LANDTEK LIMITED
Consulting Engineers

205 Nebo Road, Unit 4B
Hamilton, Ontario
L8W 2E1

Phone: 905-383-3733
engineering@landtek.ca
www.landtek.ca

Geotechnical Investigation Report
Proposed Residential Development
256 First Road West
Hamilton, Ontario

Prepared for:

New Horizon Development Group
200-3170 Harvester Road
Burlington, Ontario
L7N 3W8

Landtek File: 21170
June 28, 2021

EXECUTIVE SUMMARY

SCOPE OF SERVICES	
Proposed Development	New Horizon Development Group is intending to develop the site identified as 256 First Road West in Hamilton, Ontario as residential properties.
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	599205, 4782873 — **Site Area (approx.)** 0.59 hectares (5,936 m^2)
Site Description	The project site is situated to the south of Mud Street West and to the east of First Road West, and is bound to the south by residential premises. The site is relatively flat with slight undulations and is covered predominately by unmaintained grasses shrubbery.
Geology	Topsoil was encountered at the surface. Underlying the surface material is predominantly silty clay. Fill was encountered in some areas to depths of between 1.3 m and 1.5 m below the existing ground surface. Underlying the fill and silty clay deposits is dolostone bedrock at depths of 3 m to 4 m below existing ground surface. No rock coring was undertaken to confirm the bedrock.
ENGINEERING CONSIDERATIONS	
Foundations	It is considered by Landtek that bearing conditions to support the proposed structure on concrete footings can be provided by the silty clay deposits and dolostone 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. For the dolostone bedrock, SLS condition will not govern the foundation design as the stress required to induce 25 mm of movement (typical settlement criteria for SLS) is anticipated to exceed ULS.
Earthquake Considerations	The subject property is considered to be a 'B' 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 native 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 silty clay soils. The dolostone bedrock has strength characteristics that exceed Type 1 soils.
Dewatering	It should be possible to control water seepage into excavations by pumping from sumps using perimeter drainage swales at the base of the excavations. Water seepage into open excavations is not expected to be a construction issue that would require a Permit To Take Water (herein "*PTTW*"), i.e. less than 50,000 litres per day.
Material Reuse	The native soils and dolostone 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.

TABLE OF CONTENTS

1.0 INTRODUCTION

Landtek Limited (herein "*Landtek*") is pleased to submit the geotechnical investigation report for the proposed residential development at 256 First Road West in Hamilton, Ontario. The work was authorized by Mr. Jason Garland of New Horizon Development Group (herein *"New Horizon")* on May, 2021. All work was completed in accordance with our proposal reference P21131R, dated May 4, 2021.

It is understood that the proposed development is to consist of residential townhouse blocks. The development will also include at-grade asphalt paved parking, access routes, and full site servicing. It is assumed that the units will include either one level of basement or partial-basement.

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 New Horizon, 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 four boreholes (boreholes BH1 to BH4) were drilled on June 8, 2121. 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 track-mounted drilling rig equipped with continuous flight, solid stem augers, and were advanced to practical auger refusal at a depths of between approximately 3.0 m and 4.0 m below existing ground level.

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.

Elevations at the borehole locations were established by Landtek relative to site measurements using a top of catch basin cover located on the east side of First Road West immediately opposite the northwest corner of the subject site as the temporary benchmark (TBM). An assumed elevation of 100.0 was used for the TBM.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Location

The site is located in Hamilton, Ontario, and is centered at approximate grid reference 599205, 4782873 (UTM 17T coordinates). The general Geodetic elevation of the ground surface in the area of the site ranges between approximately 203 m and 204 m.

The site location is shown in Figure 1 below.

Figure 1
Site Location Plan

The project site is situated to the south of Mud Street West and to the east of First Road West and is bound by residential properties to the south and a stormwater management pond to the east. The site covers an area of approximately 5,936 m^2 (0.59 hectares) and is relatively flat with slight undulations. It is covered predominately by unmaintained grasses.

Based on published geological information [1,2] for the area, the predominant subsurface soil is glaciolacustrine clay and silt. The bedrock in the area is identified as dolostone of the Lockport Formation.

The borehole information is generally consistent with the geological data, and the predominant native soils comprise of clay and silt deposits. Bedrock was encountered at depths of between approximately 3.0 m and 4.0 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 all boreholes and is approximately 120 mm (borehole BH2) to 250 mm (borehole BH3 and BH4) thick.

Fill

Silty clay fill was encountered underlying the topsoil in boreholes BH1 and BH2, and extends to depths of approximately 1.3 m to 1.5 m below existing ground level. The fill is brown to dark brown and includes rootlets, organics, and iron stains. Moisture are typically in the order of 13 to 21 percent.

Silty Clay

Silty clay was encountered below the organic soil in boreholes and extends to a depth of between 3.0 m (borehole BH4) and 4.0 m (borehole BH3) below existing ground level. The silty clay is brown and fissured and contains traces of gravel and iron staining.

SPT 'N' values ranging from 10 to 56 blows for 300 mm of penetration were reported, indicating the silty clay to be stiff to hard. Moisture contents in the silty clay generally range between 16 and 26 percent.

Bedrock

Bedrock was encountered underlying the clayey silt and silty clay. No rotary coring was conducted to confirm bedrock structure or strength, though examination of the bedrock fragments in the boreholes indicates the bedrock to be dolostone.

Groundwater

No water seepage was encountered during drilling and the boreholes remained dry on completion of drilling.

It should be noted that the groundwater condition is 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 water is expected to be perched in fill deposits.

4.0 FOUNDATION DESIGN CONSIDERATIONS

4.1 Foundations Design

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 silty clay and dolostone bedrock. It is assumed that the units will include either one level of basement or partial-basement such that the expected underside of footings will be at depths of between 1.5 m to 3.0 m below the existing ground level, and will be seated within the silty clay or possibly dolostone 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/silty clay soils and dolostone bedrock. Where foundations are to be seated in bedrock, then the SLS condition will not govern their design as the stress required to induce the typical 25 mm settlement criteria at the SLS is anticipated to exceed the ULS. It should be noted that the design parameters have been determined by Landtek for the design stage only.

