REPORT ON

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION
1240 BRITANNIA ROAD WEST
MISSISSAUGA, ONTARIO

PREPARED FOR:

NATIONAL HOMES (1240 BRITANNIA) INC.

Project No: 19-337-100
Date: January 28, 2020

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1. INTRODUCTION

DS Consultants Ltd (DS) was retained by National Homes (1240 Britannia) Inc. to undertake a supplementary geotechnical investigation for the proposed development located at 1240 Britannia Road West, Mississauga, Ontario.

It is understood that the project will entail a residential subdivision consisting of 108 condo townhouse units, one single detached home, roads and sewers.

It is also understood that a previous preliminary geotechnical investigation at the subject site was carried out by Arcadis Canada Inc. between May 30 and June 03, 2019 and a total of six (6) boreholes were drilled to a depth of 6.7m below ground surface. The borehole location plan and boreholes logs of Arcadis Canada Inc. geotechnical investigation are attached in **Appendix A**.

DS drilled three (3) boreholes in January 2020 to a depth of 8.2m below ground surface. This geotechnical investigation report is prepared based on the information of both Arcadis Canada Inc. and DS investigations.

This report deals with the geotechnical aspects of the site only.

The purpose of this geotechnical investigation was to obtain information about the subsurface conditions by means of boreholes and from the findings in the boreholes to make recommendations pertaining to the geotechnical design of underground utilities and subdivision roads and to comment on the foundation conditions for general house construction.

This report is provided on the basis of the terms of reference presented above and, on the assumption, that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for National Homes (1240 Britannia) Inc. and its designers. Third party use of this report without DS Consultants Ltd (DS) consent is prohibited.

2. FIELD AND LABORATORY WORK

During the previous investigation carried out by Arcadis, a total of six (6) boreholes (MW19-1, BH19-4, MW19-6, MW19-8, BH 19-9 and BH19-11) were drilled to a depth of 6.7m between May 30 and June 03, 2019.

A total of three (3) boreholes (BH20-1 through BH20-3) were drilled by DS at the subject site in January 2020 to a depth of 8.2 m. Boreholes were drilled with solid stem continuous flight auger equipment by a drilling sub-contractor under the direction and supervision of DS personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the DS laboratory for detailed examination by the project engineer and for laboratory testing.

As well as visual examination in the laboratory, all soil samples for the boreholes drilled by DS were tested for moisture contents. Grain size analyses of one cohesive silt till deposit sample from Arcadis Borehole (BH19-11/SS6) was conducted and the result is presented in **Appendix A.**

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Three (3) boreholes (MW19-1, MW19-6 and MW19-8) drilled by Arcadis were equipped with monitoring wells. One monitoring well was installed in BH20-1 drilled by DS for long-term groundwater level monitoring.

The surface elevations at the borehole locations were surveyed by DS staff using differential GPS system.

3. SITE AND SUBSURFACE CONDITIONS

The investigated property covers an area of approximately 1.769 ha (approximately 4.37 acres) and is currently covered by two residential dwellings.

The DS borehole location is shown on **Drawing 1**. Notes on sample description are presented on **Drawing 1A**. The subsurface conditions encountered in DS boreholes are presented in the individual borehole logs (**Drawing Nos. 2 to 4 inclusive**). The subsurface conditions encountered in Arcadis and DS boreholes are summarized in the following paragraphs.

3.1 Soil Conditions in Arcadis Canada Inc. Boreholes

Pavement Structure/ Fill Material: Borehole BH(MW)19-6 was drilled on paved surface and encountered a pavement structure consisting of 50mm asphalt overlying 25mm of granular base.

Below the pavement structure in BH(MW)19-6 and below ground surface in BH19-4, fill material consisting of sand, silt and organic silt were found and extended to depths varying from 0.08m to 0.56m below ground surface.

Organic Silt (Native): A surficial organic silt layer varying in thickness of 80mm to 760mm was encountered in Boreholes BH(MW)19-1, BH(MW)19-8, BH19-9 and BH19-11.

Silt (Till): Below the fill and native organic silt, cohesive silt (Till) deposit was encountered in all boreholes extending to depths ranging from 4.8 to 6.7m below ground surface. BH19-11 was terminated in silt (till) deposit. This deposit was generally found in a dense to very dense state with occasional compact layers, with measured SPT 'N' values ranging from 16 to more than 50 blows per 300mm penetration.

Grain size analyses of one cohesive silt till deposit sample (BH19-11/SS6) was conducted and the result in **Appendix A**, with the following fractions:

Clay: 23%

Silt: 45%

Sand: 27%

Gravel: 5%

Clayey Silt (Till): Below the silt (Till) deposit in all boreholes except BH19-11, a cohesive deposit of clayey silt (Till) was encountered and extended to the maximum explored depth of the boreholes. This deposit was found to have generally a stiff to very stiff consistency with occasional hard layers, with measured SPT 'N' values ranging from 8 to 31 blows per 300mm penetration.

3.1.1 Groundwater Conditions in Arcadis Canada Inc. Boreholes

Three (3) boreholes (MW19-1, MW19-6 and MW19-8) drilled by Arcadis were equipped with monitoring wells for the measurement of long-term groundwater monitoring. The groundwater levels measured in the monitoring wells between June 07, 2019 and June 24, 2019 were found below the depths of 4.6 to 5.9m below ground surface, corresponding to Elevations 166.9 to 169.0m, as summarized in **Table 1**.

Table 1: Summary of Groundwater Level Measurements in Monitoring Wells in Arcadis Canada Inc. Boreholes

Borehole No.	Ground Surface Elev. (m)	Date of Observation	Depth of Groundwater (m)	Elevation of Groundwater (m)
MW19-1	172.4	June 07, 2019	Dry	Dry to Elev. 172.4
		June 21, 2019	5.5	166.9
		June 24, 2019	5.6	166.8
MW19-6	174.1	June 07, 2019	5.9	168.2
		June 21, 2019	4.9	169.2
		June 24, 2019	5.2	168.9
MW19-8	174.2	June 07, 2019	5.5	168.9
		June 21, 2019	4.6	169.7
		June 24, 2019	5.4	169.0

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

3.2 Soil Conditions in DS Boreholes

Topsoil: A surficial layer of topsoil of 100mm to 200mm thick was found at DS Boreholes BH20-1 to BH20-3. It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site.

