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Geotechnical Investigation Report
Proposed Residential/ Commercial Development
28 Bronte Street North
Milton, Ontario

Prepared for:

2183271 Ontario Inc.
c/o Mr. Jacob Kaven
Korsiak Urban Planning

Landtek File: 16413
March 9, 2017

EXECUTIVE SUMMARY

SCOPE OF SERVICES

Proposed Development	2183271 Ontario Inc. is intending to develop the site identified as 28 Bronte Street North in Milton, Ontario as a residential and commercial property.
Report Deliverables	The purposes of the Geotechnical Investigation were to confirm the subsurface conditions at the site and to provide design and construction recommendations with regards to building foundations, floor slabs, pavement structures, and subsurface drainage and utilities.

SITE DETAILS AND SETTING

UTM 17T Coordinates	589729, 4817974	**Site Area (approx.)**	2.25 hectares (22,500 m^2)
Site Description	The project site is situated to the north of Tremaine Road and to the east of Steeles Avenue West, and is bound to the east by Main Street West and to the north by Bronte Street North. The east section of the site is a developed area and includes commercial premises and an adjacent, asphalt parking lot to the north of the commercial buildings, while the west side is covered predominately by unmaintained grass and loose clusters of trees. A CN railroad is located in the vicinity of the site, approximately 15 m south of the site.		
Geology	Topsoil, gravel (fill), and asphalt were encountered at the surface. Underlying the surface materials was clayey silt till. The clayey silt till extends to a depth of between 6.1 m and 10.6 m below the existing ground surface. Underlying the clayey silt till is red shale bedrock that extends to the maximum proven depth of approximately 12.8 m below the ground surface.		

ENGINEERING CONSIDERATIONS

Foundations	It is considered by Landtek that bearing conditions to support the proposed structure on concrete footings can be provided by the native clayey silt till and shale bedrock.
Settlements	The general limiting of the total settlement of 25 mm and the differential settlement to 19 mm by the recommended geotechnical reaction at the SLS is considered appropriate for the native soils at the site.
Earthquake Considerations	The subject property is considered to be a 'C' Site Class
Floor Slabs	The subgrade conditions can adequately support the concrete floor slab on grade, provided that areas of softened native soils are excavated to uncover, more competent soils underlying the soft sections.

CONSTRUCTION CONSIDERATIONS

Excavations	The subsurface soils to be encountered during excavation at the site are expected, in general, to behave as Type "2" materials according to the OHSA classification in Part III. Type 2 materials are characteristic of the generally very stiff clayey silt till. The weathered shale is characteristic of a Type 1 material.
Dewatering	Groundwater seepage was observed in some boreholes during drilling. A Permit To Take Water may be required to enable an appropriate level of groundwater control where excavating below a depth of approximately 9.0 m below existing ground level.
Material Reuse	The native soils and shale bedrock encountered on site are considered from a geotechnical perspective as suitable for re-use as engineered backfill.
Pavements	The subgrade soil should be inspected and proof-rolled using a loaded tandem axle truck to traverse the exposed subgrade, prior to the placement of pavement granular fill.

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1.0 INTRODUCTION

Landtek Limited (herein "*Landtek*") is pleased to submit the geotechnical investigation report for the proposed multi-storey commercial/residential development at 28 Bronte Street North in Milton, Ontario. The work was authorized by Mr. Jacob Kaven of 2183271 Ontario Inc. on December 8, 2016. All work was completed in accordance with our proposal reference P16343a, dated October 18, 2016.

Limited information regarding the proposed development was available at the time of writing this report, with only a partial conceptual design available. From this, it is understood that the development is anticipated to comprise a multi-storey residential and commercial development. It is assumed that the proposed development will also include for a maximum of three levels of basement parking, together with new access roads, at-grade paved parking areas and full site servicing.

The primary objectives of this investigation were:

- To confirm the subsurface soil and groundwater conditions for foundation design and construction;
- Provide design and construction recommendations with regards to building foundations, floor slabs, pavement structures, and subsurface drainage and utilities; and,
- Assess the characteristics of the soils to be excavated and their suitability for reuse on site as fill material.

This report has been prepared for 2183271 Ontario Inc., their nominated engineers, designers, and project managers. Further dissemination of this report is not permitted without Landtek's prior written approval. Further details of the limitations of this report are presented in Appendix A.

2.0 METHODOLOGY

Fieldwork undertaken at the site by Landtek included clearance of underground services, borehole layout, borehole drilling and soil sampling, and field supervision. A total of eight boreholes (boreholes BH1 to BH8) were drilled on January 9 and 10, 2017. All boreholes were logged using those standard symbols and terms defined in Appendix B. The borehole location plan, Drawing 1, and the borehole logs are provided in Appendix C.

All boreholes were drilled using a CME 55 truck-mounted drilling rig equipped with continuous flight, solid stem augers, and were advanced to a maximum depth of 12.8 m below existing ground level.

Standpipe piezometers (50 mm diameter PVC) were installed in boreholes BH2 and BH7, and water level readings were subsequently taken on January 19, 2017.

Standard Penetration Tests (SPT's) and split spoon samples were taken during drilling at selected depths. Full time supervision of drilling and soil sampling operations was carried out by a representative of Landtek. The soil samples were then transported to Landtek`s in-house, CCIL certified laboratory and visually examined to determine their textural classification. Moisture contents were carried out on all samples.

Geodetic elevations at the borehole locations were established by Landtek relative to the borehole location plan for the site, as provided to Landtek by 2183271 Ontario Inc.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Location

The site is located in Milton, Ontario, and is centered at approximate grid reference 589729, 4817974 (UTM 17T coordinates). The general Geodetic elevation of the ground surface in the area of the site is 200 m.

The site location is shown in Figure 1 below.

Figure 1
Site Location Plan

The project site is situated to the north of Tremaine Road and to the east of Steeles Avenue West, and is bound to the east by Main Street West and to the north by Bronte Street North. The site covers an area of approximately 22500 m^2 (2.25 hectares) and is relatively flat. The east section of the site is a developed area and includes commercial premises and an adjacent, asphalt parking lot to the north of the commercial buildings, while the west side is covered predominately by unmaintained grass and some trees. An active CN railroad is located in the vicinity of the site, approximately 15 m to the south of the site.

Based on published geological information [1,2] for the area, the predominant subsurface soil is red to brown, gritty to clayey silt till. It is mapped in this area as the Halton Till. The bedrock in the area is identified as red shale of the Queenston Formation.

The borehole information is generally consistent with the geological data, and the predominant soils comprise of clayey silt till deposits. Red shale bedrock was encountered at depth of between 6.1 m and 10.6 m below existing ground surface during this investigation. The detailed borehole logs are presented in Appendix C, and the ground conditions encountered by the boreholes are discussed further in the following sections.

Organic Soil

Topsoil was encountered at the ground surface in boreholes BH5, BH7, and BH8 and is approximately 100 mm to 150 mm thick.

Existing Pavement Structures

Boreholes BH2 and BH4 were drilled in the asphalt surfaced parking area and the asphalt thickness is approximately 100 mm. Pavement granular material were encountered underlying the asphalt and is approximately 200 mm thick.

A gravel pavement surface was encountered in boreholes BH1, BH3, and BH6 and is approximately 150 mm to 300 mm thick.

Fill Material

Fill comprising silty clay was encountered underlying the topsoil in borehole BH7 and extends to a depth of approximately 1.2 m below the existing ground level. The fill is brown and black, and comprises of some organics and trace of coal.

Clayey Silt Till

Clayey silt till was encountered below the organic soil or fill in all the boreholes and extends to a depth of between 6.1 m and 10.6 m below existing ground level. The clayey silt till is reddish brown, and contains traces of gravel, silt lenses, red and grey shale fragments, and rust staining.

SPT 'N' values ranging from 14 to 50 blows for 50 mm of penetration were reported, indicating the clayey silt till to be stiff to hard. The clayey silt till becomes harder at increased depth. Moisture contents in the clayey silt till range between 8 % and 19 %.

Bedrock

Red shale of the Queenston Formation was encountered at depths of between approximately 6.1 m (borehole BH5) and 10.6 m (borehole BH3) below existing ground level.

The shale is generally moderately weak and is highly weathered to weathered, though will become more competent at depth. The shale is typically classified under the Canadian Foundation Engineering Manual classification rating criteria as being a Grade R3 rock which is a relatively weak rock.

Groundwater

Water seepage was encountered during drilling at depths of 8.1 m (borehole BH1) and 10.7 m (borehole BH3) below existing ground level. On completion of drilling, standpipe piezometers were installed in boreholes BH2 and BH7. Water level readings in the standpipe piezometers

were recorded, and the water level readings were reported at 1.5 m (borehole BH2) and 3.8 m (borehole BH7) below existing ground level.

It should be noted that these groundwater levels are not considered to reflect the long term stabilized water table. Groundwater conditions are expected to vary according to the time of the year and seasonal precipitation levels. During wet weather, an increase in water seepage is to be expected in the shallow fill deposits.

