GeoPro Consulting Limited

Geotechnical-Hydrogeology-Environmental-Materials-Inspection

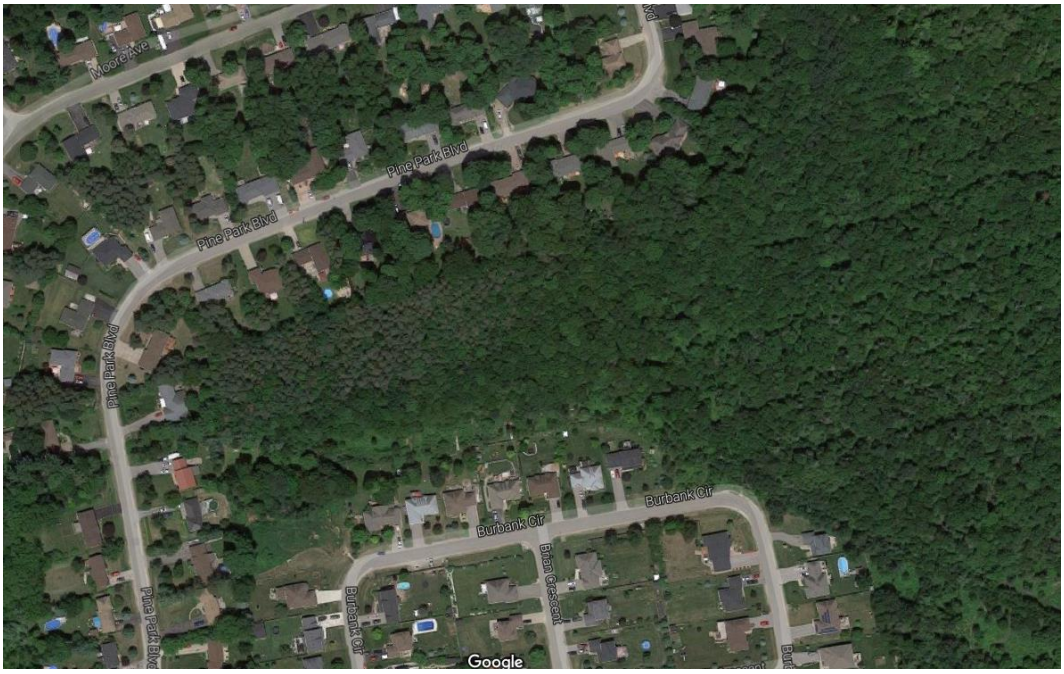
Geotechnical Investigation

Proposed Subdivision Developments

North of Burbank Circle, Everett, Ontario

Prepared For:

Winzen Developments Limited



GeoPro Project No.: 16-1710G

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GeoPro CONSULTING LIMITED

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1. INTRODUCTION

GeoPro Consulting Limited (GeoPro) was retained by Winzen Development Limited (the Client) to conduct a geotechnical investigation for the proposed subdivision developments located at the north side of Burbank Circle, Everett, Ontario.

The purpose of this geotechnical investigation was to obtain information on the existing subsurface conditions by means of a limited number of boreholes, test pits, 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 is 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 for most part 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 only. 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. FIELD AND LABORATORY WORK

The field work for the geotechnical investigation was carried out during February 2 and 6, 2017, during which time four (4) boreholes (Boreholes BH1 to BH4) were advanced at the locations shown on the Borehole Location Plan, Drawing 1. The boreholes were drilled to depths ranging from about 4.6 m to 8.1 m below the existing ground surface.

The boreholes were advanced using a continuous flight auger drilling equipment and a continuous split spoon 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.

The field work for this investigation was monitored by a member of our engineering staff who also determined the approximate borehole locations in the field, logged the boreholes and cared for the recovered samples.

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 contents, grain size distributions and Atterberg limits, when applicable) were carried out on selected soil samples. The results of grain size analyses of the selected soil sample are shown in Figure 1.

The groundwater condition observations were made in the boreholes during drilling and immediately upon completion of drilling. The boreholes were backfilled and sealed upon completion of drilling. Monitoring wells (51/38 mm in diameter) and piezometer (19 mm in diameter) were installed in all of the boreholes for groundwater level monitoring.

The borehole locations plotted on the Borehole Location Plan, Drawing 1 were based on the measurement of the site features and should be considered to be approximate. The ground surface elevations at the as drilled borehole locations were not available at the time of preparing the report.

3. SUBSURFACE CONDITIONS

Notes on sample descriptions are presented on Enclosure 1A. An explanation of terms used in borehole logs is presented in Enclosure 1B. The subsurface conditions in the boreholes (BH1 to BH4) are presented on the borehole logs (Enclosure 2 to 5 inclusive). The following are the detailed descriptions of the major soil strata encountered in the boreholes.

3.1 Soil Conditions

Topsoil

Topsoil with thicknesses ranging from about 230 mm to 300 mm was encountered surficially in Boreholes BH1 to BH4.

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 sand to sand were encountered below the topsoil in Borehole BH1, and extended to a depth of about 1.4 m below the existing ground surface. SPT N values ranging from 2 to 4 blows per 300 mm penetration indicated a very loose compactness. The in-situ moisture content measured in the soil samples ranged from approximately 10% to 15%.

Reworked Silty Sand

Reworked silty sand was encountered below the topsoil in Borehole BH3, and extended to a depth of about 0.8 m below the existing ground surface. SPT N value of 2 blows per 300 mm penetration indicated a very loose compactness. The in-situ moisture content measured in the soil sample was approximately 19%.