Clayey Silt (Weathered/Disturbed): Below the topsoil in DS Boreholes clayey silt deposit was encountered which was found to be weathered/disturbed material due to ploughing activities in the past. Traces of rootlets and topsoil inclusions were also observed in the weathered deposit. These weathered/disturbed soils extended to a depth of 0.8m below ground surface. This deposit was found to have a firm to stiff consistency, with measured SPT 'N' values ranging from 7 to 11 blows per 300mm penetration.

Clayey Silt Till/Silty Clay Till: Below the weathered deposits, native soil consisting of clayey silt till to silty clay till was found in all boreholes, extending to the maximum explored depth of boreholes. The clayey silt till was found to have generally a stiff to very stiff consistency with occasional hard layers, with measured SPT 'N' values ranging from 8 to more than 50 blows per 300 mm penetration. The till is known to contain layers and pockets of sand. Large boulders are also known to be present in the till.

3.2.1 Groundwater Conditions in DS Boreholes

One monitoring well of 50mm dia. was installed in BH20-1 for the measurement of long-term groundwater monitoring. The groundwater levels measured on Jan. 28, 2020 was found at a depth of 2.9m below ground surface, corresponding to Elevation 169.5m.

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

4. DISCUSSION AND RECOMMENDATIONS

It is proposed to develop the site as a residential subdivision. The lots will therefore be serviced by a network of roads, watermains and storm and sanitary sewers.

4.1 Roads

The investigation has shown that the predominant subgrade soil, after stripping the topsoil, loose fill and any other organic and otherwise unsuitable subsoil, will generally consist of silt till/clayey silt till.

Based on the above and assuming that traffic usage will be residential minor local or local, the following minimum pavement thickness is recommended for roads to be constructed within the subdivision:

40 mm HL3 Asphaltic Concrete

65 mm HL8 Asphaltic Concrete

200 mm Granular 'A'

250 mm Granular 'B'

These values may need to be adjusted according to the City of Mississauga Standards. The site subgrade and weather conditions (i.e. if wet) at the time of construction may necessitate the placement of thicker granular sub-base layer in order to facilitate the construction. Furthermore, heavy construction equipment may have to be kept off the newly constructed roads before the placement of asphalt and/or immediately thereafter, to avoid damaging the weak subgrade by heavy truck traffic.

4.1.1 Stripping, Sub-excavation and Grading

The site should be stripped of all topsoil, weathered soils, and any organic or otherwise unsuitable soils to the full depth of the roads, both in cut and fill areas.

Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof-rolled, in the presence of the Geotechnical Engineer, by at least several passes of a heavy compactor having a rated capacity of at least 8 tonnes. Any soft spots thus

exposed should be removed and replaced by select fill material, similar to the existing subgrade soil and approved by the Geotechnical Engineer. The subgrade should then be re-compacted from the surface to at least 98% of its Standard Proctor Maximum Dry Density (SPMDD). The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Owing to the clayey (i.e. impervious) nature of the subsoil at the site, proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial for this project. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular materials by heavy construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material may need to be used.

Any fill required for re-grading the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 95% of its SPMDD. The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, or as per the City Standards. The compaction of the new fill should be checked by frequent field density tests.

4.1.2 Construction

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to at least 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.1.3 Drainage

The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

All paved surfaces should be sloped to provide satisfactory drainage towards catch basins. As discussed in **Section 4.1.1**, by means of good planning any water trapped in the granular sub-base materials should be drained rapidly towards subdrains or other interceptors.

4.2 Sewers

As a part of the site development, a network of new storm and sanitary sewers is to be constructed. It is assumed that the trenches are generally within 4 to 5 m below the existing grade.

4.2.1 Trenching

Based on the boreholes, the trenches will be dug through the weathered soil, silt till and clayey silt to silty clay till. No major problems due to groundwater seepage are anticipated during construction in trenches dug through the clayey soils. The rate of groundwater seepage through the till is expected to be slow to moderate and can be handled by gravity drainage and pumping from filtered sumps established at the base of the excavation. However, contractor should be prepared to employ more elaborate dewatering system, should the water seepage become sever.

Excavations in overburden can be carried out with heavy hydraulic backhoe.

The sides of excavations in the natural strata above groundwater can be expected to be temporarily stable at relatively steep side slopes for short periods of time but they should be cut back at slopes no steeper than 1:1 in order to comply with the safety regulations. If steep side slopes are required, the sides should be supported by braced skeleton or close sheeting.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the fill material and stiff clayey soils can be classified as Type 3 Soil above the groundwater table and Type 4 Soil in the perched water condition. The stiff to hard clayey silt to silty clay till can be classified as Type 2 Soil above the groundwater table and Type 3 below the groundwater table.

4.2.2 Bedding

The undisturbed native soils will provide adequate support for the sewer pipes and allow the use of normal Class B type bedding. The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soil at the trench base level consists of wet, dilatant silt. The bedding material should consist of well graded granular material such as Granular 'A' or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local Authority, should be placed. Where the bedding falls below the anticipated water table, the bedding stone must be surrounded with a geotextile filter cloth.

To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the poorly graded bedding material.

4.2.3 Backfilling of Trenches

Based on visual and tactile examination, the on-site excavated inorganic silt till and clayey silt till deposits, free from topsoil and organics are considered to be suitable for re-use as backfill in the service trenches provided their moisture contents at the time of construction are at or near optimum.

Granular B material should be used as backfill for trenches located under slab on grade or paved areas. Compaction of the granular soils should be carried out with vibratory compactors and loose lifts not exceeding about 200 mm.

The clayey till especially when its consistency is very stiff to hard is likely to be excavated in cohesive chunks or blocks and will be difficult to compact in confined areas. For use as backfill, the clayey material will have to pulverized and placed in thin layers. The clayey soils will have to be compacted using heavy equipment suitable for these soils which may be difficult to operate in the narrow confines of the trenches. Unless the clayey materials are properly pulverized and compacted in sufficiently thin lifts post-construction settlements could occur. Their use in narrow trenches such as laterals (where heavy compaction equipment cannot be operated) may not be feasible.

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 last 95% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

The on-site excavated soils and especially the clayey soils should not be used in confined areas (e.g. around catchbasins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of imported granular fill together with an appropriate frost taper would be preferable in confined areas and around structures, such as catchbasins.