4.0 FOUNDATION DESIGN CONSIDERATIONS

4.1 Foundations in Native Soils

Based on the ground conditions observed at the borehole locations, it is considered by Landtek that bearing conditions to support the proposed structure on concrete footings can be provided by the native clayey silt till and shale bedrock. In the absence of preliminary design information, it has been assumed that the proposed structure will include a maximum of three basement parking levels. Therefore, it is anticipated that the underside of footings will be at depths of approximately 3.0 m to 9.0 m below existing ground level, and will be seated within the clayey silt till or shale bedrock.

Table 1 summarizes the recommended geotechnical reactions at the Serviceability Limit State (herein "*SLS*") and factored geotechnical resistances at the Ultimate Limit State (herein "*ULS*") for the clayey silt soils. It should be noted that the determined design parameters have been determined by Landtek for the design stage only.

Subsurface conditions can vary over relatively short distances and the subsurface conditions revealed at the test locations may not be representative of subsurface conditions across the site. Therefore, a Geotechnical Engineer should be engaged during construction to examine the exposed sub-soil quality and condition, and confirm the subsurface conditions are consistent with design assumptions. This is in compliance with field review requirements in the National Building Code, Volume 1, Clause 4.2.2.3.

Table 1
Recommended Limit State Foundation Design Values

Founding Elevation Range		Founding Stratum	Foundation Design Value	
Depth Range	Geodetic Elevation		SLS [1,2]	ULS [3,4]
1.5 m to 3.0 m	198.5 m to 197.0 m	Clayey Silt Till	150 kPa	225 kPa
3.0 m to 6.0 m	197.0 m to 194.0 m	Clayey Silt Till	250 kPa	375 kPa
6.0 m to 9.0 m	194.0 m to 191.0 m	Clayey Silt Till/ Shale	400 kPa	600 kPa

Notes:
1. The National Building Code general safety criterion for the serviceability limit states is: SLS resistance ≥effect of service loads.
2. Recommended SLS bearing values conform to Estimated Values based on soil types given in Tables K-8 and K-9 of the National Building Codes User's Guide.
3. The ULS resistance factor for shallow foundations is 0.5, as given in Table K-1 of the National Building Code User's Guide.
4. The National Building Code general safety criterion for the ultimate limit states is: factored ULS resistance ≥effect of factored loads.

4.2 Frost Susceptibility

The native clayey silt till encountered at shallow depths across the site are considered sensitive to water and frost, and their physical and mechanical properties are dependent on in-situ moisture content. As such, the founding soils at the site are considered to have a moderate to high frost susceptibility, being classified as Frost Group "*F4*" (Table 13.1 of the "*Canadian Foundation Engineering Manual*", 4th Edition). However, the identified depths for foundations, as given in Section 4.1 are considered to be below the maximum depth for frost penetration of 1.2 m in the Milton area.

Should any re-grading be required as part of the proposed development and adjacent to the new structures, it will be important to ensure that the associated exterior footings will have a minimum of 1.2 m of soil cover, or equivalent suitable insulation, for frost protection.

4.3 Settlement Considerations

Based on the outline information provided for the nature of the proposed redevelopment of the site, it is anticipated that the loads to be applied to the ground by any such structure will be generally moderate intensity. As such, associated settlements are not expected to be large. Therefore, the general limiting of the total settlement to 25 mm and the differential settlement to 19 mm by the recommended geotechnical reaction at the SLS is considered appropriate.

4.4 Seismic Design Considerations

In accordance with Table 4.1.8.4.A. of the Ontario Building Code (herein "*OBC*") the subject property is considered to be a 'C' Site Class. The acceleration and velocity-based site coefficients, F_a and F_v, should be determined from Tables 4.1.8.4.B. and 4.1.8.4.C. respectively of the OBC for the above recommended Site Class. The seismic design data given in Table 1.2 of Supplementary Standard SB-1 in Volume 2 of the OBC, for selected Municipal locations, should be used to complete the seismic analysis.

4.5 Demolition of Existing Structures

It is understood that the existing commercial buildings and associated infrastructure located on site will be demolished prior to the proposed redevelopment of the site. For the purposes of this report, it has been assumed that the existing structures will be removed in full, including all associated substructures.

Should there be a need to fill excavations created by the demolition of the existing structure's foundations, or any other excavation, with engineered fill or unshrinkable backfill prior to commencing the proposed development, Landtek should be contacted to determine the most appropriate placement requirements of the fill material.

5.0 FLOOR SLAB AND PERIMETER DRAINAGE CONSIDERATIONS

Based on the borehole soil conditions and preliminary design information provided to Landtek, it should be possible to construct the floor slab level using slab-on-grade methods. The subgrade support conditions are anticipated to be native clayey silt till soils and shale bedrock, which should provide competent conditions for placing the vapour barrier material. However, after the subgrade has been prepared to the underfloor design elevation it is recommended that the area be assessed by Landtek to determine if there is a need for any remedial work.

Any required grade raising below floor slabs or localized, 'soft-spot' remediation to the subgrade should be completed using select subgrade material placed per Sections 8.0 and 10.0 of this report. The select subgrade materials are to be compacted to a recommended target compaction of 100 % Standard Proctor Maximum Dry Density (herein *"SPMDD"),* with no individual test below 98 % SPMDD.

It is recommended that a minimum 150 mm layer of clear 19 mm crushed quarried stone be used as the vapour barrier under the floor slab. The vapour barrier stone should meet the requirements of Ontario Provincial Standard Specifications (herein "*OPSS*") 1004 for 19 mm Type II clear stone. If a graded crushed stone is substituted for clear stone, the material should be limited to a maximum of 5 % fines (passing the 0.075 mm sieve). The floor slab thickness should meet the specifications of the project based on anticipated floor loadings.

The finished exterior ground surface should be sloped away from the buildings at a grade in the order of 2 %.

The concrete properties should meet the requirements of OPSS 1350. Contraction and isolation jointing practices should be in accordance with current Portland Cement Association recommendations, as given in the engineering bulletin "*Concrete Floors on Ground*", second edition, by R. E. Spears, and W. C. Panarese.

Perimeter drainage should be provided around all subsurface floor areas where water may accumulate. Underfloor drains may be required depending on excavation and groundwater seepage conditions. The drainage system should comply with the current OBC and associated amendments.

6.0 EARTH PRESSURE CONSIDERATIONS ON SUBSURFACE WALLS

The earth pressure, p, acting on subsurface walls at any depth, h, in metres below the ground surface assumes an equivalent triangular fluid pressure distribution and may be calculated using expression (1) below. It is assumed that granular material is used as backfill. Allowances for pressure due to compaction operations should be included in the earth pressure determinations and a value of 12 kPa is applicable for a vibratory compactor and granular material.

If the structure retaining soil can move slightly, the active earth pressure case can be used in determining the lateral earth pressure. For restrained structures and no yielding an "at rest" earth pressure condition should be used. The determination of the earth pressures should be based on the following expression:

$$p = K (\delta h + q) \qquad (1)$$

where:

p = the pressure in kPa acting against any subsurface wall at depth, h, in metres (feet) below the ground surface;

K = the at rest earth pressure coefficient considered appropriate for subsurface walls; OPSS 1010 Granular B Type 1 (pit-run sand and gravel) material has an effective angle of friction estimated to be 32° with a corresponding at rest earth pressure coefficient, K_o, of 0.45;

δ = the moist bulk unit weight of the retained backfill; 21.5 kN/m^3

and,

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

h = the depth, in m, at which the pressure is calculated

Granular B backfill should meet OPSS 1010 Type I or Type II material specifications. The granular fill should be compacted to a minimum of 97 % SPMDD, or to the levels and backfilling procedures specified.

The subsurface walls should be damp proofed and comply with the OBC requirements. As a minimum it is recommended that the damp proofing system include a Delta Drainage Board or MiraDrain 2000 series product, or an approved alternative, along with an asphalt based spray-on wall coating.

7.0 SUBSURFACE CONCRETE

7.1 General Considerations

The requirements for subsurface concrete subject to a sulphate environment are presented in Canadian Standards Association (CSA) specification CAN/CSA-A3000-13. Experience in the area indicates that the native soils generally have a mild sulphate environment and are not aggressive to concrete (CSA criteria of less than 0.2 % water soluble sulphate in the soils). It is recommended that subsurface concrete at the site have the following characteristics for an S-3 exposure class:

- minimum 28-day compressive strength = 25 MPa;
- minimum 56-day strength = 30 MPa;
- maximum water to cement ratio = 0.50;
- cementing materials:
  MS hydraulic cement or MSb; as per tables 3 and 4 respectively in CSA A23.1-04; and,
- air content:
  4 – 7 % for 14 mm to 20 mm nominal size coarse aggregate
  3 – 6 % for 28 mm to 40 mm nominal size coarse aggregate

7.2 Methods for Specifying Concrete

Alternative methods of specifying concrete for a project are outlined in CSA A23.1-14 and allow for "*Performance*" or "*Prescription*" based methods. Each method attaches different levels of responsibility to the owner, the contractor, and the concrete supplier. The pros and cons of each method should be examined prior to completion of the specifications for the project.