Where the bearing levels of the footings are at different design elevations, the footing base levels should be stepped along a line of 7 vertical to 10 horizontal, drawn upwards from the lowest footing, to avoid overlapping stresses.

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 and bedrock 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	TBM Elevation		SLS [1 2]	ULS [3 4]
1.5 m to 3.5 m	98.9 m to 100.4 m	Silty Clay	180 kPa	270 kPa
3.0 m to 4.0 m	96.4 m to 97.4 m	Dolostone	-	750 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 silt and clay deposits 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 Hamilton 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.

Concerns regarding frost protection to footings are more directed towards those seated within soils rather than bedrock, as is anticipated for the proposed development. This given however, consideration should be given to the use of non-frost susceptible materials as backfill for the foundation wall excavations and the installation of foundation drainage in order to minimize the risk of adfreezing.

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. Settlements for foundations seated within bedrock are to be deemed negligible (i.e. less than 15 mm).

It is recommended that foundations for each structure are seated within the same geological unit in order to minimize differential settlements that may arise from founding within strata of differing geotechnical properties.

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 'B' 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.

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 silty clay soils and dolostone 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 predominant 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 and silty clay. The dolostone bedrock has strength characteristics that exceed Type 1 soils. All fill soils should be classified as Type 3 soils.

Based on the findings of the investigation, it is considered that excavation of the overburden soils at the site can be carried out using a conventional backhoe excavator. Excavation into the dolostone bedrock will require the use of more unconventional, heavier excavation equipment such as a rock chisel/breaker or a rock-ripping (tiger teeth-fitted) excavator bucket, particularly as the competence of dolostone bedrock tends to improve very quickly with depth.

Excavation slopes in the silty clay soils are expected to be stable for the construction period at slopes of about 45° degrees to the horizontal although wet sand and silt pockets may result in sloughing of slopes to flatter inclinations. The dolostone bedrock is expected to remain relatively stable at near vertical slopes for short periods of time. It is recommended that the dolostone excavation slopes be scaled of loose rock pieces and overhang, and that frequent inspections of exposed rock excavation faces are be carried out by a geotechnical engineer to ensure their stability is appropriately maintained.

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 Figure 2 to avoid overlapping stresses and minimize the risk of undermining existing adjacent foundations/utilities and/or triggering additional settlements of the existing foundations/utilities due to soil disturbance. Shoring may be required to avoid undermining existing adjacent foundations during construction or provide safe working conditions.

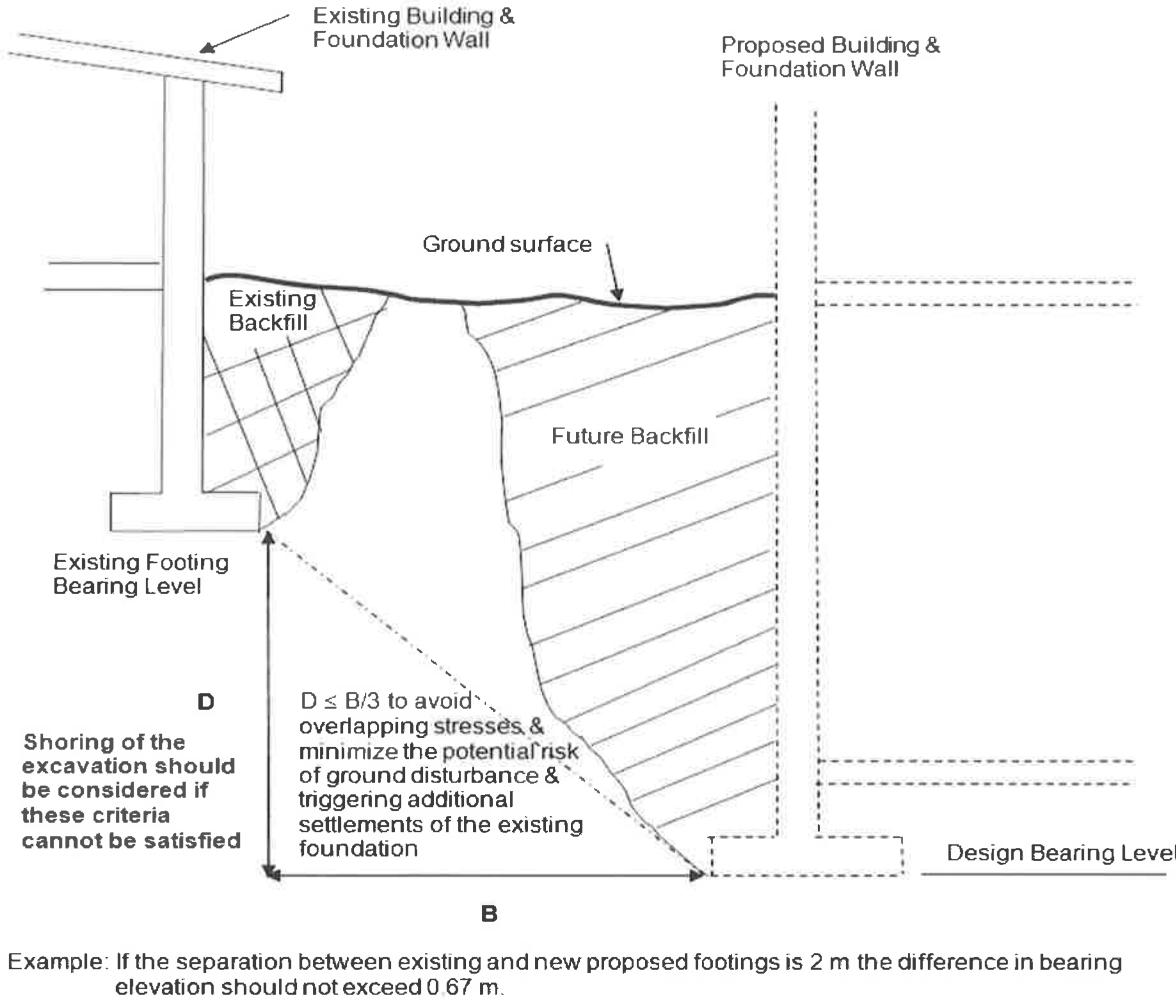


Figure 2
Criteria for Assessing Excavation Shoring Requirements (Not to Scale)

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 excavated dolostone can be reused as backfill, provided that the dolostone particle sizes are broken down to minus 200 mm material, the moisture content of the material is maintained at near optimum levels, the rock particles are mixed with the native clayey silt soils to reduce void spaces, 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 is not expected to be significant concern and it should be possible to control water seepage into excavations by pumping from sumps using perimeter drainage swales at the base of the excavations. Water seepage into open excavations is not expected to be a construction issue such that the project would require either registration under the Environmental Activity and Sector Registry (herein "*EASR*") framework (i.e. exceeding 50,000 l/day) or a Permit To Take Water (herein "*PTTW*").

