ontario Water Resources Act – R.R.O. 1990, Regulation 903 – Amended to O. Reg. 128/03.

5. Engineering Discussion and Geotechnical Recommendations

5.1 General

The project involves the design and construction of single-family residential dwellings together with the necessary municipal infrastructure such as roads, sewers, water and other services.

The following subsections provide geotechnical engineering guidelines for the design and construction of the proposed residential development.

5.2 Site Grading

Based on preliminary grading plan drawing provided by R.J. Burnside & Associates Limited (Burnside) dated April 22, 2022, some cut and fill operations will be required. Following procedures are recommended for the construction of structural fill for building lots and pavement areas, where required. Additionally, following procedures are also recommended for the two remediated backfilled areas.

- All vegetation, topsoil, loose fill and loose native soil should be removed from proposed building and pavement areas.

- The exposed subgrade surface should be proof-rolled with a heavy roller and examined by a geotechnical engineer from EXP. Any soft or loose spots encountered during the process should be sub-excavated and replaced with approved on-site or imported materials, compacted to 100 % standard Proctor maximum dry density (SPMDD).

- Within the remediated area located north/northeast portion of the site, according to the preliminary grading plan drawing, underside elevation of the footing of the proposed dwellings (with basement) will vary from ~256.5 to 256.9 m. According to the information presented in Boreholes BH21-3 and BH21-4, the top of the native soil is at elevation ~255.8m. Fill layer of about 0.7 to 1.1 m thick is therefore anticipated below the proposed basement and footings levels for the dwellings. The existing fill should all be sub-excavated down to the competent native soils and backfilled with engineered fill. The area can then be brought up to final subgrade level with approved on-site or imported material placed in lifts not exceeding 300 mm and compacted to 100% SPMDD within building areas (“engineered fill”).

- As a general rule, low and excavated areas can then be brought up to final subgrade level with approved on-site or imported material placed in lifts not exceeding 300 mm and compacted to 100% SPMDD within building areas (“engineered fill”) and 95% SPMDD to within 600 mm of final subgrade level and 98% SPMDD for the upper 600 mm in pavement areas. The moisture content of the fill to be placed should be at or near its optimum

moisture content in order to assure the specified densities can be achieved with reasonable compactive effort. Some of the on-site soils will require partial drying before they can be properly compacted. Any organic or excessively wet or otherwise deleterious material should not be used for backfilling purposes.

- All imported borrow fill material from local sources should be free from organic material and foreign objects (i.e., trees, roots, debris, etc.) and should be tested geotechnically by EXP prior to transport to the site. In addition, the chemical quality of the borrow fill material should be assessed by EXP in accordance with applicable soil criteria listed in the Ministry of the Environment and Climate Change Standards (Ontario Regulation 153), dated April 15, 2011.

- All excavation, backfilling and compaction operations for engineered fills should be monitored on a full-time basis by qualified geotechnical staff to approve materials and to confirm that the specified degrees of compaction have been obtained.

5.3 Site Servicing

5.3.1 Watermain and Sewer Installation

5.3.1.1 Open Cut Excavation

The sewer and watermain invert levels have not yet been determined at the time of investigation, but they are expected to extend to the typical depths of up to approximately 1.8 to 6 m below existing grades. Based on the results of the investigation, excavation will generally be carried out within the fills and into the native deposit of sandy silt till and clayey silt till.

Subject to groundwater control measures discussed in the following section as well as in the hydrogeological report (under separate cover), excavation may be carried out in open cuts using conventional equipment. Side slopes of temporary excavation must conform to the Occupational Health and Safety Act (OHSA) and local regulations. Within the meaning of OHSA, the fills are classified as Type 3 soil and the sandy silt till as well as clayey silt till deposits are classified as Type 2 soil. In areas where localized seepage of groundwater is encountered it may be necessary to flatten the side slopes. Locally, due to spatial restrictions, vertical trenching may be required. It is our opinion that steeper temporary slopes may be permitted if a trench box is utilized, subject to on-site inspection.

It should be noted that boulders frequently occur in till deposits and their presence may influence the progress of excavation. Consequently, provisions should be made in the contract documents to cover any delays caused by boulder obstructions.

5.3.1.2 Groundwater Control

Seepage into the trenches across most of the site is expected to primarily originate from perched conditions in the fill and wet sand seams and layers in the native till deposits. The quantity of water from these sources will vary depending upon the extent and thickness of individual wet seams and layers. It should be recognized that groundwater levels are also influenced by the effects of precipitation as well as seasonal fluctuations. It is our opinion that the seepage produced by these sources can be handled using conventional sump pumping in conjunction with oversized excavations.

5.3.1.3 Pipe Bedding

It is anticipated the sewer and watermain pipes will be founded on competent native soils or on engineered fill. Provided adequate groundwater control measures are implemented, no bearing capacity problems are envisaged.

In general, the pipe bedding may consist of a minimum thickness of 150 mm of compacted OPSS Granular "A" material. Where wet conditions are encountered, the pipe bedding may comprise 150 mm of 19 mm clear stone or HL-6 stone material. However, the clear stone or HL-6 stone bedding must be completely wrapped in a geotextile filter fabric to prevent the migration of fines from the surrounding soils, which may result in settlement of the pipes. The chosen geotextile should be compatible with the existing soils on site. For preliminary guidance, it is anticipated Terrafix 270R or similar should suffice.

The base of the excavations in the competent compact to very dense and stiff to hard soils should remain stable provided excavations are not left open for extended periods of time and the work is done in accordance with good construction practice.

The bedding material should be placed in 150 mm lifts and compacted to at least 98% SPMDD. Particular attention should be given to ensure material placed beneath the bottom quadrants of the pipe is adequately compacted. Compaction is not required for clear stone or HL-6 stone bedding.

Pipe cover material should consist of fine sand which can be more readily compacted with light equipment to avoid damaging the pipes. The cover material should be placed in 150 mm lifts, compacted to 98% SPMDD and extend to 300 mm above the top of the pipe.

5.3.1.4 Backfilling Operations

The existing fill and native soils which are not contaminated with topsoil and other obviously unsuitable material may be reused as trench backfill if the moisture contents are within 2% of their optimum values.

Excavated topsoil and fill with organics should not be used for trench backfilling purposes. These materials may be used in landscaping areas. Any organic or excessively wet or otherwise deleterious material should not be used for backfilling purposes. Any shortfall of suitable on-site excavated material can be made up with imported clean approved fill or granular material, OPSS Granular 'B' or equivalent.

In general, the on-site native soils are not free draining and therefore should not be used where this characteristic is required, or in confined areas. Imported granular material conforming to OPSS Granular 'B' would also be suitable for these purposes.

In areas where substantial cutting and filling is required, the compaction of the fill should be monitored on a full-time basis by qualified geotechnical personnel.

All backfilling and compaction operations for trench backfill must be closely examined by qualified geotechnical personnel to confirm that uniform compaction to specification requirements is achieved, especially in the vicinity of manholes and catch basins, near the ends of compaction runs, and in all areas that are not readily accessible to compaction equipment, etc. All backfilling should be placed in maximum 300 mm horizontal lifts and uniformly compacted to 95% SPMDD. Within the upper 600 mm of road subgrade, the fill material should be compacted to at least 98% SPMDD. Smaller lifts may be required depending on the size of compaction equipment used by the contractor and the moisture content of fill at the time of construction.

To minimize potential problems, backfilling operations should follow closely after excavation so that only minimal length of trench slope is exposed. This will minimize wetting of the subgrade material. Should construction extend to the winter season, particular attention should be given to ensure that frozen material is not used as backfill.

5.3.2 Pavement Design and Construction

The pavement subgrade is expected to comprise native sandy silt till and/or compacted engineered fill. Based on estimated CBR values, the frost susceptibility of the anticipated subgrade materials, expected traffic loading, and assuming adequate drainage, the following minimum pavement structure component thicknesses specified by the Town of Caledon (Table 4) are considered satisfactory. Other thickness combinations can be used provided the Granular Base Equivalency (GBE) is maintained and any minimum component thickness specified by the Town of Caledon is met.

Table 4: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Local Roadway	Collector Roadway	Driveway
Asphaltic Concrete (OPSS 310)	92 % MRD	40 mm HL3 65 mm HL8	40 mm HL3 90 mm HL8	50 mm HL3A
OPSS Granular A Base (OPSS 1010)	100% SPMDD*	150 mm	150 mm	150 mm
OPSS Granular B Subbase (OPSS 1010)	100% SPMDD*	300 mm	450 mm	-

* Denotes standard Proctor maximum dry density, ASTM-D698

The foregoing design assumes construction is carried out during dry periods and the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather and heaving or rolling of the subgrade is experienced, additional thickness of subbase course material may be required.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and sloped to provide effective surface drainage toward catchbasins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas.