8.0 EXCAVATION AND BACKFILL CONSIDERATIONS

8.1 General Excavation Considerations

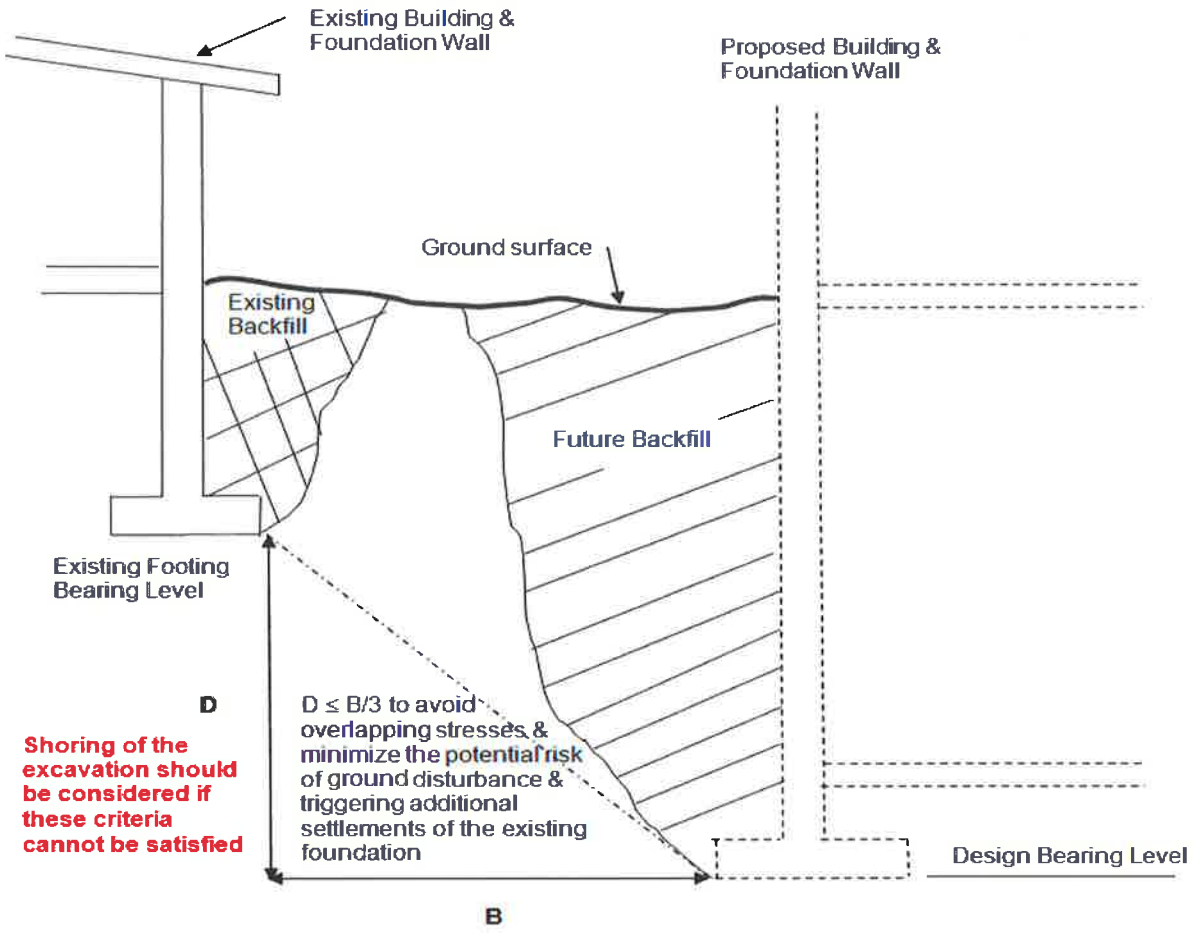
All temporary excavations and unbraced side slopes in the soils should conform to standards set out in the Occupational Health and Safety Act, Ontario Regulation 213/91 "*Construction Projects*" (herein "*OHSA*"). The subsurface soils to be encountered during excavation at the site are expected, in general, to behave as Type "2" materials according to the OHSA classification in Part III. Type 2 materials are characteristic of the generally very stiff clayey silt till. The weathered shale is characteristic of a Type 1 material. Type 1 soils have a low natural moisture content and a high degree of internal strength.

It should be possible to excavate the overburden soils and upper weathered shale using a hydraulic backhoe, though a backhoe equipped with a hydraulic breaker and/or a bucket with rock-ripping 'tiger teeth' may be required where seams and bands of harder strata (such as siltstone or limestone) are encountered within the weathered shale. Moist Type 2 soils are expected to be stable for short construction periods at slopes of approximately 45° to the horizontal (i.e. 1V:1H).

Consideration should be given to existing service trenches and backfill that may be present directly behind cut slopes within the native soils that may appear to be stable on first excavation. In these circumstances, slopes can suddenly slough or collapse due to the effects of the adjacent backfill. Consequently, for excavation conditions that cannot satisfy the OHSA requirements for unbraced 1H:1V side slopes, a trench box system should be used, or temporary shoring should be installed to maintain safe working conditions. This may be more applicable to service trench excavations, though may also apply to basement excavations etc., particularly where in close proximity to new road pavements or associated infrastructure.

It should be noted that the design of a temporary shoring system, should one be required, is the responsibility of the Contractor. Therefore, a specialist shoring contractor should be consulted to provide the most appropriate shoring type method and associated installation procedures. In any event, the shoring design should be based on the procedures outlined in the latest edition of the "*Canadian Foundation Engineering Manual*". It is also recommended that lateral and vertical movement of the shoring system be monitored during construction to ensure that movements are within the acceptable range.

Excavations for new foundations should satisfy the criteria given in the example shown in Figure 2 to avoid overlapping stresses and minimize the risk of undermining existing adjacent structures, including utilities, and/or triggering additional settlements of the existing structures due to soil disturbance. Shoring may be required to avoid undermining existing adjacent foundations during construction or provide safe working conditions.



Example: If the separation between existing and new proposed footings is 2 m the difference in bearing elevation should not exceed 0.67 m.

Figure 2
Criteria for Assessing Excavation Shoring Requirements (Not to Scale)

8.2 General Backfill Considerations

Backfill next to foundation walls and in service trenches should be selected to be compactable in narrow trench conditions. The on-site clayey silt till soils and excavated shale are expected to be reusable as trench backfill and backfill around the proposed structures on the site. Any variation in the moisture contents of the soils encountered may require selective separation of material to avoid the use of wet soil. Experience with shale indicates that long term settlements can occur unless quality control procedures are in place to ensure the shale particle sizes are broken down to minus 200 mm material, the moisture content of the material is maintained at near optimum levels, and the material is placed in maximum lift thicknesses of 300 mm.

Site servicing trench backfill should be uniformly compacted to a density that minimizes the risk of long-term settlements. It is recommended that the target compaction specification for trench backfill be 97 % SPMDD with no individual test below 95 % SPMDD.

Groundwater seepage is expected to be variable and will depend upon the depth of the excavations, the time of year, and precipitation levels preceding construction. The site information indicates that groundwater should be expected below a depth of approximately

9.0 m. A Permit To Take Water (herein "*PTTW*") may be required to enable an appropriate level of groundwater control where excavating below a depth of approximately 9.0 m below existing ground level.

During inclement weather the native soils may become too wet to achieve satisfactory compaction. If construction is proposed for late in the year, a reduced level of trench compaction with a higher risk of future settlements is to be anticipated, and it is recommended that provisional contract quantities be established for the supply and placement of imported granular fill under such circumstances. The imported granular should meet the requirements of OPSS 1010 for Granular B Type I material as a minimum requirement.

8.3 Bedrock Considerations

Competent shale of the Queenston Formation has the characteristics of becoming soft or degraded after excavation and subsequent exposure to the elements, the results of which would be basal heaving and compression from rock squeezing along excavation side walls. As such, these effects should be minimized during construction, and requires a well planned construction program to ensure that the exposure of the shale bedrock is kept to a minimum. Alternatively, the application of a mud mat and/or sprayed concrete may be included to allow an open trench section to remain open for an extended time period.

Methane gas is known to be present within the fracture networks of the Queenston Formation shale, normally below the top 1 m and becoming more concentrated with depth. As such, the potential could exist for the development of an explosive or oxygen-depleted air environment. Therefore, Landtek recommends that the appropriate air space monitoring is undertaken within all confined excavations, particularly those located close to or within bedrock, as defined by the OHSA.

