Report

220 Arkell Road, Guelph, ON

June 11, 2019

Prepared for:

Rockpoint Properties Inc.
195 Hanlon Creek Blvd, Unit 100
Guelph, ON N1C 0A1

Prepared by:

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo, ON N2L 0A4

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Prepared by _____
(signature)

Jeff Dietz, P.Eng.
Senior Geotechnical Engineer, Consulting Engineer
Geotechnical Engineering

Reviewed by _____
(signature)

Peter Healy, C.E.T.
Senior Associate,
Geotechnical Engineering

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1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained to carry out a geotechnical investigation for a proposed residential subdivision development at an existing residential property located at 220 Arkell Road in Guelph, Ontario.

The work was carried out in accordance with Stantec's proposal under Project Number 161413338, dated March 23, 2017.

The information provided in this report is specific to the scope of the investigation and the scope of the proposed development as discussed herein and should not be used for any application or purpose other than that stated herein. The scope of this report includes focusing on the geotechnical aspects of the project and does not include hydrogeological or environmental components. However, a hydrogeological investigation was carried out by Stantec in conjunction with this geotechnical investigation. The hydrogeological investigation report is provided under a separate cover.

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**.

2.0 STUDY AREA DESCRIPTION

2.1 LOCATION AND CURRENT LAND USE

The site is situated in the City of Guelph, Ontario, and is set back to the north of Arkell Road, as shown on the Key Plan, Drawing 1, in **Appendix B**. The central part of the site has a large residential house and numerous associated outbuildings and a pool. The reminder of the property contains grassed areas and tree lines, with a forested area at the southwest corner. The plan area of the property is approximately 3 hectares, and the overall site is generally rectangular in shape. The site is bordered on the south by residential properties fronting on to Dawes Avenue, on the west by a forested area, on the north by a golf course, and on the east by an agricultural field. Historical air photos indicate that a pond was previously located in the south end of the property, immediately east of the entrance driveway connected to Arkell Road.

2.2 TOPOGRAPHY & DRAINAGE

The Site generally slopes from the east to the west, with a ground relief of 6.5 m at the borehole locations. Ground surface elevations at the borehole locations were surveyed by Stantec's geomatics team. The borehole elevations and locations are provided on the Borehole Locations Plan in **Appendix B** and on the Borehole Logs in **Appendix C**.

3.0 PROPOSED DEVELOPMENT

3.1 OVERVIEW

It is understood that the development will comprise the construction of lots for single detached homes, blocks for townhouses, and associated municipal servicing, driveways and parking spots. Construction of a stormwater management (SWM) facility is planned for the northwest corner of the site. The stormwater management strategy also incorporates a combination of lot level and centralized infiltration trenches to promote groundwater recharge.

4.0 METHOD OF INVESTIGATION

4.1 FIELD INVESTIGATION

As a component of our standard procedures, Stantec obtained ground clearances from public and private underground utility locators prior to commencing the field investigation.

The field drilling program was carried out on April 5, 2015. Four (4) boreholes (BH01-17 through BH04-17) were advanced to depths of 5.2 to 8.2 m below ground surface. The boreholes were advanced at the locations shown on Drawing 2, in **Appendix B**, using a track mounted Dietrich D–50 Turbo drill rig operated by a specialist drilling subcontractor.

The subsurface stratigraphy encountered in the boreholes was recorded in the field by Stantec personnel. Split spoon samples were collected at regular depth intervals in the boreholes via the completion of Standard Penetration Tests (SPTs) in accordance with ASTM Standard D1586-11. All soil samples recovered from the boreholes were placed in moisture-proof bags, appropriately labeled, and returned to the Stantec Kitchener laboratory for classification and testing.

Groundwater levels were measured (where present) in the open boreholes upon completion of drilling. Monitoring wells were installed in all boreholes. The monitoring wells comprised 50 mm PVC pipe with1.5 or 3.0 m long slotted and filtered screens. Water levels were measured in the monitoring wells on April 13 and September 15, 2017.

4.2 BOREHOLE LOCATION AND ELEVATION SURVEY

The ground surface elevations and UTM coordinates at the boreholes collected by the Stantec geomatics team are provided in Table 4.1 below.

Table 4.1 Borehole Elevations and Approximate Coordinates

Borehole Number	Elevation (m)	Easting (UTM)	Northing (UTM)
BH 01-16	333.48	564970	4819008
BH 02-16	337.19	565193	4819204
BH 03-16	334.30	565155	4818983
BH 04-16	339.95	565287	4819111

4.3 GEOTECHNICAL LABORATORY TESTING PROGRAM

All samples recovered from the geotechnical investigation were returned to Stantec's geotechnical laboratory and were visually examined by a geotechnical specialist.

The scope of the geotechnical laboratory testing program is outlined below in Table 4.2.

Table 4.2 Geotechnical Laboratory Testing Program

Laboratory Test	Number of Samples Tested
ASTM D2216-10 – Natural Moisture Content	Selected samples from the boreholes
ASTM D422-63 (2007) – Grain Size Distribution with/without Hydrometer	4
Corrosion Potential (subcontractor)	1

The results of the laboratory tests are discussed in the text of this report. The results of the moisture content tests are shown on the Borehole Records in **Appendix C**. The results of the grain size distribution tests and corrosion potential tests are provided in **Appendix D**.

Samples remaining after testing will be placed in storage for a period of three months after issue of this geotechnical report. After the storage period, the samples will be discarded.

5.0 RESULTS OF INVESTIGATION

5.1 SUBSURFACE CONDITIONS

5.1.1 Frame of Reference & Overview

The soils encountered in the boreholes and reported herein have been classified in accordance with the Unified Soil Classification System (USCS) as defined in ASTM D2487-11 and D2488-09a, with modifications consistent with the methods of the Ontario Ministry of Transportation (MTO). The modifications specifically include the removal of the descriptions "lean" and "fat" with reference to clay soils and include a "Medium" category with respect to plasticity.

The subsurface conditions encountered in the boreholes are presented in detail on the Borehole records provided in **Appendix C**. An explanation of the symbols and terms used to describe the Borehole Records is also included in **Appendix C**.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling and should be considered approximate only. Variations to the conditions reported and discussed herein must be anticipated.

5.1.2 General Subsurface Stratigraphy

In general, the subsurface stratigraphy encountered in the boreholes advanced on the subject property consisted of topsoil and a veneer of sand, or fill, overlying glacial till. The glacial till generally comprised silty sand and gravel till.

Bedrock was not encountered in the boreholes advanced for this investigation.

5.2 SUBSURFACE STRATIGRAPHY

5.2.1 Fill

Fill was encountered at borehole BH03-17 and extended to a depth of 2.4 m. A review of historical air photos indicates that borehole BH 03-17 is located in an area where a pond had previously been located. The upper 300 mm of the fill comprises topsoil. The remainder of the fill ranged from silty sand with some clay and trace gravel to sandy silty clay with gravel. SPT N-values of 6 to 8 blows per 300 mm penetration of a split spoon sampler indicate that the fill is loose. The fill was described as moist on the field logs.