Additional comments on the construction of proposed roadways are as follows:

1. As part of the subgrade preparation, proposed roadways should be stripped of topsoil, loose fill, loose native soil and other obviously unsuitable material. Soft or spongy subgrade areas identified during proofrolling should be subexcavated and replaced with suitable approved backfill. Fill required to raise the grades to design elevations should be organic-free and at a moisture content which will permit compaction to 98% SPMDD. The final subgrade surface should be properly shaped and crowned.

2. The location and extent of subdrainage required within the paved areas should be reviewed by this office in conjunction with the proposed site grading. In view of the silty nature of the subgrade soils, we recommend subdrains be installed on both sides of the roadways at least 300 m below the granular subbase In addition, subdrains extending from and between catch basins should also be installed. This will ensure no water collects

in the granular courses which could result in pre-mature pavement failure during the spring thaw.

3. To minimize problems of differential movement between the pavement and catch basins/manholes due to frost action, backfill around these structures should consist of free-draining granular material. The granular material should be compacted to 98% SPMDD with a small tamper to avoid damaging the structures. In addition, catch basins should be perforated just above the drain and the holes screened with filter cloth.

4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, etc. may be required, especially if construction is carried out during unfavorable weather

5.4 Residential Dwellings Construction

5.4.1 Foundation Considerations

The site is considered suitable for construction of single-family dwellings. Two foundation support scenarios, namely footings on native soils and footings on engineered fill are presented below:

5.4.1.1 Footings on Native Soil

Based on Burnside's grading plan drawing, the lowest level for single family dwellings with a basement may extend to about 1.0 to 2.0 m below existing grade. The proposed structures may be supported on conventional spread and strip footings founded on the compact to dense sandy silt till and /or very stiff to hard clayey silt till and may be designed for a Geotechnical Reaction of up to 200 kPa at Serviceability Limit States (S.L.S.), subject to inspection during construction. The factored Geotechnical Resistance at Ultimate Limit States (U.L.S.) is 300 kPa.

5.4.1.2 Engineered Fill

If the foundations are above the native till deposits (including north-northeast remediated areas as mentioned in Section 5.2), the proposed structures may be supported on footings founded on engineered fill compacted to 100% standard Proctor maximum dry density. All fill below the foundation level should be sub-excavated down to the native soil in the deep fill areas. The engineered fill should then be placed over the competent clayey silt till and the footings for the new houses can be designed utilizing a Geotechnical Reaction of 150 kPa at S.L.S and Geotechnical Resistance of 225 kPa at U.L.S. The engineered fill should be constructed up to the level of the garage footings for the single-family dwellings.

The engineered fill should be constructed by removing all topsoil and existing fills in the remediated areas or below the topsoils down to the competent native till deposits. The engineered fill should extend at least 600 mm beyond the outside edge of exterior footings. The required extent of engineered fill should be determined based on a known fixed location for the structures and adherence to the conditions outlined above. The boundaries of the engineered fill should be laid out by a surveyor in consultation with qualified engineering staff.

As mentioned in the 'Site Grading' subsection, the exposed subgrade surface should be proof-rolled and examined by qualified geotechnical personnel prior to placement of engineered fill. Any loose or soft areas detected during proof-rolling should be removed and replaced with approved material compacted to 100% SPMDD. The areas can then be brought up to design subgrade level with approved on-site or imported material placed in lifts not exceeding 300 mm and compacted to 100% SPMDD. The fill materials encountered on site contain rootlets and some organic staining and should therefore not be used for construction of engineered fill. Some of the on-site native soils will require partial drying before they can be compacted to 100% SMPDD.

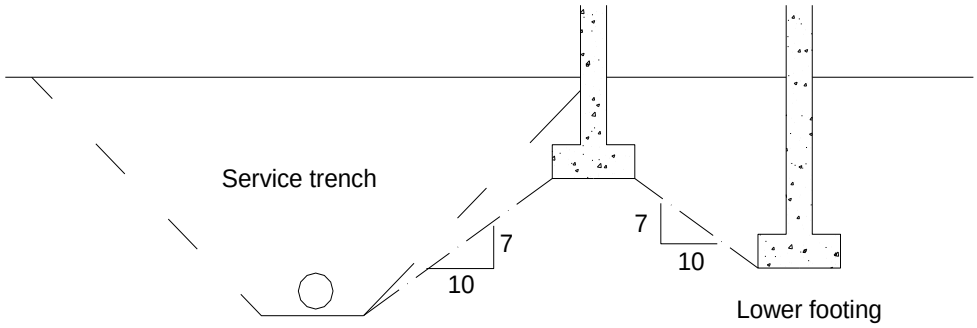
The engineered fill construction should be monitored on a full-time basis by qualified geotechnical personnel to examine and approve backfill materials, to evaluate placement operations, and to verify the specified degree of compaction is being achieved uniformly throughout the fill.

It is recommended that nominal reinforcing steel be installed in the footings and foundation walls of structures supported on engineered fill to minimize cracking from differential settlement. The basement walls should be reinforced continuously with 2-15M bars above the footings and below the windowsill. If the basement walls are made from concrete blocks, equivalent top and bottom reinforcing should be provided as designed by a structural engineer.

Engineered Fill construction details are summarized in Appendix A.

5.4.1.3 Foundations General

Footings which are to be placed at different elevations should be located such that the higher footings are set below a line drawn up at 10 horizontal to 7 vertical from the near edge of the lower footing. This concept should also be applied to excavations for new foundations in relation to existing footings or underground services. This concept is illustrated in the following sketch:



FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

All footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m of soil cover or equivalent insulation, depending on the final design requirements.

The total and differential settlements of well designed and constructed footings placed in accordance with the foregoing recommendations, are expected to be less than 25 mm and 20 mm, respectively.

It should be noted that the recommended bearing capacities have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily ongoing as new information on underground conditions becomes available. For example, it should be appreciated that modifications to bearing levels may be required if unforeseen subsoil conditions are revealed after the excavation is exposed to full view or if final design decisions differ from those assumed in this report. For this reason this office should be retained to review final foundation drawings and to examine footing conditions.

5.4.2 Excavation and Groundwater Control

Excavation for single family dwellings with a basement will extend to about 2 to 2.5 m below finished grade. Excavation should be relatively straightforward and must be carried out in accordance with the latest edition of the OHSA and local regulations. The fill materials can be classified as Type 3 soils and the native till deposit is a Type 2 soils. For preliminary guidance, side slopes of one vertical to one horizontal may be used, subject to geotechnical inspection. Where loose soil is encountered, it may be necessary to locally flatten the side slopes.

Groundwater seepage into the excavation(s) should be anticipated during construction. It should be possible to control and remove seepage water entering the excavation(s) from the more pervious seams in the clayey silt till deposit or from perched conditions in the fill, using conventional construction dewatering techniques, i.e., pumping from sumps.

It should be noted that boulders frequently occur in till deposits and their presence may influence the progress of excavation. Consequently, provisions should be made in the contract documents to cover any delays caused by the presence of boulders.

5.4.3 Floor Slab Construction and Permanent Drainage

The floor slab may be constructed as a slab-on-grade on a properly prepared subgrade (i.e., on native undisturbed soils or engineered fill). In this regard, all topsoil and other obviously unsuitable material should be removed from the entire underfloor area and the exposed subgrade thoroughly proof-rolled. Any soft spots detected should be sub-excavated and the area brought up to design grades using approved clean fill in the manner described in the "Site Grading" section of this report.

A 200 mm layer of 19 mm clear stone should be placed between the prepared subgrade and the floor slab to serve as a moisture barrier.

It is recommended that the foundation walls be covered with a bituminous damp-proofing spray and a drainage sheet. In addition, a weeping tile surrounded with 300 mm of 19 mm clear stone and wrapped with a filter cloth should be installed around the perimeter of the basement and connected to a frost-free outlet. The recommended arrangements are shown in Drawing 7.

In areas where the subgrade consists of wet/saturated soil or where persistent groundwater seepage is encountered during excavation, underfloor subdrains should also be installed. The subdrains should consist of 100 mm diameter perforated pipe surrounded by 150 mm of 19 mm clear stone all wrapped in Terrafix 270R or equivalent. The drainage system should lead to frost free sumps or outlets from which the water can be removed. The need for underfloor subdrains should be further assessed upon basement excavation.