Sand to Fine Sand

Sand to fine sand deposits were encountered below the topsoil, the fill materials or reworked silty sand in all boreholes, and extended to depths ranging from about 4.6 m to 8.1 m below the existing ground surface. SPT N values ranging 3 from 32 blows for 300 mm penetration indicated a very loose to dense compactness. All boreholes were terminated in these deposits. The natural moisture content measured in the soil samples ranged from 5% to 21%.

Silt

Silt deposit was encountered within sand to fine sand deposits in Borehole BH3, and extended to a depth of about 3.1 m below the existing ground surface. SPT N value of 25 blows per 300mm penetration indicated a compact compactness.

3.2 Groundwater Conditions

The groundwater condition observations made in the boreholes during and immediately upon completion of drilling are shown in the borehole logs and 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 Depths on Completion of Drilling (mBGS)
BH1	8.1	-	-	2.4
BH2	4.6	1.5	-	-
BH3	4.6	1.5	-	-
BH3	4.6	1.5	-	-

The monitoring well construction details and the measured groundwater levels shown in the borehole logs and also summarized in the following table.

Monitoring Well ID	Screen Interval (mBGS)	Date of Monitoring: March 7, 2017
		Water Level (mBGS)
BH1	3.8 – 5.3	2.74
BH2	2.1 – 3.7	1.37
BH3	3.1 – 4.6	1.10
BH4	3.1 – 4.6	0.80

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.

4. DISCUSSION AND RECOMMENDATION

This report contains the findings of GeoPro's geotechnical investigation, together with the 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 and monitoring wells may not be sufficient to determine all the 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, which 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. Construction methods discussed, however, express GeoPro's opinion only and are not intended to direct the contractors on how to carry out the construction. Contractors should also be aware that the data and their interpretation presented in this report may not be sufficient to assess all the factors that may have an effect on the construction.

The 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.

4.1 Site and Project Description

It is understood that the proposed residential developments are located north of Burbank Circle, in Everett, Ontario as shown in Drawing 1. It is understood that the proposed developments consist of single houses with one level basement.

4.2 Subgrade Preparation and Engineered Fill

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 house foundations, roads, utilities, etc.

For the preparation of subgrade prior to the placement of the engineered fill, all topsoil and existing fill materials and reworked soils (up to depths ranging from about 0.8 m to 1.4 m below existing ground surface) and surficially softened native soils must be removed; the exposed subgrade must be 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, reworked soils, and any other deleterious materials 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, majority of the fill materials and native soils above the groundwater tables have water contents generally near their estimated laboratory optimum water contents for compaction. However, the cohesionless silty/sandy soils below the groundwater tables are generally wet of their estimated laboratory optimum water contents for compaction. These materials will likely require some adjustments in their water content (drying) prior to placement and compaction. In consideration of the poorly graded and fine textured nature of these materials, some difficulties may be anticipated in using these soils for compaction.

It should be noted that due to the fine-grained nature of the soils encountered at the site, their workability is sensitive to moisture conditions and some difficulty would be expected in achieving adequate compaction. In this regard, imported materials may 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 A. 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, the thickness will be determined. The contractor must provide with 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 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 and existing fill materials. Subgrade must be proof-rolled by 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. Engineered fill compacted to 98% SPMDD will settle under its own weight 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 structural and fill loads will occur.
6. Full-time geotechnical inspection and compaction testing by GeoPro during placement of engineered fill must be required. 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.

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 (say 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.

4.3 Foundation Considerations

The native 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 75 kPa at Serviceability Limit States (SLS), and a factored geotechnical bearing resistance of 115 kPa at Ultimate Limit States (ULS), may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed, competent subsoils below the existing fill materials and reworked soils. The soil bearing resistance at Serviceability Limit States (SLS) and a factored bearing resistance at Ultimate Limit States (ULS) together with the corresponding founding depths at the borehole locations are provided in the following table.

BH No.	Bearing Resistance at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth below Existing Ground (m)	Anticipated Bearing Soil
BH1	75	115	1.4 m	Loose to compact sand to fine sand
BH2	75	115	1.0 m	Loose to compact sand to fine sand
BH3	75	115	0.9 m	Loose to compact sand to fine sand

BH No.	Bearing Resistance at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth below Existing Ground (m)	Anticipated Bearing Soil
BH4	75	115	1.0 m	Loose to compact sand to fine sand

Footings founded on approved engineered fill, the geotechnical bearing resistance may be taken as 75 kPa at Serviceability Limit States (SLS), and a factored bearing resistance of 115 kPa at Ultimate Limit States (ULS), provided that all requirements on Appendix A is adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the construction must be considered.

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.

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

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 1.6 meters or equivalent insulation to satisfy frost protection requirements.

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.

It is suggested that finalized basement floor elevations should be set at least 1.0 m above the local water table. However, underfloor drains and upgraded level of water-proofing would be necessary in areas of the site if basements are proposed to be located below the local

groundwater table and in potentially water bearing soils. Under-floor-slab drainage shall 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 Drainage and Backfill Recommendations, Drawing No. 2. 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 sandy silt and silt 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 exterior foundations walls below ground surfaces.

4.4 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.

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. Water pressure must be considered, if continuous wall drains are not used.

