GeoPro Consulting Limited

Geotechnical-Hydrogeology-Environmental-Materials-Inspection

Supplementary Geotechnical Investigation

Proposed Residential Development

Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

Prepared For:

869547 Ontario Inc.

GeoPro Project No.: 17-1780GHE3
Report Date: December 5, 2022

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GeoPro CONSULTING LIMITED

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1. INTRODUCTION

GeoPro Consulting Limited (GeoPro) was retained by 869547 Ontario Inc. (the Client) to conduct a supplementary geotechnical investigation for the proposed residential development located at Parts of Lots 3 and 4, Concession 5, Pickering, Ontario.

The purpose of this geotechnical investigation was to obtain information on the existing subsurface conditions by means of a limited number of boreholes, in-situ tests and laboratory tests of soil samples to provide required geotechnical design information. Based on GeoPro's interpretation of the data obtained, geotechnical comments and recommendations related to the project designs are provided.

The report is prepared with the condition that the design will be in accordance with all applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practice. Further, the recommendations and opinions in this report are applicable only to the proposed project as described above. On-going liaison and communication with GeoPro during the design stage and construction phase of the project are strongly recommended to confirm that the recommendations in this report are applicable and/or correctly interpreted and implemented. Also, any queries concerning the geotechnical aspects of the proposed project shall be directed to GeoPro for further elaboration and/or clarification.

This report is provided on the basis of the terms of reference presented in our approved proposal prepared based on our understanding of the project. 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 report can be relied upon.

This report deals with geotechnical issues only. The geo-environmental (chemical) aspects of the subsurface conditions, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, were not investigated and were beyond the scope of this assignment.

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

This report has been prepared for the Client. Third party use of this report without GeoPro's consent is prohibited. The limitations to the report presented in this report form an integral part of the report and they must be considered in conjunction with this report.

2. SITE AND PROJECT DESCRIPTION

The subject sites are located at Concession Road 5 (east of Sideline 4 and north of Dexshire Drive) in the City of Pickering, Ontario. The proposed developments consist of single houses, roads, municipal watermain, storm sewer and private septic system on each of the thirteen separate lots on both sides of the creek.

3. PREVIOUS GEOTECHNICAL INVESTIGATION BY GEOPRO

A previous geotechnical investigation was carried out for the proposed residential development in 2017. The previous geotechnical report entitled "*Geotechnical Investigation* – Proposed Residential Developments, Parts of Lots 3 and 4, Concession 5, Pickering, Ontario*"* was submitted to JFC Developments Ltd. dated May 31, 2017. The borehole logs of the previous geotechnical investigation carried out by GeoPro are attached in Appendix A.

4. INVESTIGATION PROCEDURE

The field work for the geotechnical investigation was carried out on August 27 and 29, 2021, during which time six (6) boreholes (Boreholes BH101 to BH106) were advanced to a depth of about 5.0 m below the existing ground surface. The borehole locations are shown on the attached Drawings.

A proposed borehole location plan prepared by GeoPro was provided to Client for review prior to the field investigation work. The approved borehole locations were staked in the field by GeoPro; the borehole locations in the field were adjusted according to the drill rig accessibility and the underground utility conditions. The field work for this investigation was monitored by a member of our engineering staff who logged the boreholes and cared for the recovered samples.

The boreholes were advanced using a continuous flight auger drilling equipment supplied by a drilling specialist subcontracted to GeoPro. Samples were retrieved with a 51 mm (2 inches) O.D. split-barrel (split spoon) sampler driven with a hammer weighing 624 N and dropping 760 mm (30 inches) in accordance with the Standard Penetration Test (SPT) method.

Groundwater condition observations were made in the boreholes during drilling and upon completion of drilling. All boreholes were backfilled and sealed upon completion of drilling.

All soil samples obtained during this investigation were brought to our laboratory for further examination. These soil samples will be stored for a period of three (3) months after the day of issuing draft report, after which time they will be discarded unless we are advised otherwise in writing. Geotechnical classification testing (including water content, grain size distribution and Atterberg Limits, when applicable) was carried out on selected soil samples.

The ground surface elevations at the as drilled borehole locations were not available at the time of preparing this report. Therefore, the stratigraphy at each borehole location has been referenced to the current grade level. Contractors performing the work should confirm the

elevations prior to construction. The borehole locations plotted on Borehole Location Plan were based on the measurements of the site features and should be considered to be approximate.

5. SUBSURFACE CONDITIONS

Notes on sample descriptions are presented in Enclosure 1A. Explanations of terms used in the borehole logs are presented in Enclosure 1B. The subsurface conditions in the boreholes are presented in the individual borehole logs. Detailed descriptions of the major soil strata encountered in the boreholes drilled at the site are provided as follows.

5.1 Soil Conditions

Topsoil

Topsoil with thicknesses ranging from 120 mm to 350 mm was encountered surficially in all boreholes. In general, the topsoil consists of high contents of organics with trace to some rootlets.

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.

Fill Materials

Fill materials consisting of silty fine sand were encountered in Boreholes BH101, BH105 and BH106 below the topsoil, and extended to depths ranging from about 0.7 m to 1.8 m below the existing ground surface. SPT N values ranging from 3 to 13 blows per 300 mm penetration indicated a very loose to compact compactness.

Probable Fill Materials

Probable fill materials consisting of silty fine sand was encountered in Borehole BH101 below the topsoil, and extended to a depth of about 2.1 m below the existing ground surface. An SPT N value of 6 blows per 300 mm penetration indicated a loose compactness.

Reworked Silty Fine Sand

Reworked silty fine sand (native soils disturbed by previous site activities such as farming) were encountered below the topsoil in Boreholes BH102 to BH104, and extended to a depth of about 1.1 m below the existing ground surface. SPT N values ranging from 2 to 7 blows per 300 mm penetration indicated a very loose to loose compactness.

Silt, (Fine) Sandy Silt, Fine Sand and Silt, and Silty (Fine) Sand

Silt, (fine) sandy silt, fine sand and silt, and silty (fine) sand deposits were encountered below the (probable) fill materials, reworked soils and/or clayey silt deposit in all boreholes, and extended to depths ranging from about 2.9 m to 5.0 m below the existing ground surface. Boreholes BH101

to BH105 were terminated in these deposits. SPT N values ranging from 2 to 70 blows per 300 mm penetration indicated a very loose to very dense compactness.

Clayey Silt

Clayey silt deposit was encountered below the fill materials in Borehole BH106, and extended to a depth of about 1.4 m below the existing ground surface. An SPT N value of 22 blows per 300 mm penetration indicated a very stiff consistency.

Sandy Silt Till

Sandy silt till deposit was encountered below the sandy silt deposit in Borehole BH106, and extended to a depth of about 5.0 m below the existing ground surface. Borehole BH106 was terminated in this deposit. SPT N values ranging from 33 to 50 blows per 300 mm penetration indicated a dense compactness.

5.2 Groundwater Conditions

Groundwater condition observations made in the boreholes during and immediately upon completion of drilling are shown in the borehole logs and are also summarized in the following table.

BH No.	BH Depths (m)	Water Level during Drilling (mBGS)	Water Level on Completion of Drilling (mBGS)	Cave-in Depth on Completion of Drilling (mBGS)
BH101	5.0	3.0	3.2	4.2
BH102	5.0	4.6	4.4	4.6
BH103	5.0	3.0	3.2	4.3
BH104	5.0	1.4	2.0	3.2
BH105	5.0	1.8	2.2	3.4
BH106	5.0	-	-	4.5

Note: mBGS = meter below ground surface

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

6. DISCUSSION AND RECOMMENDATIONS

6.1 General

This report contains the findings of GeoPro's geotechnical investigation, together with geotechnical engineering recommendations and comments. These recommendations and

comments are based on factual information and are intended only for use by the design engineers. The number of boreholes may not be sufficient to determine all factors that may affect construction methods and costs. Subsurface conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction that could not be detected or anticipated at the time of the site investigation. The anticipated construction conditions are also discussed, but only to the extent that they may influence design decisions. The construction methods discussed, however, express GeoPro's opinion only and are not intended to direct contractors on how to carry out construction. Contractors should also be aware that the data and interpretation presented in this report may not be sufficient to assess all factors that may have an effect on construction.

The detail design drawings of the project are not available at the time of preparing this report. Once the design drawings and detail site plan are available, this report should be reviewed by GeoPro and further recommendations be provided as appropriate.

6.2 Subgrade Preparation and Engineered Fill

The proposed site grading plans are not available at this time. However, it is anticipated that cut and fill operations would be required to establish appropriate subgrade levels throughout the site. In the areas where earth fill is required for site grading purposes, engineered fill may be utilized to support foundations of buildings, roads, etc.

For the preparation of subgrade prior to the placement of the engineered fill, all topsoil, existing (probable) fill materials, existing reworked soils and surficially softened/loosened native soils must be removed and the exposed subgrade proof rolled. Any soft spots revealed during proof rolling must be sub-excavated and re-engineered, and the excavation base must be inspected and approved by GeoPro prior to the placement of backfill. The extent and thickness of the existing fill materials and reworked soils must be inspected at the time of construction to make sure that all fill materials and reworked soils are removed prior to the placement of the engineered fill. Materials for the use of engineered fill must be approved by GeoPro prior to placement.

Based on the measured water contents, the majority the native silty/sandy/gravelly deposits above the groundwater tables, native glacial tills and native stiff to hard clayey soils have water contents generally near their estimated laboratory optimum water contents for compaction. On the other hand, the cohesionless soils below the prevailing groundwater tables are expected to be generally wet of their optimum water contents for compaction and these soils will likely require some drying prior to placement.

It should be noted that due to the fine-grained nature of the soils encountered at the site (e.g., clayey/silty/fine sandy soils), their workability is sensitive to moisture conditions and some difficulty would be expected in achieving adequate compaction. In this regard, imported materials may have to be used for engineered fill. The materials used for engineered fill must be approved by GeoPro at the source(s), prior to hauling to the site. The engineered fill consisting of

approved inorganic material should be placed in maximum 300 mm loose lifts and uniformly compacted to 98% Standard Proctor Maximum Dry Density (SPMDD) throughout.