9.0 SITE SERVICING CONSIDERATIONS

There is no indication that special pipe bedding materials or procedures are required for the installation of services. All bedding cover and backfill materials should be selected in accordance with OPSS 1010 Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

The pipes should be placed with a minimum bedding thickness in conformance of OPSD 802.010 series (typical 150 mm for flexible pipes, OPSD 802.010, 802.013 and 802.014). The use of normal Class B type bedding is applicable for the pipe.

Bedding material shall be placed in layers not exceeding 300 mm in thickness, loose measurement, and compacted to 95 % of the SPMDD before a subsequent layer is placed. Site servicing trench backfill should be uniformly compacted to a density that minimizes the risk of long-term settlements. Bedding on each side of the pipe shall be completed simultaneously. At no time shall the levels on each side differ by more than the 300 mm uncompacted layer. The remainder of the trench should be backfilled as per the requirements defined in Sections 8.0 and 10.0.

10.0 ENVIRONMENTAL CONSIDERATIONS AND SOIL MANAGEMENT

10.1 Environmental Considerations

A total of 2 soil samples were submitted for chemical analyses to AGAT Laboratories Ltd. to determine metals and inorganic properties *(Regulation 153/04).*

In comparison to O. Reg. 153 Table 1: Industrial/Commercial/Community (herein *"ICC")* criteria of the Ministry of the Environment and Climate Change (herein *"MOECC")* document "*Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*", dated April 15, 2011, no soil sample exceeded guidelines related to metals and inorganics. The test results are provided in Appendix D and are summarized in Table 2 below

Table 2
Summary of O. Reg. 153 Metals & Inorganics Test Data

Sample ID	Composite Sample Depth	Parameters Analyzed	MOECC Table Comparison	
			Table 1 (ICC)	Exceedance
BH1 SS4	3.0 m – 3.5 m	O. Reg. 153 Metals & Inorganics	✓	
BH8 SS2	1.5 m – 2.0 m	O. Reg. 153 Metals & Inorganics	✓	

✓ Meets MOECC Table 1 soil quality guidelines

This given, the test results for metals and inorganic parameters indicate that the selected subgrade soil samples obtained from the boreholes all meet soil quality requirements for MOECC Table 1 ICC. Therefore, based on these results and guidance provided by the MOECC, all excavated soils are considered suitable for reuse within the full site area.

The soils may be excavated and sent off-site to sites accepting Table 1 soils. However, if excavated subgrade soils are to be disposed of off-site it should be noted that there may be soil quality criteria established for the site that is to receive the excavated materials. As such, the owners or operators of potential receiving sites must be notified of the environmental quality of the material and must agree in writing to accept the material. Some variability in soil quality parameters may occur along the length of a road section, and the contractor may be required to complete testing to address a designated list of chemical parameters for the receiving site.

10.2 Soil Management

Construction for the proposed development may involve cut and fill operations. From a geotechnical perspective, and in order to optimize the use of the on-site soils, a Soil Management Plan should be established. The plan objective should be to achieve a self-sustainable development with respect to excavated materials, and control the placement of organic soils so that there is negligible impact on the settlement performance of the compacted fill material.

The soil management criteria should be as follows:

1. Surface vegetation, topsoil and organic soils should not be placed within the proposed roadways, below finished subgrade level for pavement construction or building limits. These materials should be placed in landscaped areas where settlements are not critical;

2. Excavated soils for structural fill in pavement areas and building floor slab areas, which does not have topsoil or organic matter and are compactable with moisture contents within 2 % to

3 % of the optimum value, should be placed and compacted to a target density of 97 % of the SPMDD with no individual test result below 95 % SPMDD; if engineered fill is required to support building foundations, the engineered fill should be placed and compacted in lifts to a target density of 100 % SPMDD with no individual tests below 98 % SPMDD; the soil should be placed in a loose lift thickness not exceeding 250 mm and should be compacted using a large (10 ton or larger) pad-foot type roller with vibratory capability; if engineered fill to support building foundations is being considered it is recommended that a pre-construction meeting be scheduled to review the proposed fill materials, fill placement and compaction procedures, and the testing and inspection requirements;

3. Soils to be placed in landscaped areas where settlements are not critical should receive nominal compaction effort in order to achieve at least 90 % of the SPMDD; and,

4. Prior to the placement of underfloor granular fill or pavement granular fill, the exposed subgrade soil should be inspected and proof-rolled using a loaded tandem axle truck and traversing the exposed subgrade for full coverage; the proof-rolling should be monitored by a geotechnical representative of this office to delineate any soft areas which may require repair.

11.0 PAVEMENT CONSIDERATIONS

It is anticipated that the development project will include for new access road and parking lot pavements, and new sidewalks.

11.1 Pavement Design Considerations

In the absence of anticipated traffic volumes or traffic loading requirements, the pavement structure thicknesses presented in Table 3 take into account the accepted design practice that the total pavement structure thickness should meet or exceed one-half the anticipated depth of frost penetration for the geographical area, or as close as practicable for the given purpose of the pavement. For the Milton area, this is 1.2 m. Consideration has been also given to the Corporation of the Town of Milton (herein "*Town of Milton*") Engineering Standards for pavement design, Section 1.1.4.

Table 3
Recommended Pavement Structure Layer Thicknesses

Pavement Layer	Access and Fire Routes	Light Duty Parking Areas
Surface Course Asphalt OPSS HL 3	40 mm	40 mm
Binder Course Asphalt OPSS HL 8	60 mm	40 mm
Granular Base OPSS Granular A	150 mm	150 mm
Granular Subbase OPSS Granular B, Type II	350 mm	250 mm
Total Thickness	600 mm	480 mm

The overall performance of the new pavement structure will greatly depend upon the support provided by the developed subgrade. A number of factors should be considered at the construction stages to ensure that an acceptable subgrade condition is developed and maintained:

- Sub-drains should be installed and should be 100 mm diameter perforated plastic pipe, with outfalls to catch basins at a continuous and uniform grade. The sub-drains should conform to OPSD 216.01;
- Any soft areas of notable deflection to the subgrade should be sub-excavated and replaced with a suitable backfill material approved by a qualified geotechnical engineer and compacted to 98 % of its SPMDD;
- The subgrade should be properly shaped, crowned and then proof-rolled under the full time observation of a geotechnical representative of this office to delineate any soft areas which may require repair before placing the granular materials; and,
- Surface water should not be allowed to pond on the surface of or adjacent to the outside edges of any developed subgrade.

The following consideration should be maintained during paving:

- The requirements OPSS 310 and OPSS.PROV.313 for the design and construction of lap joints between and transitions from existing and new asphaltic concrete pavements when connecting the new pavement construction to the existing pavements of adjacent roads;
- A tack coat should be applied to all contact surfaces prior to placing any hot mix asphalt layers or between asphaltic layers as per OPSS 308; and,
- The placing, spreading and rolling of the asphalt should be in accordance with current provincial standards.

In general, pavements that are proposed for larger scale, residential developments are constructed as two-stage paving operations. Where this is the case it is important to ensure that the following is undertaken to develop the surface of the binder course being used as a "*temporary*" surface during the construction phase:

- The surface is thoroughly cleaned and power washed to remove all residual contaminants;
- All deficiencies are corrected to meet the required design specifications; and,
- A suitable tack coat is appropriately applied immediately prior to the placement of the upper asphaltic concrete course(s).

Such preparatory works are to be completed in accordance with the appropriate OPSS, as required.

11.2 Pavement Materials

Granular Base Course and Subbase

The granular base course materials should meet OPSS Granular "A" specifications. Quarried 20 mm limestone crushed to Granular "A" gradation specifications is recommended. The granular subbase should meet OPSS Granular B Type II requirements for 100 % crushed quarried bedrock (50 mm crusher-run limestone).

Hot Mix Asphalt

The binder course and surface course asphalt should meet current specifications for HL 8 and HL 3 respectively, as prescribed by the Town of Milton or, alternatively, OPSS 1150.

The standard asphalt binder grade for the climate conditions in the Milton area is PG 64-28. Given the observed high volume of traffic, there is a consideration for a bump up to a higher PG grade of asphalt cement.

Compaction

Granular base course and subbase course fill material should be compacted to 100 % SPMDD. Hot mix asphalt should be compacted to the criteria set out by the Town of Milton.

11.3 Sidewalk Reinstatement Considerations

The reinstatement of the concrete sidewalks at the site should be completed to the satisfaction of the Town of Milton's Engineering Standards, Section 1.1.6, and as detailed in Table 4. The concrete and aggregates should be produced and placed to meet those standards also stipulated by the Town of Milton's Engineering Standards.

Table 4
Minimum Concrete Sidewalk Specifications

Materials	Compaction Requirements	Layer Thickness
Normal Portland GU (32 MPa) (CAN3-CSA A23.1) - Class C-2	N/A	Standard thickness: 125 mm Through driveways: 150 mm
OPSS Granular 'A' Base	95 % SPMDD*	150 mm

* Standard Proctor Maximum Dry Density

Where finished sidewalks are on level ground, and to ensure that they remain free of ponding water, a final slope/gradient of the concrete sidewalk surface of at least 2.0 % should be maintained. In addition, construction joints in the sidewalk concrete should be properly sealed (e.g. bitumen filler) to minimize the water migration.