4.3 Engineered Fill

In the areas where earth fill is required for site grading purposes, an engineered fill may be constructed below house foundations, roads, boulevards, etc.

General guidelines for the placement and preparation of engineered fill are presented on **Appendix B**. Bearing capacity values of 150 kPa at SLS and 225 kPa at ULS can be used on

engineered fill, provided that all requirements on **Appendix B** are adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential.

The following is a recommended procedure for an engineered fill:

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained, and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and DS. Without this confirmation no responsibility for the performance of the structure can be accepted by DS. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a DS engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur.

6. Full-time geotechnical inspection by DS during placement of engineered fill is required. Work cannot commence or continue without the presence of the DS representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to sketches for minimum requirements. Take careful note that the projection of the compacted pad

beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. Bearing capacity values of 150 kPa at SLS and 225 kPa at ULS may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings should be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

10. After completion of the pad a second contractor may be selected to install footings. All excavations must be backfilled under full time supervision by DS to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of DS.

11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

The inorganic clayey silt (till) are considered suitable for use as engineered fill, provided that their moisture contents at the time of construction are at or near optimum. As mentioned before in Section 4.2.3 of this report, the clayey tills are likely to be excavated in cohesive chunks or blocks and will be difficult to compact. They should be pulverized and placed in thin layers not exceeding 150 to 200 mm and compacted using heavy equipment suitable for these types of soils (e.g. heavy sheepsfoot compactors).

5. Foundation Conditions

It is understood that the proposed subdivision will consist of condo townhouses with one level basement. The finish floor elevations of these proposed singles are not known to us at the time of writing this report.

The proposed condo townhouses with one level basement can be supported by spread and strip footings founded on the undisturbed native soils below weathered/disturbed soils for a bearing capacity of 150 kPa at SLS (Serviceability Limit State), and for a factored geotechnical resistance of 225 kPa at ULS (Ultimate Limit State). All footings must be founded below the weathered/disturbed soils and any loose or soft soils and 0.3m into the native undisturbed soils

The proposed townhouses can also be supported by spread and strip footings founded on engineered fill for a bearing capacity of 150 kPa at the serviceability limit states (SLS) and for a factored geotechnical resistance of 225 kPa at the ultimate limit states (ULS), provided all requirements on **Appendix B** are adhered to. Prior to the placement of the engineered fill, all of the existing fill and surficially softened native soils must be removed and the exposed surface proof rolled. Any soft spots revealed during proof rolling must be sub-excavated and re-engineered. The engineered fill consisting of approved inorganic material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential.

Foundations designed to the specified bearing capacities at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

It should be noted that the recommended bearing capacities have been calculated by DS from the borehole information for the preliminary design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by DS to validate the information for use during the construction stage.

6. Earth Pressures

The lateral earth pressures acting on basement walls may be calculated from the following expression:

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

where p = Lateral earth pressure in kPa acting at depth h

K = Earth pressure coefficient equal to 0.40 for vertical walls and horizontal backfill used for permanent construction. Water pressure must be considered, if continuous wall drains are not used.

γ = Unit weight of backfill, a value of 21.0 kN/m^3 may be assumed

h = Depth to point of interest in metres

q = Equivalent value of surcharge on the ground surface in kPa

The above expression assumes that the perimeter drainage system prevents the buildup of any hydrostatic pressure behind the wall.

7. GENERAL COMMENTS AND LIMITATIONS OF REPORT

DS Consultants Ltd (DS) 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, DS will assume no responsibility for interpretation of the recommendations in the report.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to DS at the time of preparation. Unless otherwise agreed in writing by DS, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The sub-surface conditions are interpreted as relevant to the design and construction of the proposed houses and underground utilities. Comments relating to construction are intended for the guidance of the design engineer to establish constructability and must not be considered as being specifications or recommendations to the prospective contractors, or as being the only suitable methods. Prospective contractors should evaluate all of the factual information, obtain additional subsurface information as they might deem necessary and should select their construction methods, sequencing and equipment based on their own experience in similar ground conditions. The readers of this report are also reminded that the conditions are known only at the borehole locations and in view of the generally wide spacing of the boreholes, conditions may vary significantly between boreholes.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. DS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

DS CONSULTANTS LTD.

Naeem Ehsan, M.Eng., P.Eng.

Alka Sangar, M.Eng., P.Eng.

Drawings

J:\-GIS\19-337-100 1240 Britannia Road\1-QGIS\Geotechnical\Figure 1 - Borehole Location Plan.qgs Jan-09 14:28

Legend

- Approx Property Boundary
- Proposed Borehole Location

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Client: NATIONAL HOMES (1240 BRITANNIA) INC.

Project: GEOTECHNICAL INVESTIGATION
1240 and 1310 Britannia Road W, Mississauga, ON

Title: **BOREHOLE LOCATION PLAN**

N

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	N.W	S.Y	January 2020
Rev: 0	Scale: As Shown	Project No.: 19-337-100	Figure No.: 1

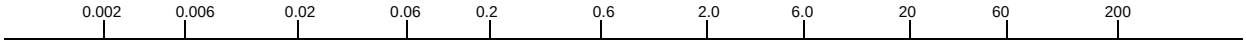
Image/Map Source: *Google Satellite Image*

Drawing 1A: Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by DSCL also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have 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 preliminary 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.