4.5 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	75
Granular Material (OPSS 1010)	OPSS Granular A Base	150	150
	OPSS Granular B Subbase	300	400
		Prepared and Approved Subgrade	

The recommended pavement structures should be considered for preliminary design purposes only. A functional design life of ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. 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, which 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 qualified the geotechnical engineer prior to placing the Granular B subbase and additional granular material placed, as required, consistent with the prevailing weather conditions and anticipated use by construction traffic.

4.5.1 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.

4.5.2 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 grading of the material should conform to current OPS Specifications.

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

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

4.5.3 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, 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 paver 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.

4.6 Site Servicing

The invert depths of the proposed site services are not available at the time of preparing the report. We have assumed that the majority of the sewer and watermain 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 trench can be maintained during construction. The suitability of the existing 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 fill materials for supporting the pipes. Once the actual service invert depths are finalized, the following comments and recommendations should be reviewed and revised as necessary.

4.6.1 Trenching Excavation

Based on the results of this investigation, excavations (assumed up to 2 m to 4 m below existing ground surface) for the site servicing will be subexcavated through fills, reworked soils, predominant silty/sandy deposit, and potential engineered fill. The site servicing pipes are anticipated to be generally below the measured groundwater tables.

Perched groundwater may be expected in the fill materials and native cohesionless sandy/silty soils above the groundwater tables at various depths. Groundwater control during excavation within the fill materials and native sandy/silty soils above the groundwater tables 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 will be expected from any wet cohesionless silty/sandy deposits below the groundwater tables encountered at the site. Depending upon the prevailing groundwater tables at the time of construction and the finalized design pipe invert depths, some form of positive (pro-active) groundwater control or depressurization should 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).

It is anticipated that the trench excavations will consist of conventional temporary open cuts with side slopes not steeper than 1.5H:1V. 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 or wet sandy/silty deposits) or where localized seepage is encountered. 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 fills, native soils would be classified as Type 3 soils above the groundwater tables. However, should excavations extend into the wet sandy/silty soils below ground water levels, the soils would be classified as Type 4 and unless supported by shoring or other approved retaining method, the excavations will require minimum side slopes of 3H:1V. 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 sandy/silty 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.

4.6.2 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. 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 95 percent of the materials 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.

4.6.3 Backfilling of Trenches

Based on visual and tactile examination and the measured nature water contents of the soil samples, the on-site majority of native silty/sandy soils above the groundwater tables are anticipated to be generally near their estimated optimum water contents for compaction; however, the majority of the cohesionless silty/sandy soils below the groundwater tables are considered to be wet of the optimum water contents, which will require some drying prior to be used 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 predominantly poorly graded fine-grained soils, some difficulty would be expected in achieving adequate compaction during wet weather.

Below existing and future roads, the top 1.5 m of subgrade backfill below the underside of the pavement structure should be placed in maximum loose lift of 300 mm at or near (±2%) their optimum moisture content and compacted to 98% SPMDD. The remaining backfill should be placed in maximum 300 mm thick loose layers at or near (±2%) their optimum moisture content and each layer should be compacted to at least 95% SPMDD. The existing road pavement structure should be reinstated. New granular must match in to the underside of existing granular to ensure unimpeded cross drainage. Where a free-draining backfill is needed or where the backfill is needed for structural support of overlying structures, the soils on the site will not be suitable and OPSS Granular B or A sand and gravel will be required.

It should be noted that if the soils for trench backfilling were placed and compacted at wet of their optimum water content, 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.

In consideration of the extensive fine sandy soil deposits, the vibration from the vibratory rollers may cause differential settlement of these deposits, which may lead to the displacement of the pipes. Therefore, vibratory rollers must not be used for the first 2 m trench backfill above the pipes. The vibration compaction should be approved by the geotechnical engineer for the trench backfill greater than 2 m above the pipes. Full time inspection by a geotechnical engineer from GeoPro should be considered during the trench backfill.

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 98 percent of standard Proctor maximum dry density. 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 will be reflected at the ground surface and in pavement reconstruction areas, may be compensated for where necessary by placing additional granular material prior to asphalt paving. However, since it is anticipated that the asphalt binder course will be placed shortly following the completion of trench backfilling operations, 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. In any event, it is recommended that the surface course asphalt should not be placed over the binder course asphalt for at least 12 months. Post-construction settlement of the restored ground surface in off-road trench areas is also expected and should be topped-up and re-landscaped, as required.

4.7 Excess Soil Characterization

4.7.1 Soil Sample Submission

In order to provide information on the chemical quality of the subsurface soils, selected soil samples were submitted to AGAT Laboratories in Mississauga, Ontario (“AGAT”) for chemical analyses. Descriptions of the selected soil samples and analytical parameters are presented in the following table:

Sample ID	Soil Depth (mBGS)	Primary Soil	Analytical Parameters
BH1 SS1	0.23 – 0.61	Silty Sand to Sand Fill	Metals/Inorganics
BH1 SS4	2.29 – 2.74	Sand to Fine Sand	Metals/Inorganics
BH2 SS3	1.52 – 2.29	Sand to Fine Sand	Metals/Inorganics
BH3 SS1	0.30 – 0.76	Reworked Silty Sand	Metals/Inorganics

It should be noted that at the time of the sampling, no obvious visual or olfactory evidence of environmental impact (i.e. staining or odours) was observed at the sampling locations.

4.7.2 Soil Analytical Results

Metals and Inorganics

A total of four (4) soil samples were analysed for the parameters of metals and inorganics under Ontario Regulation 153/04 ("O. Reg. 153/04") as amended. A copy of the soil analytical results is provided in the Laboratory Certificate of Analysis, attached in Appendix A.