12.0 CLOSURE

The Limitations of Report, as stated in Appendix A, are an integral part of this report.

Soil samples will be retained and stored by Landtek for a period of three months after the report is issued. The samples will be disposed of at the end of the three month period unless a written request from the client to extend the storage period is received.

We trust this report will be of assistance with the design and construction of the proposed development. Should you have any questions, please do not hesitate to contact our office.

Yours sincerely,

LANDTEK LIMITED

Isaac Asonya, EIT
Author

LICENSED PROFESSIONAL ENGINEER
R. DI CIENZO
Mar. 9/17
PROVINCE OF ONTARIO

James Dann, B.Eng. (Hons)
Geotechnical Manager

Ralph Di Cienzo, P. Eng.
Consulting Engineer

REFERENCES

[1] Karrow, P.F. and Easton, J. 2005. Quaternary Geology of the Brampton area, Ontario Geological Survey, Map 2223, scale 1:50 000.

[2] Bond, I.J., Liberty, B.A. and Telford, P.G. 1976. Paleozoic geology, Brampton, southern Ontario; Ontario Division of Mines, Map 2337, 1: 50 000,

APPENDIX A
LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the borehole locations. Subsurface and ground water conditions between and beyond the Boreholes may be different 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 geotechnical investigation. It is recommended practice that Landtek be retained during construction to confirm that the subsurface conditions throughout the site are consistent with the conditions encountered in the Boreholes.

The comments made in this report on potential construction problems and possible remedial methods are intended only for the guidance of the designer. The number of Boreholes may not be sufficient to determine all the factors that may influence construction methods and costs. For example, the thickness and quality of surficial topsoil or fill layers may vary markedly and unpredictably. Additionally, bedrock contact depths throughout the site may vary significantly from what was encountered at the exact borehole locations. Contractors bidding on the project, or undertaking construction on the site should make their own interpretation of the factual borehole information, and establish their own conclusions as to how the subsurface conditions may affect their work.

The survey elevations in the report were obtained by Landtek Limited or others, and are strictly for use by Landtek in the preparation of the geotechnical report. The elevations should not be used by any other parties for any other purpose.

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. Landtek Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

This report does not reflect environmental issues or concerns related to the property unless otherwise stated in the report. The design recommendations given in the report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, it is recommended that Landtek Limited be retained during the final design stage to verify that the design is consistent with the report recommendations, and that the assumptions made in the report are still valid.

APPENDIX B
SYMBOLS AND TERMS USED IN THE REPORT

RELATIVE PROPORTIONS

Term	Range
Trace	0 - 5%
A Little	5 – 15%
Some	15 – 30%
With	30 – 50%

CLASSIFICATION BY PARTICLE SIZE

Boulder ---------- > 200 mm
Cobble ---------- 80 mm – 200 mm
Gravel -
Coarse ---------- 19 mm – 80 mm
Fine ---------- 4.75 mm – 19 mm
Sand -
Coarse ---------- 4.75 mm – 2 mm
Medium -------- 2 mm – 0.425 mm
Fine ---------- 0.425 mm – 0.75 mm
Silt ---------- 0.075 mm – 0.002 mm
Clay ---------- < 0.002 mm

DENSITY OF NON-COHESIVE SOILS

Descriptive Term	Relative Density	Standard Penetration Test
Very Loose	0 – 15%	0 – 4 Blows Per 300 mm Penetration
Loose	15 – 35%	4 – 10 Blows Per 300 mm Penetration
Compact	35 – 65%	10 – 30 Blows Per 300 mm Penetration
Dense	65 – 85%	30 – 50 Blows Per 300 mm Penetration
Very Dense	85 – 100%	Over 50 Blows Per 300 mm Penetration

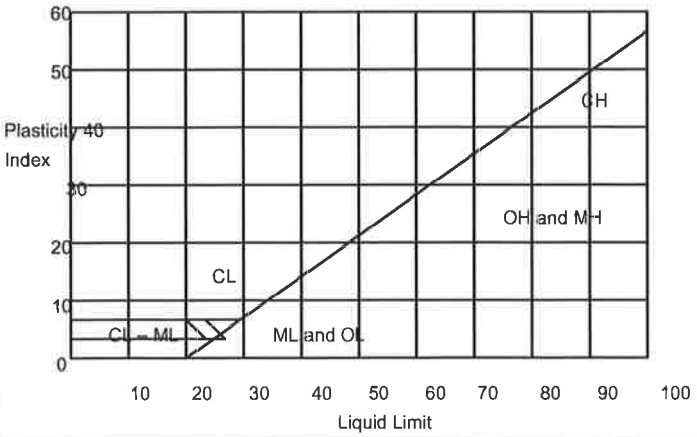
CONSISTENCY OF COHESIVE SOILS

Descriptive Term	Undrained Shear Strength kPa (psf)	N Value Standard Penetration Test	Remarks
Very Soft	< 12 (< 250)	< 2	Can penetrate with fist
Soft	12 – 25 (250 – 500)	2 – 4	Can indent with fist
Firm	25 – 50 (500 –1000)	4 – 8	Can penetrate with thumb
Stiff	50 – 100 (1000 – 2000)	8 – 15	Can indent with thumb
Very Stiff	100 – 200 (2000 – 4000)	15 – 30	Can indent with thumb-nail
Hard	> 200 (> 4000)	> 30	Can indent with thumb-nail

Notes: 1. Relative density determined by standard laboratory tests.
2. N value – blows/300 mm penetration of a 623 N (140 Lb.) hammer falling 760 mm (30 in.) on a 50 mm O.D. split spoon soil sampler. The split spoon sampler is driven 450 mm (18 in.) or 610 mm (24 in.). The "N" value is the Standard Penetration Test (SPT) value and is normally taken as the number of blows to advance the sampler the last 300 mm.

APPENDIX B CONTINUED
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM Designation: D 2487 - 69 AND D 2488 – 69
(Unified Soil Classification System)

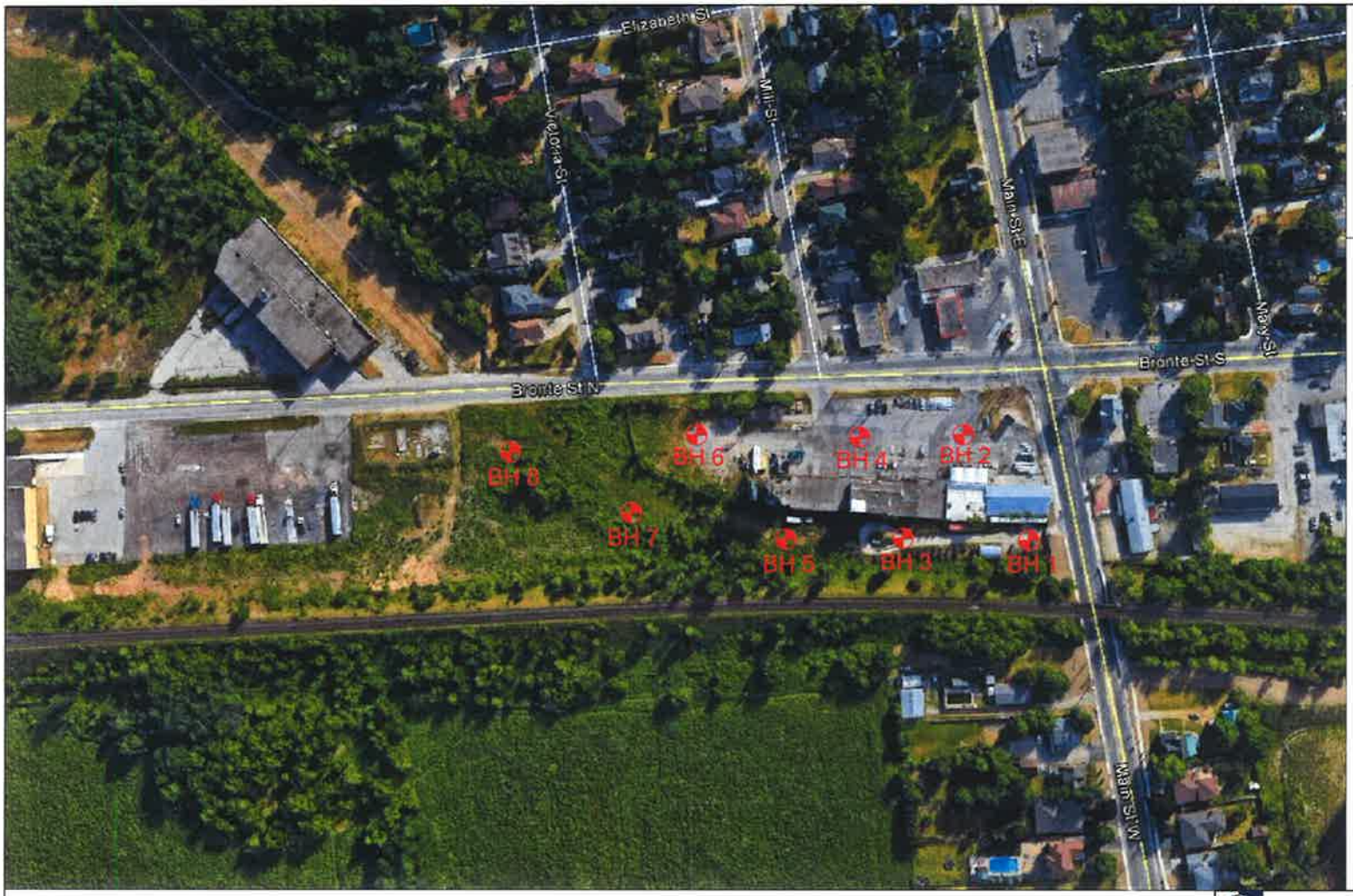
Major Divisions			Group Symbols	Typical Names	Classification Criteria		
Coarse-grained soils More than 50% retained on No. 200 sieve *	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines Less than 5% pass No. 200 sieve . . . . . GW, GP, SW, SP More than 12% pass No. 200 sieve . . . . . GM, GC, SM, SC 5 to 12% pass No.200 sieve . . . . . Borderline classifications requiring use of dual symbols	C_u=D60/D10 greater than 4; $C_z = (D30)^2/(D10xD60)$ between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines		C_u=D60/D10 greater than 6; $C_z = (D30)^2/(D10xD60)$ between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		Sands with fines	SM	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils 50% or more passes No. 200 sieve *	Silts and clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	Plasticity Chart For classification of fine-grained soils and fine fraction of coarse-grained soils. Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols. Equation of A-line: PI=0.73 (LL-20)		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silts			
			OL	Organic silts and organic silts of low plasticity			
	Silts and clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
	Highly organic soils		Pt	Peat, much and other highly organic soils	* Based on the material passing the 3 in. (76mm) sieve.		