DS CONSULTANTS LTD.
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH20-1

PROJECT: Geotechnical Investigation
CLIENT: 1240 Britannia Inc
PROJECT LOCATION: 1240 Britannia Road, ON
DATUM: Geodetic
BH LOCATION: N 4828404.302 E 604361.513

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jan-13-2020

REF. NO.: 19-337-100
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
172.5						
172.4 0.1	**TOPSOIL:** 100mm					
171.7	**CLAYEY SILT:** trace gravel, trace topsoil, trace rootlets, brown, moist, stiff (weathered)	1	SS	6		172
0.8	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble, brown, moist, stiff to hard	2	SS	16		
		3	SS	20		171
					Bentonite	
		4	SS	39		170
					W. L. 169.5 m Jan 28, 2020	
		5	SS	25		169
		6	SS	11		168
	sandy, grey below 6.1m					167
					Filter Pack	
					Slotted Pipe	
		7	SS	15		166
165.2						
7.3	**SILTY CLAY TILL:** trace gravel, brown, moist, stiff					165
		8	SS	8		
164.3						
8.2	**END OF BOREHOLE:**					

Notes:
1) 50 mm diameter monitoring well installed upon completion.
2) Water level Readings:

Date:	Water Depth (mbgl)
Jan 28 , 2020	2.95

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)
SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 19-337-100.GPJ DS.GDT 20-1-31

DS CONSULTANTS LTD.
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH20-2

PROJECT: Geotechnical Investigation
CLIENT: 1240 Britannia Inc
PROJECT LOCATION: 1240 Britannia Road, ON
DATUM: Geodetic
BH LOCATION: N 4828341.023 E 604374.191

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jan-13-2020

REF. NO.: 19-337-100
ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
171.3					
171.2 / 0.1	**TOPSOIL:** 125mm				
	CLAYEY SILT: trace gravel, trace topsoil, trace rootlets, brown, moist, stiff (weathered)	1	SS	11	171
170.5 / 0.8	**CLAYEY SILT TILL:** sandy, trace gravel, occasional cobble/boulder, brown, moist, very stiff to hard	2	SS	22	
		3	SS	26	170
		4	SS	33	169
		5	SS	32	168
	grey, stiff below 4.6m	6	SS	11	167
	wet sand seams below 6.1m	7	SS	10	166
					165
		8	SS	8	164
163.1 / 8.2	**END OF BOREHOLE:**				

Notes:
1) Borehole open and dry upon completion

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 19-337-100.GPJ DS.GDT 20-1-31

DS CONSULTANTS LTD.
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH20-3

PROJECT: Geotechnical Investigation
CLIENT: 1240 Britannia Inc
PROJECT LOCATION: 1240 Britannia Road, ON
DATUM: Geodetic
BH LOCATION: N 4828319.165 E 604402.729

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Jan-13-2020

REF. NO.: 19-337-100
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / 0.3 m "N"	ELEVATION
172.1					172
171.9 0.0	**TOPSOIL:** 200mm				
0.2	**CLAYEY SILT:** trace gravel, trace topsoil, trace rootlets, brown, moist, firm (weathered)	1	SS	7	
171.3					
1 0.8	**CLAYEY SILT TILL:** sandy, trace gravel, greyish brown, moist, very stiff to hard	2	SS	18	171
	occasional cobble/boulder below 1.5m	3	SS	26	
2		4	SS	27	170
3		5	SS	53	169
4	grey, stiff below 4.6m	6	SS	15	168
5					167
6	wet sand seams below 6.1m	7	SS	14	166
7					165
8 163.9		8	SS	12	164
8.2	**END OF BOREHOLE:** Notes: 1) Borehole open and dry upon completion				

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

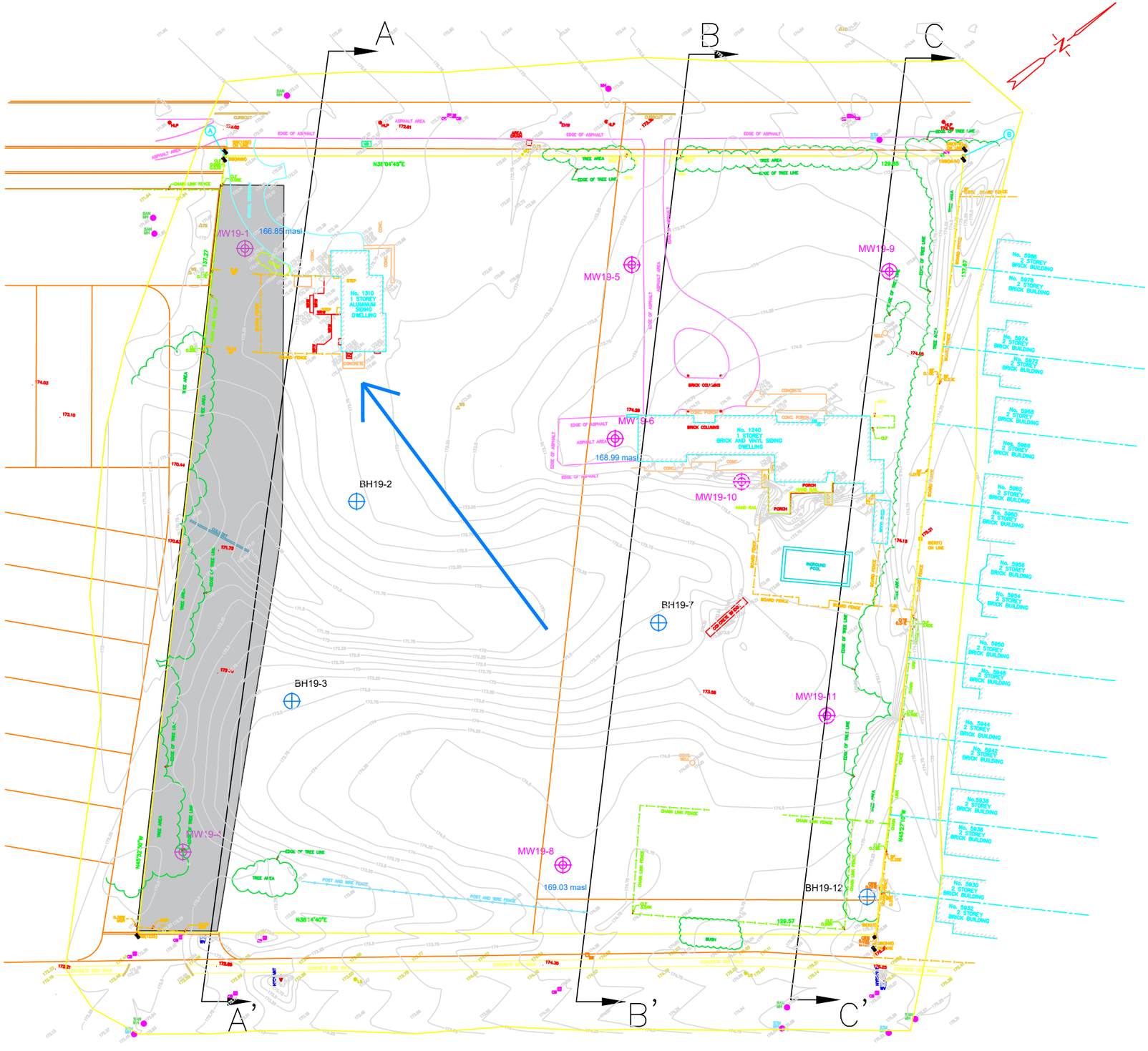
GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