General guidelines for the preparation of the subgrade and the placement of engineered fill are presented in Appendix B. The recommended procedures for the placement of engineered fill is outlined below:

1. Prior to the site work involving engineered fill, a kick-off site meeting to discuss all aspects of the engineered fill placement must be carried out with all parties. The surveyor, contractor, design engineer and geotechnical engineer must attend the kick-off meeting. At the meeting, the construction schedule and the detailed design information in regard to the engineered fills, such as the boundary, and the thickness will be determined. The contractor must provide the construction schedule including the source site(s) of the fill materials, for review by the geotechnical engineer. The geotechnical engineer will arrange for the soil sampling at the source site(s) and carry out related laboratory testing. No soils can be hauled to the site prior to the approval by the geotechnical engineer.

2. Detailed design drawings such as grading drawings indicating the underside elevations of the engineered fill as well as the finished elevations of the engineered fill must be made 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 GeoPro. Without this confirmation in writing, no responsibility for the performance of the structure can be accepted by GeoPro. Survey drawings of the pre and post fill location and elevations will also be required.

4. The subgrade area must be stripped of all topsoil, reworked soils and fill materials. Subgrade must be proof-rolled in the presence of a qualified engineering staff from GeoPro. Any soft/loose spots revealed by proofroll must be subexcavated and be replaced with engineered fill. The stripped native subgrade must be examined and approved by a GeoPro engineer prior to placement of engineered fill.

5. The approved engineered fill must be compacted to 98% Standard Proctor Maximum Dry Density throughout. Granular fill materials consisting well graded cohesionless sand and gravel are preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Settlement of Engineered Fill will occur and is discussed further in the following section. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads may occur.

6. Full-time geotechnical inspection and compaction testing by GeoPro during placement of engineered fill are required and must be undertaken. The placement

of the engineered fill must not commence or continue without the presence of the GeoPro's representative.

7. Excavations must be carried out in accordance with the Occupational Health and Safety Regulations of Ontario.

8. Surface water cannot be allowed to pond in any area of the engineered fill footprint.

9. Clear stone backfill must not be used in any portion of the engineered fill unless it is approved by GeoPro in writing.

10. Upon completion of engineered fill, the surface of the pad must be protected from disturbance from traffic, rain and frost.

11. Should the construction of the structures on the engineered fill be not carried out for a period of time, the finished engineered fill pad must be inspected and accepted by GeoPro. The location of the structure must be reconfirmed that it remains within the pad.

6.3 Settlement of Engineered Fill

Engineered fill compacted to 98% of SPMDD will settle under its own weight approximately 0.25% to 0.75% of the fill thickness. The designer and the structural engineer must be aware of this settlement. For example, where the engineered fill is 5 m in thickness, the settlement of fill under its own weight is expected to be in the range of 25 mm on a non-yielding subgrade. The settlement of the engineered fill will occur with time. For engineered fill consisting of sandy silt to silty sand material, about 75% of the settlement is expected to occur within 3 months after the placement of the engineered fill; for engineered fill consisting of clayey silt to silty clay material, about 75% of the settlement is expected to occur within 3 to 6 months or longer after the placement of the engineered fill.

Engineered fill which consists of Granular B material (sand and gravel) will undergo less self-weight settlement (about 0.25% to 0.5% of the fill thickness). In addition, the settlement of engineered Granular B fill will be completed in a shorter period of time. For engineered fill consisting of Granular B material compacted to 98% of SPMDD, a major portion (75% or higher) of the settlement due to the self-weight is expected to be completed during the construction stage before the placement of the structures.

6.4 Foundation Conditions

Footings founded on approved engineered fill, the geotechnical bearing resistance may be taken as 150 kPa at Serviceability Limit State (SLS), and a factored bearing resistance of 225 kPa at

Ultimate Limit State (ULS) in the vicinity of all boreholes except Borehole BH103; the geotechnical bearing resistance may be taken as 100 kPa at Serviceability Limit State (SLS), and a factored bearing resistance of 150 kPa at Ultimate Limit State (ULS) in the vicinity of Borehole BH103, provided that all requirements in Appendix B are adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the construction must be considered.

The native compact to very dense/very stiff to hard subsoils at the site are considered to be suitable for supporting conventional shallow foundations for light residential houses with basements. A geotechnical bearing resistance of 150 kPa at Serviceability Limit States (SLS), and a factored geotechnical bearing resistance of 225 kPa at Ultimate Limit States (ULS) in the vicinity of all boreholes except Borehole BH103; the geotechnical bearing resistance may be taken as 100 kPa at Serviceability Limit State (SLS), and a factored bearing resistance of 150 kPa at Ultimate Limit State (ULS) in the vicinity of Borehole BH103, may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed, competent subsoils.

Variations in the soil conditions are expected between and beyond the borehole locations, and during construction, the actual subgrade should be carefully inspected and its bearing capacity evaluated by the geotechnical engineer from GeoPro.

In general, for any houses placed wholly or in part on engineered fill, it is recommended that the foundations be provided with nominal reinforcement using steel rebar. Once the final thicknesses and extent of engineered fill are known, the need for and design of any reinforcement can be determined on a lot-by-lot basis by the builder's structural engineer, in consultation with the geotechnical engineer.

All foundation excavations at the site should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The founding materials are susceptible to disturbance by construction activity especially during wet weather and care should be taken to preserve the integrity of the materials as bearing strata. Prior to pouring concrete for the footings, the foundation excavations **must** be inspected by GeoPro to confirm that the footings are founded on an undisturbed and competent bearing stratum that has been cleaned of ponded water and all disturbed, softened, loosened, organic and other deleterious material.

All footings exposed to seasonal freezing and thawing must be provided with a minimum earth cover of 1.2 meters or equivalent insulation to satisfy frost protection requirements.

Settlements induced by the recommended SLS bearing pressures will be less than 25 mm total and 19 mm differential and within the tolerable limits of construction.

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

6.5 Basement Floor Slab

Should the finalized basement floor drainage pipe elevations be set at least 1.0 m above the highest local water tables, the underfloor drains may not be required unless water bearing soils or wet soils are encountered. Underfloor drains and upgraded level of water-proofing would be necessary in areas of the site if basements are proposed to be located near or below the local groundwater tables and in potentially water bearing soils or wet soils. Under-floor-slab drainage may be required for basements under such conditions and these conditions should be identified in the field by GeoPro on a lot-by-lot basis. The drainage tiles consisting of 100 mm diameter perforated pipes with filter fabric, should discharge into a positive frost-free outlet, as shown on schematic Drainage and Backfill Recommendations, Drawing 2 or, alternatively, the drainage tiles can be connected to sump wells/pits. Perimeter drainage tiles must be considered and should discharge into a positive frost free outlet. Exterior basement walls should be damp-proofed above the water table, and water-proofed below the water table. The backfill against the footing and foundation walls should consist of free-draining, non-frost-susceptible granular or equivalent. The on-site materials such as clayey/silty soils may have adfreezing potential; if these soils are used to backfill against the perimeter foundation walls, a polyethylene slip-membrane should be placed below ground surface on the perimeter foundations walls. Vertical drains should be installed at the window wells and connected to the perimeter drains to reduce basement dampness. GeoPro recommends that 'dimple board' be used on all foundation walls below ground surfaces.

It should be noted that the artesian conditions were encountered in some boreholes which should be considered in the design.

6.6 Earth Pressures on Basement Walls

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 kN/m^3 may be assumed

h = Depth to point of interest in meters

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 walls.

6.7 Excavations and Groundwater Control

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the existing loose to compact (probable) fill materials, loose to dense reworked soils and native stiff to hard/loose to very dense native soils can be classified as Type 3 soils above the groundwater table and Type 4 soils below the groundwater table; the existing very loose (probable) fill materials, very loose reworked soils and very loose native soils can be classified as Type 4 soils. However, depending upon the construction procedures adopted by the contractor, actual groundwater seepage conditions, the success of the contractor's groundwater control methods and weather conditions at the time of construction, some flattening and/or blanketing of the slopes may be required, especially in loose/soft zones (i.e. in fills or wet silty/sandy deposits) or where localized seepage is encountered. The stability of the side slopes and base may not be achieved for the excavations extending below the groundwater table due to the fine grained silty/sandy soils, even for temporary open cuts with side slopes not steeper than 3 horizontal to 1 vertical (3H:1V). Below the water table, unsupported excavations in the cohesionless soils cannot safely proceed unless lowering the groundwater table to at least 1 m below the base of the excavation has been achieved.

It should be noted that some difficulties may be encountered in excavating the native soils at some locations. In addition, these native soils are inferred to contain cobbles and boulders. Obstruction may be expected in the existing fill materials. It is recommended that provisions should be made in the excavation contract for the removal of such obstructions. In addition, care must be taken during excavation to ensure that adequate support is provided for any existing structures or underground services located adjacent to the excavations.

Groundwater control at the site should be required to allow for construction of foundation elements in a dry condition. Groundwater control during excavation within the native stiff to hard clayey soils and compact to very dense/very stiff to hard glacial tills can be handled, as required, by pumping from properly constructed and filtered sumps located within the excavations. Perched groundwater may be expected in the (probable) fill materials, reworked soils and native cohesionless silty/sandy/gravelly soils above the groundwater tables at various depths. Groundwater control during excavation within the (probable) fill materials, reworked soils and native cohesionless silty/sandy/gravelly deposits above the groundwater table at the site can be handled, as required, by pumping from properly constructed and filtered sumps located within the excavations. However, more significant groundwater seepage should be expected from (probable) fill materials, reworked soils, native cohesionless silty/sandy/gravelly soils encountered at the site and any cohesionless silty/sandy layers/zones within the tills and clayey deposits, if excavations extend below the prevailing groundwater tables at the time of construction. The groundwater level should be lowered to at least 1 m below the excavation base prior to excavations.