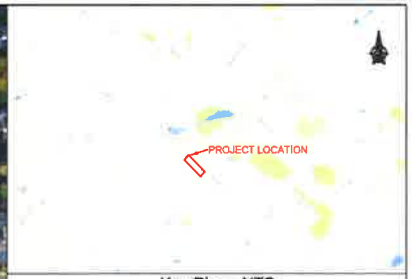


APPENDIX C

DRAWING 1 - SITE PLAN SHOWING BOREHOLE LOCATIONS

LOGS OF BOREHOLES





Key Plan - NTS

LEGEND

Approximate locations of boreholes drilled by Landtek Limited on January 9 and 10, 2017.

NOTES

1. Base plan provided by google maps
2. Borehole locations are considered approximate.

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DRAWING:	Borehole Location Plan
PROJECT:	Geotechnical Investigation Report 28 Bronte Street North, Milton, Ontario

SCALE:	NTS	**PROJECT NO.**	16413
DATE:	January, 2017	**DRAWING NO.**	1

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LOG OF BOREHOLE NO. 1

Project No.:	16413	Drill Date:	January 9, 2017
Project:	Geotechnical Investigation Report	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	28 Bronte Street North, Milton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		200.0								
±150 mm of gravel (fill)		0.0								
CLAYEY SILT TILL trace gravel, trace red shale, reddish brown, very stiff, moist			1	SS		22				
			2	SS		28				
at 2.3 m: trace silt lenses, trace of grey shale fragments			3	SS		26				
at 3.0 m: some silt lenses, hard			4	SS		72				
			5	SS		43				
at 6.1 m: trace sand			6	SS		50/130 mm				
			7	SS		59				
at 8.1 m: wet		190.9								
SHALE weathered, red, moderately weak		9.1 190.4	8	SS		50/50 mm				
END OF BOREHOLE AT TARGET DEPTH		9.6								

SPT "N" Value: 0 25 50 75 100 | Soil Moisture (%): 0 25 50

Scale (m): 0.0 -0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0 -10.5 -11.0 -11.5 -12.0 -12.5 -13.0 -13.5 -14.0

Notes: 1. On completion, borehole open to 9.1 m.
2. Groundwater encountered at 8.1 m

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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LOG OF BOREHOLE NO. 2

Project No.:	16413	Drill Date:	January 9, 2017
Project:	Geotechnical Investigation Report	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	28 Bronte Street North, Milton, Ontario	Datum:	Geodetic

Material Description	Elev. Depth	Samples No.	Type	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface	200.0							
± 100 mm of Asphalt	0.0	1	SS	18	9			Flush Mount
FILL	199.7							
Sand and Gravel	0.3							
CLAYEY SILT TILL		2	SS	17	14			
trace gravel, trace red shale, reddish brown, very stiff to hard, moist		3	SS	24	13			WL = 1.5 m Jan.19/ 2017
		4	SS	24	11			bentonite backfill to top of borehole
at 3.0 m: some silt pockets		5	SS	27	10			
at 4.5 m: hard		6	SS	50/130 mm	8			
		7	SS	50/100 mm	8			
at 7.6 m: inclusion of silt lenses		8	SS	63	16			
	190.9							
SHALE BEDROCK	9.1	9	SS	50/100 mm	8			sand backfill to 9.5 m
moderately weak, highly weathered to weathered, red and grey, hard		10	SS	50/130 mm	8			9.8 m
		11	SS	50/25 mm	11			3.0m of slotted 50 mm dia. PVC pipe
	187.2							
AUGER REFUSAL at 12.8 m	12.8							12.8 m

Notes:
1. Upon completion of drilling, borehole was dry and open to 12.8 m
2. Water level reading: 1.5 m on January 19, 2017

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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LOG OF BOREHOLE NO. 3

Project No.:	16413	Drill Date:	January 9, 2017
Project:	Geotechnical Investigation Report	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	28 Bronte Street North, Milton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		200.0								
±300 mm of gravel (fill)		0.0								
CLAYEY SILT TILL trace gravel, trace red shale, reddish brown, very stiff to hard, moist			1	SS		16				
at 1.5 m: inclusion of grey shale fragments			2	SS		30				
at 2.5 m: hard			3	SS		34				
			4	SS		52				
at 4.6 m: very clayey			5	SS		43				
			6	SS		50/130 mm				
			7	SS		50/130 mm				
at 9.1 m: inclusion of grey shale fragments			8	SS		50/130 mm				
		189.4								
SHALE moderately weak, highly weathered to weathered, red and grey, hard		10.6	9	SS		50/130 mm				
		187.4	10	SS		50/25 mm				
AUGER REFUSAL AT 12.6 m		12.6								

Notes: 1. On completion, borehole open to 12.2 m.
2. Groundwater encountered at 10.7 m

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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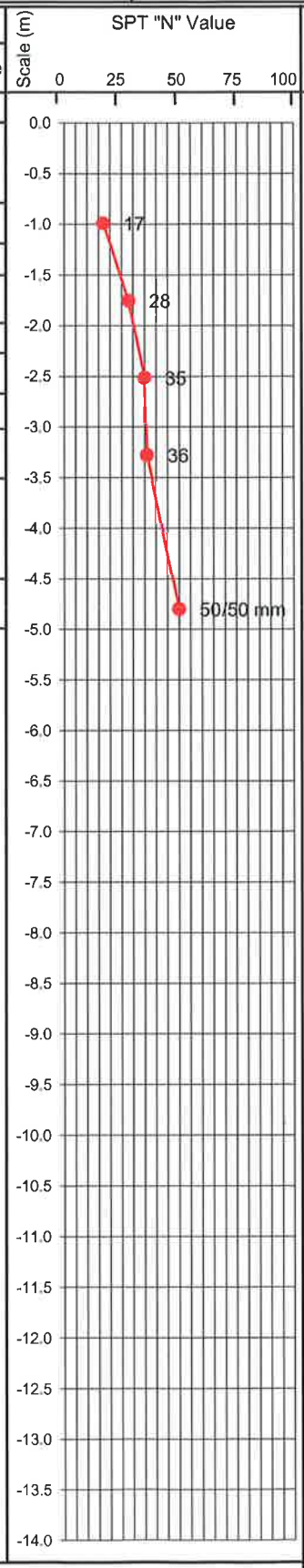
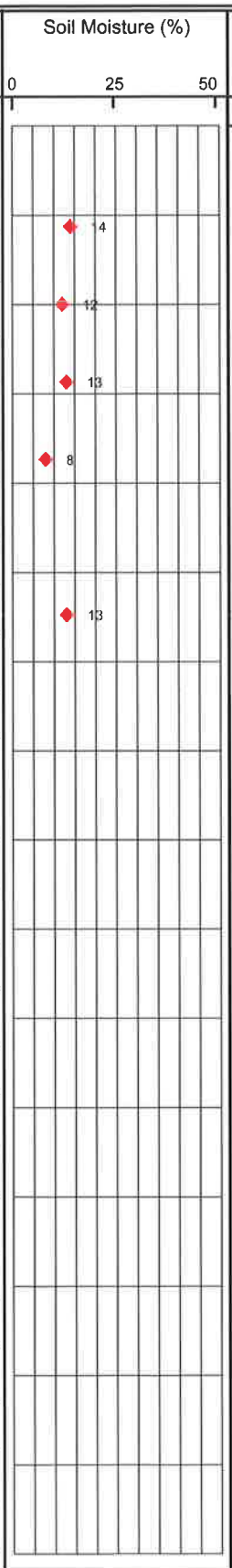
LOG OF BOREHOLE NO. 4