5.4.4 Earth Pressure on Subsurface Walls

The lateral earth pressure acting on subsurface walls (i.e., basement walls) may be calculated from the following equation:

$$p = k(\gamma h + q)$$

where: p = the pressure in kPa acting against any subsurface wall at depth, h;

k = the earth pressure coefficient considered to be appropriate for the subsurface walls, for this case, 0.4;

γ = the bulk unit weight of the backfill, use 22.5 kN/m3;

h = the depth in m below the ground surface at which the pressure, p, is to be computed; and,

q = the value of any adjacent surcharge in kPa which may be acting close to the wall.

The above expression assumes an effective perimeter tile drain system will be incorporated to prevent the build-up of hydrostatic pressure behind the subsurface wall. All subsurface walls should be waterproofed. To minimize infiltration of surface water, the upper 600 mm of backfill should comprise compacted relatively impervious material sloped away from the structure.

If the dwellings are founded on engineered fill, reinforcement should be provided in the foundation wall as shown in Drawing 8.

5.4.5 Earthquake Considerations

The recommendations for the geotechnical aspects to determine the earthquake loading are presented below.

5.4.5.1 Subsoil Conditions

The subsoil and groundwater information at this site have been examined in relation to Section 4.1.8.4 of OBC 2012. The subsoil consisted of topsoil, fill, compact to dense sandy silt till and stiff to hard clayey silt till. The foundations will be founded on the competent native soil or on engineered fill. The reported N-values for the soil below the anticipated floor slab level ranged from 12 to 35. There have been no shear wave velocity measurements carried out at this site and therefore, N-values will be used to determine the site classification.

5.4.5.2 Depth of Boreholes

Table 4.1.8.4.A. Site Classification for Seismic Site Response in OBC 2012 indicated that to determine the site classification, the average properties in the top 30 m are to be used. The boreholes at this site were advanced to approximately 8.1 m depth.

5.4.5.3 Site Classification

Based on the soil conditions, the Site Class for this site is “D” as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012.

6. Soil Chemistry- Potential for Sulphate Attack

As per the scope of work, two (2) soil samples, identified as BH21-1 SS4 and BH21-4 SS5 were also analyzed for water soluble sulphate. The soluble sulphate contents in the samples BH21-1 SS4 and BH21-4 SS5 were reported as 99 µg/g (0.0099 %) and <20 µg/g (<0.002%) respectively. Table 3 of the Canadian Standards Association (CSA) A.23.1-09 lists 0.1 % sulphate as the minimum concentration of sulphate in soil that warrants additional requirements for concrete. At the measured concentration, the degree of exposure to sulphate attack is considered to be "negligible" and therefore normal Portland cement (Type 10) can be used in subsurface concrete.

Test results from the laboratory are included in Appendix B.

7. General Comments

The information presented in this report is based on a limited investigation designed to provide information to support an overall assessment of the geotechnical conditions of the subject property. The conclusions presented in this report reflect site conditions existing at the time of the investigation.

EXP Services Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, EXP Services Inc. will assume no responsibility for interpretation of the recommendations in the report.

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

More specific information, with respect to the conditions between samples, or the lateral and vertical extent of materials, may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operation. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, EXP Services Inc. should be contacted to assess the situation and additional testing and reporting may be required. EXP Services Inc. has qualified personnel to provide assistance in regards to future geotechnical and environmental issues related to this property.

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

EXP Services Inc.

Aamna Arora, P.Eng.
Project Manager
Earth & Environmental

LICENSED PROFESSIONAL ENGINEER
A. ARORA
100147160
May 18, 2022
PROVINCE OF ONTARIO

Stephen S. M. Cheng

Digitally signed by Stephen S. M. Cheng
Date: 2022.05.18 14:29:32 -04'00'

Stephen S. M. Cheng, P.Eng.
Discipline Manager
Geotechnical Division

DRAWINGS:

Borehole Location Plan

Notes on Sample Description

Borehole Logs

N

Extent of Remediated Area ~ 1.5 - 2.0 m deep

Extent of Remediated Area ~ 2.3 m deep

EXP Services Inc.
1595 Clark Boulevard
Brampton, Ontario
L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

SCALE: As Shown

DATE: February 2022

BOREHOLE LOCATION PLAN

Geotechnical Investigation- Proposed Residential Subdivision
12197 Hurontario Street, Brampton, Ontario
and 12211-12233 Hurontario Street, Caledon, Ontario

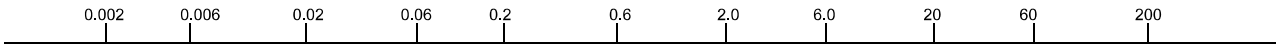
DWN.:AA	CHKD.:	PROJECT NO.: BRM-00257876-D0	DRAWING NO.: 1

Notes On Sample Descriptions Drawing 1A

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

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole BH21-1

Project No. BRM-00257876-D0 Drawing No. 2

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: NE Corner of Hurontario Street and Highwood Road, Brampton/Caledon

Date Drilled: December 21, 2021

Drill Type: CME-55, track mount machine

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)
~ 120 mm TOPSOIL over **FILL:** clayey silt to sandy silt, trace rootlets, minor organics, brown, moist	257.91	0
	~256.9	1
SANDY SILT TILL: some clay, trace gravel, brown, oxidized seams, moist, compact to very dense		2
		3
		4
		5
Silt layer, some clay, between~ 6.0 to 6.6 m depth		6
	~251.3	
	~250.7	7
CLAYEY SILT TILL: some sand, trace gravel, grey, moist		
	~249.8	8
END OF BOREHOLE		

SPT (N Value): 7, 14, 21, 25, 38, 57, 32, 22

Shear Strength (kPa): 20 40 60 80 | 100 200

Combustible Vapour Reading (ppm): 25 50 75

Natural Moisture Content % / Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m³: 22.9

Date	Water Level (m)	Hole Open to (m)
On completion	Dry	
January 5, 2022	6.59	
January 12, 2022	6.49	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 2/2/22

Log of Borehole BH21-2

Project No. BRM-00257876-D0 Drawing No. 3

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: NE Corner of Hurontario Street and Highwood Road, Brampton/Caledon

Date Drilled: December 21, 2021

Drill Type: CME-55, track mount machine

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Groundwater	Soil/Rock Symbol	Soil Description	ELEV. m	Depth (m)
		~ 120 mm TOPSOIL over **FILL:** clayey silt to sandy silt, some gravel, trace organics, brown, moist	258.48	0
			~257.9	
		SANDY SILT TILL: some clay, trace gravel, brown, oxidized seams, moist, compact to very dense	~257.5	1
				2
				3
			~254.3	4
		CLAYEY SILT TILL: trace sand, trace gravel, brown to grey, moist		5
		- becoming grey below ~5.0 m depth		6
		-becoming hard		7
		-becoming very stiff		8
			~250.1	
		END OF BOREHOLE		

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

SPT values: 10, 20, 29, 24, 29, 18, 56, >, 27

Sample | Natural Unit Weight kN/m³: 21.0

Date	Water Level (m)	Hole Open to (m)
On completion	8.0	
January 5, 2022	0.56	
January 12, 2022	1.72	

exp.