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.

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 SOIL MANAGEMENT

Chemical analysis of soils was not included in the scope of services for this investigation. It should be noted that, if there is a need for off-site disposal of surplus excavated soils, the Contractor may be required to complete chemical testing to satisfy the soil quality requirements of the site receiving the material.

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

11.1 Pavement Design Considerations

The proposed building development includes asphalt pavement for private, ground level car parking and commercial vehicle access. Recommended pavement structure layer thicknesses are provided in Table 3 for a 20 year design life. Site-specific development requirements set out by the City of Hamilton may override the recommendations of this report.

The recommended pavement design section takes 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 (i.e. 1.2 m), or as close as practicable.

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	50 mm
Granular Base OPSS Granular A	150 mm	150 mm
Granular Subbase OPSS Granular B, Type II	350 mm	300 mm
Total Thickness	600 mm	540 mm

11.2 Pavement Construction Considerations

The overall performance of the 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.

Should the pavements proposed for the development be constructed as a two-stage paving operation it will 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.

Sub-drains

Sub-drains should be 100 mm diameter perforated plastic pipe and should outlet to catch basins at a continuous and uniform grade. The sub-drains should conform to OPSD 216.01.

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. If the option with granular subbase material is used, 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 City of Hamilton or, alternatively, OPSS 1150.

The standard asphalt binder grade for the climate conditions in Hamilton is PG 58-28. Given the observed low volume of commercial truck traffic it is considered that there is no requirement 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 City of Hamilton.

11.3 Subgrade Considerations

The subgrade conditions and bearing strength may be variable along the road section and some subgrade repairs should be anticipated.

It is recommended that, prior to the placement of pavement granular fill, the exposed subgrade soil should be inspected and proof-rolled using a loaded tandem axle truck to traverse the exposed subgrade and provide 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. Repairs should be undertaken to avoid creating "*bathtub*" conditions in the subgrade within the pavement structure.

12.0 SOIL CORROSIVITY AND SUBSURFACE CONCRETE

12.1 Soil Corrosivity

Four selected, composite soil samples were submitted to AGAT for analysis of PH, soil conductivity and redox potential, and concentrations of sulphides, sulphates, and chlorides.

The American Water Works Association (AWWA) document, *"Polyethylene Encasement for Ductile-Iron Pipe Systems" ANSI/AWWA C105/A21.5-18*, dated December 1, 2018, uses a 10-point scoring method to determine the soil corrosivity potential. For each given soil sample, points were assigned to the different parameters to evaluate their contribution towards the corrosivity of soil. The test results are provided in Appendix D and are summarized in Table 12.1.1.

Table 12.1.1: Results of Soil Corrosivity Potential

Sample ID	Composite Sample Depth	Parameters Analysed	Measured Value	ANSI/AWWA Point Rating	Total ANSI/AWWA Points
BH1-SS4	2.4 – 2.6 (m)	Sulphide (%)	<0.05	2	13
		pH (pH units)	7.91	0	
		Resistivity (ohm.cm)	775	10	
		Redox Potential (mV)	258	0	
		Moisture (%)	23.0	1	
BH2-SS4	2.4 – 2.6 (m)	Sulphide (%)	<0.05	2	5
		pH (pH units)	8.24	0	
		Resistivity (ohm.cm)	2180	2	
		Redox Potential (mV)	280	0	
		Moisture (%)	10.0	1	
BH3-SS3	1.5 – 1.7 (m)	Sulphide (%)	<0.05	2	13
		pH (pH units)	8.01	0	
		Resistivity (ohm.cm)	820	10	
		Redox Potential (mV)	263	0	
		Moisture (%)	20.0	1	
BH4-SS4	2.4 – 2.6 (m)	Sulphide (%)	<0.05	2	8
		pH (pH units)	8.12	0	
		Resistivity (ohm.cm)	2030	5	
		Redox Potential (mV)	265	0	
		Moisture (%)	25.0	1	

Corrosion protection for buried ductile-iron pipes is recommended, when a score of 10 points or greater is reported. Based on the total ANSI/AWWA value of 13 noted above, the underlying native soils at the site are considered corrosive to ductile-iron pipes. Therefore, ductile-iron pipes used at the site will require corrosion protective measures such as cathodic protection. It should be noted that the analytical results only provide an indication of the potential for corrosion.

The contribution of chloride ions to soil corrosivity towards buried metallic improvements or steel structures is very significant. According to the Corrosion Guidelines (Caltrans, January 2015, version 2.1), a site is considered corrosive if, "*chloride concentration is 500 ppm or greater, sulphate concentration is 2,000 ppm or greater, or the pH is 5.5 or less.* "

In addition, the Canadian Standards Association (CSA) A23.1-14 "*Concrete materials and methods of concrete construction*", Table 3, "*Additional requirements for concrete subjected to sulphate attack*", states that design requirements for sulphate resistant concrete are only necessary when the water-soluble sulphate content of the soil in which the concrete is to be embedded is greater than 0.1 % (1,000 µg/g).

The representative soil samples at the site are reported to contain average sulphate and chloride ion concentrations of up to 1,260 µg/g (0. 12 %) and 13 µg/g (0.0013%) respectively. The test results indicate a potential of sulphate and chloride attack on buried reinforced concrete structures.

12.2 Concrete Class Considerations

For information regarding selection of cement type for concrete structures, reference is made to the Canadian Standards Association specification, CSA A23.1-14 *"Concrete Materials and Methods of Concrete Construction, Tables 1-4"*.