5.2.2 Topsoil

Native topsoil was encountered surficially at boreholes BH01-17, BH02-17, and BH04-17. The topsoil is 280 to 300 mm thick at these locations and comprises dark brown silty topsoil.

5.2.3 Sand (SM)

A layer of sand was encountered below the topsoil in boreholes BH01-17, BH02-17, and BH04-17. This deposit comprises sand with trace gravel and silt and is 0.4 to 3.8 m thick at the borehole locations. The sand is thickest at the northwest end of the site (BH01-17). The upper 0.6 to 1.5 m of this deposit is loose based on SPT N-values of 5 to 9 blows per 300 mm. Below this upper loose portion, the sand deposit is typically compact with SPT N-values ranging from 11 to 21 blows per 300 mm. The sand is moist to wet, as indicated by moisture content results of 6 to 18%.

5.2.4 Silty Sand (SM) Till and Silty Sand with Gravel (SM) Till

A native deposit of glacial till was encountered beneath the topsoil, sand, and fill throughout the site. The silty sand till or silty sand with gravel glacial till extended to a depth of 7.2 m below ground surface in

borehole BH02-17; and, below the termination depths of the other boreholes. The results of particle size distribution tests performed on four samples of the glacial till are shown below in Table 5.1 and shown on Figure No. 1, provided in **Appendix D**.

Table 5.1 Grain Size Distribution – Glacial Till (SM)

Borehole	Sample	Depth (m)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH02-17	SS5	3.2	Silty Sand (SM) Till	6	38	42	14
BH03-17	SS5	3.4	Silty Sand with Gravel (SM) Till	23	28	41	8
BH04-17	SS4	2.6	Silty Sand with Gravel (SM) Till	18	36	37	9
BH04-17	SS6	4.7	Silty Sand with Gravel (SM) Till	27	32	32	9

SPT N-values typically ranging from 25 to greater than 50 blows per 300 mm indicate that the glacial till deposit has a compact to very dense relative density. Moisture content results of 6 to 12%, indicate that the glacial till is moist to wet.

5.2.5 Silty Clay (CL) Till

A deposit of silty clay till was encountered below the silty sand till at 7.2 m depth in borehole BH02-17. This deposit extended below the termination depth of the borehole and comprised grey silty clay with trace gravel. A SPT N-value of over 50 indicates the clay till is hard. A moisture content test result of 9% indicates that this deposit is moist.

5.3 GROUNDWATER CONDITIONS

Groundwater levels were measured in the wells installed in the boreholes on multiple occasions, and water level dataloggers were installed as part of the hydrogeological investigation. The initial groundwater measurement, and the high groundwater level from the datalogger results are summarized in the following Table 5.2.

Table 5.2 Groundwater Level Measurements

Borehole Number	Measurement	Groundwater Level	
		Depth (m)	Elevation (m)
BH01-17	April 13, 2017	0.29	333.19
	High datalogger result	0.12	333.36
BH02-17	April 17, 2017	0.40	336.79
	High datalogger result	-0.06	337.25
BH03-17	April 13, 2017	0.69	333.61
	High datalogger result	0.56	333.74
BH04-17	April 17, 2017	2.85	337.10
	High datalogger result	2.28	337.67

The water levels indicate that groundwater is either perched in the fill or sand above the glacial till, or contained in seams within the glacial till. The water level readings show significant variation between the April and September readings. Additional fluctuations in the above stabilized groundwater levels should be anticipated throughout the various seasons.

6.0 DESIGN DISCUSSION & RECOMMENDATIONS

It is proposed to develop the site as a residential subdivision. One L-shaped municipal road is planned from the north property line to the east property line, to connect to the proposed subdivisions on these sides of the site. Single family residential lots are planned to the north, south, and west of the municipal road. A townhouse development is planned in the south end of the site. A dry SWM facility is planned for the northwest end on the site. The proposed lot fabric is shown on the Borehole Location Plan.

6.1 SUBSURFACE CONDITIONS OVERVIEW

The subsurface conditions encountered in the boreholes advanced for the geotechnical investigation generally consisted of topsoil and a veneer of sand, or fill, overlying glacial till. The glacial till generally comprised silty sand and gravel till. Groundwater is perched in fill or sand deposits above the glacial till or contained in saturated seams within the glacial till.

Bedrock was not encountered in the boreholes advanced at the site for this investigation.

6.2 GEOTECHNICAL CONSIDERATIONS AND CONSTRAINTS

Based on the conditions encountered in the boreholes and the general details of the proposed development, the following considerations and constraints are anticipated for this site.

The existing buildings, surficial vegetation and topsoil and asphalt will require stripping and removal to facilitate construction.

Existing fill material, which was encountered in the area of a historical pond (BH03-17) is not considered a suitable founding stratum for the construction of the proposed building foundations and site pavements.

The undisturbed native soils are compact to dense and are considered a suitable founding stratum for the construction of the proposed development.

A combination of engineered fill, placed and compacted in accordance with the recommendations provided herein, overlying the undisturbed native soils will provide a suitable founding stratum for the construction of the buildings, site services and roads subject to completing the site preparation activities as described herein.

Groundwater was recorded perched in fill or sand deposits above the glacial till. Moderate to high seepage may be encountered in excavations through the saturated deposits of these soils. Excavations

for sewer installation will likely extend below seasonal high water level along a portion of the sewer route. Excavations below the groundwater table may require positive dewatering.

7.0 GEOTECHNICAL DESIGN

7.1 SITE PREPARATION AND GRADING

7.1.1 Grading Overview

The current grading plan indicates that up to about 3 m of fill will be required at the east and west ends of the site. A cut of up to about 3 m will be made in the central portion of the site. Up to about 1 m of soil will be cut from the bottom of the dry SWM facility, at the northwest end of the site. Areas of existing fill, such as at BH03-17 will require subexcavation as part of the area grading activities.

7.1.2 Erosion & Sediment Control and Regulatory Constraints

An erosion and sediment control plan should be developed and implemented prior to commencement of construction, to direct precipitation and ground surface runoff away from the areas of construction. Identification of an outfall/discharge location will be required for this purpose. All erosion sedimentation control should be conducted in accordance to the approved for construction design drawings.

7.1.3 Sub-Excavation and Proof Rolling

Subexcavation of existing fill will be required. Existing fill was found in a borehole positioned in an area previously occupied by a pond (BH03-17). The fill was 2.4 m thick at this location.

Groundwater may be perched in the fill depending on the time of year of the work. Moderate seepage may be expected from excavations in this area.

The areas of stripping and any areas of engineered fill are to be inspected by geotechnical personnel to ensure that all unsuitable materials are removed. Any soft zones or remaining unsuitable soil identified during site preparation or during general construction activities, are to be removed and replaced with approved Engineered Fill, as referenced below.