Log of Borehole BH21-3

Project No. BRM-00257876-D0 Drawing No. 4

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: NE Corner of Hurontario Street and Highwood Road, Brampton/Caledon

Date Drilled: December 20, 2021

Drill Type: CME-55, track mount machine

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)	Sample	Natural Unit Weight kN/m³
FILL: sandy silt to silty sand, some gravel, trace rootlets, brown, moist	258.30	0		
-changing to clayey silt (disturbed material)	~257.7			
- becoming wet	~257.1	1		
CLAYEY SILT TILL: some sand, trace gravel, brown to grey below ~4.5 m, moist	~255.8	2		
		3		22.8
-sandy silt till layer between ~4.5 to 5.2 m depth		4		
		5		
		6		23.6
		7		
	~250.2	8		
END OF BOREHOLE				

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

SPT values: 14, 5, 18, 29, 64, 41, 28, 30

Date	Water Level (m)	Hole Open to (m)
On completion	7.9	
January 5, 2022	1.23	
January 12, 2022	1.55	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 2/5/22

Log of Borehole BH21-4

Project No. BRM-00257876-D0 Drawing No. 5

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: NE Corner of Hurontario Street and Highwood Road, Brampton/Caledon

Date Drilled: December 21, 2021

Drill Type: CME-55, track mount machine

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m	Depth (m)	Sample	Natural Unit Weight kN/m³
FILL: sandy silt with sand & gravel pockets, brown, moist	257.80			
-Brown sandy silt, some gravel (reworked on-site material)	~257.2			
SANDY SILT TILL: some sand, trace gravel, brown, oxidized seams, moist	~255.8			
CLAYEY SILT TILL: some sand, trace gravel, grey , moist	~253.3			23.2
	~251.7			21.1
END OF BOREHOLE	~249.7			

SPT (N Value): 20 40 60 80
Shear Strength: 100 200 kPa
Combustible Vapour Reading (ppm): 25 50 75
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

SPT values: 31, 11, 27, 33, 31, 25, 21, 16

Date	Water Level (m)	Hole Open to (m)
On completion	8.0	
January 5, 2022	6.08	
January 12, 2022	6.20	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 2/2/22

Log of Borehole BH21-5

Project No. BRM-00257876-D0 Drawing No. 6

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: NE Corner of Hurontario Street and Highwood Road, Brampton/Caledon

Date Drilled: December 21, 2021

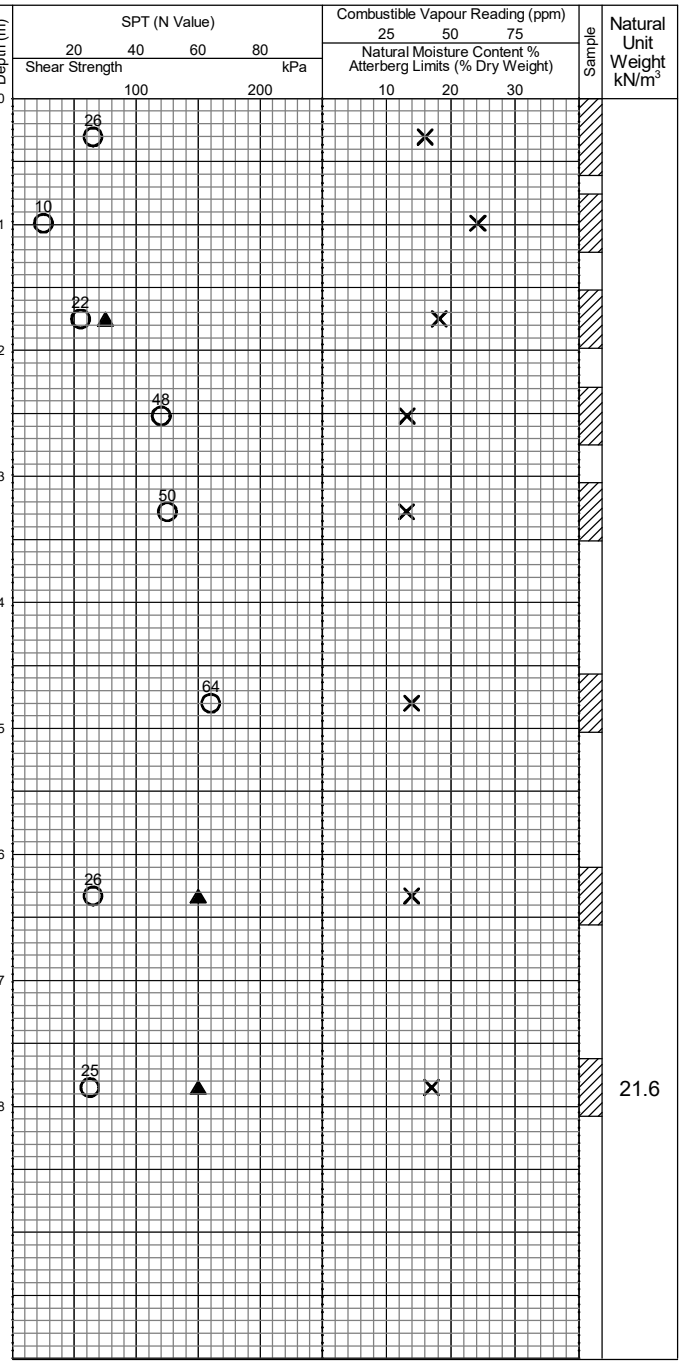
Drill Type: CME-55, track mount machine

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test ——
Shelby Tube ■
Field Vane Test ✚ S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Soil Description	ELEV. m
~ 120 mm TOPSOIL over **FILL:** sandy silt to clayey silt, some sand, trace gravel, brown to brown-grey, moist possible fill or disturbed native	257.03
CLAYEY SILT TILL: trace sand, trace gravel, brown to grey below 4.5 m, moist	~255.2
Silt layer, some clay, between~ 4.5 to 5.0 m depth	~248.9
END OF BOREHOLE	



Date	Water Level (m)	Hole Open to (m)
On completion	8.0	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 2/2/22

Log of Borehole BH21-6

Project No. BRM-00257876-D0 Drawing No. 7

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: NE Corner of Hurontario Street and Highwood Road, Brampton/Caledon

Date Drilled: December 21, 2021

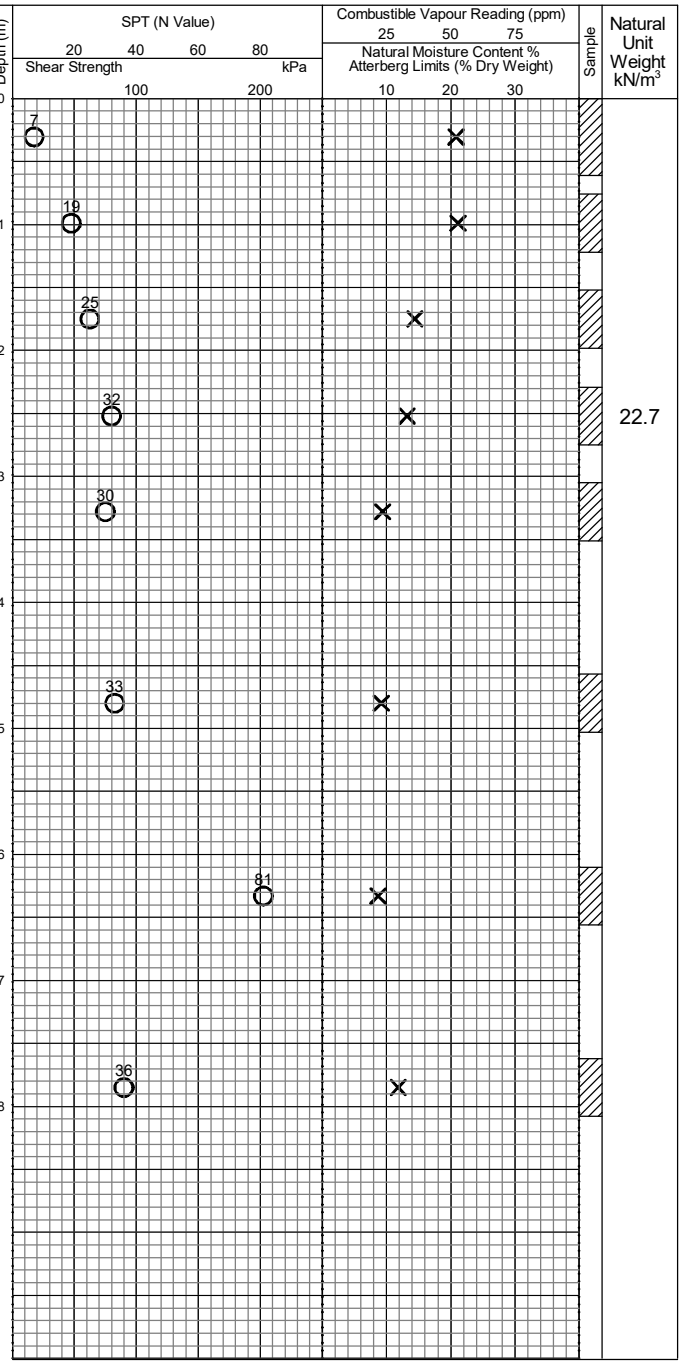
Drill Type: CME-55, track mount machine

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test S

Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Soil Description	ELEV. m
~ 120 mm TOPSOIL over **FILL:** clayey silt, trace gravel, trace rootlets, brown, moist	257.93
	~256.8
SANDY SILT TILL: some clay, trace gravel, brown to grey below 4.5 m, moist	
- - - - - - - - - - - - - silty sand layer between ~6.0 to 6.5m depth - - - - - - - - - - - - -	
- becoming wet	
	~249.8
END OF BOREHOLE	