The soil analytical results were compared with the Ontario Ministry of the Environment and Climate Change ("MOECC") "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", April 2011, Table 1: Full Depth Background Site Condition Standards for Residential/Parkland/Institutional/Industrial/Commercial/Community Property Uses ("2011 MOECC Table 1 Standards"); Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition ("2011 MOECC Table 2 Standards"), and Table 3: Full Depth Generic Site Condition Standards in a non-potable Ground Water Condition ("2011 MOECC Table 3 Standards").

Based on the comparison, no exceedances of MOECC Table 1, Table 2 or Table 3 standards were noted for metals and inorganics in the tested soil samples from Boreholes BH1, BH2 and BH3.

4.7.3 Discussion of Analytical Results

Based on the analytical results, no exceedances of the MOECC Table 1, Table 2 or Table 3 Standards were noted for metals and inorganics in the tested soil samples.

Based on the results of soil sample analysis, GeoPro would recommend the following disposal options:

- The soils generated near Boreholes BH1, BH2 and BH3 at the tested depths with no identified exceedances can be re-used on Site or re-used at a receiving site which is not used for agricultural purposes and would accept the soils as per the test results. However, additional chemical testing may be required by the receiving site.

It should be noted that the results of the chemical analysis refer only to the soil samples analyzed, which were obtained from specific sampling locations and sampling depths, and that the soil chemistry may vary between and beyond the location and depth of the samples taken. Therefore, soil materials to be used on site or transported to other sites must be inspected during excavation for indication of variance in composition or any chemical/environmental constraints. If conditions indicate significant variations, further chemical analyses should be carried out.

Please note that the level of 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. Furthermore, it must be noted that our scope of work was only limited to the review of the analytical results of the limited number of samples. The scope of work did not include any environmental evaluation or assessment of the subject site (such as a Phase One or Phase Two Environmental Site Assessment).

Sites accepting fill may have requirements relating to its aesthetic or engineering properties in addition to its chemical quality. Some receiving sites may have specific chemical testing protocols, which may require additional tests to meet the requirements. The requirements for accepting the fill at an off-site location must be confirmed in advance. GeoPro would be pleased to assist once the receiving sites are determined and the requirements of the receiving sites are available.

5. 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.

6. CLOSURE

We trust the information provided in the report is sufficient to meet the present requirements. Please do not hesitate to contact our office should you wish to discuss, in further detail, any aspects of this project.