Given the mild sulphate and low chloride test results, normal General use (GU) hydraulic cement can be used for the below grade concrete structures. For the parking garage decks and ramps it is recommended that the concrete exposure class be S-3 and the concrete have the following minimum properties:

- minimum 56-day compressive strength = 35 MPa;
- maximum water to cementing materials ratio = 0.40;
- chloride ion penetrability requirement = < 1500 coulombs within 91 days)
- cementing materials; GU (general use hydraulic cement) or GUb (blended general use)
- air content; as per CSA A23.1-14 Table 4, air content category 1 (freeze-thaw environment)

The concrete should be placed without segregation and should be consolidated to achieve a uniform dense mass.

12.3 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.

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

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

LICENSED PROFESSIONAL ENGINEER
R. DI CIENZO
PROVINCE OF ONTARIO

Ralph Di Cienzo, P. Eng.
Consulting Engineer

REFERENCES

[1] Feenstra, B.H. 1975: Quaternary Geology of the Grimsby Area, Southern Ontario. Ontario Div. Mines, Prelim. Map P.993, Geol. Ser. scale 1:50 000.Geology 1974

[2] Paleozoic geology of the Grimsby Area, southern Ontario; Ontario Division of Mines, Map M2343.scale 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

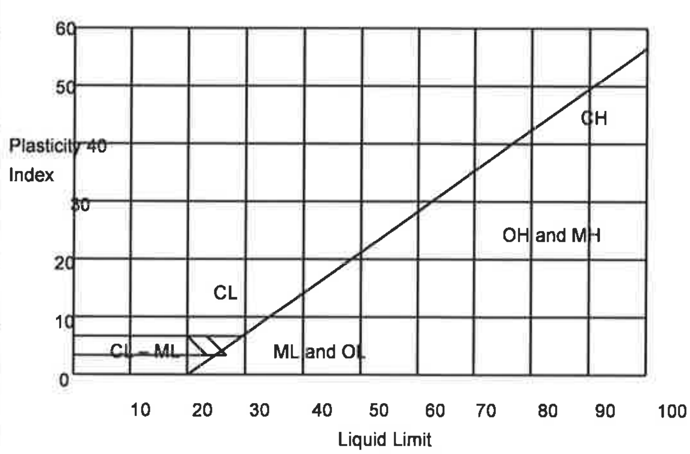
Descriptive Term	Relative Density	Standard Penetration Test
Very Loose	0 – 15%	0 – 4 Blows Per 300 mm Penetration
Loose	15 – 35%	4 – 10 Blows Per 300 mm Penetration
Compact	35 – 65%	10 – 30 Blows Per 300 mm Penetration
Dense	65 – 85%	30 – 50 Blows Per 300 mm Penetration
Very Dense	85 – 100%	Over 50 Blows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

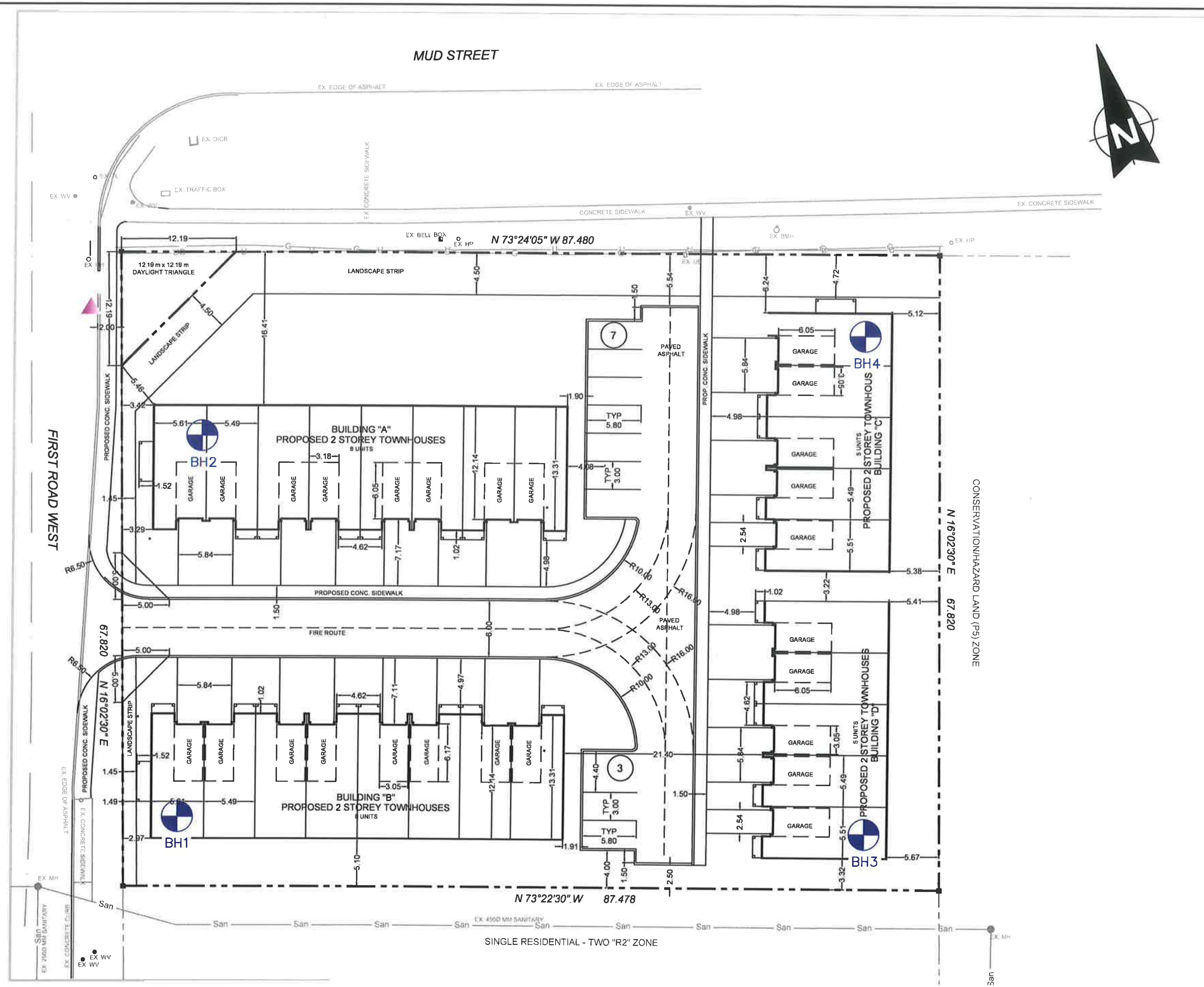
APPENDIX B CONTINUED
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM Designation: D 2487 - 69 AND D 2488 – 69
(Unified Soil Classification System)