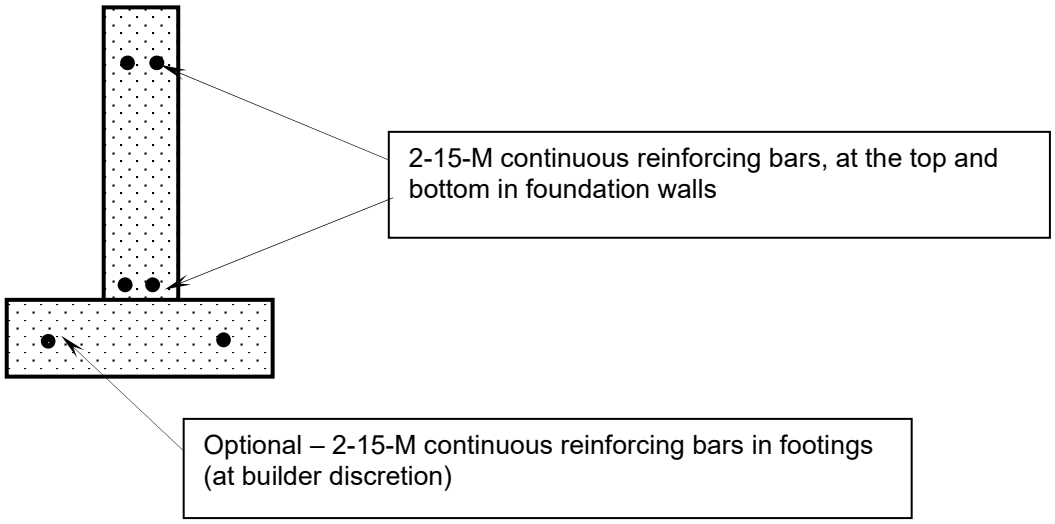
Date	Water Level (m)	Hole Open to (m)
On completion	7.0	

EXPLOGBRAMPTON BOREHOLE LOGS.GPJ NEW.GDT 2/2/22

Drawing 8

Steel Reinforcement for Footings and Foundation Walls on Engineered Fill

The sketch below outlines the reinforcement required for footings founded on engineered fill.



Note: At windows, reinforcing bars should be placed both above and below the windows.

(Drawing: Not to Scale)

1595 Clark Boulevard, Brampton, ON L6T 4V1, Canada
T: +1.905.793.9800 • www.exp.com

APPENDICES

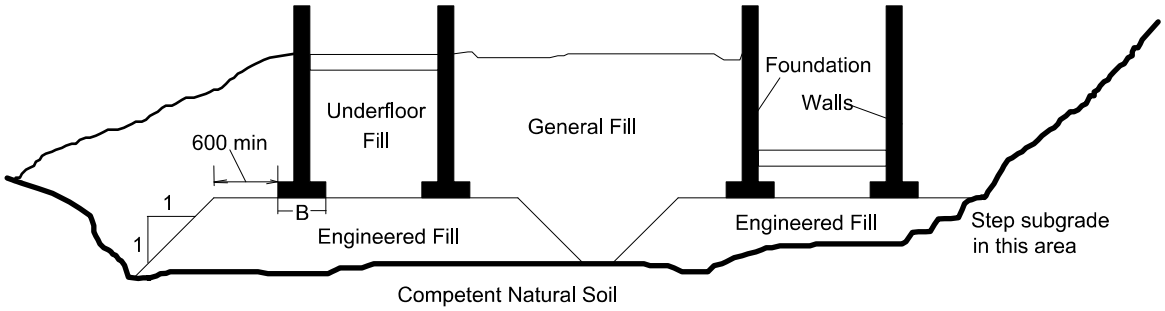
APPENDIX A

Engineered Fill Summary

Foundations placed on engineered fill comprising native soil from the site - or imported materials - may be designed for an SLS geotechnical reaction of 150 kPa (ULS factored geotechnical resistance of 225 kPa).

Additional comments with regards to engineered fill are as follows:

- The area must be stripped of all topsoil, existing fill material or other deleterious material and proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a geotechnical engineer prior to placement of fill.
- The approved engineered fill must be placed in loose lifts not exceeding 200 mm and compacted to 100% Standard Proctor dry density throughout. Granular fill is preferred.
- Full time geotechnical inspection during placement of engineered fill is required.
- The fill must be placed such that the specified geometry is achieved as follows:.



Foundations on Engineered Fill (schematic)

- A minimum footing width of 500 mm (20 inches) is suggested. It is recommended that poured concrete basement walls should be reinforced with 2 – 15M rebars above the footings and below the window sill.
- All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

APPENDIX B

Certificate of Analysis- Soil Test Results

Your P.O. #: BRM-GEO
Your Project #: BRM-00257876-D0
Site Location: HIGHWOOD & HURONTARIO STREET, BRAMPTON, ON
Your C.O.C. #: 105486

Attention: Aamna Arora

exp Services Inc
Brampton Branch
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2022/02/04
Report #: R6991307
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C224335
Received: 2022/01/28, 17:53

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
pH CaCl2 EXTRACT	2	2022/02/02	2022/02/02	CAM SOP-00413	EPA 9045 D m
Sulphate (20:1 Extract)	2	2022/02/04	2022/02/04	CAM SOP-00464	EPA 375.4 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your P.O. #: BRM-GEO
Your Project #: BRM-00257876-D0
Site Location: HIGHWOOD & HURONTARIO STREET, BRAMPTON, ON
Your C.O.C. #: 105486

Attention: Aamna Arora

exp Services Inc
Brampton Branch
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2022/02/04
Report #: R6991307
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C224335
Received: 2022/01/28, 17:53

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Patricia Legette, Project Manager
Email: Patricia.Legette@bureauveritas.com
Phone# (905)817-5799
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Job #: C224335
Report Date: 2022/02/04

exp Services Inc
Client Project #: BRM-00257876-D0
Site Location: HIGHWOOD & HURONTARIO STREET, BRAMPTON, ON
Your P.O. #: BRM-GEO
Sampler Initials: DP

RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		RSQ273	RSQ273		RSQ274		
Sampling Date		2021/12/21	2021/12/21		2021/12/20		
COC Number		105486	105486		105486		
	UNITS	**BH21-1 SS4**	**BH21-1 SS4 Lab-Dup**	**QC Batch**	**BH21-4 SS5**	**RDL**	**QC Batch**
Inorganics							
Available (CaCl2) pH	pH	7.86	7.87	7812466	7.84		7812439
Soluble (20:1) Sulphate (SO4)	ug/g	99	96	7816913	<20	20	7816913

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Bureau Veritas Job #: C224335
Report Date: 2022/02/04

exp Services Inc
Client Project #: BRM-00257876-D0
Site Location: HIGHWOOD & HURONTARIO STREET, BRAMPTON, ON
Your P.O. #: BRM-GEO
Sampler Initials: DP

TEST SUMMARY

Bureau Veritas ID: RSQ273
Sample ID: BH21-1 SS4
Matrix: Soil
Collected: 2021/12/21
Shipped:
Received: 2022/01/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	7812466	2022/02/02	2022/02/02	Taslima Aktar
Sulphate (20:1 Extract)	KONE/EC	7816913	2022/02/04	2022/02/04	Avneet Kour Sudan

Bureau Veritas ID: RSQ273 Dup
Sample ID: BH21-1 SS4
Matrix: Soil
Collected: 2021/12/21
Shipped:
Received: 2022/01/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	7812466	2022/02/02	2022/02/02	Taslima Aktar
Sulphate (20:1 Extract)	KONE/EC	7816913	2022/02/04	2022/02/04	Avneet Kour Sudan

Bureau Veritas ID: RSQ274
Sample ID: BH21-4 SS5
Matrix: Soil
Collected: 2021/12/20
Shipped:
Received: 2022/01/28

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	7812439	2022/02/02	2022/02/02	Taslima Aktar
Sulphate (20:1 Extract)	KONE/EC	7816913	2022/02/04	2022/02/04	Avneet Kour Sudan

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Bureau Veritas Job #: C224335
Report Date: 2022/02/04

exp Services Inc
Client Project #: BRM-00257876-D0
Site Location: HIGHWOOD & HURONTARIO STREET, BRAMPTON, ON
Your P.O. #: BRM-GEO
Sampler Initials: DP

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	-1.0°C

Results relate only to the items tested.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Bureau Veritas Job #: C224335
Report Date: 2022/02/04

QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: BRM-00257876-D0
Site Location: HIGHWOOD & HURONTARIO STREET, BRAMPTON, ON
Your P.O. #: BRM-GEO
Sampler Initials: DP

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7812439	Available (CaCl2) pH	2022/02/02			100	97 - 103			0.090	N/A
7812466	Available (CaCl2) pH	2022/02/02			100	97 - 103			0.025	N/A
7816913	Soluble (20:1) Sulphate (SO4)	2022/02/04	NC	70 - 130	97	70 - 130	<20	ug/g	2.6	35

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

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Bureau Veritas Job #: C224335
Report Date: 2022/02/04

exp Services Inc
Client Project #: BRM-00257876-D0
Site Location: HIGHWOOD & HURONTARIO STREET, BRAMPTON, ON
Your P.O. #: BRM-GEO
Sampler Initials: DP

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Maxxam
A Bureau Veritas Group Company

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/3

CHAIN OF CUSTODY RECORD 105486 Page ____ of ____

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: EXP Services Inc	Company Name:	Quotation #: Stream - 3	[X] Regular TAT (5-7 days) Most analyses
Contact Name: Aamna Arora	Contact Name:	P.O. #/ AFE#: BRM - GEO	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 1595 Clark Blvd BRAMPTON	Address: Same	Project #: BRM-00257876-D0	Rush TAT (Surcharges will be applied)
Phone: Fax:	Phone: Fax:	Site Location: Highwood & Hurontario	[ ] 1 Day [ ] 2 Days [ ] 3-4 Days
Email: aamna.arora@exp.com	Email:	Site #: Street, BRAMPTON	Date Required:
		Sampled By: D.P	Rush Confirmation #:

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153
[ ] Table 1 [ ] Res/Park [ ] Med/ Fine
[ ] Table 2 [ ] Ind/Comm [ ] Coarse
[ ] Table 3 [ ] Agri/ Other
[ ] Table N/A
FOR RSC (PLEASE CIRCLE) Y / N

Other Regulations
[ ] CCME [ ] Sanitary Sewer Bylaw
[ ] MISA [ ] Storm Sewer Bylaw
[ ] PWQO Region
[ ] Other (Specify)
[ ] REG 558 (MIN. 3 DAY TAT REQUIRED)

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Pkg. Cr VI, ICPMS Metals, HWS - B)	pH	SULPHATE						HOLD- DO NOT ANALYZE
1	BH 21-1 SS4	2021/12/21	am	Soil	1								X	X						
2	BH 21-4 SS5	2021/12/20	"	"	1								X	X						
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
		-0 | -1 | -2

COOLING MEDIA PRESENT: Y / N

COMMENTS

1: 250ml Jar
2: "

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
Devendra	2022/01/28		Raj Mansani	2022/01/28	17:53

28-Jan-22 17:53
Patricia Legette
C224335
DSG ENV-930

Unless otherwise agreed to in writing, work submitted on this Chain of Custody is subject to Maxxam's standard Terms and Conditions. Signing of this Chain of Custody document is acknowle available for viewing at www.maxxam.ca/terms. Sample container, preservation, hold time and packages information can be viewed at http://maxxam.ca/wp-content/uploads/Ontario-COC.pdf.

COC-1004 (03/17)

White: Maxxam ~ Yellow: Client

APPENDIX C

Grain Size Analysis

exp Services Inc.
1595 Clark Boulevard, Brampton
Ontario, Canada, L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

Grain Size Analysis & Hydrometer Test Report

ST0

Sample Test No.: 389055-1 **Report No.:** 1 **Date Reported:** 10-Jan-22

Project No.: brm-00257876-d0 100
Project Name: Geotechnical

Grain Size Proportion (%)

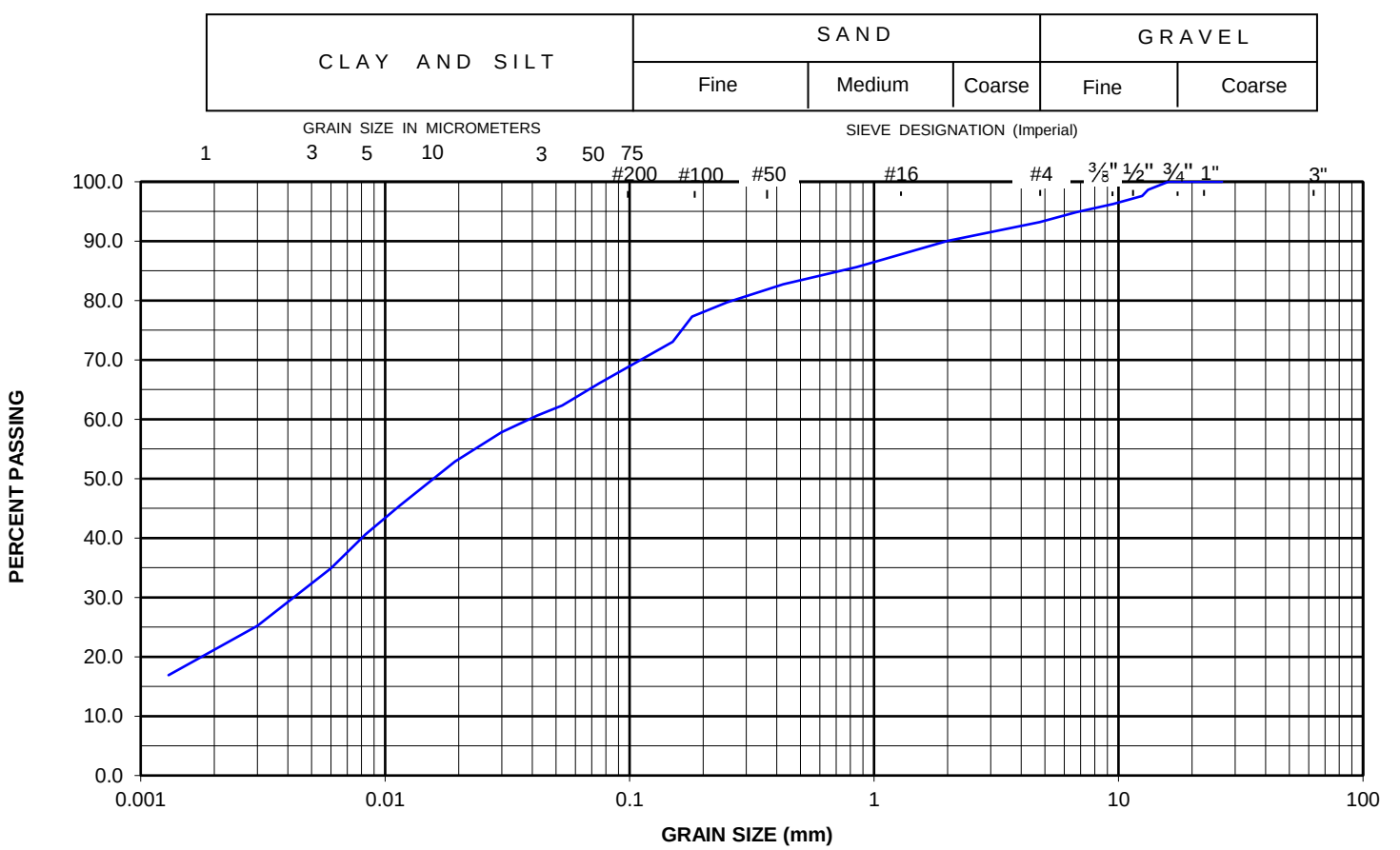
Gravel (> 4.75mm):	**6.8**
Sand (> 75µm, < 4.75mm):	**27.1**
Silt (> 2µm), < 75µm):	**45.8**
Clay (< 2µm):	**20.3**
Total:	**100.0**

Sample Information

Location: BH 21-1
Sample Method: SS
Sample No.: 5
Depth: 3.0 - 3.7 m
Sample Description: Clayey, Sandy Silt; trace Gravel; Brown
Sampled By: exp Brampton
Sampling Date: 12/21/2021
Date Received: 12/30/2021
Client Sample ID:
Comments:

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	**0.0418**	60.6
22.4	100.0	**0.0299**	57.8
19	100.0	**0.0193**	52.9
16	100.0	**0.0115**	45.5
13.2	98.7	**0.0083**	40.6
12.5	97.6	**0.0060**	34.9
9.5	96.2	**0.0030**	25.2
6.7	94.8	**0.0013**	16.9
4.75	93.2		
2	90.1		
0.85	85.6		
0.425	82.7		
0.25	79.7		
0.18	77.3		
0.15	73.0		
0.075	66.1		
0.053	62.3		