The exposed sub-grade surface should be proof rolled and compacted across the entire area of the planned development. The proof rolling program should be undertaken using large, vibratory compaction equipment having a minimum static weight of 10 tonnes.

7.1.4 Grading and Earthworks

Fill will be required in the east and west ends of the site; and, and in areas where existing fill is subexcavated. Fill required to backfill localized sub-excavations or for use as engineered fill to raise the site grades should consist of approved select portions of the native materials or imported granular soils

that conform to the requirements of Ontario Provincial Standard Specification (OPSS) Select Subgrade Material (SSM) or Granular 'B' Type I. Further comment in this regard are provided below in Section 8.3.

All engineered fill material should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 98% of the material's SPMDD.

Fill below paved areas should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 98% of the material's SPMDD.

7.2 FOUNDATIONS

7.2.1 General Foundation Overview

Given the conditions encountered in the boreholes, the use of conventional spread and strip footing foundations should provide a practical approach for the residential development.

7.2.2 Foundation Design Parameters

Subject to preparing the Study Area in accordance with the recommendations provided above, the preliminary Ultimate Limit States (ULS) and the geotechnical reaction at Serviceability Limit States (SLS) provided below in Table 7.1 may be considered for use in design of conventional shallow foundations founded on engineered fill and/or native soils.

Table 7.1 Geotechnical Bearing Reactions and Resistances for Design of Conventional Foundations

Ultimate Limit States (kPa)	Serviceability Limit States (kPa)
225	150

7.2.3 Foundation Design Commentary

The geotechnical bearing resistance, ULS incorporates a resistance factor of 0.5. The geotechnical reaction, SLS, is the bearing pressure that corresponds to 25 mm of total settlement.

In some cases, the design grades in combination with the prevailing soil conditions may result in foundations being placed on a combination of the native soils and engineered fill. Typically, placing foundations on a combination of soils is considered to pose a risk due to the different behaviors of native soils and fill materials. As such, it is preferred to place the foundations on only one soil/fill type.

If foundation excavations need to be deepened beyond the intended founding depth, either the height of the foundation walls will need to be increased or the excavation will need to be backfilled to the design

founding depth with lean mix concrete. The placement and material specifications for the lean mix concrete should be in accordance with OPSS 1359.

All perimeter footings for heated structures should be protected from frost action by a minimum soil cover of 1.2 m. Where footings have insufficient soil cover for frost protection, the use of manufactured insulation will be required.

7.2.4 Foundation Wall Backfill

The exteriors of foundation walls should be backfilled with free-draining granular material such as OPSS Granular B Type 1. If native soils are used for backfilling of foundations, then a manufactured drainage layer must be utilized on the outside face of the foundation wall.

The exterior (perimeter) wall backfill should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 95% of the material's SPMDD. Care should be taken immediately adjacent to existing foundation walls to avoid over-compaction of the soil which could result in damage to the walls

7.3 SEISMIC SITE CLASS

The selection of the seismic site classification is based on the soil conditions encountered in the upper 30 m of the stratigraphy. For this project, the boreholes were terminated at a maximum depth of 8.2 m. The stratigraphy below this depth has therefore been interpreted based on the conditions encountered, supplemented by the conditions described on the regional geological maps and from the Ontario MOE Water Well Records electronic database.

Based on the conditions encountered in the boreholes, the recommended site classification for seismic site response for this Study Area is Site Class D in accordance with Table 4.1.8.4.A of the 2010 National Building Code (NBC).

7.4 PAVEMENT DESIGN RECOMMENDATIONS

A public road and private roads for the multi-family block will be constructed as part of the development. Parking areas will also be constructed in the multi-family block. The sub-grade within the road right-of-way, driveway and parking areas should be prepared as outlined in Section 7.1.

It has been assumed that the pavement in the multi-family block will be used by both passenger vehicles and truck traffic. No traffic study or traffic counts were available at the time of this report. The following pavement designs are recommended based on the anticipated loading and subgrade conditions, and City of Guelph requirements for residential roads.

Table 7.2 Recommended Pavement Structure

Material	Design Pavement Structure Thicknesses (mm)		
	Public Roads	Private Roads	Parking Areas
Superpave 12.5 or HL3 PG 64-28 Top course	40	35	35
Superpave 19.0 or HL8 PG 64-28 Base course	50	50	50
OPSS Granular 'A' Base	175	150	150
OPSS Granular 'B' Sub-base	350	350	300

The design for the roadways should provide a pavement service life in the order of 15 years, although operation and maintenance efforts will be required during the life cycle of the pavements.

The finished sub-grade surface and the pavement surface should be crowned and graded to direct runoff water away from the development and associated infrastructure.

The base and sub-base materials should be compacted to a minimum of 100% SPMDD. The asphaltic concrete should be compacted to a minimum of 92.0% of Maximum Relative Density (MRD) for all asphalt types with the exception of SuperPave 19.0 which should be compacted to at a minimum of 91.0% of MRD.

Sub drains are recommended at the site, since the sub-grade soil anticipated will predominantly comprise silty glacial till soils. The pavement subdrains should comprise 100 mm or 150 mm perforated corrugated pipe in filter sock, bedded in concrete sand outletted to the catch basins. The subdrains should be positioned such that the top of subdrain bedding is at the lower limit of the Granular 'B' subbase. The subgrade below the Granular 'B' subbase should be sloped towards the subdrain locations. Because of this, along roads crowned at the centre, subdrains are typically installed below the curb line.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 TEMPORARY EXCAVATIONS

It is anticipated that the depth of excavations will vary for the proposed scope of work. Shallow excavations are likely to be required for foundations whereas deeper excavations may be required for servicing.

Temporary open cut excavations should be conducted in accordance with the requirements of the Occupational Health & Safety Act & Regulations (OH&S Act) for Construction Projects.

The undisturbed native soils at this site and engineered fill materials should be considered to be Type 3 soils in accordance with the OH&S Act. Temporary excavations in these soils should be sloped at 1H:1V (horizontal to vertical) from the base of the excavation or top of the trench box.

Where the native soils extend below the static groundwater level, these materials and soils must be considered to be Type 4 soils in accordance with the OHSA. Unsupported excavation sidewalls in Type 4 soils must be 3H: 1V or flatter, from the base of the excavation.

Some sloughing and caving must be anticipated for excavations in the silty sand, sand and gravel, and silt, particularly where excess moisture (precipitation, ground surface runoff and the groundwater table) is present.

Based on groundwater information from the Hydrogeological Investigation, and the proposed sewer inverts, some of the excavations for the sewers may extend below the seasonal high groundwater level, potentially requiring the use of positive dewatering.

8.2 DEWATERING

A hydrogeological Investigation was completed by Stantec in conjunction with the geotechnical investigation. Results of the hydrogeological investigation report are provided under separate cover for additional details related to groundwater and dewatering.