It should be noted that any construction dewatering or water taking in Ontario is governed by Ontario Regulation 387/04 - Water Taking and Transfer, made under the Ontario Water Resources Act (OWRA), and/or Ontario Regulation 63/16 – Registrations under Part II.2 of the Act – Water

Taking, made under Environmental Protection Act. Based on these regulations, water taking of more than 400,000 L/day is subject to a Permit to Take Water (PTTW), while water taking of 50,000 L/day to 400,000 L/day is to be registered through the Environmental Activity and Sector Registry (EASR). A hydrogeological study was concurrently carried out by GeoPro and will be reported under a separate cover.

6.8 Winter Condition

In the event of construction during freezing temperatures, the foundation stratum should be protected from freezing by the use of loose straw, tarpaulins, propane heaters or other suitable means. In this regard, the base of the excavation should be insulated from sub-zero temperatures immediately upon exposure and until such time the footings are protected with sufficient soil cover to prevent freezing at the foundation level.

6.9 Roads

Based on the subsurface conditions encountered at the site and the assumed traffic usage for residential local streets, the following pavement designs are recommended for the subdivision streets:

MATERIAL		THICKNESS OF PAVEMENT ELEMENTS (MM)	
		LOCAL	COLLECTOR
Asphaltic Material (OPSS 1150)	HL 3 Surface Course	40	40
	HL 8 Binder Course	50	100 (2 lifts)
Granular Material (OPSS 1010)	Granular A Base (or 20 mm Crusher Run Limestone Base)	150	150
	OPSS Granular B Subbase	300	450
Prepared and Approved Subgrade			

The recommended pavement structures should be considered for preliminary design purposes only. The pavement thickness should also conform to the requirements of the local municipality. This pavement design requires a number of years to the first rehabilitation and regular maintenance. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific traffic data input from the Client.

Subject to the subgrade conditions (i.e. backfill materials wet of optimum water contents being placed) and weather conditions (i.e. during wet weather), the placement of thicker granular base/sub-base layer in order to facilitate the construction may be required. The need for filter

fabric/geo-grid can be evaluated during construction. Furthermore, heavy construction equipment/vehicles may cause the disturbance to the subgrade and granular base/subbase before the placement of asphalt, especially during wet weather, and should be considered during construction.

It should be noted that in some cases, even though the compaction requirements have been met, the subgrade strength in the trench backfill areas may not be adequate to support heavy construction loading, especially during wet weather or where backfill materials wet of optimum water contents have been placed. In any event, the subgrade should be proofrolled and inspected by a qualified geotechnical engineer prior to placing the Granular B subbase and additional granular material, as required, consistent with the prevailing weather conditions and anticipated use by construction traffic.

6.9.1 Stripping, Sub-excavation and Grading

The site should be stripped of all topsoil and any organic or other unsuitable soils to the full depth of the pavement areas.

Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof-rolled by a heavily loaded truck, in the presence of the geotechnical engineer from GeoPro. Any soft spots exposed during the proofroll should be completely 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). If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported select material may need to be used.

The final subgrade should be cambered or shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate. Proper cambering which allows the water to escape towards the sides (where it can be removed by means of subdrains or ditches) should be considered for the project. Otherwise, any water trapped in the granular base and subbase materials may cause problems due to softened subgrade, and differential frost heave, etc.

Any fill materials required for re-grading the site or backfill should be free of topsoil, organic or any other unsuitable matter and must be approved by the geotechnical engineer from GeoPro. The fill should be placed in thin layers and compacted to at least 95 percent of its SPMDD. The compaction should be increased to 98 percent of the SPMDD within the top 1.0 m of the subgrade, or as per local municipal standards. The compaction of the new fill should be checked by frequent field density tests, which should satisfy the engineers and/or local municipal standards.

6.9.2 Construction

Once the subgrade has been inspected, proofrolled and approved, the granular base and subbase course materials should be placed in layers not exceeding 300 mm (uncompacted loose lift thickness) and should be compacted to at least 98% of their respective SPMDD. The construction and 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.

6.9.3 Drainage

Should ditch drainage be considered, the bottom of the ditch should be at least 0.5 m lower than the underside elevation of the granular subbase. The ditch should be provided with sufficient gradient to promote the drainage.

Alternatively, if installation of full-length subdrains along all roads, should be required, the subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

The sub-drains system should consist of 100 mm or 150 mm diameter geotextile wrapped perforated pipe, placed inside a 300 mm X 300 mm trench and surrounded on all sides by 20 mm clear stone (minimum 50 mm at the bottom side) and wrapped in filter cloth (Terrafix 270R or the equivalent approved by the engineers). The filter cloth wrap should have a minimum overlap of at least 150 mm. The pipes should be placed such that the top of the sand filter is at subgrade level and connected to catchbasins or some other permanently frost-free outlet to provide positive drainage. In addition, the subgrade should be graded at a slope of minimum 2% downwards towards the subdrains to promote the drainage.

All paved surfaces should be sloped to provide satisfactory drainage towards catchbasins. The finished pavement surface and underlying subgrade should be free of depressions and should be crowned and sloped (at a crossfall of minimum 1.5% for the paved surface and minimum 2% for the subgrade subject to the design engineers or local design standards) to provide effective drainage. As discussed above, by means of good planning any water trapped in the granular base materials should be drained rapidly towards subdrains or other interceptors.

6.10 Site Servicing

The invert depths of the proposed watermain and storm sewer were not available at the time of preparing the report. We have assumed that the majority of the site services installations will require excavations between about 2 m and 4 m below the existing ground surface. The native soils and properly constructed engineered fills are considered to be suitable for supporting the pipes, provided the integrity of the base of the trenches can be maintained during construction.

The suitability of the reworked soils or (probable) fill materials to support the pipes, if encountered at the base of the trenches, should be further assessed during construction. This assessment will require inspection during construction by qualified geotechnical personnel from GeoPro to determine the suitability of the (probable) fill materials and reworked soils for supporting the pipes. It should be noted that some difficulties may be encountered in excavating the native soils at some locations. In addition, these native soils are inferred to contain cobbles and boulders. Obstruction may be expected in the fill materials. Once the actual service invert depths are finalized, the following comments and recommendations should be reviewed and revised as necessary.

6.11 Trenching Excavation and Temporary Groundwater Control

Based on the results of this investigation, excavations (assumed up to 4 m below ground surface) for the site services will be subexcavated through (probable) fill materials, reworked soils, native cohesionless silty/sandy soils, native cohesive clayey soils and glacial tills. The site servicing pipes are anticipated to be generally be below the groundwater tables measured at borehole locations.

Groundwater control during excavation within the native very stiff clayey soils and compact to very dense/hard glacial tills can be handled, as required, by pumping from properly constructed and filtered sumps located within the excavations. Perched groundwater may be expected in the (probable) fill materials, reworked soils and native cohesionless silty/sandy soils above the groundwater tables at various depths which can be handled, as required, by pumping from properly constructed and filtered sumps located within the excavations. However, more significant groundwater seepage should be expected from (probable) fill materials, reworked soils, native cohesionless silty/sandy soils below the prevailing groundwater tables and any cohesionless wet silty/sandy layers/zones within the tills and clayey deposits. Depending upon the actual thickness and extent of these water bearing soils, the finalized design pipe invert depths, and the prevailing groundwater tables at the time of construction, some form of positive (pro-active) groundwater control or depressurization may be required to maintain the stability of the base and side slopes of the trench excavations, in addition to pumping from sumps. The groundwater level should be lowered to at least 1 m below the excavation base prior to excavating for the site services.

It should be noted that any construction dewatering or water taking in Ontario is governed by Ontario Regulation 387/04 - Water Taking and Transfer, made under the Ontario Water Resources Act (OWRA), and/or Ontario Regulation 63/16 – Registrations under Part II.2 of the Act – Water Taking, made under Environmental Protection Act. Based on these regulations, water taking of more than 400,000 L/day is subject to a Permit to Take Water (PTTW), while water taking of 50,000 L/day to 400,000 L/day is to be registered through the Environmental Activity and Sector Registry (EASR). A hydrogeological study was concurrently carried out by GeoPro and will be reported under a separate cover.

Care should be taken to direct surface runoff away from the open excavations and all excavations should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. According to the Act, the existing loose to compact (probable) fill materials, loose to dense reworked soils and native stiff to hard/loose to very dense native soils can be classified as Type 3 soils above the groundwater table and Type 4 soils below the groundwater table; the existing very loose (probable) fill materials, very loose reworked soils and very loose native soils can be classified as Type 4 soils and unless supported by shoring or other approved retaining method, the excavations will require minimum side slopes of 3H:1V for Type 4 soils. However, depending upon the construction procedures adopted by the contractor, groundwater seepage conditions and weather conditions at the time of construction, some local flattening of the slopes may be required, especially in looser/softer zones (i.e. in fills, reworked soils or wet silty/sandy/gravelly deposits) or where localized seepage is encountered. The stability of the side slopes and base may not be achieved for the excavations extending below the groundwater table due to the fine grained silty/sandy soils, even for temporary open cuts with side slopes not steeper than 3 horizontal to 1 vertical (3H:1V). Below the water table, unsupported excavations in the cohesionless soils cannot safely proceed unless lowering the groundwater table to at least 1 m below the base of the excavation has been achieved. In addition, care must be taken during excavation to ensure that adequate support is provided for any existing structures and underground services located adjacent to the excavations.

Where the excavation side slopes must be steepened to limit the extent of the excavation, some form of temporary trench support, such as a trench box system, will be required. Where cohesionless silty/sandy/gravelly soils are present in close proximity to the proposed excavation above the invert elevations, some loss of ground should be expected for the sections of nearly vertical excavation where a trench box is used. It is anticipated that the unsupported cohesionless soils on the trench sides will relax, filling the void between the trench walls and trench box. This may lead to loss of ground. In order to minimize this effect, the gap between the trench walls and trench box should be minimized during the excavation and trench box installation. It must be emphasized that a trench liner box provides protection for construction personnel but does not provide any lateral support for the adjacent excavation walls, underground services or existing structures. In addition, steepened excavations should be left open for as short a duration as possible and completely backfilled at the end of each working day.