UNIFIED SOIL CLASSIFICATION SYSTEM



Project Manager: Aamna Arora **Approved By:** *Original Signed By* **Date Approved:** 10-Jan-22
Willie Rodych, Lab Supervisor

exp Services Inc.
1595 Clark Boulevard, Brampton
Ontario, Canada, L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

Grain Size Analysis & Hydrometer Test Report

ST08

Sample Test No.: 389056-1 **Report No.:** 2 **Date Reported:** 10-Jan-22

Project No.: brm-00257876-d0 100
Project Name: Geotechnical

Grain Size Proportion (%)

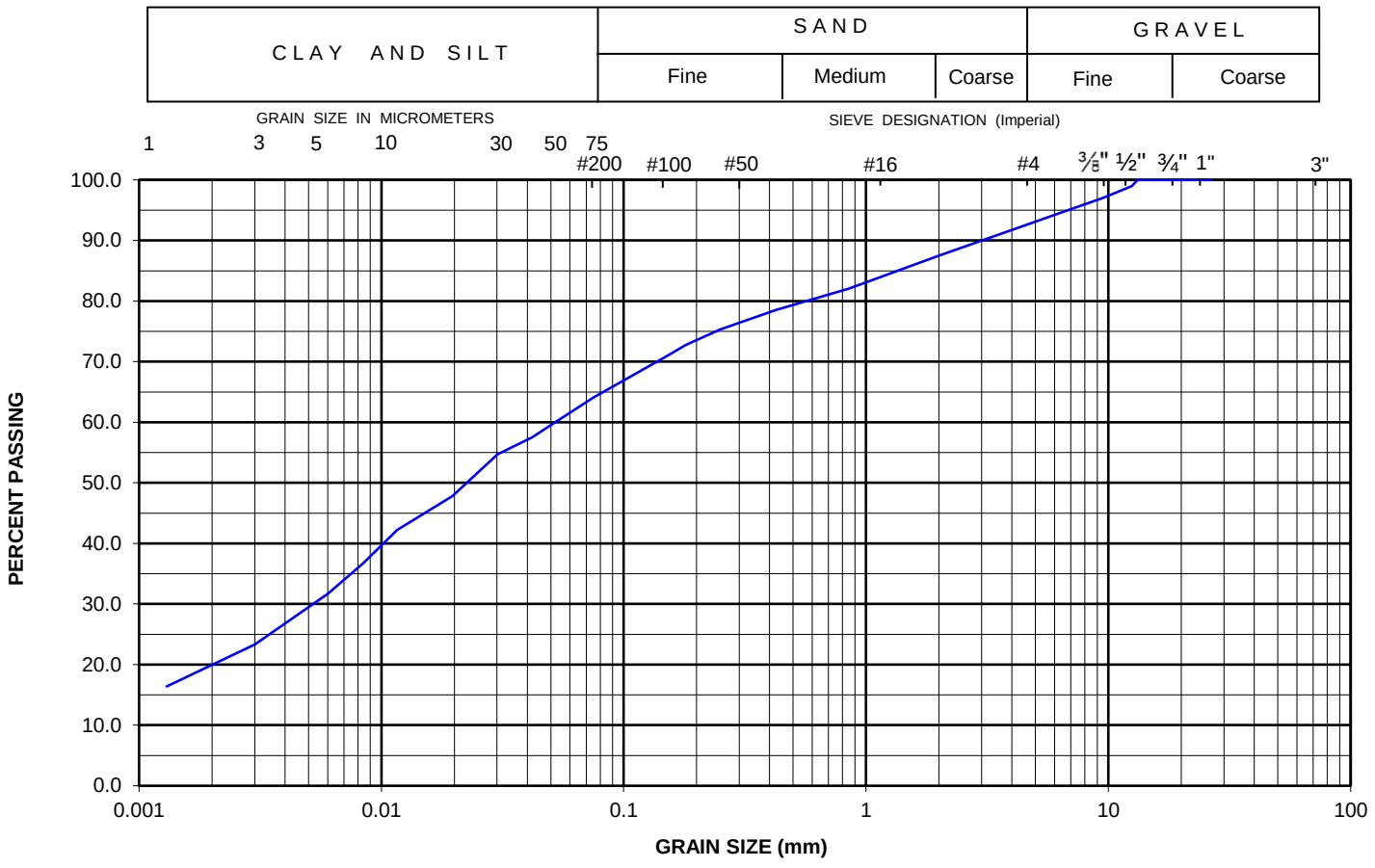
Gravel (> 4.75mm):	**7.2**
Sand (> 75μm, < 4.75mm):	**28.7**
Silt (> 2μm), < 75μm):	**44.9**
Clay (< 2μm):	**19.2**
Total:	**100.0**

Sample Information

Location: BH 21-2
Sample Method: SS
Sample No.: 5
Depth: 3.0 - 3.5 m
Sample Description: Sandy Silt, some Clay; trace Gravel; Brown
Sampled By: exp Brampton
Sampling Date: 12/21/2021
Date Received: 12/30/2021
Client Sample ID:
Comments:

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	**0.0420**	57.5
22.4	100.0	**0.0301**	54.7
19	100.0	**0.0196**	47.8
16	100.0	**0.0116**	42.2
13.2	100.0	**0.0084**	36.7
12.5	99.0	**0.0060**	31.7
9.5	97.0	**0.0030**	23.3
6.7	94.9	**0.0013**	16.4
4.75	92.8		
2	87.5		
0.85	82.1		
0.425	78.5		
0.25	75.3		
0.18	72.7		
0.15	70.9		
0.075	64.1		
0.053	60.2		

UNIFIED SOIL CLASSIFICATION SYSTEM



Project Manager: Aamna Arora **Approved By:** *Original Signed By* **Date Approved:** 10-Jan-22
Willie Rodych, Lab Supervisor

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Ontario, Canada, L6T 4V1
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Grain Size Analysis & Hydrometer Test Report

ST08

Sample Test No.: 389057-1 **Report No.:** 3 **Date Reported:** 10-Jan-22

Project No.: brm-00257876-d0 100
Project Name: Geotechnical

Grain Size Proportion (%)

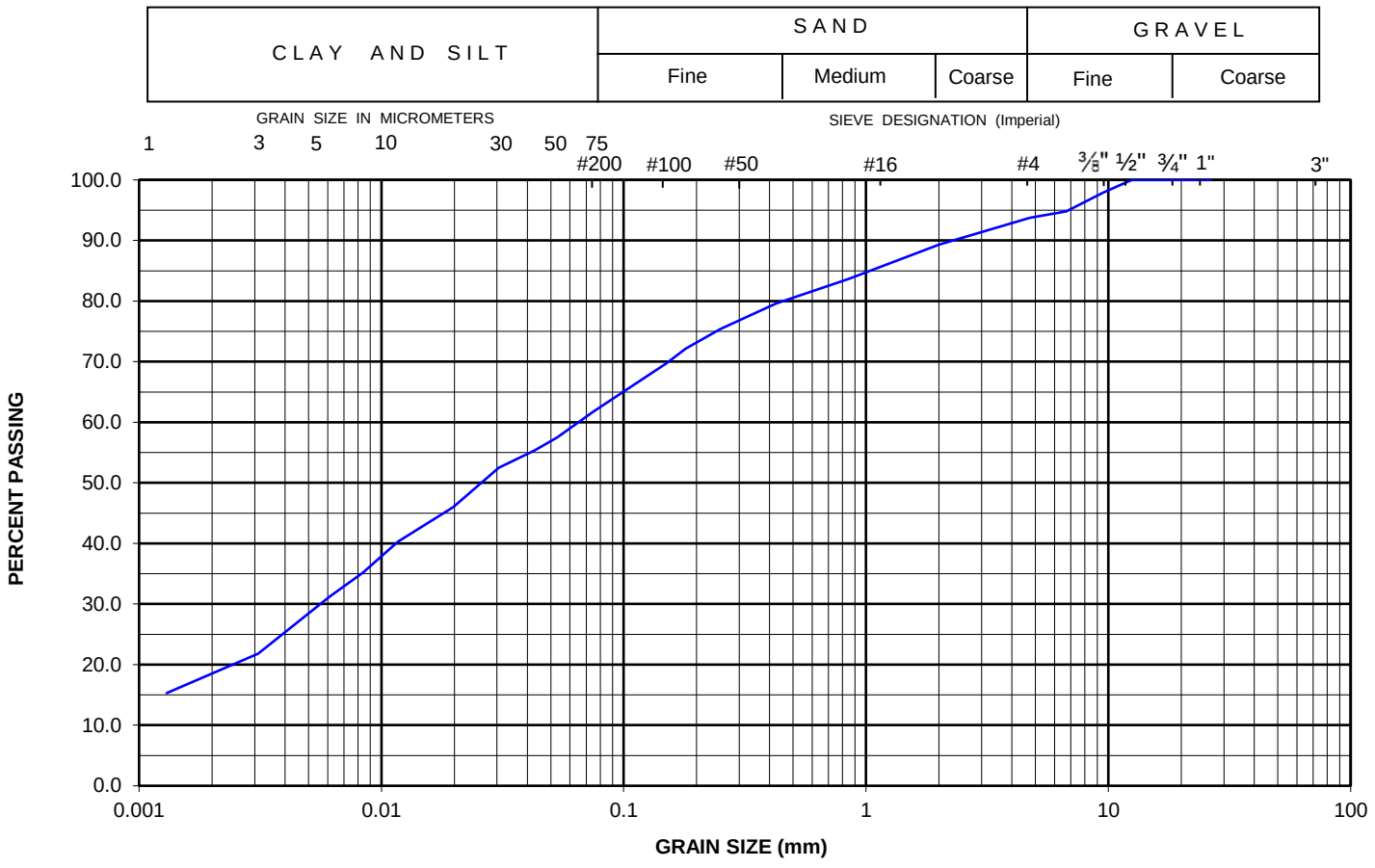
Gravel (> 4.75mm):	**6.2**
Sand (> 75μm, < 4.75mm):	**32.0**
Silt (> 2μm), < 75μm):	**44.0**
Clay (< 2μm):	**17.8**
Total:	**100.0**