8.3 REUSE OF ONSITE SOILS

8.3.1 Existing Fill

The existing fill encountered at BH03-17 contained clay. This material may be considered for reuse below paved areas or in landscaped areas. Some moisture conditioning may be required, which could make use problematic during wet or cold weather.

8.3.2 Topsoil

Topsoil may be re-used in landscaped areas. Any excess topsoil should be removed from site.

8.3.3 Sand

These soils are generally considered suitable for reuse as bulk fill for paved areas, engineered fill below structures, and as backfill in excavations to the finished sub-grade level.

This material should be placed with moisture contents that are within +/- 2.0% of the optimum moisture content level. It is recommended that the material be approved at the time of placement by qualified geotechnical personnel.

This material is assessed as having low frost susceptibility in accordance in accordance to Section 3.1.5 of the MTO's Pavement Design and Rehabilitation Manual.

This material may have variable silt content. Additional testing would be needed if this material is to be considered for use in applications where free-draining soils are required, such as for drainage layers, or foundation wall backfill.

8.3.4 Glacial Till

These soils are generally considered suitable for reuse as bulk fill for paved areas, engineered fill below structures, and as backfill in excavations to the finished sub-grade level.

The results of the gradation analyses on these materials indicate that the glacial till has a high percentage of silt and clay size particles. The glacial till may be difficult to handle, place, and compact in "less-than-ideal" weather conditions. Disturbance and loss of strength in the presence of excess moisture and/or construction traffic is a concern. It is recommended that reuse of this soil be scheduled for times of year that are typically warm and dry.

This material should be placed with moisture contents that are within +/- 2.0% of the optimum moisture content level. It is recommended that the material be approved at the time of placement by qualified geotechnical personnel. Due to the high in-situ moisture content of the glacial till soils, scarifying and drying may be required prior to placement.

This material is assessed as having moderate to high frost susceptibility in accordance in accordance to Section 3.1.5 of the MTO's Pavement Design and Rehabilitation Manual.

This material should not be considered as free-draining. Therefore, this soil should not be used as backfill in any application requiring the use of free draining material, such as for drainage layers, foundation wall backfill, service pipe bedding, or subbase and base layers in pavements.

8.4 IMPORTING AND EXPORTING SOIL MATERIALS

8.4.1 Overview

Excess soils intended for off-site disposal will be subject to environmental requirements as stated by the MOECC.

All fill materials imported to the site must meet all applicable municipal, provincial, and federal guidelines and requirements associated with environmental characterization of the materials.

Imported fill materials should contain no recycled materials such as concrete or asphalt. The imported fill material intended for this purpose should be tested and approved by the Geotechnical Engineer prior to delivery to the site.

8.4.2 Engineered Fill

It is presumed that this construction project may require some amount of imported fill material required to develop the design grades for the development depending on the usability of the excavated materials at the time of construction. It is recommended that imported fill material for the purpose of placement as

"engineered fill" comprise imported sand or sand and gravel, preferably meeting the requirements of OPSS 1010 Granular 'B' or OPSS 1010 Select Subgrade Material (SSM).

8.5 BEDDING AND BACKFILL

8.5.1 Service Pipe Bedding

Bedding for services should consist of OPSS Granular 'A' material. In general, a minimum of 150 mm of bedding and 300 mm of cover material is recommended.

The bedding and cover material should be compacted to achieve a minimum of 100% of the material's SPMDD.

These recommendations should be confirmed with the pipe manufacturer and care must be taken to avoid incurring damage to the services. Pipe manufactures may have additional/alternative requirements that should be reviewed by the Designer and Contractor prior to installation of the services.

8.5.2 Service Trench Backfill

Service trench backfill placed over the pipe bedding and cover material can consist of the excavated native soils, or approved imported backfill, subject to inspection and approval by the geotechnical consultant to confirm the condition at the time of backfilling. Any wet soils may not be suitable for use as backfill without first being allowed to dry. Due to this, some native soils may not be suitable for re-use as trench backfill during wet weather. The comments provided above with respect to the reuse of the native soils apply in this respect.

The trench backfill should be placed in loose lifts having a maximum thickness of 300 mm. Each lift should be uniformly compacted using suitable compaction equipment for the purpose intended, to achieve a minimum of 98% of the material's SPMDD.

8.5.3 Municipal Infrastructure Backfilling

Where manholes and catchbasins are required for the sewer or reinstatement of existing manholes and catch basins is required, these components should be constructed and backfilled in accordance with specifications outlined in OPSS 407: Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation.

Settlements around manholes are common, and the settlements can be reduced by backfilling immediately around the manhole structure using OPSS Granular B material.

8.6 SOIL CORROSIVITY POTENTIAL

One (1) soil sample was submitted to AGAT Laboratories in Mississauga, Ontario, for analysis of pH, soil conductivity and redox potential, and concentrations of sulphides. The purpose of the testing was to evaluate the potential for corrosion of ductile iron pipe in contact with the soil and groundwater at the site,

consistent with the methods described by ANSI/AWWA. The test results are summarized in the table below.

Table 8.1 Results of Chemical Analysis and ANSI/AWWA Soil Corrosivity Potential

Borehole No.	BH04-17	
Sample No.	SS2	
Median Depth (m)	1.1	
Parameter	**Measured Value**	**ANSI / ASSA Point Rating**
Resistivity (Ohm-cm)	10000	0
pH	8.60	3
Redox Potential (mV)	287	0
Sulphides (%)	<0.05	0
Moisture	Fair	1
Total ANSI / AWWA Points	**4**	

The ANSI/AWWA rating system considers a score of 10 points or more indicative of the potential for corrosion of buried steel (less than 10 points indicates no potential for corrosion of buried steel). Based on the ANSI/AWWA rating system, the soil samples tested have little potential for corrosion.

It is noted that other factors may influence the corrosion potential, such as the application of deicing salts that leach into the soil, or the presence of stray electrical currents.

8.7 FOUNDATIONS

The base of all footing excavations should be inspected by geotechnical personnel prior to placing concrete to confirm the founding conditions are consistent with the recommendations described herein, and to ensure that there is no disturbance of the soil at the founding surface. Any deleterious materials, organics, or loose/soft or wet conditions observed, should be sub-excavated and removed and the excavations backfilled with engineered fill in accordance with the recommendations provided herein.

Where construction is undertaken during winter conditions, the subgrade at the founding elevation and below, must be protected from freezing at all times.

8.8 SURFACE WATER MANAGEMENT

8.8.1 Storm Water Management Facility

A dry storm water management facility is proposed to be constructed at the northwest end of the site as part of the proposed development. The proposed bottom of pond elevation ranges from Elevation 333.0 to 333.5 m.