The excavated material should be placed well back from the edge of the excavation and stockpiling of materials adjacent to the excavation should be prohibited, to minimize surcharge loading near the excavation crest.

6.12 Bedding

The bedding for the service pipes should be compatible with the type and class of pipe, the surrounding subsoil and anticipated loading conditions and should be designed in accordance with the standards of the local municipality or Ontario Provincial Standard Specifications (OPSS). Where granular bedding is deemed to be acceptable, it should consist of at least 150 mm of OPSS Granular A or 19 mm crusher run limestone material. The thickness of the bedding may, however,

have to be increased (i.e. 300 mm to 450 mm) depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soils at the trench base level consists of wet sandy/silty deposits. From springline to 300 mm above obvert of the pipe, sand cover could be used. All bedding and cover material should be placed in 150 mm loose lifts and uniformly compacted to at least 98 percent of the material's Standard Proctor Maximum Dry Density (SPMDD).

To avoid the loss of soil fines from the subgrade, clear stone bedding material should not be used in any case for pipe bedding or to stabilize the bases.

6.13 Backfilling of Trenches

Based on visual and tactile examination and the measured nature water contents of the soil samples, the majority of the existing cohesionless (probable) fill materials, reworked soils, and native silty/sandy deposits above the groundwater tables, native glacial tills and native very stiff clayey soils are anticipated to be generally near their estimated optimum water contents for compaction; however, the water contents of the cohesionless soils below the groundwater tables may be greater than the optimum water contents, which would require some drying prior to being reused as backfill materials.

The excavated materials at suitable water contents may be reused as trench backfill provided they are free of significant amounts of topsoil, organics or other deleterious material, and are placed and compacted as outlined below. It should also be noted that due to the existing fine-grained, clayey/silty/fine sandy nature of the majority of the existing native soils, some difficulty would be expected in achieving adequate compaction during wet weather.

The backfill should be placed in maximum 300 mm loose lifts at or near (±2%) their optimum moisture content and each lift should be compacted to at least 95% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling. In pavement areas, the upper zone of the trench backfill within the depth of 1.2 m below the pavement surface should be non frost susceptible materials without excessive fines and compacted to at least 98% SPMDD. The fine grained silty soils encountered at the site is potentially with highly frost susceptibility and should not be used in the upper zone of the trench backfill within the depth of 1.2 m below the pavement surface. Cobbles and boulders were encountered in the boreholes carried out at the site. Provision of removal of the cobbles and boulders shall be considered in the contract.

The service pipes exposed to seasonal freezing and thawing must be provided with a minimum earth cover of 1.2 meters or equivalent insulation to satisfy frost protection requirements.

It should be noted that if the soils for trench backfilling were placed and compacted at wet of their optimum water content (>2%), we would expect pumping and rolling conditions which would require mitigative measures in order to construct roads and utilities. This might include significant

extra thickness of granular base, base reinforcement using geogrids or importing of better quality common fill.

Alternatively, if placement water contents at the time of construction are too high, or if there is a shortage of suitable in-situ material, then an approved imported sandy material which meets the requirements for OPSS Select Subgrade Material (SSM) could be used. It should be placed in loose lift thicknesses as indicated above and uniformly compacted to at least 95% of SPMDD. Backfilling operations during cold weather should avoid inclusions of frozen lumps of material, snow and ice.

Normal post-construction settlement of the compacted trench backfill should be anticipated, with the majority of such settlement taking place within about 6 months following the completion of trench backfilling operations. This settlement may be compensated for, where necessary, by placing additional granular material prior to asphalt paving. Alternatively, if the asphalt binder course is placed shortly following the completion of trench backfilling operations in these areas, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding.

7. MONITORING AND TESTING

The geotechnical aspects of the final design drawings and specifications should be reviewed by GeoPro prior to tendering and construction, to confirm that the intent of this report has been met. During construction, full-time engineered fill monitoring and sufficient foundation inspections, subgrade inspections, in-situ density tests and materials testing should be carried out to confirm that the conditions exposed are consistent with those encountered in the boreholes, and to monitor conformance to the pertinent project specifications.

8. CLOSURE

We appreciate the opportunity to be of service to you and trust that this report provides sufficient geotechnical engineering information to facilitate the detail design of this project. We look forward to providing you with continuing service during the construction stage. Please do not hesitate to contact our office should you wish to discuss, in further detail, any aspects of this project.