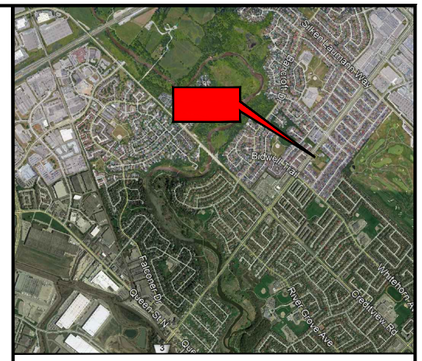
GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG 19-337-100.GPJ DS.GDT 20-1-31

Appendix A

Borehole Location Plan, Boreholes Logs and Grain Size Analysis Result of Arcadis Canada Inc.





KEY PLAN

LEGEND:

MW19-1	MONITORING WELL LOCATION
BH19-7	BOREHOLE LOCATION
169.03 masl	GROUNDWATER ELEVATION
	INFERRED DIRECTION OF GROUNDWATER FLOW

PRELIMINARY DRILLING PROGRAM

MW19-1
MW19-4
MW19-6
MW19-8
MW19-9
MW19-11

Meters
10 0 10 20
1:750

ARCADIS

EDENSHAW HOMES LTD.

PROPOSED RESIDENTIAL REDEVELOPMENT

1240 BRITANNIA ROAD WEST,
MISSISSAUGA,ONTARIO

GEOTECHNICAL INVESTIGATION
BOREHOLE PLAN

Drawn By: P.A.F.	Approved By: R.B.G.	Project No: 351583
Date: JUNE 2019	Scale: 1:500	Drawing No: 351583-003-1

Project: **Edenshaw Homes** Contract No: **351583**

Boring date: **2019-5-31** Supervised by: **B.Nketia**

Borehole Location: **1240 Britannia Road West, Mississauga**

Driller: **Orbit Garant Drilling**

Drilling Method: **CME 75 with Hollow Stem Auger**

Borehole: **BH(MW)19-1**

Monitoring Well: **Installed**

Sheet 1 of 1

Scale (m)	Elev. (m) Depth (m)	Description	Sample Type and Number	Condition	Blows/ 150mm	% Recovery	RQD	Odour	Remarks and Sample Analyses
		Ground Surface Elevation:172.48m							
	172.40 0.08	**ORGANIC SILT (NATIVE)**, dark brown, moist, trace gravel and rootlets	1		2 9 23 16	67		N	PCBs, Metals and Inorganics analysis. Duplicate sample (DUP4)
		SILT (TILL), brown, moist to dry, some clay, trace gravel and sand, dense							
		- becomes compact to very dense from 0.61 to 2.44 m	2		3 7 8 13	100		N	
1			3		3 11 24 30			N	
2		- becomes dry with trace oxidation at 1.83 m	4		10 21 29 41	100		N	
		- becomes dense from 2.44 to 3.05 m	5		11 19 25 27	100		N	
3		- becomes compact at 3.05 m	6		7 13 16 24	100		N	
		- becomes dense to compact from 3.66 to 4.88 m	7		7 15 15 20			N	PAHs, Metals and Inorganic anlysis
4		- becomes greyish brown and moist at 4.27 m	8		9 10 14 14	83		N	
	167.60 4.88	**CLAYEY SILT (TILL)**, greyish brown, moist to dry, some, trace gravel and sand, stiff	9		3 5 6 9	100		N	
5			10-		2 4 5 6	100		N	
6			11		2 4 4 5			N	
	165.77 6.71	End of Borehole at 6.71 m Monitoring well was dry (El. 172.48 m) on June 7, 2019 Groundwater level at 5.56 m (El. 166.92 m) on June 21, 2019 Groundwater level at 5.63 m (El. 166.85 m) on June 24, 2019							Groundwater sample analyzed for VOCs, PAHs, PHCs (F1 to F4), Metals and Inorganics
7									

Headspace TOV (ppm) 100 200 300 400

Headspace TOV (%LEL) 20 40 60 80

Water Content (%) 20 40 60 80

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS- Very Strong

Prepared by: **B.Nketia**

Checked by: **R.B.German**

Date: **19-6-4**

ARCADIS

Project: **Edenshaw Homes** Contract No: **351583**

Boring date: **2019-6-3** Supervised by: **B.Nketia**

Borehole Location: **1240 Britannia Road West, Mississauga**

Driller: **Orbit Garant Drilling**

Drilling Method: **CME 75 with Hollow Stem Auger**

Borehole: **BH(MW)19-6**

Monitoring Well: **Installed**

Sheet 1 of 1

Scale (m)	Elev. (m) Depth (m)	Description (Ground Surface Elevation:174.19m)	Symbol	Well Details	Water Level	Sample Type and Number	Condition	Blows/ 150mm	% Recovery	RQD	Odour	Headspace TOV (ppm) 100 200 300 400 / Headspace TOV(%LEL) 20 40 60 80 / Water Content (%) 20 40 60 80	Remarks and Sample Analyses
	174.14	**ASPHALT**-50 mm				1		2	58		N		PAHs and Duplicate (DUP 1) analysis
	0.05	**GRANULAR BASE (FILL)**, brown, moist, loose						3					
	173.94	**SAND (FILL)**, brown, moist, fine grained, loose						4					
	0.25							4					
	173.81	**SILT (FILL)**, brown, dry, trace clay, gravel and sand, loose				2		4	75		N		
	0.38							8					
	173.58	**SILT (TILL)**, brown, moist to dry, some clay, trace gravel and sand, compact to very dense						14					
1	0.61							24					
						3		10	92		N		BTEX/PHCs and VOCs analysis
								17					
								26					
								27					
2		- trace oxidation at 1.83 m				4		17	83		N		Metals and Inorganics and Duplicate (DUP) analysis
								16					
								23					
								25					
						5		10	100		N		PAHs analysis
								19					
								29					
3								41					
						6		15	100		N		
								25					
								48					
								49					
						7		17	100		N		
								33					
4								45					
								50/					
						8		50	0		N		
								mm					
								50/					
	169.31							0					
5	4.88	**CLAYEY SILT (TILL)**, greyish brown, moist, trace gravel and sand, very stiff			▽	9		mm	100		N		
								6					
								12					
								13					
								19					
						10-		13	100		N		
								9					
								11					
6								17					
						11		2	100		N		
								10					
								12					
	167.48							17					
	6.71	End of Borehole at 6.71 m Groundwater level at 5.90 m (El. 168.29 m) on June 7, 2019 Groundwater level at 4.93 m (El. 169.26 m) on June 21, 2019 Groundwater level at 5.20 m (El. 168.99 m) on June 24, 2019											Groundwater sample analyzed for VOCs, PAHs, PHCs (F1 to F4), Metals and Inorganics
7													