The soil conditions in the borehole closest to the proposed dry SWM facility comprises surficial topsoil overlying a native sand deposit to a depth of over 4 m below existing grade. Groundwater level measurements show the seasonal high groundwater level is around Elevation 333.3 m These conditions indicate that the facility will be suitable for infiltration of collected water, except during the time of year where groundwater levels are high.

8.8.2 Infiltration Galleries

Infiltration galleries will also be used at this site. The predominant glacial till soils at this site are silty. Infiltration galleries could still be designed and constructed as long as they are positioned above the groundwater table, sized using a suitably low infiltration rate, and provided with subsurface overflows connected to suitable frost-free outlets, such as a storm sewer.

Hydraulic conductivity for the predominant native materials on site is provided below in Table 8.2. These numbers were obtained from supplementary standard B-6 to the Ontario Building Code.

Table 8.2 Percolation Time and Coefficient of Permeability Estimates

Native Soil Type	Estimated Percolation Time (T) (minutes/cm)	Estimated Coefficient of Permeability (K) (cm/sec)
Glacial Till	8 to 50	$1x10^{-3}$ to $1x10^{-6}$
Sand	8 to 20	$1x10^{-3}$ to $1x10^{-5}$

As per City of Guelph guidelines, it is recommended that the infiltration rates be confirmed by in-situ tests methods, such as the double-ring infiltrometer.

We refer to the Stormwater Management Report, completed by Stantec under separate cover, for additional information on stormwater management for this site.

8.9 RADON GAS

Radon gas is a radioactive gas that is produced naturally. It is known that there are areas of Guelph where residential houses have recorded concentrations of radon gas over the Canadian Guidelines for indoor air. As the concentration of radon gas in a home is a result of a combination of factors, including the underlying soil conditions, air pressure differentials, and the air tightness of the house construction, it is recommended that basements in houses at this development be tested for radon gas concentration following construction. Any issues with radon concentrations above the Canadian Guidelines should be referred to a Radon Mitigation Professional.

9.0 CLOSURE

Use of this report is subject to the Statement of General Conditions provided on the following page. It is the responsibility of Rockpoint Properties Inc. who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd. should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report;
- Basis of the report;
- Standard of care;
- Interpretation of site conditions;
- Varying or unexpected site conditions; and,
- Planning, design or construction.

This report has been prepared by Jeff Dietz and reviewed by Peter Healy.

Respectfully submitted;

STANTEC CONSULTING LTD.

REPORT

Appendix A
June 12, 2019

APPENDICES

Appendix A

A.1 STATEMENT OF GENERAL CONDITIONS

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

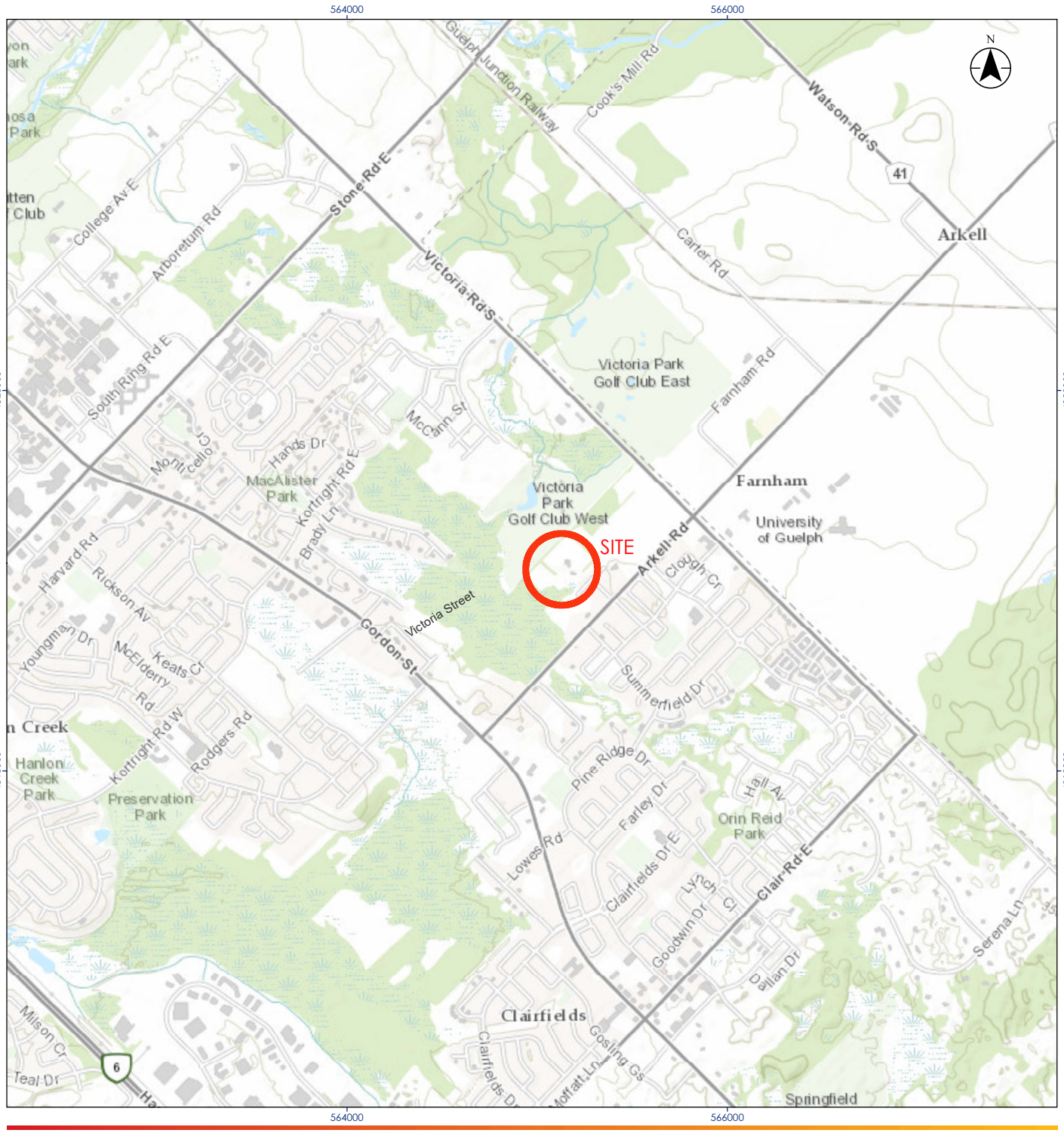
VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

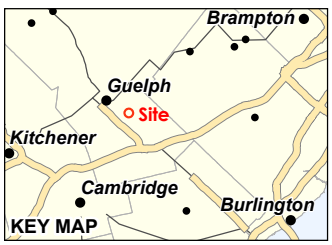
PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

Appendix B

B.1 DRAWINGS

T:\Autocad\Drawings\Project Drawings\2019\161413338\Key Plan (gis)\161413338_Keyplan.mxd Revised: 2019-06-12 By: gbriones