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; $C_z = (D30)^2/(D10 \times D60)$ 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; $C_z = (D30)^2/(D10 \times D60)$ 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



LANDTEK LIMITED

205 Nebo Road, Unit 3
Hamilton, Ontario L8W 2E1
p: +1 (905) 383-3733 ∘ f: +1 (905) 383-8433
engineering@landteklimited.com
www.landteklimited.com

project location

Key plan provided by Maps.Hamilton.

Approximate location of borehole as drilled by Landtek Limited on June 8 , 2021.

TBM: Top of existing Catch Basin. Elevation at the TBM was assumed as 100 m.

Base plan provided by Urban Solutions.

revisions/ submissions

#	date	description
1	June 30, 2021	Issued for report

client
New Horizon Development Group

municipality
City of Hamilton, Ontario

project
Geotechnical Investigation
256 First Road West, Stoney Creek

sheet
Borehole Location Plan

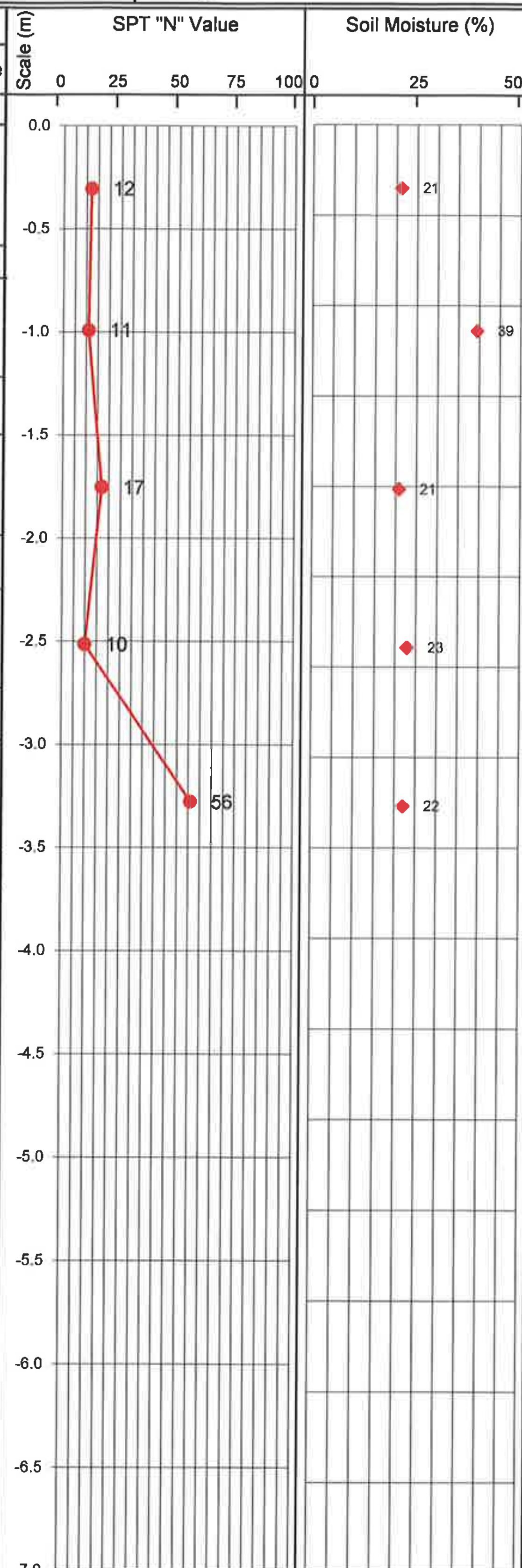
date: June 8, 2021
drawn: MDC
checked: N/A
project #: 21170
scale: NOT TO SCALE

21170-01

LANDTEK LIMITED BH 1

Project No.:	21170	Drill Date:	June 8, 2021
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	256 First Road West, Stoney Creek, Ontario	Datum:	TBM - assumed elevation 100.0 m

Material Description	Elev. / Depth	Sample No.	Sample Type
Ground Surface	100.3		
±200 mm of Topsoil	0.0		
FILL: silty clay, brown to dark brown, organic, stff, moist		1	SS
... brown/black, iron staining approximately 1.0 m		2	SS
	98.8 / 1.5		
SILTY CLAY: native, brown/grey, trace iron staining, trace rootlets, moist fissured		3	SS
		4	SS
		5	SS
	96.7 / 3.6		
BOREHOLE TERMINATED AT BEDROCK			



GWL | Monitor Details | Test Data

Notes:
1. On completion, borehole open to 4.0 m.
2. Groundwater not 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

LANDTEK LIMITED

BH 2

Project No.:	21170	Drill Date:	June 8, 2021
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	256 First Road West, Stoney Creek, Ontario	Datum:	TBM - assumed elevation 100.0 m

Material Description	Elev. / Depth	Sample No.	Sample Type	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface	100.4							
±120 mm of Topsoil	0.0							
FILL: silty clay, brown to dark brown, organic, stff, moist		1	SS	7	13			
... iron staining approximately 1.0 m		2	SS	7	17			
	99.1 / 1.3							
SILTY CLAY: native, brown/grey, trace iron staining, moist, hard fissured		3	SS	16	16			
		4	SS	50	0			
	96.8 / 3.6							
BOREHOLE TERMINATED AT BEDROCK								

Scale (m): 0.0 to -7.0; SPT "N" Value axis: 0, 25, 50, 75, 100; Soil Moisture (%) axis: 0, 25, 50