Sample Information

Location: BH 21-4
Sample Method: SS
Sample No.: 4
Depth: 2.3 - 2.7 m
Sample Description: Sandy silt, some Clay; trace Gravel; Brown
Sampled By: exp Brampton
Sampling Date: 12/21/2021
Date Received: 12/30/2021
Client Sample ID:
Comments:

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	**0.0427**	55.3
22.4	100.0	**0.0305**	52.5
19	100.0	**0.0198**	46.0
16	100.0	**0.0117**	40.3
13.2	100.0	**0.0084**	35.2
12.5	100.0	**0.0061**	31.2
9.5	97.9	**0.0031**	21.8
6.7	94.8	**0.0013**	15.3
4.75	93.8		
2	89.3		
0.85	83.7		
0.425	79.6		
0.25	75.4		
0.18	72.1		
0.15	69.7		
0.075	61.7		
0.053	57.5		

UNIFIED SOIL CLASSIFICATION SYSTEM



Project Manager: Aamna Arora **Approved By:** *Original Signed By* **Date Approved:** 10-Jan-22
Willie Rodych, Lab Supervisor

exp Services Inc.
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Ontario, Canada, L6T 4V1
Telephone: (905) 793-9800
Fax: (905) 793-0641

Grain Size Analysis & Hydrometer Test Report

ST08

Sample Test No.: 389058-1 **Report No.:** 4 **Date Reported:** 10-Jan-22

Project No.: brm-00257876-d0 100
Project Name: Geotechnical

Grain Size Proportion (%)

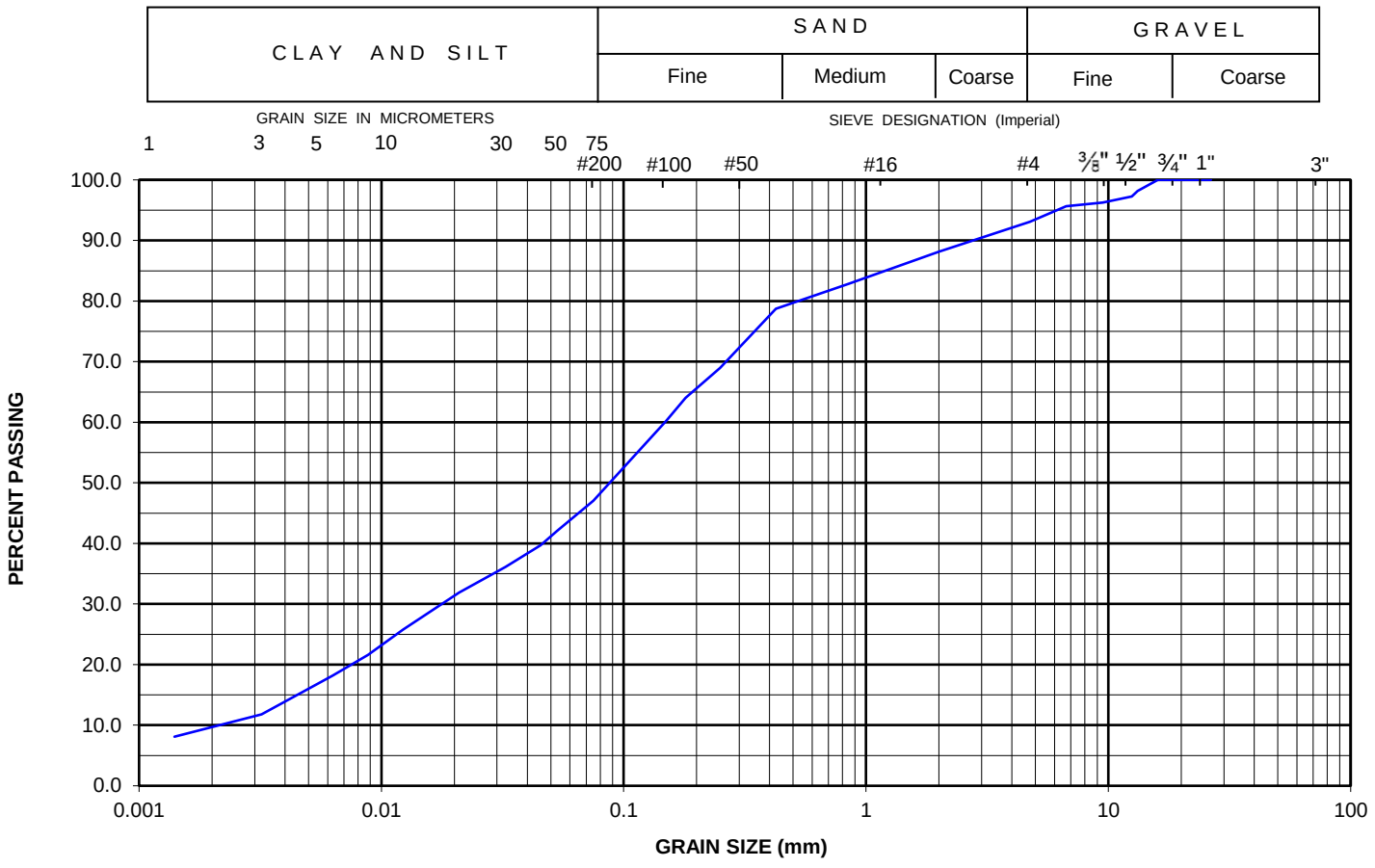
Gravel (> 4.75mm):	**6.9**
Sand (> 75μm, < 4.75mm):	**46.1**
Silt (> 2μm), < 75μm):	**37.7**
Clay (< 2μm):	**9.3**
Total:	**100.0**

Sample Information

Location: BH 21-6
Sample Method: SS
Sample No.: 7
Depth: 6.1 - 6.6 m
Sample Description: Sand and Silt, trace Clay and Gravel; Grey
Sampled By: exp Brampton
Sampling Date: 12/20/2021
Date Received: 12/30/2021
Client Sample ID:
Comments:

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
26.5	100.0	**0.0454**	39.7
22.4	100.0	**0.0325**	36.1
19	100.0	**0.0209**	31.9
16	100.0	**0.0123**	25.8
13.2	98.2	**0.0088**	21.6
12.5	97.3	**0.0063**	18.2
9.5	96.2	**0.0032**	11.8
6.7	95.7	**0.0014**	8.1
4.75	93.1		
2	88.1		
0.85	82.8		
0.425	78.7		
0.25	69.0		
0.18	64.0		
0.15	60.2		
0.075	47.0		
0.053	42.1		

UNIFIED SOIL CLASSIFICATION SYSTEM



Project Manager: Aamna Arora **Approved By:** *Original Signed By* **Date Approved:** 10-Jan-22
Willie Rodych, Lab Supervisor