Legend

Site Location

0 500 1,000 metres

1:30,000 (at original document size of 8.5x11)

Stantec

Project Location
220 Arkell Road
Guelph, Ontario

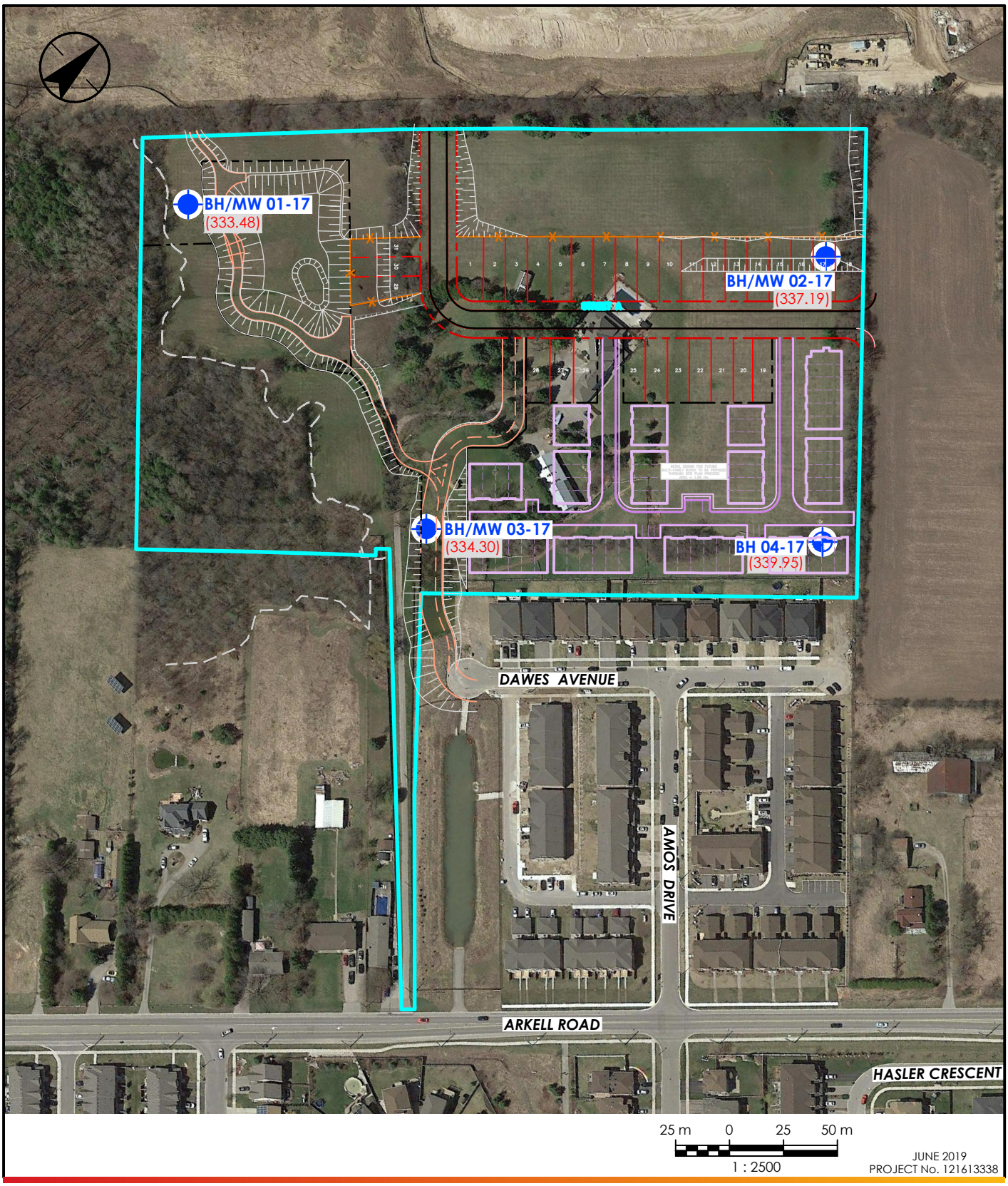
Project No. 121413338
Prepared by Gliceria Briones
on 2019-06-12

Client/Project
ROCKPOINT PROPERTIES INC.
GEOTECHNICAL INVESTIGATION

Drawing No.
1

Title
Key Plan

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2016.
3. Imagery provided by Esri ©2017.



JUNE 2019
PROJECT No. 121613338

T:\Autocad\Drawings\Project Drawings\2019\161413338\161413338_Boreholes.dwg
2019/06/12 11:56 AM By: Briones, Gliceria

Stantec

400 - 1331 Clyde Avenue
Ottawa, ON, Canada K2C 3G4
www.stantec.com

LEGEND

APPROXIMATE BOREHOLE LOCATION

APPROXIMATE BOREHOLE WITH MONITORING WELL LOCATION

(337.19) GROUND SURFACE ELEVATION (m)

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17.
2. IMAGERY: SCREENSHOT FROM GOOGLE EARTH ©2017.

Client/Project

ROCKPOINT PROPERTIES INC.
GEOTECHNICAL INVESTIGATION
220 ARKELL ROAD, GUELPH, ONTARIO

Drawing No.

2

Title

BOREHOLE LOCATION PLAN

Appendix C

C.1 SYMBOLS & TERMS USED ON BOREHOLE RECORDS

C.2 BOREHOLE RECORDS

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Rootmat	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
Fill	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	- having cracks, and hence a blocky structure
Varved	- composed of regular alternating layers of silt and clay
Stratified	- composed of alternating successions of different soil types, e.g. silt and sand
Layer	- > 75 mm in thickness
Seam	- 2 mm to 75 mm in thickness
Parting	- < 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 – 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality*
25-50	*Poor Quality*
50-75	*Fair Quality*
75-90	*Good Quality*
90-100	*Excellent Quality*

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	*Crushed*
Severely Fractured	*Shattered or Very Blocky*
Fractured	*Blocky*
Moderately Jointed	*Sound*
Intact	*Very Sound*

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.