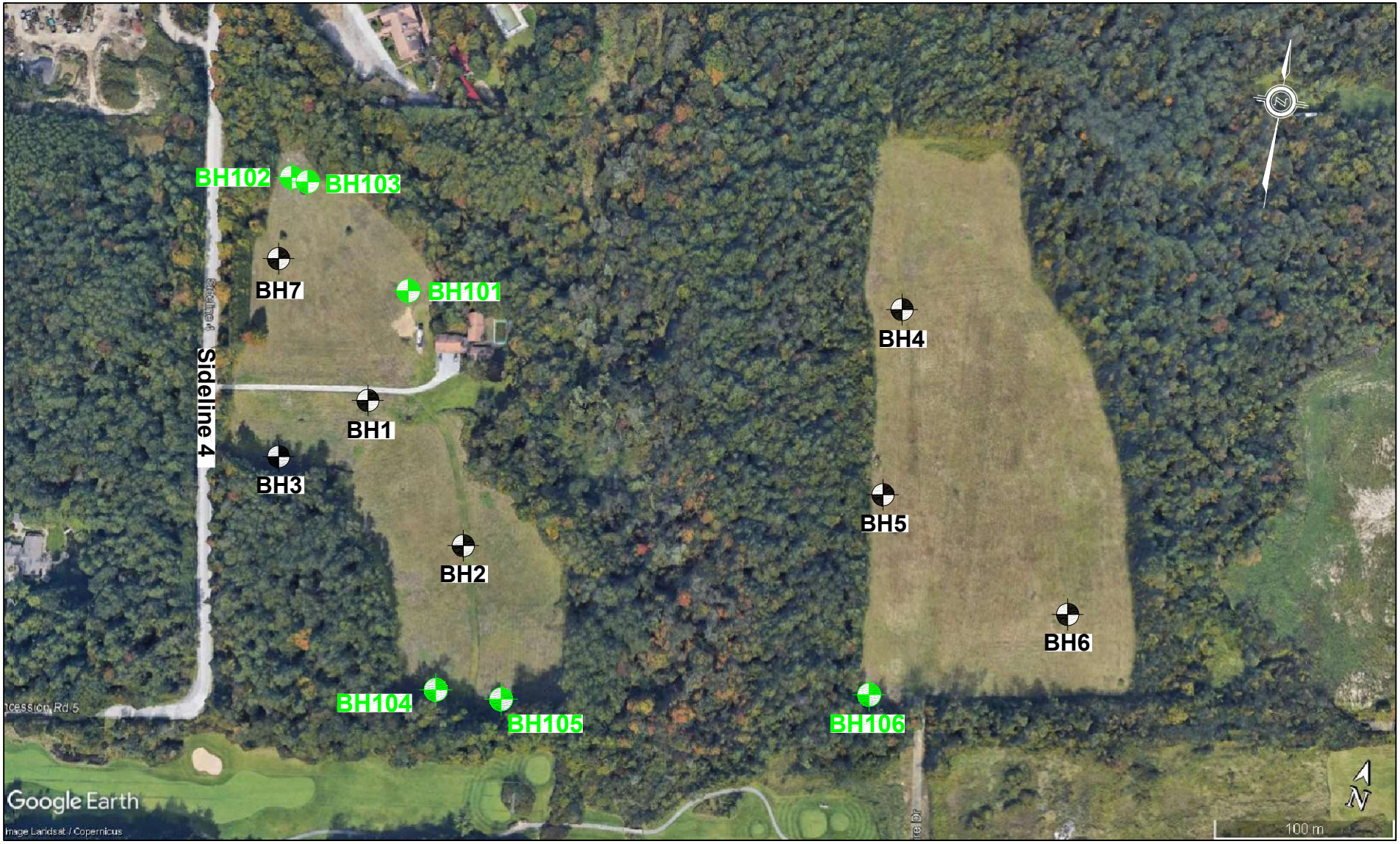
Yours very truly,

GEOPRO CONSULTING LIMITED

Nikol C. Carrasco, B.Eng.
Geotechnical Group

David B. Liu, P.Eng., Principal

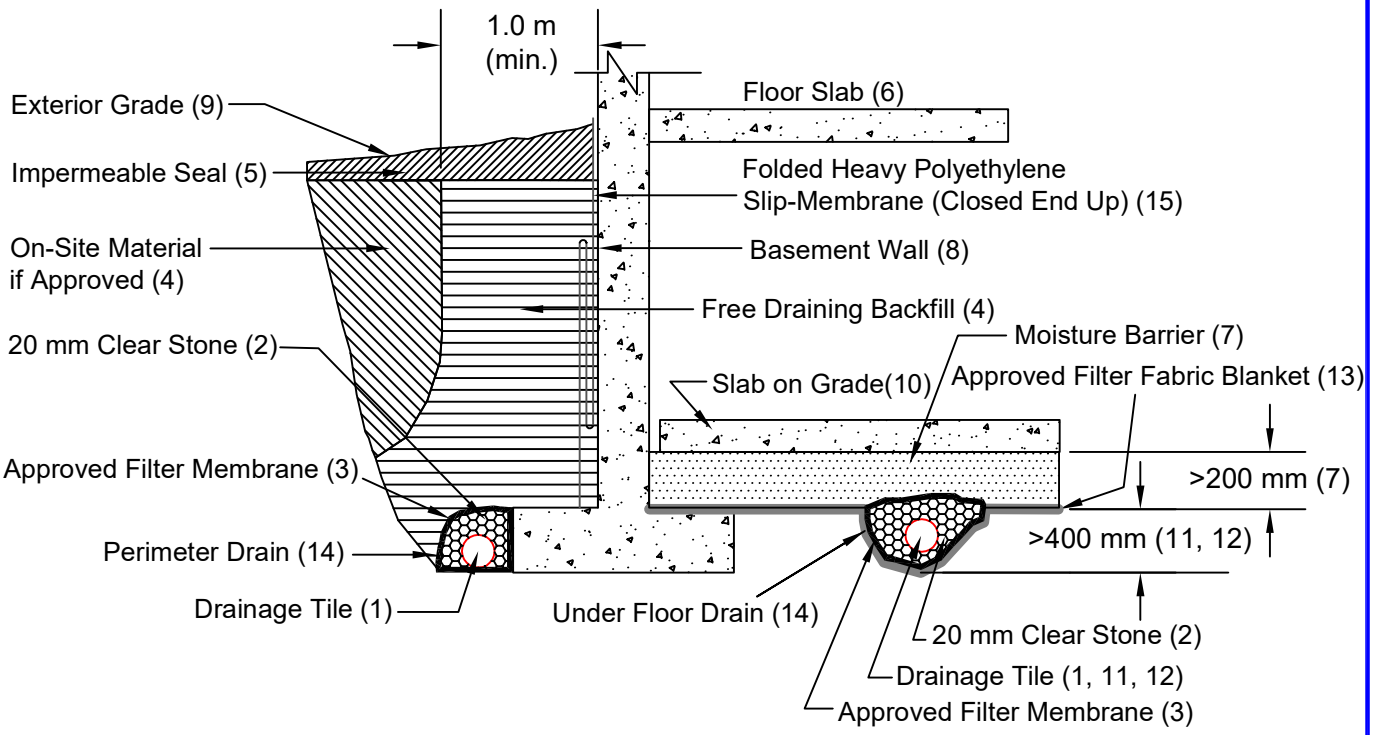
DRAWINGS



Legend:

- Borehole Location
- Previous Borehole Location

Client:	869547 Ontario Inc.			Project No.: 17-1780GHE3	Drawing No.: 1
Drawn:	RF	Approved:	DL	Title:	Borehole Location Plan
Date:	Nov. 2022	Scale:	N.T.S	Project:	Geotechnical Investigation for Proposed Residential Development Parts of Lots 3 and 4, Pickering, Ontario
Original Size:	Letter	Rev:	DX		GeoPro Consulting Limited



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed /water proofed.
9. Exterior grade to slope away from building.
10. Slab on grade should not be structurally connected to the wall or footing.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 2 to 6 m (7' to 20') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Externally Applied Folded Heavy Polyethylene Drainage Membrane.
16. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage
(not to scale)

ENCLOSURES

Enclosure 1A: Notes on Sample Descriptions

1. Each soil stratum is described according to the *Modified Unified Soil Classification System*. The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined according to Canadian Foundation Engineering Manual, 4th Edition. Different soil classification systems may be used by others. Please note that a description of the soil stratums is based on visual and tactile examination of the samples augmented with field and laboratory test results, such as a grain size analysis and/or Atterberg Limits testing. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

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 (75 to 300 mm) or boulders (over 300 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.

Enclosure 1B: Explanation of Terms Used in the Record of Boreholes

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
NR	No recovery
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube Sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

PM – Samples advanced by manual pressure
WR – Samples advanced by weight of sampler and rod
WH – Samples advanced by static weight of hammer

Dynamic Cone Penetration Resistance, N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in).

Piezo-Cone Penetration Test (CPT):

An electronic cone penetrometer with a 60 degree conical tip and a projected end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurement of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

Textural Classification of Soils (ASTM D2487)

Classification	Particle Size
Boulders	> 300 mm
Cobbles	75 mm - 300 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm – 4.75 mm
Silt	0.002 mm-0.075 mm
Clay	<0.002 mm(*)

(*) Canadian Foundation Engineering Manual (4th Edition)

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

Soil Description

a) Cohesive Soils (*)

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(*) Hierarchy of Shear Strength prediction

1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT "N" value
5. Pocket penetrometer

b) Cohesionless Soils (*)

Compactness Condition (Formerly Relative Density)	SPT "N" Value
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

LOG OF BOREHOLE BH101

PROJECT: Supplementray Geotechnical Investigation for Proposed Residential Development

CLIENT: 869547 Ontario Inc.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, ON

DATUM: N/A

BH LOCATION: See Borehole Plan Location

DRILLING DATA

METHOD: Continuous Flight Auger - Auto Hammer | DIAMETER: 155 mm

FIELD ENGINEER: JF | DATE: 2021-08-27

SAMPLE REVIEW: CL | REF. NO.: 17-1780GHE3

CHECKED: DX | ENCL. NO.: 2

ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3m	GROUND WATER ELEVATION
0.0	**TOPSOIL:** (120 mm)					
0.1	**FILL:** silty fine sand, organic inclusions, rootlet inclusions, brown, moist, compact		1	SS	11	
0.7	**PROBABLE FILL:** silty fine sand, brown, moist, loose		2	SS	6	
			3	SS	6	
2.1	**FINE SANDY SILT:** trace clay, containing cobbles and boulders, brown, moist to wet, very dense		4	SS	65	
	--- auger grinding		5	SS	70	
4.0	**SILTY FINE SAND:** grey, wet, dense		6	SS	43	
5.0	**END OF BOREHOLE**					

Notes:

1) Water encountered at a depth of 3.0 m below ground surface (mBGS) during drilling.
2) Water was at a depth of 3.2 mBGS upon completion of drilling.
3) Borehole caved at a depth of 4.2 mBGS upon completion of drilling.

DYNAMIC PENETRATION TEST
○ SPT ≈ Cone blows/0.3m
20 40 60 80

SHEAR STRENGTH (kPa)
● Unconfined ✕ Field Vane & Sensitivity
▲ Quick Triaxial ⊠ Penetrometer + Lab Vane
20 40 60 80

Plastic Limit | Natural Moisture Content | Liquid Limit
w_P w w_L
WATER CONTENT (%)
10 20 30 40

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

01 - GEOPRO SOIL LOG GEOPRO 17-1780GHE3 BH LOG 20211118 - NT - NG - DX.GPJ 2022-11-18 10:34

LOG OF BOREHOLE BH102

PROJECT: Supplementray Geotechnical Investigation for Proposed Residential Development

CLIENT: 869547 Ontario Inc.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, ON

DATUM: N/A

BH LOCATION: See Borehole Plan Location

DRILLING DATA

METHOD: Continuous Flight Auger - Auto Hammer | DIAMETER: 155 mm

FIELD ENGINEER: JF | DATE: 2021-08-29

SAMPLE REVIEW: CL | REF. NO.: 17-1780GHE3

CHECKED: DX | ENCL. NO.: 3

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3m	GROUND WATER ELEVATION
0.0	**TOPSOIL:** (300 mm)					
0.3	**REWORKED SILTY FINE SAND:** rootlet inclusions, brown, moist, very loose to loose		1	SS	4	
1.1	**SILTY FINE SAND:** pockets of sandy silt, brown, moist, very loose to dense		2A	SS	4	
			2B	SS		
			3	SS	21	
			4	SS	45	
	--- layers of fine sandy silt		5	SS	46	
4.0	**SILTY SAND:** brown, wet, compact		6	SS	28	
5.0	**END OF BOREHOLE**					

DYNAMIC PENETRATION TEST: ○ SPT, ≈ Cone, blows/0.3m (20, 40, 60, 80)

SHEAR STRENGTH (kPa): ● Unconfined, ▲ Quick Triaxial, × Field Vane & Sensitivity, ⊠ Penetrometer, + Lab Vane (20, 40, 60, 80)

Plastic Limit (w_P) | Natural Moisture Content (w) | Liquid Limit (w_L)

WATER CONTENT (%) (10, 20, 30, 40)

UNIT WT (kN/m³)

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

Notes:

1) Water encountered at a depth of 4.6 m below ground surface (mBGS) during drilling.
2) Water was at a depth of 4.4 mBGS upon completion of drilling.
3) Borehole caved at a depth of 4.6 mBGS upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

LOG OF BOREHOLE BH103

PROJECT: Supplementray Geotechnical Investigation for Proposed Residential Development

CLIENT: 869547 Ontario Inc.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, ON

DATUM: N/A

BH LOCATION: See Borehole Plan Location

DRILLING DATA

METHOD: Continuous Flight Auger - Auto Hammer | DIAMETER: 155 mm

FIELD ENGINEER: JF | DATE: 2021-08-27

SAMPLE REVIEW: CL | REF. NO.: 17-1780GHE3

CHECKED: DX | ENCL. NO.: 4

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3m	GROUND WATER ELEVATION
0.0	**TOPSOIL:** (300 mm)		1	SS	2	
0.3	**REWORKED SILTY FINE SAND:** organic inclusions, rootlet inclusions, brown, moist, very loose		2A	SS	2	
1			2B	SS		
1.1	**SILTY FINE SAND:** containing cobbles and boulders, brown, moist, very loose to dense		3	SS	11	
2	--- auger grinding		4	SS	32	
2.9	**FINE SAND AND SILT TO FINE SANDY SILT:** layers of silt, layers of silty sand, brown, moist to wet, compact		5	SS	25	
4						
4.0	**SILTY SAND:** trace gravel, layers of sandy silt, brown, wet, compact		6	SS	27	
5						
5.0	**END OF BOREHOLE**					

Notes:

1) Water encountered at a depth of 3.0 m below ground surface (mBGS) during drilling.
2) Water was at a depth of 3.2 mBGS upon completion of drilling.
3) Borehole caved at a depth of 4.3 mBGS upon completion of drilling.