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS- Very Strong

Prepared by: **B.Nketia**

Checked by: **R.B.German**

Date: **19-6-4**

ARCADIS

Project: **Edenshaw Homes** Contract No: **351583**

Boring date: **2019-5-31** Supervised by: **B.Nketia**

Borehole Location: **1240 Britannia Road West, Mississauga**

Driller: **Orbit Garant Drilling**

Drilling Method: **CME 75 with Hollow Stem Auger**

Borehole: **BH(MW)19-8**

Monitoring Well: **Installed**

Sheet 1 of 1

Scale (m)	Elev. (m) Depth (m)	Description (Ground Surface Elevation:174.48m)	Symbol	Well Details	Water Level	Sample Type and Number	Condition	Blows/ 150mm	% Recovery	RQD	Odour	Headspace TOV (ppm) 100 200 300 400 / Headspace TOV (%LEL) 20 40 60 80 / Water Content (%) 20 40 60 80	Remarks and Sample Analyses
	174.28 0.20	**ORGANIC SILT (NATIVE)**, dark brown, moist, trace rootlets, loose				1		2 4 5 8	75		N		
		SILT (TILL), brown, moist to dry, some clay, trace gravel and sand, loose to dense				2		5 12 15 21	92		N		
1						3		8 15 23 26	83		N		
2		- becomes dry with trace oxidation from 1.83 to 3.66 m				4		11 19 19 28	83		N		
		- becomes very dense to dense from 2.44 to 3.66 m				5		9 18 34 31	100		N		
3						6		20 17 26 35	100		N		
		- becomes very dense to dense from 3.66 to 5.49 m				7		23 50 40 55	13		N		
4		- becomes greyish brown colour and moist from 4.27 to 5.49 m				8		12 26 22 31	100		N		
5						9		8 17 18 28	33		N		Metals and Inorganics analysis
	168.99 5.49	**CLAYEY SILT (TILL)**, greyish brown, moist, trace gravel and sand, very stiff to hard			▽	10-		6 8 13 20	100		N		
6						11		9 13 18 21	18		N		
	167.77 6.71	End of Borehole at 6.71 m Groundwater level at 5.57 m (El. 168.91 m) on June 7, 2019 Groundwater level at 4.69 m (El. 169.79 m) on June 21, 2019 Groundwater level at 5.45 m (El. 169.03 m) on June 24, 2019												Groundwater sample and duplicate analyzed for VOCs, PAHs, PHCs (F1 to F4), Metals and Inorganics
7													

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS- Very Strong

Prepared by: **B.Nketia**

Checked by: **R.B.German**

Date: **19-6-4**

ARCADIS

Project: **Edenshaw Homes** Contract No: **351583**

Boring date: **2019-6-3** Supervised by: **B.Nketia**

Borehole Location: **1240 Britannia Road West, Mississauga**

Driller: **Orbit Garant Drilling**

Drilling Method: **CME 75 with Hollow Stem Auger**

Borehole: **BH19-11**

Monitoring Well: **n/a**

Sheet 1 of 1

Scale (m)	Elev. (m) Depth (m)	Description (Ground Surface Elevation:173.36m)	Symbol	Well Details	Water Level	Sample Type and Number	Condition	Blows/ 150mm	% Recovery	RQD	Odour	Headspace TOV (ppm) 100 200 300 400 / Headspace TOV (%LEL) 20 40 60 80 / Water Content (%) 20 40 60 80	Remarks and Sample Analyses
		ORGANIC SILT (NATIVE), dark brown, wet, trace to some clay, trace gravel and rootlets, very loose				1		1 1 2 3			N		PHCs, Metals and Inorganics analysis
	172.60 0.76	**SILT (TILL)**, brown, moist to dry, some clay, trace gravel and sand, compact to very dense				2		2 5 6 10	83		N		
1						3		2 10 12 24	100		N		
2						4		12 21 22 31	100		N		VOCs and Duplicate (DUP 3) analysis
		trace oxidation and large gravel at 2.44 m				5		14 37 42 48	100		N		
3						6		13 29 33 49	100		N		Grain Size and Hydrometer analysis
		- becomes dense at 3.66 m				7		8 18 20 23	83		N		
4						8		4 10 10 13	100		N		
5						9		4 9 10 12	92		N		
		- interbedded wet sand seams at 5.49 m				10-		3 5 11 13	88		N		
6						11		3 7 11 14	100		N		
	166.65 6.71	End of Borehole at 6.71 m											
7													