Boulders Cobbles Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Igneous Bedrock | Meta-morphic Bedrock | Sedi-mentary Bedrock

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

measured in standpipe, piezometer, or well

inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

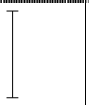
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to 'A' size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

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BOREHOLE RECORD

N: 4 819 008 E: 564 970

BH01-17

CLIENT Rockpoint Properties Inc. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 334.36

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
0	333.5	**Grass Field**					
	333.2	300 mm TOPSOIL	0				
		Loose to compact, brown, SAND (SM) - trace gravel and silt - wet	1	SS	1	280/610	6
1			3	SS	2	250/610	9
			6	SS	3	100/610	17
2			8	SS	4	230/610	21
		- grey, some silt	10				
3			11	SS	5	460/610	5
	329.4		13				
		Very dense, grey, Silty Sand with Gravel (SM) TILL - wet	15				
4			16	SS	6	380/610	54
	328.3		17				
		END OF BOREHOLE at approximately 5.2 m below existing grade. Water level measured at 2.1 m below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.	18				
5			20				
			23				
6			26				
			29				
7			33				
			36				
8			39				
			43				
9			46				
			49				
10			52				
			56				
11			59				
			62				
12			66				

UNDRAINED SHEAR STRENGTH (kPa)

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

REMARKS & GRAIN SIZE DISTRIBUTION (%)

10 20 30 40 50 60 70 80 90 100

GR SA SI CL

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 819 204 E: 565 193

BH02-17

CLIENT Rockpoint Properties Inc. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 338.12

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
0	337.2	**Grass Field**	0				
	336.9	280 mm TOPSOIL					
		Compact, brown, SAND (SM) - trace gravel and silt - moist	1	SS	1	200/610	5
1	335.8		3	SS	2	51/610	11
		Loose, brown, Silty Sand (SM) TILL - wet	6	SS	3	100/610	7
2			7				
		- very dense, moist	8	SS	4	250/250	50/100
3			9				
		- grey	10	SS	5	230/230	50/76
4			11				
			12				
		- auger grinding	13				
			14				
			15	SS	6	250/280	50/130
5		- auger grinding	16				
			17				
			18				
			19				
6		- moist to wet	20	SS	7	76/76	50/76
			21				
			22				
			23				
7	330.0		24				
		Hard, grey, Silty Clay (CL) TILL - trace gravel	25				
	329.3	- moist		SS	8	280/280	50/130
8		END OF BOREHOLE at approximately 7.9 m below existing grade.	26				
			27				
		Water level measured at 2.3 below grade on completion of drilling.	28				
			29				
9			30				
			31				
		Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.	32				
10			33				
			34				
			35				
11			36				
			37				
			38				
12			39				

UNDRAINED SHEAR STRENGTH (kPa)

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90 100

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

6 38 42 14

□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 818 983 E: 565 155

BH03-17

CLIENT Rockpoint Properties Inc. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 335.26

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	**334.3**	**Grass Field**
	334.0	FILL: 300 mm TOPSOIL
1		FILL: brown silty sand, some clay, trace gravel - moist
	332.9	
2		FILL: brown sandy silty clay, trace gravel - moist
	331.9	
3		Compact, brown, Silty Sand with Gravel (SM) TILL - moist to saturated
4		
5	329.1	
		END OF BOREHOLE at approximately 5.2 m below existing grade. Water level measured at 2.4 m below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 1.5 m to 4.6 m below grade.
6		
7		
8		
9		
10		
11		
12		

STRATA PLOT

WATER LEVEL

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
0				
1	SS	1	460/610	8
2				
3	SS	2	200/610	8
4				
5	SS	3	250/610	6
6				
7	SS	4	25/610	25
8				
9	SS	5	300/610	26
10				
11				
12	SS	6	430/610	28
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				

SAMPLES

UNDRAINED SHEAR STRENGTH (kPa)

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m

STANDARD PENETRATION TEST, BLOWS/0.3m

10 20 30 40 50 60 70 80 90 100

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

23 28 41 8

- Field Vane Test, kPa
- Remoulded Vane Test, kPa
- Pocket Penetrometer Test, kPa

Stantec

BOREHOLE RECORD

N: 4 819 111 E: 565 287

BH04-17

CLIENT Rockpoint Properties Inc. PROJECT No. 161413338

LOCATION 220 Arkell Road, Guelph, ON DATUM Geodetic

DATES: BORING April 5, 2017 WATER LEVEL TPC ELEVATION 340.86

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	**340.0**	**Grass Field**
	339.7	280 mm TOPSOIL
	339.3	Loose, brown, SAND (SM) - some gravel, trace silt - wet
1		Compact to very dense, brown, Silty Sand with Gravel (SM) TILL - moist
2		
3		
4		
5		
6		- wet
7		
8	331.8	
		END OF BOREHOLE at approximately 8.2 m below existing grade. Water level measured at 6.4 m below grade on completion of drilling. Monitoring well installed with 50 mm screen from approximately 4.6 m to 7.6 m below grade.
9		
10		
11		
12		

STRATA PLOT

WATER LEVEL ▽

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
0				
1	SS	1	230/610	8
2				
3	SS	2	460/610	11
4				
5				
6	SS	3	430/610	26
7				
8	SS	4	460/610	67
9				
10				
11	SS	5	460/610	87
12				
13				
14				
15	SS	6	250/250	50/100
16				
17				
18				
19				
20	SS	7	130/130	50/130
21				
22				
23				
24				
25				
26	SS	8	460/610	84
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				

SAMPLES

UNDRAINED SHEAR STRENGTH (kPa)

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC CONE PENETRATION TEST, BLOWS/0.3m ▼

STANDARD PENETRATION TEST, BLOWS/0.3m ●

REMARKS & GRAIN SIZE DISTRIBUTION (%)