DYNAMIC PENETRATION TEST
○ SPT ≈ Cone blows/0.3m
20 40 60 80

SHEAR STRENGTH (kPa)
● Unconfined ✕ Field Vane & Sensitivity
▲ Quick Triaxial ⊠ Penetrometer + Lab Vane
20 40 60 80

Plastic Limit | Natural Moisture Content | Liquid Limit
w_P w w_L
WATER CONTENT (%)
10 20 30 40

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

LOG OF BOREHOLE BH104

PROJECT: Supplementray Geotechnical Investigation for Proposed Residential Development

CLIENT: 869547 Ontario Inc.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, ON

DATUM: N/A

BH LOCATION: See Borehole Plan Location

DRILLING DATA

METHOD: Continuous Flight Auger - Auto Hammer | DIAMETER: 155 mm

FIELD ENGINEER: JF | DATE: 2021-08-27

SAMPLE REVIEW: CL | REF. NO.: 17-1780GHE3

CHECKED: DX | ENCL. NO.: 5

ELEV DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3m
0.0	**TOPSOIL:** (250 mm)			
0.3	**REWORKED SILTY FINE SAND:** some silt, organic inclusions, rootlet inclusions, brown, moist, loose	1	SS	7
		2A	SS	5
1.1	**SILTY FINE SAND:** brown, moist to wet, loose to compact	2B	SS	
		3	SS	20
2.1	**FINE SANDY SILT:** trace clay, grey, moist to wet, dense	4	SS	31
2.9	**SILT:** trace clay, some sand, grey, wet, dense	5	SS	43
4.0	**FINE SANDY SILT:** some clay, grey, wet, very dense	6	SS	58
5.0	**END OF BOREHOLE**			

Notes:

1) Water encountered at a depth of 1.4 m below ground surface (mBGS) during drilling.
2) Water was at a depth of 2.0 mBGS upon completion of drilling.
3) Borehole caved at a depth of 3.2 mBGS upon completion of drilling.

DYNAMIC PENETRATION TEST: ○ SPT, ≈ Cone, blows/0.3m; 20 40 60 80

SHEAR STRENGTH (kPa): ● Unconfined, ✕ Field Vane & Sensitivity, ▲ Quick Triaxial, ⊠ Penetrometer, + Lab Vane; 20 40 60 80

Plastic Limit w_P | Natural Moisture Content w | Liquid Limit w_L

WATER CONTENT (%): 10 20 30 40

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

LOG OF BOREHOLE BH105

PROJECT: Supplementray Geotechnical Investigation for Proposed Residential Development

CLIENT: 869547 Ontario Inc.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, ON

DATUM: N/A

BH LOCATION: See Borehole Plan Location

DRILLING DATA

METHOD: Continuous Flight Auger - Auto Hammer | DIAMETER: 155 mm

FIELD ENGINEER: JF | DATE: 2021-08-27

SAMPLE REVIEW: CL | REF. NO.: 17-1780GHE3

CHECKED: DX | ENCL. NO.: 6

ELEV DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3m
0.0	**TOPSOIL:** (250 mm)			
0.3	**FILL:** silty fine sand, trace gravel, organic inclusions, rootlet inclusions, containing rock fragments, brown, moist, loose to compact	1	SS	13
		2	SS	6
		3A	SS	5
		3B	SS	
1.8	**SILTY FINE SAND:** layers of silt, containing cobbles and boulders, brown, wet, loose to compact --- auger grinding	4	SS	26
2.9	**FINE SAND AND SILT TO SILTY FINE SAND:** grey, moist to wet, dense	5	SS	43
4.0	**SILT:** trace to some clay, trace sand, interlayers of clayey silt, grey, moist to wet, dense	6	SS	33
5.0	**END OF BOREHOLE** Notes: 1) Water encountered at a depth of 1.8 m below ground surface (mBGS) during drilling. 2) Water was at a depth of 2.2 mBGS upon completion of drilling. 3) Borehole caved at a depth of 3.4 mBGS upon completion of drilling.			

GROUND WATER ELEVATION

DYNAMIC PENETRATION TEST
○ SPT ≈ Cone blows/0.3m
20 40 60 80

SHEAR STRENGTH (kPa)
● Unconfined ✕ Field Vane & Sensitivity
▲ Quick Triaxial ⊠ Penetrometer + Lab Vane
20 40 60 80

Plastic Limit | Natural Moisture Content | Liquid Limit
w_P w w_L
WATER CONTENT (%)
10 20 30 40

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

LOG OF BOREHOLE BH106

PROJECT: Supplementray Geotechnical Investigation for Proposed Residential Development

CLIENT: 869547 Ontario Inc.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, ON

DATUM: N/A

BH LOCATION: See Borehole Plan Location

DRILLING DATA

METHOD: Continuous Flight Auger - Auto Hammer | DIAMETER: 155 mm

FIELD ENGINEER: JF | DATE: 2021-08-27

SAMPLE REVIEW: CL | REF. NO.: 17-1780GHE3

CHECKED: DX | ENCL. NO.: 7

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	"N" BLOWS/0.3m	GROUND WATER ELEVATION
0.0	**TOPSOIL:** (350 mm)		1	SS	3	
0.4	**FILL:** silty fine sand, organic matters, rootlet inclusions, dark brown, moist, very loose					
0.7	**CLAYEY SILT:** some sand, trace gravel, interlayers of silt, layers of fine sand and silt, seams of sand, brown, moist, very stiff		2	SS	22	
1.4	**SANDY SILT:** some clay, trace gravel, layers of clayey silt, brown, moist, compact		3	SS	22	
			4	SS	20	
2.9	**SANDY SILT TILL:** some clay, trace gravel, layers of sandy silt, containing cobbles and boulders, grey, moist, dense		5	SS	33	
	--- auger grinding		6	SS	50	
5.0	**END OF BOREHOLE**					

Note:

1) Borehole caved at a depth of 4.5 m below ground surface (mBGS) upon completion of drilling.

DYNAMIC PENETRATION TEST: ○ SPT, ≈ Cone, blows/0.3m (20, 40, 60, 80)

SHEAR STRENGTH (kPa): ● Unconfined, ▲ Quick Triaxial, × Field Vane & Sensitivity, ⊠ Penetrometer, + Lab Vane (20, 40, 60, 80)

Plastic Limit (w_P) | Natural Moisture Content (w) | Liquid Limit (w_L)

WATER CONTENT (%) (10, 20, 30, 40)

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

APPENDIX A

LOG OF BOREHOLE BH1

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/10/2017

REF. NO.: 17-1780GHE

ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
135.3							
135.0 / 0.0	**TOPSOIL:** (180 mm)					Concrete	
0.2	**REWORKED SILTY FINE SAND:** trace organics, trace rootlets, brown, moist, loose		1	SS	4		135
134.2			2	SS	4		
1.1	**SILTY FINE SAND:** trace organics, trace rootlets, brown, wet, loose to compact						134
			3	SS	23	W. L. 133.9 m May 09, 2017 W. L. 133.6 m Apr 28, 2017	
133.2							
2.1	**FINE SAND AND SILT TO FINE SANDY SILT:** trace clay, brown to grey, wet, dense to very dense						133
			4	SS	37	Bentonite	
			5	SS	55		132
	--- grey		6	SS	82		131
							130
						Sand	
						Screen	
			7	SS	50 / 150 mm		129
						Natural Pack	
127.4			8	SS	50 / 150 mm		
7.9	**END OF BOREHOLE**						

Notes:
1) Water encountered at a depth of 1.5 m below ground surface (mBGS) during drilling.
2) Water was at a depth of 3.0 mBGS upon completion of drilling.
3) Borehole caved at a depth of 3.0 mBGS upon completion of drilling.
4) 51 mm dia. Monitoring Well was installed in borehole upon completion of drilling.

Water Level Reading

Date	W.L. Depth (mBGS)
April 28, 2017	1.72
May 9, 2017	1.35

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × 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
○ 8=3% Strain at Failure

LOG OF BOREHOLE BH2

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/10/2017

REF. NO.: 17-1780GHE

ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × 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
133.0												
0.0 / 132.7	**TOPSOIL:** (250 mm)											
0.3 / 132.3	**REWORKED SILTY FINE SAND:** trace clay, trace organics, trace rootlets, brown, moist, loose		1	SS	5							
0.7 / 131.6	**NO RECOVERY:** likely silty fine sand, loose		2	NR	6							
1.4	**FINE SAND AND SILT:** trace clay, trace organics, seams of clayey silt, brown to grey, wet, compact to very dense		3	SS	18							
	--- grey		4	SS	30							
			5	SS	32							
			6	SS	46							
			7	SS	53							
7.1 / 125.9	**CLAYEY SILT:** some fine sand, seams of sand, grey, wet, stiff		8	SS	10							
8.6 / 124.3	**CLAYEY SILT (TILL LIKE):** trace to some sand, trace gravel, containing cobbles and boulders, grey, wet, stiff		9	SS	10							
10.1 / 122.8	**CLAYEY SILT TILL TO SILTY CLAY TILL:** trace sand, trace gravel, containing cobbles and boulders, grey, moist, hard		10	SS	80							
12												

Concrete

W. L. 132.3 m May 09, 2017

W. L. 131.9 m Apr 28, 2017

Sand

Screen

Natural Pack

131 130 129 128 127 126 125 124 123 122

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+3, ×3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

LOG OF BOREHOLE BH2

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/10/2017

REF. NO.: 17-1780GHE

ENCL NO.: 3

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × 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
120.3			11	SS	90/ 280 mm				○		
12.6	**END OF BOREHOLE** Notes: 1) Water encountered at a depth of 1.5 m below ground surface (mBGS) during drilling. 2) Water was at a depth of 2.1 mBGS upon completion of drilling. 3) Borehole caved at a depth of 2.1 mBGS upon completion of drilling. 4) 51 mm dia. Monitoring Well was installed in borehole upon completion of drilling. Water Level Reading Date W.L. Depth (mBGS) April 28, 2017 1.05 May 9, 2017 0.70										

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3$, $\times^3$: Numbers refer to Sensitivity ○ ε_f=3% Strain at Failure

GeoPro CONSULTING LIMITED

LOG OF BOREHOLE BH3

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/10/2017

REF. NO.: 17-1780GHE

ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × 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
133.6												
133.4 0.2	**TOPSOIL:** (180 mm)											
	REWORKED SILTY FINE SAND: trace organics, trace rootlets, dark brown to brown, wet, loose to compact		1	SS	4				○			
132.5 1.1			2	SS	23				○			
132.2 1.4	**SILTY FINE SAND:** trace clay, trace rootlets, brown, wet, compact											
	FINE SAND AND SILT TO FINE SANDY SILT: trace clay, brown to grey, wet, compact to dense		3	SS	26				○			
2			4	SS	48		131		○			
3	--- grey		5	SS	43				○			
129.5 4.0	**SILT:** some fine sand, trace clay, layers of fine sand and silt, grey, wet, dense		6	SS	39		130 129		○			
5												
128.0 5.6	**FINE SAND AND SILT:** trace clay, grey, wet, very dense						128					
6			7	SS	50/ 150 mm		127		○			
126.6 7.0	**SILT:** some fine sand, trace to some clay, seams of fine sand, grey, wet, compact						126					
8 125.5 8.1	**END OF BOREHOLE**		8	SS	30				○			

Notes:
1) Water encountered at a depth of 0.8 m below ground surface (mBGS) during drilling.
2) Borehole caved at a depth of 1.8 mBGS upon completion of drilling.
3) 51 mm dia. Monitoring Well was installed in borehole upon completion of drilling.