Notes: 1. On completion, borehole open to 3.2 m.
2. Groundwater not 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

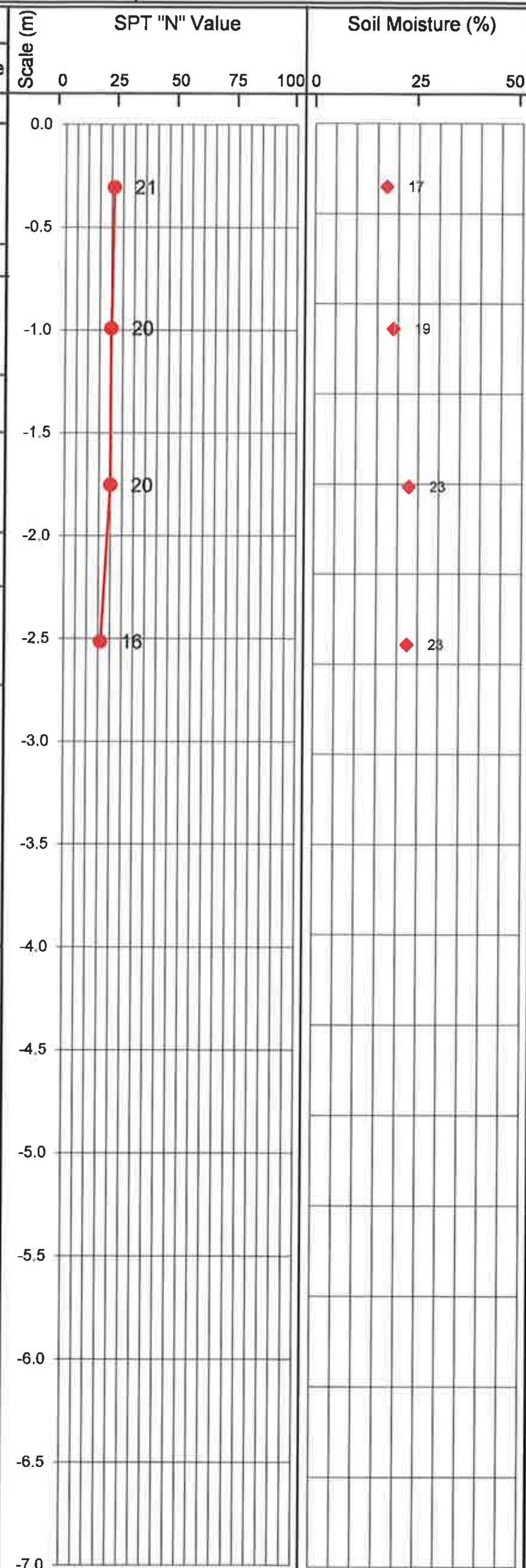
LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 3

Project No.:	21170	Drill Date:	June 8, 2021
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	256 First Road West, Stoney Creek, Ontario	Datum:	TBM - assumed elevation 100.0 m

Material Description	Symbol	Elev. / Depth	Samples No.	Samples Type	GWL	Monitor Details	Test Data
Ground Surface		100.3					
±250 mm of Topsoil		0.0					
SILTY CLAY: trace till, brown/grey, trace iron staining, moist, very stiff fissured ... trace silt, trace iron staining approximately 1.0 m			1	SS			
			2	SS			
			3	SS			
			4	SS			
		96.3					
BOREHOLE TERMINATED AT BEDROCK		4.0					



Notes:
1. On completion, borehole open to 4.1 m.
2. Groundwater not 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

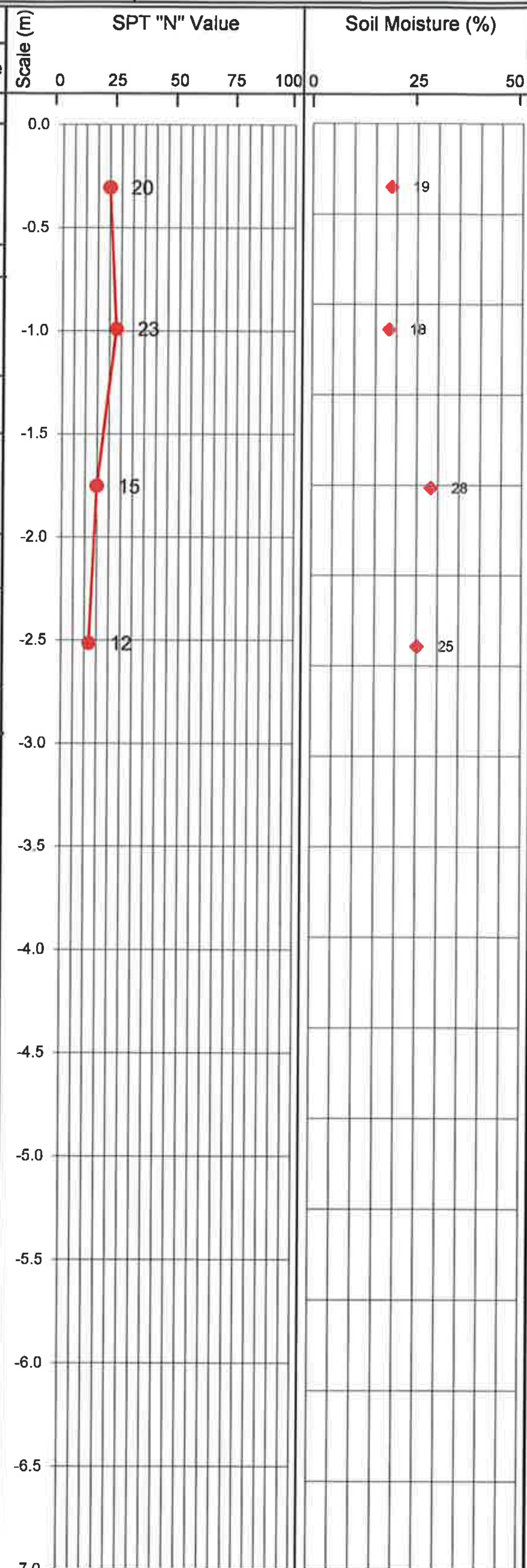
LANDTEK LIMITED
205 Nebo Road, Unit 3
Hamilton, Ontario, Canada, L8W 2E1
Ph: (905) 383-3733 Fax: (905) 383-8433
www.landteklimited.com