10 20 30 40 50 60 70 80 90 100

GR SA SI CL

18 36 37 9

27 32 32 9

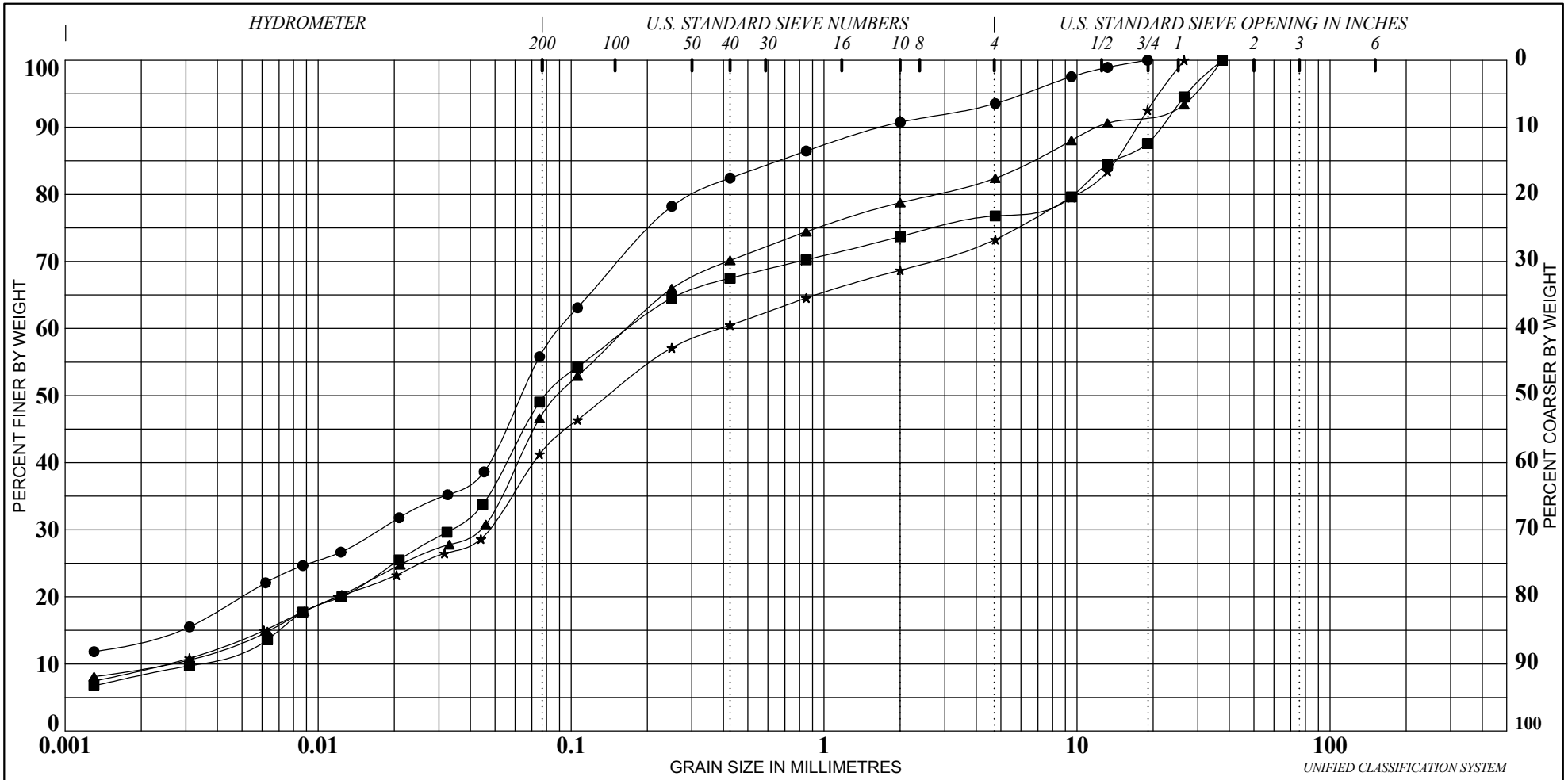
□ Field Vane Test, kPa

■ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Appendix D

D.1 LABORATORY TEST RESULTS



SILT & CLAY		SAND			GRAVEL		COBBLES	BLDs
CLAY	SILT	fine	medium	coarse	fine	coarse		

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH02-17	3.2	Silty Sand (SM) TILL	8				6	38	42	14
■ BH03-17	3.4	Silty Sand with Gravel (SM) TILL					23	28	41	8
▲ BH04-17	2.6	Silty Sand with Gravel (SM) TILL	6				18	36	37	9
★ BH04-17	4.7	Silty Sand with Gravel (SM) TILL	6				27	32	32	9

Stantec

Project: Arkell Road

Location: 220 Arkell Road, Guelph, ON

Project No.: 161413338

GRADATION CURVE (ASTM D422)

Figure: 1

Remarks:

AGAT Laboratories

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

CLIENT NAME: STANTEC CONSULTING LTD
100 - 300 HAGEY BOULEVARD
WATERLOO, ON N2L0A4
(519) 579-4410

ATTENTION TO: Jeff Dietz

PROJECT: 161413338-220 Arkell

AGAT WORK ORDER: 17W204004

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Apr 17, 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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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 17W204004

PROJECT: 161413338-220 Arkell

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Jeff Dietz

SAMPLING SITE:Guelph, ON

SAMPLED BY:RS

Corrosivity Package

DATE RECEIVED: 2017-04-07

DATE REPORTED: 2017-04-17

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION: BH04-17 2.5-4.5' SAMPLE TYPE: Soil DATE SAMPLED: 2017-04-05 8306282
*Sulphide	%		0.05	<0.05
Chloride (2:1)	µg/g		2	4
Sulphate (2:1)	µg/g		2	<2
pH (2:1)	pH Units		NA	8.60
Electrical Conductivity (2:1)	mS/cm		0.005	0.100
Resistivity (2:1)	ohm.cm		1	10000
Redox Potential (2:1)	mV		5	287

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8306282 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

*Sulphide analyzed at AGAT Vancouver

Certified By: Amanjot Bhela

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Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 17W204004

PROJECT: 161413338-220 Arkell

ATTENTION TO: Jeff Dietz

SAMPLING SITE:Guelph, ON

SAMPLED BY:RS

Soil Analysis

RPT Date: Apr 17, 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
Corrosivity Package															
*Sulphide	8301141		<0.05	<0.05	NA	< 0.05	100%	80%	120%						
Chloride (2:1)	8306282	8306282	4	4	NA	< 2	99%	80%	120%	100%	80%	120%	102%	70%	130%
Sulphate (2:1)	8306282	8306282	<2	<2	NA	< 2	95%	80%	120%	105%	80%	120%	104%	70%	130%
pH (2:1)	8306282	8306282	8.60	8.57	0.3%	NA	100%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	8306282	8306282	0.100	0.100	0.0%	< 0.005	93%	90%	110%	NA			NA		
Redox Potential (2:1)	8306282	8306282	287	278	3.2%	< 5	105%	70%	130%	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

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Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 17W204004

PROJECT: 161413338-220 Arkell

ATTENTION TO: Jeff Dietz

SAMPLING SITE:Guelph, ON

SAMPLED BY:RS

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
*Sulphide	INOR-181-6027	modified from ASTM E1915-11	COMBUSTION
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
www.agatlabs.com 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)

Report Information:

Company: Stantec Consulting Ltd.
Contact: Jeff Dietz
Address: 100-300 Hagey Boulevard
Waterloo
Phone: 519 579 4410 Fax:
Reports to be sent to:
1. Email: jeff.dietz@stantec.com
2. Email:

Project Information:

Project: 161413388 - 220 Arkell
Site Location: Guelph, ON
Sampled By: R Stroebel
AGAT Quote #: PO: 161413388
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐
Company: Stantec Consulting Ltd.
Contact: Jeff Dietz
Address: 100-300 Hagey Blvd., Waterloo N2L 0A4
Email: jeff.dietz@stantec.com

Regulatory Requirements:

☑ No Regulatory Requirement
(Please check all applicable boxes)

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

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

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

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

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

Laboratory Use Only

Work Order #: 17W204004
Cooler Quantity: 1 blk
Arrival Temperatures: 7.5 17.7 17.6 (ice packs)
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes:

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

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	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cr ☐ CN⁻ ☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ NO_3/NO_2 ☐ Total N ☐ Hg ☐ pH ☐ SAR (Check Applicable)	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	Corrosivity
BH 04-17 2.5-4.5'	Apr 5	N/A	1 bag	Soil																	X
		~~N/A~~	~~1 bag~~																		

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
B Frank	Apr 6/17		M. Verne M	2017/04/6	3:10 pm
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
			Milan	Apr. 8/17	9:30 am

Page 1 of 1
No:

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