Water Level Reading

Date W.L.	Depth (mBGS)
April 28, 2017	0.76
May 9, 2017	0.57

Concrete

Bentonite

W. L. 133.0 m
W. L. 132.8 m
Apr 28, 2017

Sand

Screen

Natural Pack

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ 8=3% Strain at Failure

GeoPro CONSULTING LIMITED

LOG OF BOREHOLE BH4

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/05/2017

REF. NO.: 17-1780GHE

ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × 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
136.1												
136.0 0.0	**TOPSOIL:** (200 mm)					Concrete						
0.2	**REWORKED SAND AND SILT:** some clay, some gravel, trace organics, trace rootlets, brown, wet, very loose to dense		1	SS	3	W. L. 135.8 m W. L. 135.7 m Apr 28, 2017	135					
135.0			2	SS	40							
1.1	**SANDY SILT TILL TO SAND AND SILT TILL:** some clay, trace gravel, layers of silty sand, containing cobbles and boulders, brown to grey, moist to wet, dense to very dense ---cobbles and boulders --- grey		3	SS	50/ 150 mm	Bentonite	134					
			4	SS	67		133					
132.1			5	SS	73							
4.0	**SILTY SAND:** some gravel, containing cobbles and boulders, grey, wet, very dense		6	SS	68	Sand Screen	132					
130.5							131					
5.6	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, containing cobbles and boulders, grey, moist, hard		7	SS	50 / 150 mm		130					
129.1						Natural Pack						
7.0	**CLAYEY SILT:** trace sand, trace gravel, grey, moist, hard						129					
128.3			8	SS	50 / 130 mm							
7.8	**END OF BOREHOLE** Notes: 1) Water encountered at a depth of 1.8 m below ground surface (mBGS) during drilling. 2) Water was at a depth of 1.5 mBGS upon completion of drilling. 3) 51 mm dia. Monitoring Well was installed in borehole upon completion of drilling. Water Level Reading Date W.L. Depth (mBGS) April 28, 2017 0.39 May 9, 2017 0.27											

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

LOG OF BOREHOLE BH5

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/05/2017

REF. NO.: 17-1780GHE

ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
135.5						
135.3 0.0	**TOPSOIL:** (200 mm)					
0.2 134.8	**FILL:** silty fine sand, trace organics, trace rootlets, dark brown to brown, wet, loose	1	SS	4		
0.7	**SANDY SILT TILL:** trace to some clay, trace gravel, pockets of sand, containing cobbles and boulders, brown to grey, moist, very dense	2	SS	76 / 280 mm		
		3	SS	87		
	--- grey	4	SS	94		
132.6						
2.9	**FINE SANDY SILT:** trace clay, trace gravel, grey, wet, very dense	5	SS	50 / 80 mm		
131.6						
3.9	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, containing cobbles and boulders, grey, moist, hard	6	SS	50 / 130 mm		
130.0						
5.5	**SANDY SILT TILL:** trace to some clay, trace gravel, containing cobbles and boulders, grey, moist, very dense ---cobbles and boulders	7	SS	50 / 80 mm		
128.6						
6.9	**GRAVELLY SAND:** trace silt, pockets of silt, containing cobbles and boulders, grey, wet, very dense	8	SS	59		
127.4						
8.1	**END OF BOREHOLE**					

Notes:
1) Water encountered at a depth of 0.8 m below ground surface (mBGS) during drilling.
2) Water was at a depth of 0.3 mBGS upon completion of drilling.
3) Borehole caved at a depth of 6.7 mBGS upon completion of drilling.
4) 51 mm dia. Monitoring Well was installed in borehole upon completion of drilling.

Water Level Reading

Date	W.L. Depth (mBGS)
April 28, 2017	0.76
May 9, 2017	0.49

Concrete

W. L. 135.0 m May 09, 2017

W. L. 134.7 m Apr 28, 2017

Bentonite

Sand

Screen

Natural Pack

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

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × 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: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH6

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/05/2017

REF. NO.: 17-1780GHE

ENCL NO.: 7

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
136.7							
0.0 / 136.1	**TOPSOIL:** (530 mm)		1	SS	4	Concrete	
136.0 / 0.7	**REWORKED SAND AND SILT:** trace to some clay, trace organics, trace rootlets, dark brown, wet, very loose		2	SS	14		136
1	**SANDY SILT TILL:** trace clay, trace gravel, pockets of sand, layers of silty sand, containing cobbles and boulders, brown to grey, moist to wet, compact to very dense					W. L. 135.4 m May 09, 2017	
			3	SS	44	W. L. 135.0 m Apr 28, 2017	
2			4	SS	68		134
3	--- grey		5	SS	45		
4							133
						Sand	
	--- containing shale fragments					Screen	
5			6	SS	45		132
131.1							
5.6 / 130.1	**SILTY SAND TILL:** some gravel, trace clay, layers of silty sand, containing cobbles and boulders, grey, moist to wet, very dense		7	SS	91/ 280 mm	Natural Pack	131
6.5	**END OF BOREHOLE**						

Notes:
1) Water encountered at a depth of 1.5 m below ground surface (mBGS) during drilling.
2) 51 mm dia. Monitoring Well was installed in borehole upon completion of drilling.

Water Level Reading

Date	W.L. Depth (mBGS)
April 28, 2017	1.62
May 9, 2017	1.31

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

LOG OF BOREHOLE BH7

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/13/2017

REF. NO.: 17-1780GHE

ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m
136.1 / 0.0	**TOPSOIL:** (220 mm)				
135.9 / 0.2	**REWORKED SILTY FINE SAND:** trace organics, trace rootlets, brown, moist, very loose		1	SS	2
135.1 / 1.1	**SILTY FINE SAND:** trace organics, trace rootlets, brown, moist to wet, very loose to dense		2	SS	3
			3	SS	14
133.4 / 2.7	**FINE SAND AND SILT:** trace clay, grey, wet to saturated, very dense		4	SS	40
			5	SS	52
132.1 / 4.0	**SILTY FINE SAND:** trace clay, grey, wet to saturated, dense		6	SS	46
130.6 / 5.6	**FINE SAND AND SILT:** trace clay, layers of silty fine sand, seams of clayey silt, grey, wet, very dense		7	SS	55
129.0 / 7.1	**SILTY FINE SAND:** trace clay, grey, wet, very dense		8	SS	50 / 100 mm
127.5 / 8.6	**SILT TO FINE SANDY SILT:** trace to some clay, grey, wet, compact		9	SS	12
			10	SS	28
124.5 / 11.7					

GROUNDWATER CONDITIONS: W. L. 136.8 m, Apr 28, 2017

ELEVATION (m): Concrete; 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125

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

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ε_f=3% Strain at Failure

LOG OF BOREHOLE BH7

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/13/2017

REF. NO.: 17-1780GHE

ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
	SILTY CLAY TILL: trace to some sand, trace gravel, grey, moist to wet, very stiff(Continued)		11	SS	20		124
13 122.9							
13.2	**SANDY SILT TILL:** trace clay, trace gravel, containing cobbles and boulders, grey, moist to wet, very dense						123
122.3			12	SS	50 / 80 mm		
14 13.9	---cobbles and boulders					Bentonite	
	SAND AND SILT TILL: some clay, trace to some gravel, zones of silty sand, containing cobbles and boulders, grey, wet, dense to very dense						122
15	--- auger grinding						
			13	SS	50		121
16							
							120
17	---cobbles and boulders		14	SS	50/ 100 mm		
118.4							119
17.8	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, grey, moist, hard						
18							118
			15	SS	100 / 250 mm		
19							117
20			16	SS	78		
115.3							116
20.8	**SANDY SILT TILL:** trace to some clay, trace gravel, grey, moist to wet, very dense						
21							115
			17	SS	71		
22							114
23			18	SS	61		
							113
24							

SAMPLES

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

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

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

LOG OF BOREHOLE BH7

PROJECT: Geotechnical Investigation for Proposed Residential Development

CLIENT: JFC Developments Ltd.

PROJECT LOCATION: Parts of Lots 3 and 4, Concession 5, Pickering, Ontario

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

DRILLING DATA

Method: Continuous Flight Auger- Auto Hammer

Diameter: 155/205 mm

Date: Apr/13/2017

REF. NO.: 17-1780GHE

ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × 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
	SANDY SILT TILL: trace to some clay, trace gravel, grey, moist to wet, very dense(Continued)						112					
			19	SS	66							
25							111					
26			20	SS	58		110					
27							109					
28			21	SS	53		108					
107.8												
28.4	**PROBABLE WEATHERED SHALE:** grey, moist						Sand					
29			22	SS	50/ 100 mm		Screen 107					
106.6												
29.6	**END OF BOREHOLE**											

Notes:
1) Water encountered at a depth of 1.5 m below ground surface (mBGS) during drilling.
2) 51 mm dia. Monitoring Well was installed in borehole upon completion of drilling.

Water Level Reading

Date W.L.	Depth (mBGS)
April 28, 2017	-0.65
May 9, 2017	-0.63

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

APPENDIX B

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted, imported soil that meets specific engineering requirements that is free of organics, topsoil, debris and any other deleterious materials, and that has been continually monitored on a full-time basis by a qualified geotechnical representative under the supervision of the geotechnical engineer 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 site(s). In general, most Ontario soils are too wet to achieve 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be used for engineered fill. Imported non-cohesive granular soils, such as well-graded sandy/granular soils, are preferred for all engineered fill. We recommend that OPSS Granular 'B' sand and gravel materials be used for the engineered fill material.