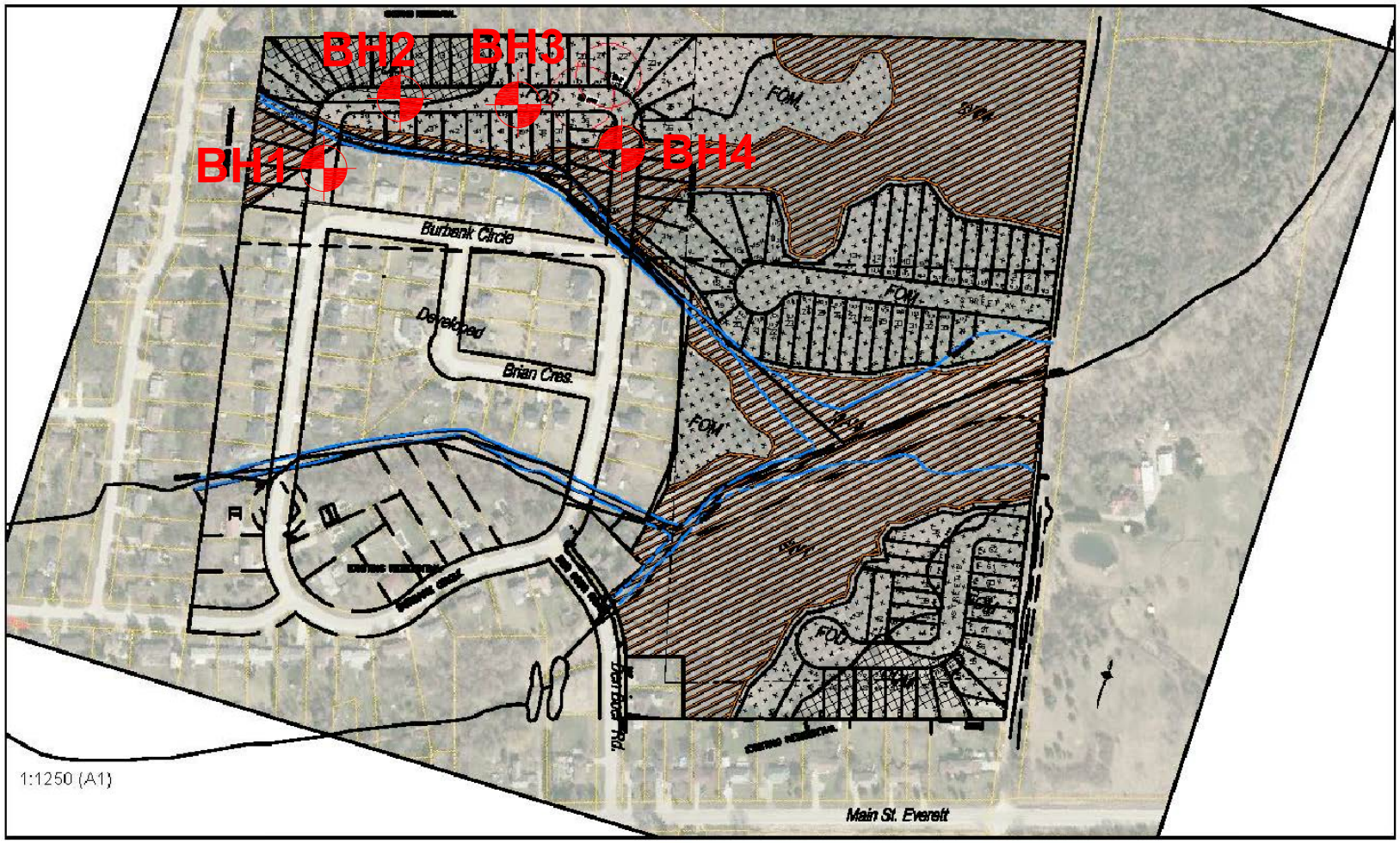
Yours very truly,

GEOPRO CONSULTING LIMITED

Dylan Q. Xiao, M.A.Sc., E.I.T., Project Engineer
Geotechnical Group

David B. Liu, P.Eng., Principal

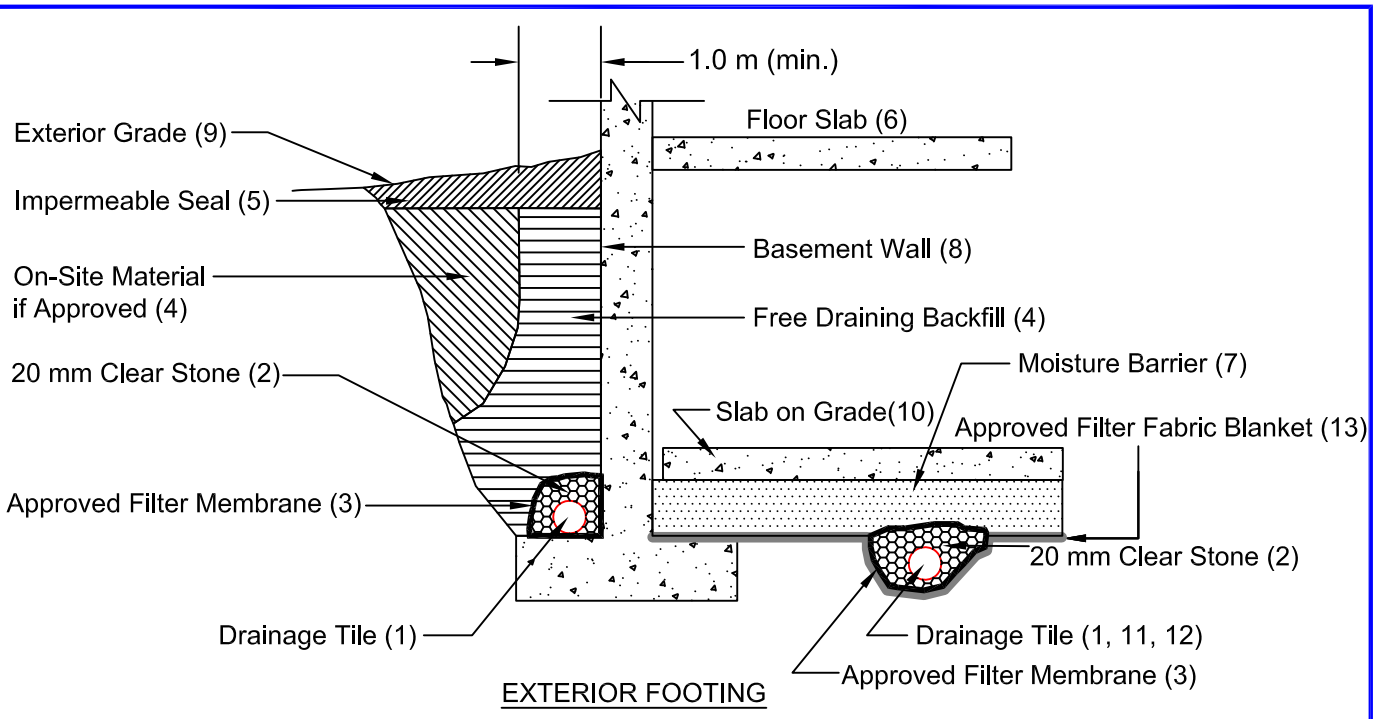
DRAWINGS



Legend:

Borehole Location

Client:	Winzen Developments Limited			Project No.: 16-1710G	Drawing No.: 1
Drawn: GH		Approved: DL		Title: Borehole Location Plan	
Date: March 2017		Scale: NTS		Project: Geotechnical Investigation for Subdivision Burbank Circle, Everett, Ontario	
Original Size: Letter		Rev: JY		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 6 to 8 m (20 to 25') 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. 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 (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

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Geotechnical-Hydrogeology-Environmental-Materials-Inspection

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	0-2
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	<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 BH1

PROJECT: Geotechnical Investigation for Proposed Subdivision Development
CLIENT: Winzen Developments Limited
PROJECT LOCATION: Everett, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Continuous Flight Auger - Auto Hammer
Diameter: 155 mm
Date: Feb/02/2017