Project No.:	16413	Drill Date:	January 9, 2017
Project:	Geotechnical Investigation Report	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	28 Bronte Street North, Milton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)
Ground Surface		200.0			
± 100 mm of Asphalt		0.0			
FILL		199.7			
Sand and Gravel		0.3			
CLAYEY SILT TILL			1	SS	
trace gravel, trace red shale, reddish					
brown, very stiff to hard			2	SS	
at 2.5 m: hard			3	SS	
at 3.0 m: inclusion of grey shale			4	SS	
fragments					
		195.0	5	SS	
END OF BOREHOLE AT TARGET DEPTH		5.0			





GWL | Monitor Details | Test Data

Notes: 1. On completion, borehole open to 4.6 m.
2. No groundwater encountered.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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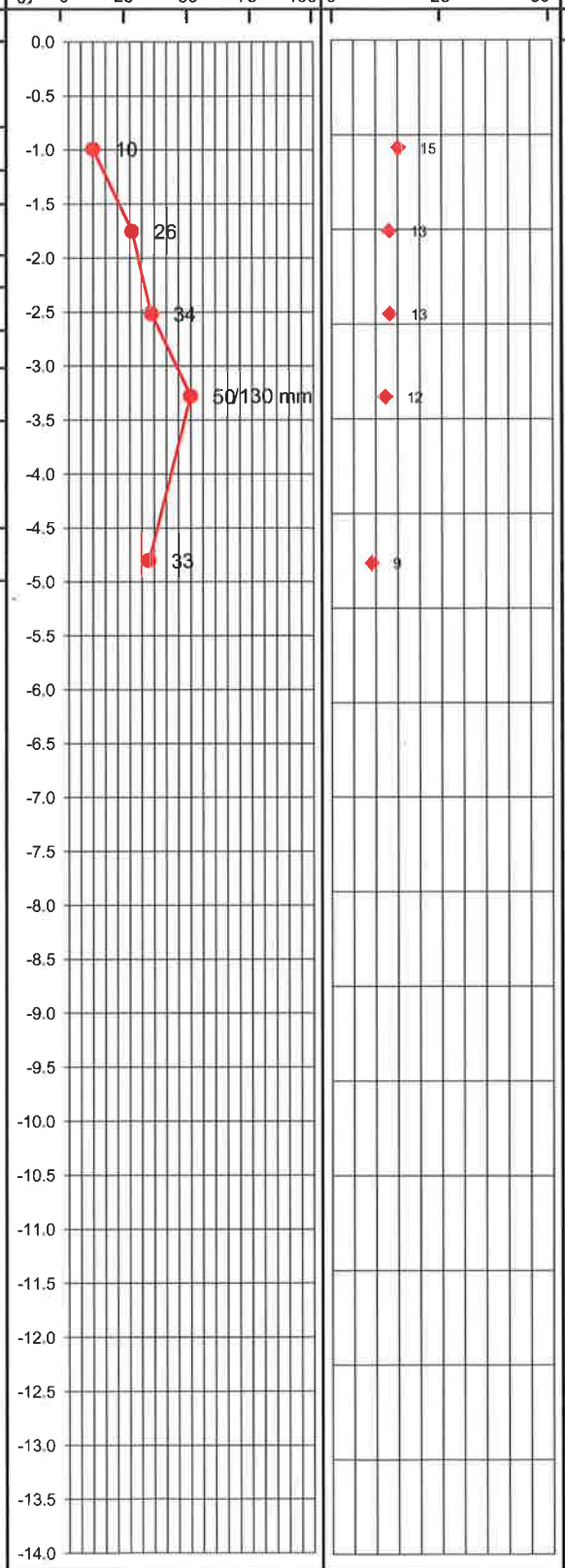
LOG OF BOREHOLE NO. 5

Project No.:	16413	Drill Date:	January 9, 2017
Project:	Geotechnical Investigation Report	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	28 Bronte Street North, Milton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		200.0								
±150 mm of topsoil		0.0								
CLAYEY SILT TILL trace gravel, trace red shale, reddish brown, very stiff to hard, moist			1	SS		10	15			
			2	SS		26	19			
at 2.5 m: hard			3	SS		34	13			
			4	SS		50/130 mm	12			
at 4.6 m: inclusion of grey shale fragments, trace quartz		195.0	5	SS		33	9			
END OF BOREHOLE AT TARGET DEPTH		5.0								



Notes: 1. On completion, borehole open to 4.6 m.
2. No groundwater encountered.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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LOG OF BOREHOLE NO. 6

Project No.:	16413	Drill Date:	January 10, 2017
Project:	Geotechnical Investigation Report	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	28 Bronte Street North, Milton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. / Depth	Samples No.	Samples Type	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		200.0							
±300 mm of gravel (fill)		0.0							
CLAYEY SILT TILL trace gravel, trace red shale, reddish brown, very stiff to hard, moist			1	SS	14	13			
at 0.8 m: stiff									
at 1.5 m: trace iron staining			2	SS	26	10			
at 2.5 m: hard			3	SS	38	11			
at 3.0 m: inclusion of grey shale fragments			4	SS	46	10			
			5	SS	50/130 mm	8			
		193.9							
SHALE moderately weak, highly weathered to weathered, red and grey, hard		6.1	6	SS	50/100 mm	10			
			7	SS	50/130 mm	6			
		190.4	8	SS	50/130 mm	11			
END OF BOREHOLE AT TARGET DEPTH		9.6							

Scale (m): 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0

SPT "N" Value: 0, 25, 50, 75, 100

Soil Moisture (%): 0, 25, 50

Notes: 1. On completion, borehole open to 9.1 m.
2. No groundwater encountered.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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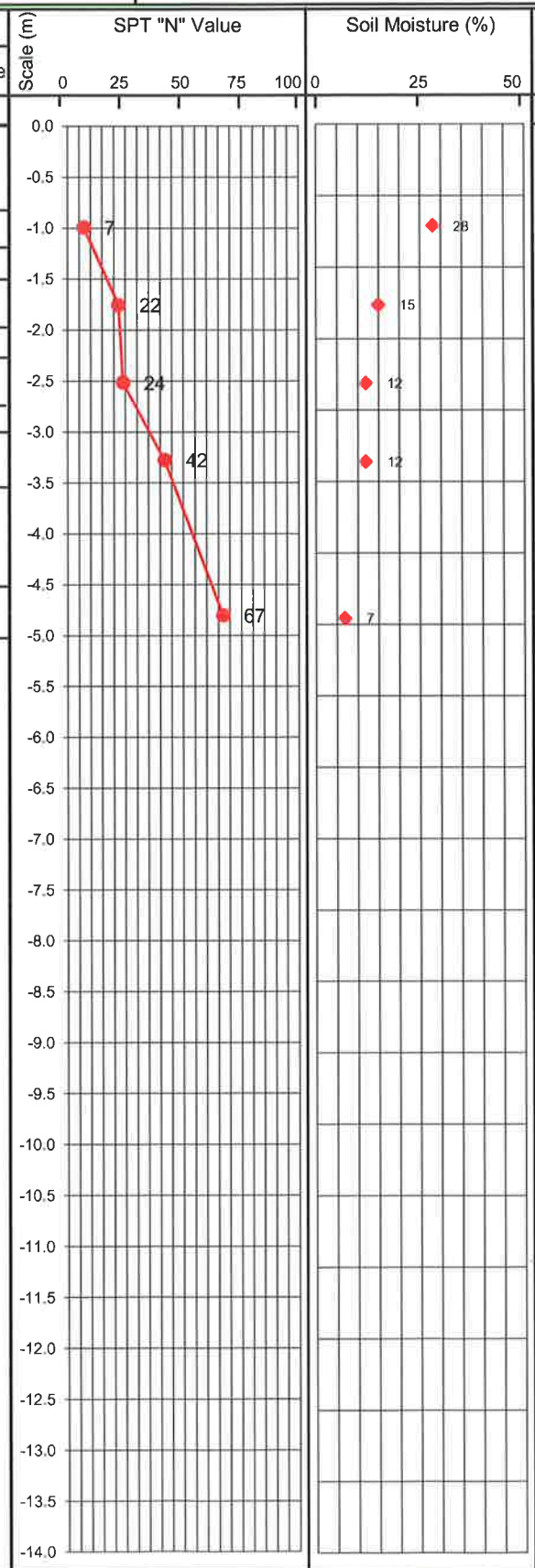
LOG OF BOREHOLE NO. 7