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS- Very Strong

Prepared by: **B.Nketia**

Checked by: **R.B.German**

Date: **19-6-4**

ARCADIS

Project: **Edenshaw Homes** Contract No: **351583**

Boring date: **2019-5-30** Supervised by: **B.Nketia**

Borehole Location: **1240 Britannia Road West, Mississauga**

Driller: **Orbit Garant Drilling**

Drilling Method: **CME 75 with Hollow Stem Auger**

Borehole: **BH19-4**

Monitoring Well: **n/a**

Sheet 1 of 1

Scale (m)	Elev. (m) Depth (m)	Description	Symbol	Well Details	Water Level	Sample Type and Number	Condition	Blows/ 150mm	% Recovery	RQD	Odour	Headspace TOV (ppm) / Headspace TOV (%LEL) / Water Content (%)	Remarks and Sample Analyses
		Ground Surface Elevation:173.39m											
	173.31 0.08	**ORGANIC SILT (FILL)**, dark brown, moist, trace rootlets and sand, compact				1		2 9 12 9	58		N		PAHs, Metals and Inorganic anlysis
		SILT (TILL), grey to brown, dry to moist, some clay, trace gravel, compact to loose											
						2		7 5 5 6	25		N		BTEX/PHCs and Duplicate (DUP 2) analysis
1													
		- trace rootlets and organic silt at 1.22 m				3		2 2 4 6	67		N		
2		- becomes compact to very dense from 1.83 to 4.88				4		2 6 8 16	92		N		
						5		9 16 22 50/	100		N		
3						6		100 mm	100		N		
								16 21 26					
						7		33 13 20	92		N		
4													
						8		28 44 15 48	100		N		
	168.51 4.88	**CLAYEY SILT (TILL)**, brown to greyish brown, moist, trace gravel and sand, very stiff				9		31 40 6 9	100		N		
5								12					
						10-		14 3 8 12	83		N		
6	167.29 6.10	End of Borehole at 6.10 m						16					
7													

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS- Very Strong

Prepared by: **B.Nketia**

Checked by: **R.B.German**

Date: **19-6-4**

ARCADIS

Project: **Edenshaw Homes** Contract No: **351583**

Boring date: **2019-6-3** Supervised by: **B.Nketia**

Borehole Location: **1240 Britannia Road West, Mississauga**

Driller: **Orbit Garant Drilling**

Drilling Method: **CME 75 with Hollow Stem Auger**

Borehole: **BH19-9**

Monitoring Well: **n/a**

Sheet 1 of 1

Scale (m)	Elev. (m) Depth (m)	Description (Ground Surface Elevation:173.86m)	Symbol	Well Details	Water Level	Sample Type and Number	Condition	Blows/ 150mm	% Recovery	RQD	Odour	Headspace TOV (ppm) 100 200 300 400 / Headspace TOV (%LEL) 20 40 60 80 / Water Content (%) 20 40 60 80	Remarks and Sample Analyses
	173.68	**ORGANIC SILT (NATIVE)**, dark brown, moist, trace rootlets and sand, loose				1		2 3 5 8	50		N		PAHs, PHCs, VOCs, Metals and Inorganics analysis
	0.18	**SILT (TILL)**, brown, moist to dry, some clay, trace gravel and sand, loose to very dense											
						2		7 10 17 25			N		
1						3		12 17 29 29	100		N		
						4		18 25 26 42	100		N		
2		trace oxidation and large gravel at 2.44 m				5		15 23 31 50	79		N		
						6		18 50/ 50 mm	25		N		
3		- becomes moist and dense to compact from 3.66 to 5.49 m				7		10 17 25 27	100		N		
		- becomes greyish brown colour and moist from 4.27 to 5.49 m				8		11 16 17 19	100		N		
4						9		6 10 12 21	100		N		
	168.37												
	5.49	**CLAYEY SILT (TILL)**, greyish brown, moist, trace gravel and sand, very stiff to stiff				10-		5 8 12 15	100		N		
5						11		3 7 7 10	100		N		VOCs analysis
	167.15												
	6.71	End of Borehole at 6.71 m											
6													
7													