REF. NO.: 16-1710G
ENCL NO.: 2

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
0.0	**TOPSOIL:** (230 mm)				Concrete
0.2	**FILL:** silty sand to sand, trace rootlets, trace organics, dark brown to brown, moist, very loose to loose	1	SS	2	
		2	SS	4	
1.4	**SAND TO FINE SAND:** trace to some silt, brown, moist to wet, loose to compact	3	SS	6	Bentonite
		4	SS	14	
	---wet ---containing layers of fine sandy silt	5	SS	13	W. L. 2.7 mBGL Mar 07, 2017
		6	SS	7	Sand Screen
		7	SS	10	Sluff
		8	SS	15	
8.1	**END OF BOREHOLE** Notes: 1) Borehole caved in at a depth of 2.4 mBGS upon completion of drilling. 2) Monitoring well was installed upon completion of drilling. Water Level Readings: Date W.L.Depth (m) March 7, 2017 2.74				

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 ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH2

PROJECT: Geotechnical Investigation for Proposed Subdivision Development
CLIENT: Winzen Developments Limited
PROJECT LOCATION: Everett, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Continuous Split Spoon
Diameter: 51 mm
Date: Feb/06/2017

REF. NO.: 16-1710G
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
0.0	**TOPSOIL:** (280 mm)											
0.3	**SAND TO FINE SAND:** trace to some silt, trace gravel, trace rootlets, trace organics, brown, moist to wet, very loose to dense		1	SS	3				○			
1	--containing wood fragments		2	SS	7				○			
2			3	SS	16				○			
3			4	SS	16				○			
			5	SS	26				○			
4			6	SS	32				○			
4.6	**END OF BOREHOLE**											

Concrete
Bentonite
W. L. 1.4 mBGL Mar 07, 2017
Sand
Screen
Sluff

Notes:
1) Water encountered at a dpeth of 1.5 mBGS during drilling.
2) Monitoring well was installed upon completion of drilling.

Water Level Readings:

Date	W.L.Depth (m)
March 7, 2017	1.37

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

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

LOG OF BOREHOLE BH3

PROJECT: Geotechnical Investigation for Proposed Subdivision Development
CLIENT: Winzen Developments Limited
PROJECT LOCATION: Everett, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Continuous Split Spoon
Diameter: 51 mm
Date: Feb/06/2017

REF. NO.: 16-1710G
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 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
0.0	**TOPSOIL:** (300 mm)						Concrete					
0.3	**REWORKED SILTY SAND:** trace rootlets, trace organics, brown to dark brown, moist, very loose		1	SS	2							
0.8	**SAND TO FINE SAND:** trace silt, trace rootlets, brown, moist to wet, loose to compact		2	SS	5		W. L. 1.1 mBGL Mar 07, 2017					
			3	SS	9							
			4	SS	25							
2.9	**SILT:** trace sand, brown, wet, compact											
3.1	**SAND TO FINE SAND:** trace silt, brown, wet, compact to dense		5	SS	21		Sand					
							Screen					
			6	SS	32							
4.6	**END OF BOREHOLE** Notes: 1) Water encountered at a dpeth of 1.5 mBGS during drilling. 2) Monitoring well was installed upon completion of drilling. Water Level Readings: Date W.L.Depth (m) March 7, 2017 1.10											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH4

PROJECT: Geotechnical Investigation for Proposed Subdivision Development
CLIENT: Winzen Developments Limited
PROJECT LOCATION: Everett, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

DRILLING DATA
Method: Continuous Split Spoon
Diameter: 51 mm
Date: Feb/06/2017

REF. NO.: 16-1710G
ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS 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
0.0	**TOPSOIL:** (300 mm)						Concrete					
0.3	**SAND TO FINE SAND:** trace to some silt, trace gravel, trace rootlets, trace organics, layers of silt, brown, moist to wet, very loose to compact		1	SS	3							
			2	SS	4		W. L. 0.8 mBGL Mar 07, 2017					
			3	SS	10		Bentonite					
			4	SS	22							
			5	SS	24		Sand					
			6	SS	29		Screen					
4.6	**END OF BOREHOLE** Notes: 1) Water encountered at a dpeth of 1.5 mBGS during drilling. 2) Monitoring well was installed upon completion of drilling. Water Level Readings: Date W.L.Depth (m) March 7, 2017 0.80											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