Project No.:	16413	Drill Date:	January 10, 2017
Project:	Geotechnical Investigation Report	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	28 Bronte Street North, Milton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Test Data
Ground Surface		200.0			Stick up
± 100 mm of topsoil		0.0			bentonite backfill to top
Fill silty clay, brown and black, some organics, trace coal seams, moist		198.8	1	SS	sand backfill to 0.9 m
CLAYEY SILT TILL trace gravel, trace red shale, reddish brown, very stiff to hard, moist		1.2	2	SS	
			3	SS	3.0m of slotted 50 mm dia. PVC pipe
at 3.0 m: hard			4	SS	WL = 3.8m January 19 /2017
at 4.5 m: inclusion of grey shale fragments		195.0	5	SS	4.6 m
END OF BOREHOLE AT TARGET DEPTH		5.0			



Notes:
1. Upon completion of drilling, borehole was dry and open to 4.6 m
2. Water level reading: 3.8 m on January 19, 2017

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

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LOG OF BOREHOLE NO. 8

Project No.:	16413	Drill Date:	January 10, 2017
Project:	Geotechnical Investigation Report	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	28 Bronte Street North, Milton, Ontario	Datum:	Geodetic

Material Description	Symbol	Elev. Depth	Samples No.	Samples Type	Scale (m)	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface		200.0								
±100 mm of topsoil		0.0								
CLAYEY SILT TILL trace gravel, trace red shale, reddish brown, very stiff to hard, moist			1	SS		14	13			
			2	SS		19	16			
at 2.5 m: inclusion of grey shale fragments, hard			3	SS		35	13			
			4	SS		49	11			
		195.0	5	SS		50/130 mm	8			
END OF BOREHOLE AT TARGET DEPTH		5.0								

Notes:
1. On completion, borehole open to 4.6 m.
2. No groundwater encountered.

PP = pocket penetrometer TCV = total combustible vapour BRD = bulk relative density
PL = plastic limit LL = liquid limit PI = plasticity index FV = field vane LV = lab vane VS = vane sensitivity

LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

APPENDIX D

LABORATORY CERTIFICATES OF ANALYSIS

AGAT Laboratories

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

CLIENT NAME: LANDTEK LTD.
205 NEBO ROAD, UNIT 3
HAMILTON, ON L8W2E1
(905) 383-3733

ATTENTION TO: Kevin Roberts

PROJECT: 16413

AGAT WORK ORDER: 17T177514

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Jan 18, 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.

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Certificate of Analysis

AGAT WORK ORDER: 17T177514

PROJECT: 16413

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Kevin Roberts

SAMPLING SITE:

SAMPLED BY:

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

DATE RECEIVED: 2017-01-12

DATE REPORTED: 2017-01-18

		SAMPLE DESCRIPTION:		BH1-SS4	BH8-SS2
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2017-01-09	2017-01-09
Parameter	Unit	G / S	RDL	8125980	8125981
Antimony	µg/g	1.3	0.8	<0.8	<0.8
Arsenic	µg/g	18	1	6	6
Barium	µg/g	220	2	78	132
Beryllium	µg/g	2.5	0.5	0.6	0.7
Boron	µg/g	36	5	12	12
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.57	0.38
Cadmium	µg/g	1.2	0.5	<0.5	<0.5
Chromium	µg/g	70	2	18	18
Cobalt	µg/g	21	0.5	11.9	12.3
Copper	µg/g	92	1	36	33
Lead	µg/g	120	1	14	13
Molybdenum	µg/g	2	0.5	0.6	<0.5
Nickel	µg/g	82	1	23	24
Selenium	µg/g	1.5	0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.6	0.6
Vanadium	µg/g	86	1	23	25
Zinc	µg/g	290	5	62	58
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	0.171	0.126
Sodium Adsorption Ratio	NA	2.4	NA	0.439	0.175
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.49	7.45

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

8125980-8125981 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: Amanjot Bhela

AGAT Laboratories

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Quality Assurance

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 17T177514

PROJECT: 16413

ATTENTION TO: Kevin Roberts

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Jan 18, 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	8127274		<0.8	<0.8	NA	< 0.8	102%	70%	130%	89%	80%	120%	88%	70%	130%
Arsenic	8127274		4	4	NA	< 1	101%	70%	130%	97%	80%	120%	99%	70%	130%
Barium	8127274		108	112	3.6%	< 2	104%	70%	130%	99%	80%	120%	103%	70%	130%
Beryllium	8127274		0.8	0.9	NA	< 0.5	101%	70%	130%	109%	80%	120%	111%	70%	130%
Boron	8127274		9	10	NA	< 5	103%	70%	130%	108%	80%	120%	106%	70%	130%
Boron (Hot Water Soluble)	8126644		0.29	0.28	NA	< 0.10	114%	60%	140%	98%	70%	130%	100%	60%	140%
Cadmium	8127274		<0.5	<0.5	NA	< 0.5	98%	70%	130%	101%	80%	120%	100%	70%	130%
Chromium	8127274		27	28	3.6%	< 2	95%	70%	130%	98%	80%	120%	98%	70%	130%
Cobalt	8127274		10.6	10.5	0.9%	< 0.5	96%	70%	130%	100%	80%	120%	98%	70%	130%
Copper	8127274		36	39	8.0%	< 1	101%	70%	130%	105%	80%	120%	105%	70%	130%
Lead	8127274		105	113	7.3%	< 1	96%	70%	130%	99%	80%	120%	100%	70%	130%
Molybdenum	8127274		0.9	0.9	NA	< 0.5	106%	70%	130%	102%	80%	120%	109%	70%	130%
Nickel	8127274		23	23	0.0%	< 1	99%	70%	130%	103%	80%	120%	98%	70%	130%
Selenium	8127274		<0.4	0.5	NA	< 0.4	97%	70%	130%	97%	80%	120%	101%	70%	130%
Silver	8127274		<0.2	<0.2	NA	< 0.2	98%	70%	130%	106%	80%	120%	105%	70%	130%
Thallium	8127274		<0.4	<0.4	NA	< 0.4	95%	70%	130%	99%	80%	120%	96%	70%	130%
Uranium	8127274		0.5	0.5	NA	< 0.5	97%	70%	130%	91%	80%	120%	87%	70%	130%
Vanadium	8127274		32	32	0.0%	< 1	95%	70%	130%	96%	80%	120%	101%	70%	130%
Zinc	8127274		125	124	0.8%	< 5	101%	70%	130%	104%	80%	120%	110%	70%	130%
Chromium VI	8125980	8125980	<0.2	<0.2	NA	< 0.2	94%	70%	130%	101%	80%	120%	104%	70%	130%
Cyanide	8123487		<0.040	<0.040	NA	< 0.040	98%	70%	130%	99%	80%	120%	109%	70%	130%
Mercury	8127274	8127274	<0.10	<0.10	NA	< 0.10	107%	70%	130%	94%	80%	120%	90%	70%	130%
Electrical Conductivity	8125985		0.788	0.802	1.8%	< 0.005	95%	90%	110%	NA			NA		
Sodium Adsorption Ratio	8126255		1.44	1.48	2.7%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	8124957		7.50	7.51	0.1%	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: Amanjot Bhela

AGAT Laboratories

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MISSISSAUGA, ONTARIO
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TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: LANDTEK LTD.

AGAT WORK ORDER: 17T177514

PROJECT: 16413

ATTENTION TO: Kevin Roberts

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

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

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 #: 17T173514

Cooler Quantity:

Arrival Temperatures: 7.7 | 8.1 | 8.1
6.7 | 7.1 | 7.1

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: LANDTEK LIMITED
Contact: ISAAC ASONYA
Address: 205 NEBO ROAD, UNIT 3
HAMILTON, ONTARIO, L8W 2E1
Phone: 905-961-4267 Fax: 905-383-8433
Reports to be sent to:
1. Email: Isaac@landteklimited.com
2. Email:

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)

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply): ___

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

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 16413
Site Location: 28 Bronte Street North, Milton
Sampled By: Wael Deiab / Isaac Asonya
AGAT Quote #: ___ 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:

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

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

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	Y / N	Field Filtered - Metals, Hg, CrVI	Metals and Inorganics ☐ Hg ☐ Hydride Metals ☐ Hg ☐ 153 Metals (excl. Hydrides)	ORPs: ☐ BHWS ☐ Cr ☐ CN ☐ CrVI ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH4 ☐ TKN ☐ NO3 ☐ NO2 ☐ NO3+NO2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use
BH1 - SS4	Jan 9, 17	am	1	Soil				✓												
BH8 - SS2	Jan 9, 17	pm	1	Soil				✓												

Isaac Asonya	Jan 13, 17	11:47 am							Page ___ of ___
Date	Date	Time	Date	Time	Date	Time			

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

N° T 040263