Adverse weather conditions, such as rain or subzero temperatures, make the placement of engineered fill to the required degree of compaction difficult or impossible; engineered fill cannot be placed during freezing conditions (i.e. normally between December 15 and April 1 in Southern Ontario).

The locations and elevations of the foundations on the engineered fill pad are critical, and certification by a qualified surveyor, to ensure that the proposed foundations are to be located within the stipulated boundaries, is mandatory. Since layout stakes are often damaged or removed during engineered 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 engineered fill as the original pad.

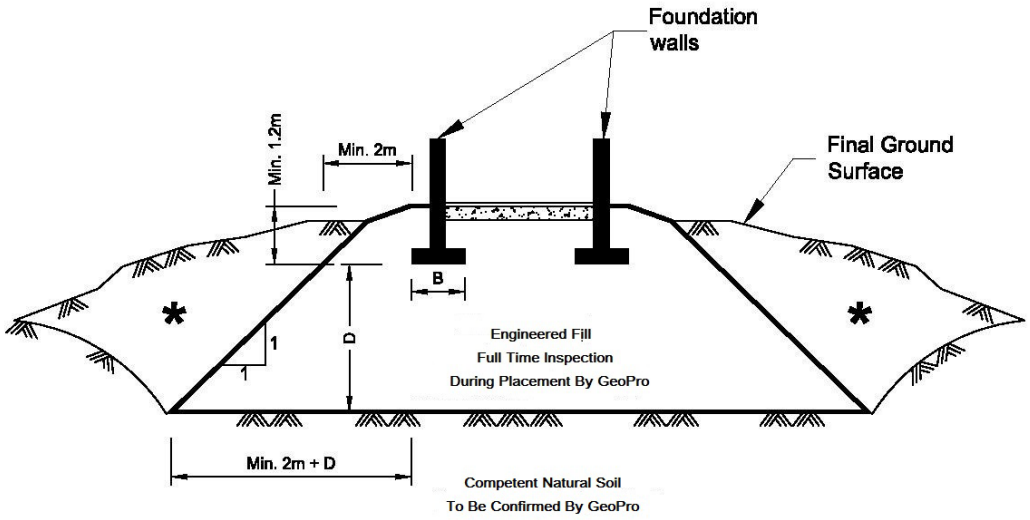
To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, and contractors, and all parties must be aware of the requirements. The minimum requirements are as follows; however, the geotechnical report must be reviewed for specific information and requirements.

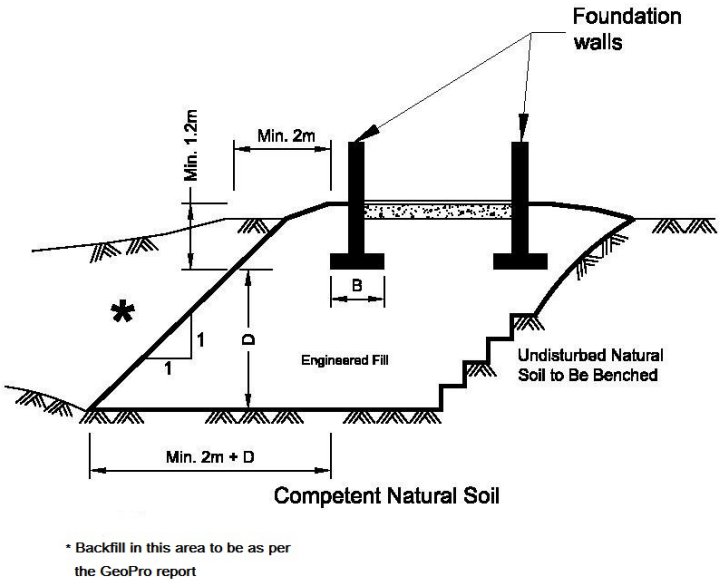
1. Prior to the site work involving engineered fill, a kick-off site meeting, to discuss all aspects of the engineered fill placement, must be carried out with all parties. The surveyor, contractor, design engineers and geotechnical engineer must attend the kick-off meeting. At the meeting, the construction schedule and the detailed design information regarding the engineered fills (such as the boundaries, thickness, competent subgrade elevations, specifications, and any special requirements from the engineers) will be discussed and determined. The contractor must provide the construction schedule including the source site(s) of the fill materials, which will have to be reviewed by the geotechnical engineer. The geotechnical engineer will arrange for soil sampling at the source site(s) and carry out the related laboratory testing. No soils can be hauled to the site prior to approval by the geotechnical engineer.
2. Detailed design drawings, such as grading drawings and other relevant drawings indicating the proposed structures or utilities as well as the underside and finished elevations of the engineered fill, should be provided in advance, and any concerns from a geotechnical perspective can be discussed at the kick-off site meeting and then approved by the engineers and other relevant parties.
3. The building footprint and base of the pad (including basements, garages, etc.) must be defined by offset stakes that will remain in place until the footings and service connections are all constructed. Confirmation, such as that the footings are within the pad, the service lines are in place, and the

grade conforms to drawings, must be obtained (by the owner) in writing from the surveyor and GeoPro. Without this confirmation in writing, no responsibility for the performance of the engineered fill can be accepted by GeoPro. Survey drawings of the pre and post fill location and elevations will also be required.

4. The subgrade area must be stripped of all topsoil, existing fill materials, loosened/softened native soils and any other deleterious materials. The subgrade must be proof-rolled by a qualified engineering representative from GeoPro. Any soft/loose spots revealed by proof-rolling must be subexcavated and replaced with engineered fill. The stripped subgrade must be examined and approved by a geotechnical engineer prior to the placement of engineered fill.
5. The approved engineered fill must be compacted to 98% SPMDD throughout. Granular fill materials consisting of well-graded, cohesionless sand and gravel are preferred. Engineered fill should not be placed (where it will support foundations) during the winter months. Engineered fill compacted to 98% SPMDD will settle under its own weight to approximately 0.25% to 0.75% 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 structures and fill loads, will occur and should be evaluated prior to placing the engineered fill.
6. Full-time geotechnical inspection and compaction testing by GeoPro during the placement of engineered fill must be required. The placement of the engineered fill must not commence or continue without the presence of GeoPro's representative.
7. Excavations must be carried out in accordance with the Occupational Health and Safety Regulations of Ontario.
8. Surface water cannot be allowed to pond in any area of the engineered fill footprint.
9. Clear stone backfill must not be used in any portion of the engineered fill unless it is approved by GeoPro in writing.
10. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for the 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.
11. A bearing resistance of 100 kPa to 150 kPa at SLS (150 kPa to 225 kPa at a factored ULS), or that being specified in the geotechnical report, can be used provided that all conditions outlined are adhered to. A minimum footing width of 500 mm (20 inches) is suggested, and footings must be provided with nominal steel reinforcement.
12. The owner may choose the same contractor or a different contractor for the foundation construction after completion of the engineered fill pad. In any case, the prepared footing bases must be inspected and evaluated by an engineering representative from GeoPro prior to pouring footing concrete. All excavations must be backfilled, under full-time supervision by GeoPro, to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in the excavations. Clear stone backfill is not allowed unless it is approved by GeoPro.
13. 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 at any stoppage in work, in order to promote rapid runoff of rainwater and to avoid any ponding of 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.

14. If the engineered fill placement is suspended for a long period of time, the engineered fill pad must be inspected by the geotechnical engineer prior to resuming the engineered fill placement. The locations of the proposed structures must be reconfirmed by the project surveyor, and the offset stakes should be reinstated by the project surveyor prior to resuming the engineered fill placement.
15. The geometry of the engineered fill, as illustrated in these General Requirements, is general and generic 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.
16. These guidelines are to be read in conjunction with GeoPro's report.





LIMITATIONS TO THE REPORT

This report is intended solely for the Client named. The report is prepared based on the work has been undertaken in accordance with normally accepted geotechnical engineering practices in Ontario.

The comments and recommendations given in this report are based on information determined at the limited number of the test hole and test pit locations. The boundaries between the various strata as shown on the borehole logs are based on non-continuous sampling and represent an inferred transition between the various strata and their lateral continuation rather than a precise plane of geological change. Subsurface and groundwater conditions between and beyond the test holes and test pits may differ significantly from those encountered at the test hole and test pit locations. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole and test pit locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

It should be noted that the results of the designated substance and chemical analysis refer only to the sample analyzed which was obtained from specific sampling location and sampling depth, and the presence of designated substance and soil chemistry may vary between and beyond the location and depth of the sample taken. Please note that the level of chemical testing outlined herein is meant to provide a broad indication of soil quality based on the limited soil samples tested. The analytical results contained in this report should not be considered a warranty with respect to the soil quality or the use of the soil for any specific purpose or the acceptability of the soils for any excess soil receiving sites.

The report reflects our best judgment based on the information available to GeoPro Consulting Limited at the time of preparation. Unless otherwise agreed in writing by GeoPro Consulting Limited, it shall not be used to express or imply warranty as to any other purposes. No portion of this report shall be used as a separate entity, it is written to be read in its entirety. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated.

The design recommendations given in this report are applicable only to the project designed and constructed completely in accordance with the details stated in this report. Otherwise, our responsibility is limited to interpreting the subsurface information at the borehole or test pit locations.

Should any comments and recommendations provided in this report be made on any construction related issues, they are intended only for the guidance of the designers. The number of test holes and test pits may not be sufficient to determine all the factors that may affect construction activities, methods and costs. Such as, the thickness of surficial topsoil or fill layers may vary significantly and unpredictably; the amount of the cobbles and boulders may vary significantly than what described in the report; unexpected water bearing zones/layers with various thickness and extent may be encountered in the fill and native soils. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and make their own conclusions as to how the subsurface conditions may affect their work and determine the proper construction methods.

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. GeoPro Consulting Limited 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.