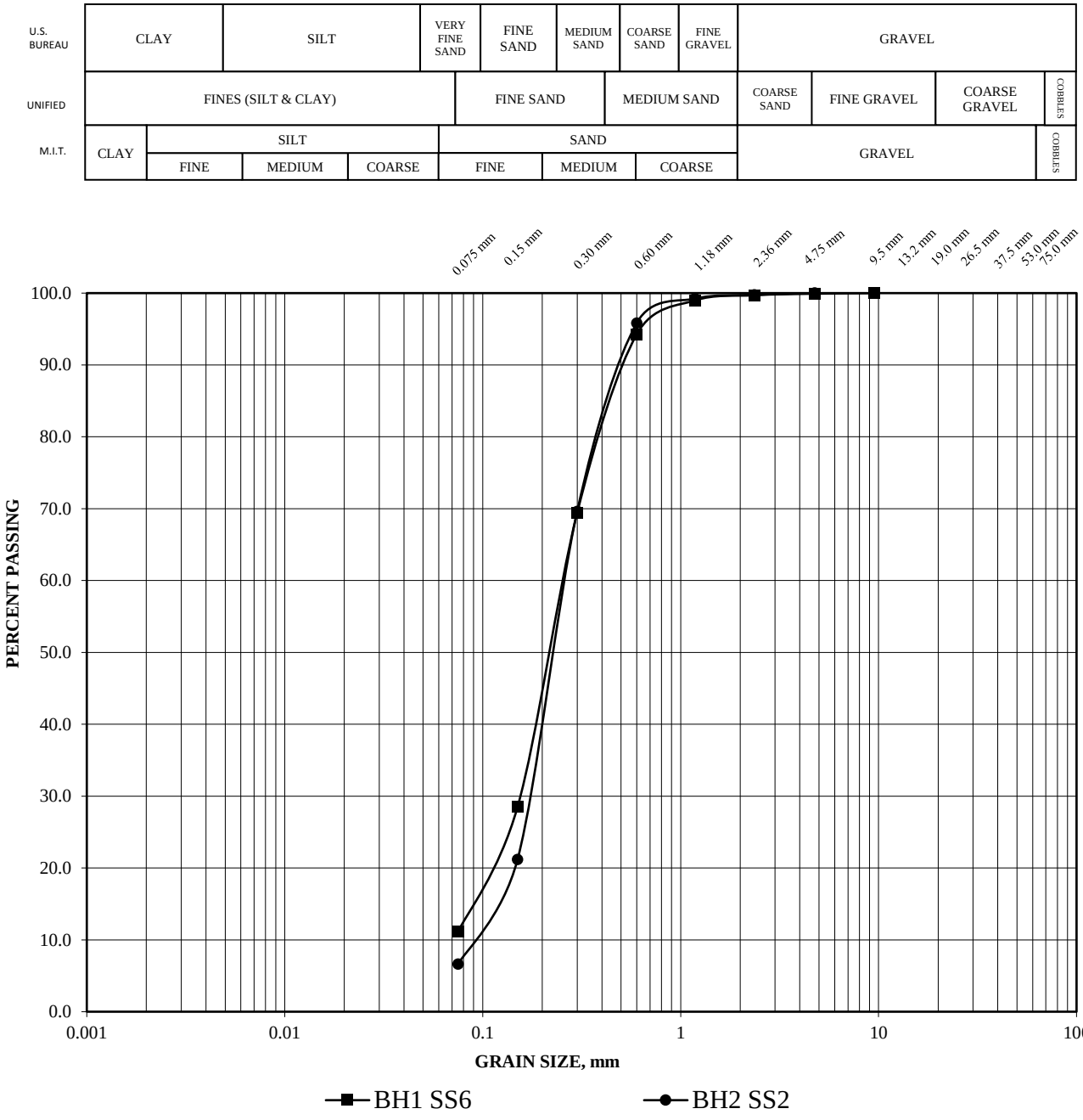
FIGURES

GeoPro Consulting Limited

Geotechnical-Hydrogeology-Environmental-Materials-Inspection

Figure 1

GRAIN SIZE DISTRIBUTION



Project No.	16-1710
Project Name	Subdivision at Burbank Circle, Everett, Ontario

APPENDIX A

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: GEOPRO CONSULTING LTD
40 VOGELL ROAD UNIT 25-27
RICHMOND HILL, ON L4B3N6
(905) 237-8336

ATTENTION TO: Bujing Guan

PROJECT: 16-1710

AGAT WORK ORDER: 17T199438

SOIL ANALYSIS REVIEWED BY: Mike Muneswar, BSc (Chem), Senior Inorganic Analyst

DATE REPORTED: Mar 31, 2017

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 17T199438

PROJECT: 16-1710

CLIENT NAME: GEOPRO CONSULTING LTD

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2017-03-23

DATE REPORTED: 2017-03-31

SAMPLE DESCRIPTION:				BH1 SS1		BH1 SS4	BH2 SS3	BH3 SS1
SAMPLE TYPE:				Soil		Soil	Soil	Soil
DATE SAMPLED:				2017-02-02		2017-02-02	2017-02-06	2017-02-06
Parameter	Unit	G / S	RDL	8276062	RDL	8276063	8276064	8276065
Antimony	µg/g	1.3	0.8	<0.8	0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	2	1	1	1	1
Barium	µg/g	220	2	26	2	7	8	26
Beryllium	µg/g	2.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5
Boron	µg/g	36	5	<5	5	<5	<5	<5
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.15	0.10	<0.10	<0.10	0.16
Cadmium	µg/g	1.2	0.5	<0.5	0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	8	2	5	4	5
Cobalt	µg/g	21	0.5	2.1	0.5	1.5	1.3	1.1
Copper	µg/g	92	1	3	1	5	3	2
Lead	µg/g	120	1	3	1	2	1	4
Molybdenum	µg/g	2	0.5	<0.5	0.5	<0.5	<0.5	<0.5
Nickel	µg/g	82	1	4	1	4	3	3
Selenium	µg/g	1.5	0.4	<0.4	0.4	<0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	<0.5	0.5	<0.5	<0.5	<0.5
Vanadium	µg/g	86	1	15	1	12	7	11
Zinc	µg/g	290	5	15	5	7	5	11
Chromium VI	µg/g	0.66	0.2	<0.2	0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.200	<0.200	0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	0.10	<0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	0.125	0.005	0.114	0.073	0.080
Sodium Adsorption Ratio	NA	2.4	NA	0.032	NA	0.089	0.200	0.190
pH, 2:1 CaCl2 Extraction	pH Units		NA	6.81	NA	7.59	7.63	4.70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

8276062 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. Note - Extract for Free Cyanide was Oily & dark in colour. As a result, dilution was necessary prior to analysis in order to reduce matrix interferences.