LANDTEK LIMITED

BH 4

Project No.:	21170	Drill Date:	June 8, 2021
Project:	Geotechnical Investigation	Drill Method:	[x] solid stem [ ] hollow stem [ ] vibratory
Location:	256 First Road West, Stoney Creek, Ontario	Datum:	TBM - assumed elevation 100.0 m

Material Description	Elev. / Depth	Samples No.	Type	SPT "N" Value	Soil Moisture (%)	GWL	Monitor Details	Test Data
Ground Surface	100.3							
±200 mm of Topsoil	0.0							
SILT CLAY: native, trace rootlets, trace iron staining, brown/grey, moist stiff, fissured ... trace silt, trace iron staining approximately 1.0 m		1	SS	20	19			
		2	SS	23	18			
		3	SS	15	28			
		4	SS	12	25			
	97.3							
BOREHOLE TERMINATED AT BEDROCK	3.0							



Notes:
1. On completion, borehole open to 3.0 m.
2. Groundwater not 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

ANALYTICAL TEST RESULTS

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: Marco Di Cienzo

PROJECT: 21170

AGAT WORK ORDER: 21H764597

SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

DATE REPORTED: Jun 29, 2021

PAGES (INCLUDING COVER): 6

VERSION*: 1

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

Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 21H764597

PROJECT: 21170

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

CLIENT NAME: LANDTEK LTD.

SAMPLING SITE:256 First Road West, Stoney Creek

ATTENTION TO: Marco Di Cienzo

SAMPLED BY:Marco

Corrosivity Package

DATE RECEIVED: 2021-06-22

DATE REPORTED: 2021-06-29

Parameter	Unit	G / S: A	G / S: B	G / S: C	RDL	BH1-SS4	BH2-SS4	BH3-SS3	BH4-SS4
					SAMPLE TYPE:	Soil	Soil	Soil	Soil
					DATE SAMPLED:	2021-06-21	2021-06-21	2021-06-21	2021-06-21
						2647063	2647065	2647067	2647069
Chloride (2:1)	µg/g	NA	NA	NA	2	13	8	9	12
Sulphate (2:1)	µg/g				2	1260	347	1180	382
pH (2:1)	pH Units				NA	7.91	8.24	8.01	8.12
Electrical Conductivity (2:1)	mS/cm	0.57	0.7	0.7	0.005	1.29[>C]	0.459[<A]	1.22[>C]	0.492[<A]
Resistivity (2:1) (Calculated)	ohm.cm				1	775	2180	820	2030
Redox Potential 1	mV				NA	257	250	261	253
Redox Potential 2	mV				NA	257	284	262	269
Redox Potential 3	mV				NA	261	287	265	271

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use, B Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Soil - Residential/Parkland/Institutional Property Use - Medium and Fine Textured Soils **pH range listed applies to surface soil only**, C Refers to Table 3: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition - Soil - Residential/Parkland/Institutional Property Use - Medium and Fine Textured Soils
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

2647063-2647069 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.
Redox potential measured on as received sample. Due to the potential for rapid change in sample equilibrium chemistry with exposure to oxidative/reduction conditions laboratory results may differ from field measured results.
Redox potential measurement in soil is quite variable and non reproducible due in part, to the general heterogeneity of a given soil. It is also related to the introduction of increased oxygen into the sample after extraction. The interpretation of soil redox potential should be considered in terms of its general range rather than as an absolute measurement.

Analysis perfomed at AGAT Toronto (unless marked by *)

Certified By:

AGAT Laboratories

Exceedance Summary

AGAT WORK ORDER: 21H764597

PROJECT: 21170

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

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Marco Di Cienzo

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
2647063	BH1-SS4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	1.29
2647063	BH1-SS4	ON T2 S RPI MFT	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.7	1.29
2647063	BH1-SS4	ON T3 S RPI MFT	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.7	1.29
2647067	BH3-SS3	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	1.22
2647067	BH3-SS3	ON T2 S RPI MFT	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.7	1.22
2647067	BH3-SS3	ON T3 S RPI MFT	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.7	1.22

AGAT Laboratories

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

Quality Assurance

CLIENT NAME: LANDTEK LTD.
PROJECT: 21170
SAMPLING SITE:256 First Road West, Stoney Creek

AGAT WORK ORDER: 21H764597
ATTENTION TO: Marco Di Cienzo
SAMPLED BY:Marco

Soil Analysis

RPT Date: Jun 29, 2021			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
Corrosivity Package															
Chloride (2:1)	2649483		5	5	NA	< 2	97%	70%	130%	105%	80%	120%	101%	70%	130%
Sulphate (2:1)	2649483		21	20	0.2%	< 2	94%	70%	130%	103%	80%	120%	99%	70%	130%
pH (2:1)	2647063	2647063	7.91	7.93	0.3%	NA	101%	80%	120%						
Electrical Conductivity (2:1)	2647063	2647063	1.29	1.26	2.1%	< 0.005	107%	80%	120%						
Redox Potential 1	1						100%	90%	110%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:

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

Method Summary

CLIENT NAME: LANDTEK LTD.
PROJECT: 21170
SAMPLING SITE:256 First Road West, Stoney Creek

AGAT WORK ORDER: 21H764597
ATTENTION TO: Marco Di Cienzo
SAMPLED BY:Marco

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	modified from MSA PART 3, CH 14 and SM 2510 B	EC METER
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential 1	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 2	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE
Redox Potential 3	INOR-93-6066	G200-20, SM 2580 B	REDOX POTENTIAL ELECTRODE

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 consumed by humans)

Laboratory Use Only

Work Order #: 21H764597
Cooler Quantity: HD COOLER
Arrival Temperatures: 12.2 | 12.3 | 12.1 / 9.9 | 9.8 | 9.9
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: ICE PACKS

Report Information:

Company: LANDTEK LIMITED.
Contact: Mario Di Cienzo
Address: 205 NEBO ROAD, UNIT 4B. HAMILTON, ONTARIO, L8W 2E1
Phone: 905-973-2752 Fax:
Reports to be sent to:
1. Email: mario@landtek.ca.
2. Email:

Regulatory Requirements:

(Please check all applicable boxes)

- ☑ Regulation 153/04 — Table 1, 2, and 3 (Indicate One) — ☐ Ind/Com ☑ Res/Park ☐ Agriculture
- Soil Texture (Check One): ☐ Coarse ☑ Fine
- ☐ Excess Soils R406 — Table ____ (Indicate One)
- ☐ Regulation 558
- ☐ CCME
- ☐ Sewer Use — ☐ Sanitary ☐ Storm — Region
- ☐ 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 (Most Analysis) ☑ 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: 21170
Site Location: 256 FIRST ROAD WEST, STONEY CREEK
Sampled By: Mario
AGAT ID #: 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, DOC (Y/N)	Metals & Inorganics	Metals - ☐ CrVI, ☐ Hg, ☐ HWS3	BTEX, F1-F4 PHCs	Analyze F4G if required ☐ Yes ☐ No	PAHs	Total PCBs ☐ Aroclor	VOC	Landfill Disposal Characterization TCLP: TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	Soil Corrosivity						Potentially Hazardous or High Concentration (Y/N)
BH1 - SS4	06/[illegible]/21	PM	1	S														✓						
BH2 - SS4.	↓	PM	1	↓														✓						
BH3 - SS3	↓	PM	1	↓														✓						
BH4 - SS4	↓	PM	1	↓														✓						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						
		AM PM																						

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Mario Di Cienzo	June 21/21	3:00 pm	DJ Aric [signature]	June 22/4	10:30AM
Aric [signature]	June 22/21	3pm	John Chaglo [signature]	June 22/21	
[signature]			John Chaglo [signature]	June 22	5:50

Page __ of __

Nº: T 114241

5623 McADAM ROAD
MISSISSAUGA, ONTARIO
CANADA L4Z 1N9
TEL (905)501-9998
FAX (905)501-0589
http://www.agatlabs.com

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

ATTENTION TO: **Marco Di Cienzo**

PROJECT: **21H764597**

AGAT WORK ORDER: **21T766624**

SOLID ANALYSIS REVIEWED BY: **Sherin Moussa, Senior Technician**

DATE REPORTED: **Jun 28, 2021**

PAGES (INCLUDING COVER): **5**

Should you require any information regarding this analysis please contact your client services representative at (905) 501-9998

NOTES

All samples are stored at no charge for 90 days. Please contact the lab if you require additional sample storage time.

Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 21T766624
PROJECT: 21H764597

5623 McADAM ROAD
MISSISSAUGA, ONTARIO
CANADA L4Z 1N9
TEL (905)501-9998
FAX (905)501-0589
http://www.agatlabs.com

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Marco Di Cienzo

(201-042) Sulfide

DATE SAMPLED: Jun 24, 2021 **DATE RECEIVED: Jun 25, 2021** **DATE REPORTED: Jun 28, 2021** **SAMPLE TYPE: Other**

Sample ID (AGAT ID)		Sulfide
	Analyte:	Sulfide
	Unit:	%
	RDL:	0.05
BH1-SS4-2647063 (2660849)		<0.05
BH1-SS4-2647063-DUP (2660850)		<0.05
BH2-SS4-2647065 (2660851)		<0.05
BH3-SS3-2647067 (2660852)		<0.05
BH4-SS4-2647069 (2660853)		<0.05

Comments: RDL - Reported Detection Limit
Analysis performed at AGAT 5623 McAdam Rd., Mississauga, ON (unless marked by *)
Insufficient Sample : IS
Sample Not Received : SNR

Certified By: Sherin Moussa

AGAT Laboratories

Quality Assurance - Replicate

AGAT WORK ORDER: 21T766624

PROJECT: 21H764597

5623 McADAM ROAD
MISSISSAUGA, ONTARIO
CANADA L4Z 1N9
TEL (905)501-9998
FAX (905)501-0589
http://www.agatlabs.com

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Marco Di Cienzo

(201-042) Sulfide

	REPLICATE #1				REPLICATE #2			
Parameter	Sample ID	Original	Replicate	RPD	Sample ID	Original	Replicate	RPD
S	2660849	0.043	0.042	2.4%	2660853	0.024	0.022	8.7%
Sulfate	2660849	< 0.01	<0.01	0.0%	2660853	< 0.01	<0.01	0.0%
Sulfide	2660849	< 0.05	<0.05	0.0%	2660853	< 0.05	<0.05	0.0%

AGAT Laboratories

Quality Assurance - Certified Reference materials

AGAT WORK ORDER: 21T766624

PROJECT: 21H764597

5623 McADAM ROAD
MISSISSAUGA, ONTARIO
CANADA L4Z 1N9
TEL (905)501-9998
FAX (905)501-0589
http://www.agatlabs.com

CLIENT NAME: LANDTEK LTD.

ATTENTION TO: Marco Di Cienzo

(201-042) Sulfide

	CRM #1				CRM #2											
Parameter	Expect	Actual	Recovery	Limits	Expect	Actual	Recovery	Limits								
S	0.80	0.80	100%	90% - 110%	0.80	0.80	100%	90% - 110%								
Sulfate	0.01	0.01	100%	90% - 110%	0.01	0.01	100%	90% - 110%								
Sulfide	0.80	0.79	98%	90% - 110%	0.80	0.79	98%	90% - 110%								

5623 McADAM ROAD
MISSISSAUGA, ONTARIO
CANADA L4Z 1N9
TEL (905)501-9998
FAX (905)501-0589
http://www.agatlabs.com

AGAT Laboratories

Method Summary

CLIENT NAME: LANDTEK LTD.
PROJECT: 21H764597
SAMPLING SITE:

AGAT WORK ORDER: 21T766624
ATTENTION TO: Marco Di Cienzo
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Solid Analysis			
Sulfide	MIN-200-12037		LECO

Results relate only to the items tested. Results apply to samples as received.