ODOUR:
N - None
T - Trace
M - Moderate
S - Strong
VS- Very Strong

Prepared by: **B.Nketia**

Checked by: **R.B.German**

Date: **19-6-4**

ARCADIS

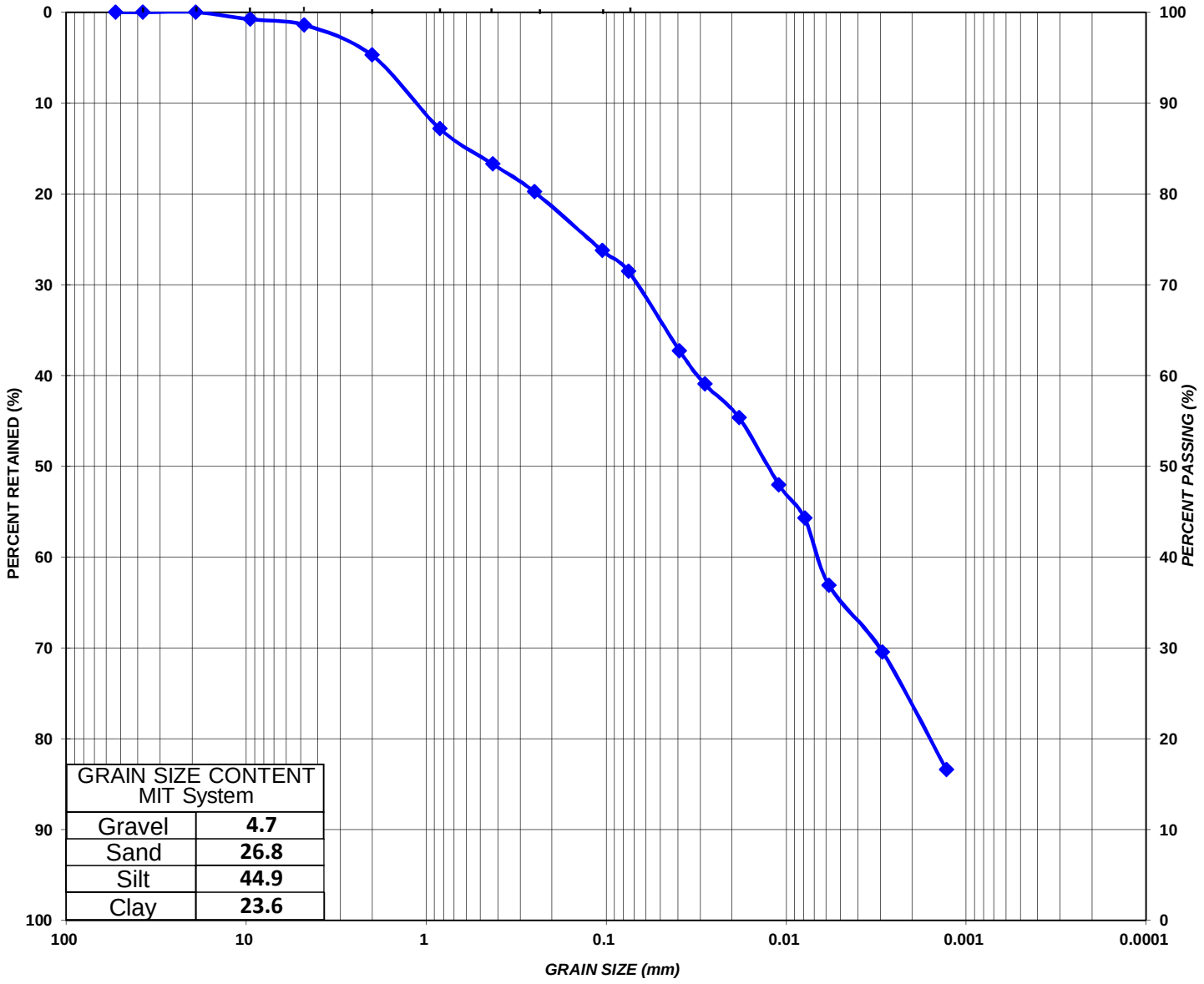
Terraprobe

SIEVE AND HYDROMETER ANALYSIS TEST REPORT

PROJECT: **1240 Britannia Road (351584)**
LOCATION: **Greater Toronto Area, On.**
CLIENT: **Arcadis Canada Inc.**
BOREHOLE: **19-11**
SAMPLE NUMBER: **6**
SAMPLE DEPTH: **10-12'**
SAMPLE DESCRIPTION: **CLAYEY SANDY SILT, trace gravel**

FILE NO.: **1-15-0599**
LAB NO.: **1178**
SAMPLE DATE: **Jun 12, 2019**
SAMPLED BY: **Client**

GRAIN SIZE DISTRIBUTION



GRAIN SIZE CONTENT MIT System	
Gravel	**4.7**
Sand	**26.8**
Silt	**44.9**
Clay	**23.6**

MIT SYSTEM	GRAVEL	COARSE	MEDIUM	FINE	SILT	CLAY
		SAND				

UNIFIED SYSTEM ASTM D2487	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
	GRAVEL		SAND			

Appendix B

General Requirements for Engineered Fill

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows; however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and DS Consultants Ltd (DSCL). Without this confirmation no responsibility for the performance of the structure can be accepted by DSCL. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a DSCL engineer prior to placement of fill.

5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by DSCL during placement of engineered fill is required. Work cannot commence or continue without the presence of the DSCL representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

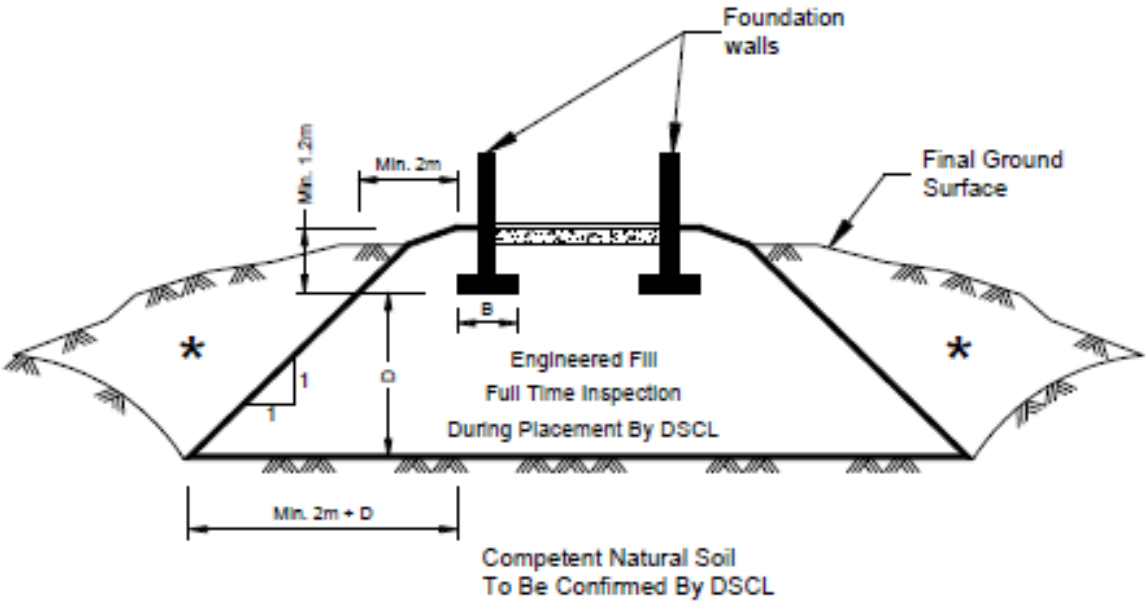
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from DSCL prior to footing concrete placements. All excavations must be backfilled under full time supervision by DSCL to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of DSCL.

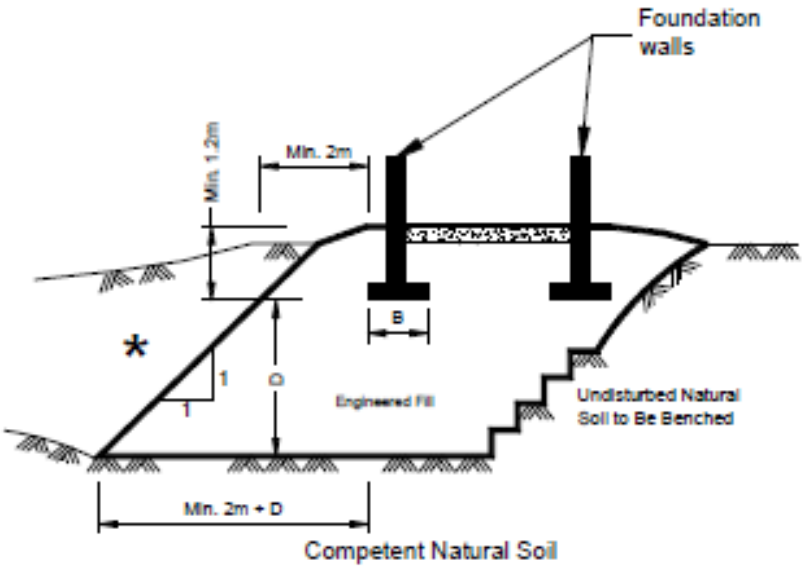
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with DS Consultants Ltd report attached.





* Backfill in this area to be as per the DSCL report.