8276063-8276065 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By:

AGAT Laboratories

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Quality Assurance

CLIENT NAME: GEOPRO CONSULTING LTD

AGAT WORK ORDER: 17T199438

PROJECT: 16-1710

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Mar 31, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	8272855		3.6	3.6	NA	< 0.8	126%	70%	130%	105%	80%	120%	96%	70%	130%
Arsenic	8272855		9	7	25.0%	< 1	108%	70%	130%	105%	80%	120%	103%	70%	130%
Barium	8272855		76	75	1.3%	< 2	101%	70%	130%	98%	80%	120%	101%	70%	130%
Beryllium	8272855		<0.5	<0.5	NA	< 0.5	83%	70%	130%	105%	80%	120%	89%	70%	130%
Boron	8272855		6	6	NA	< 5	82%	70%	130%	107%	80%	120%	93%	70%	130%
Boron (Hot Water Soluble)	8272855		0.41	0.42	NA	< 0.10	112%	60%	140%	103%	70%	130%	99%	60%	140%
Cadmium	8272855		0.8	0.8	NA	< 0.5	110%	70%	130%	106%	80%	120%	105%	70%	130%
Chromium	8272855		18	18	0.0%	< 2	96%	70%	130%	114%	80%	120%	112%	70%	130%
Cobalt	8272855		5.5	5.5	0.0%	< 0.5	102%	70%	130%	110%	80%	120%	99%	70%	130%
Copper	8272855		63	62	1.6%	< 1	101%	70%	130%	117%	80%	120%	85%	70%	130%
Lead	8272855		190	197	3.6%	< 1	105%	70%	130%	101%	80%	120%	70%	70%	130%
Molybdenum	8272855		1.3	1.3	NA	< 0.5	107%	70%	130%	103%	80%	120%	105%	70%	130%
Nickel	8272855		24	25	4.1%	< 1	103%	70%	130%	112%	80%	120%	100%	70%	130%
Selenium	8272855		0.9	1.0	NA	< 0.4	128%	70%	130%	99%	80%	120%	106%	70%	130%
Silver	8272855		<0.2	<0.2	NA	< 0.2	98%	70%	130%	115%	80%	120%	110%	70%	130%
Thallium	8272855		<0.4	<0.4	NA	< 0.4	103%	70%	130%	104%	80%	120%	98%	70%	130%
Uranium	8272855		<0.5	<0.5	NA	< 0.5	98%	70%	130%	93%	80%	120%	95%	70%	130%
Vanadium	8272855		20	20	0.0%	< 1	99%	70%	130%	109%	80%	120%	109%	70%	130%
Zinc	8272855		205	199	3.0%	< 5	102%	70%	130%	117%	80%	120%	84%	70%	130%
Chromium VI	8277762		<0.2	<0.2	NA	< 0.2	93%	70%	130%	98%	80%	120%	100%	70%	130%
Cyanide	8280335		<0.040	<0.040	NA	< 0.040	102%	70%	130%	108%	80%	120%	103%	70%	130%
Mercury	8272855		0.15	0.17	NA	< 0.10	100%	70%	130%	88%	80%	120%	93%	70%	130%
Electrical Conductivity	8277893		0.376	0.369	1.9%	< 0.005	93%	90%	110%	NA			NA		
Sodium Adsorption Ratio	8276363		0.057	0.053	7.3%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	8277854		7.37	7.42	0.7%	NA	101%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

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Method Summary

CLIENT NAME: GEOPRO CONSULTING LTD

AGAT WORK ORDER: 17T199438

PROJECT: 16-1710

ATTENTION TO: Bujing Guan

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

AGAT Laboratories

SR7

5835 Coopers Avenue
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Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 17T194438

Cooler Quantity: BOX

Arrival Temperatures: 4.5 4.5 4.1 / 3.6 3.3 3.2

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: GeoPro Consulting Ltd.
Contact: Bying Guan
Address: Unit 57, 45 Vogell Rd.
Richmond Hill, Ontario
Phone: 905-237-8336 Fax: 905-248-3699
Reports to be sent to:
1. Email: bguan@geoproconsulting.ca
2. Email: dylanx@geoproconsulting.ca

Regulatory Requirements:

☐ No Regulatory Requirement
(Please check all applicable boxes)

☑ Regulation 153/04
Table (Indicate One): ☐Ind/Com ☐Res/Park ☐Agriculture
Soil Texture (Check One): ☐Coarse ☐Fine

☐ Sewer Use
☐Sanitary ☐Storm
Region (Indicate One)

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a Record of Site Condition? ☐ Yes ☒ No

Report Guideline on Certificate of Analysis ☒ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 16-1710
Site Location: Everett, ON
Sampled By: Dylan
AGAT Quote #: GeoPro PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Please Circle) Y / N	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐B-HWS ☐Cl ☐CN ☐Cr6+ ☐EC ☐FOC ☐NO_3/NO_2 ☐Total N ☐Hg ☐pH ☐SAR	Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☐VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH1 SS1	Feb 2, 2017		1	Soil			✓														
~~BH1~~ BH1 SS4	Feb 2, 2017		1	Soil			✓														
BH2 SS3	Feb 2, 2017		1	Soil			✓														
BH3 SS1	Feb 2, 2017		1	Soil			✓														

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Dylan Xiao			Bying Guan	2017/3/23	18:52
Samples Relinquished By (Print Name and Sign): Bying Guan	2017/3/23	5:05	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page 1 of 1

Nº: T 033787

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.

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.

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.