Preliminary Geotechnical Study – Proposed Park Place Industrial Development

City of Barrie, ON

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1.0 INTRODUCTION

Stantec Consulting Ltd (Stantec), acting at the request of North American Development Group (NADG), has carried out a geotechnical investigation for the proposed Park Place Industrial Development in Barrie, Ontario. The purpose of the investigation was to establish the subsurface conditions for use in the design of the proposed development. Environmental testing and hydrogeological were not included in the current scope of work and/or are being completed by others.

The scope of the geotechnical investigation consisted of a desk top review of available geotechnical data in the area of the site, a borehole investigation consisting of 9 sampled boreholes, selective laboratory testing of soils sampled and preparation of this geotechnical report.

2.0 SITE AND PROJECT DESCRIPTION

The project site is located east of Highway 400, west of Bayview Avenue and south of Fairview Road in Barrie Ontario as shown on Drawing No. 1 – Borehole Location Plan in Appendix B. The Park Place commercial development is located south of the subject property where existing industrial developments are located to the north and east of Bayview Drive.

The site encompasses the former lands of Molson Park which also included a portion of the former Molson Brewery plant. The eastern portion of the site consists of vacant land which currently has several large stockpiles of earth fill located approximately 100 m west of Bayview avenue and extend to approximately 400 m west of Bayview Avenue. The central and western portion of the site consist of vacant weed and grass covered fields. A large steel shed is located near the center of the site and runs in an east to west configuration.

The ground surface slopes from west to east and several earth berms/earth slopes approximately 3 to 5 m in height are located in the western section of the site in the location of the former Molson Brewery building.

3.0 SURFICIAL GEOLOGY

Based on a review of surficial geology and bedrock geology data from the Ontario Geological Survey, the site is situated near a boundary between the physiographic setting of the Simcoe Lowlands and Simcoe Uplands. This area is characterized with glaciofluvial and outwash sand and silt deposits with minor clay and gravel. The ground surface is generally undulating with little local relief.

Bedrock consists mainly of sedimentary rocks of the Guelph formation which primarily consist of limestone, shale and dolomite. The depth to bedrock in the vicinity of the site is in the order of 100 m to 150 m below the ground surface elevation.

Previous experience at the Park Place commercial development revealed deposits of compact to very dense sand deposits with occasional layers of silty sand, sandy silt and occasional clay seams. Groundwater was not encountered during underground servicing of the project with excavations in the order of 10.0 m in depth.

A geotechnical investigation report was completed for the Park Place commercial Development south of the subject lands titled Updated Geotechnical Investigation Report prepared by Jacques Whitford Ltd., project # 1033078.01 and dated July 18, 2008. The report included the findings from 79 boreholes advanced across the commercial development lands and generally revealed shallow layers of fill and/or topsoil overlying a stratum of sand. Occasional layers of silty, silty sand and silty clay were encountered within the sand deposits.

An additional report was complete by Terraprobe Ltd, Titled Geotechnical Investigation, Park Place, project number 03-06-2126 and dated August 2007. The report included the findings from 52 boreholes advanced to a maximum investigated depth of 6.6 m. The boreholes revealed thin layers of topsoil and fill overlying layers of silty, silty sand, and silty clay overlying a stratum of sand which extended to the maximum investigated depth of the boreholes.

4.0 PROCEDURE

Prior to carrying out the field investigation, Stantec marked the proposed borehole locations on site. As a component of our standard procedures and due diligence, Stantec contacted the public utility authorities to clear the locations of both private and public underground utilities. In addition to the public locates Stantec engaged a private utility located service, Premier Locates, to scan each of the borehole locations to confirm that they were clear of underground utilities.

Nine (9) boreholes, identified as BH1 to BH9 were advanced on April 18-21, 2022, by Strata Soil Sampling with a track mounted drill rig. The boreholes were advanced to depths of approximately 5.2 to 17.4 meters. Five (5) monitoring wells, identified as MW1, MW3, MW4, MW7 and MW8, were installed in their respective borehole location and consisted of a 50 mm diameter rigid pipe with 3.0 m of screen at the bottom of the borehole. The monitoring wells were backfilled with silica sand within the screen portion, followed by a bentonite seal to ground surface. The monitoring wells were protected with a stick-up cover and well cap. The location of the boreholes and monitoring wells are shown on Drawing No. 1.

Personnel from our Barrie office supervised the drilling activities and logged the subsurface conditions encountered at the borehole locations. The overburden soils at the borehole locations were sampled at regular intervals using Standard Penetration Test (SPT) techniques with a 50-millimeter, outside-diameter split-barrel sampler in general accordance with the standard test method American Society for Testing and Materials (ASTM) D1586 (Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils). SPT N-values were recorded for each split-barrel sample obtained. The determination of soils density and consistency as indicated on the Borehole Records, are based on the results of the SPT.

4.1 LOCATION AND ELEVATION SURVEY

The borehole and monitoring well locations at each location was surveyed by Stantec field personnel using a hand held GPS unit. Geodetic elevations were sourced from a recent topographical survey map, provided to Stantec from NADG. Coordinates and elevations at each borehole and monitoring well location are shown in the table below.

Table 4.1: Borehole Location

Borehole I.D.	Ground Surface Elevation (m)	Northing	Easting
BH1/MW1	280.00	4911276.39	605236.11
BH2	281.00	4911173.39	605256.50
BH3/MW3	290.50	4911131.96	605111.99
BH4/MW4	290.50	4911050.60	604978.71
BH5	292.00	4911062.74	604890.90
BH6	295.80	4911008.02	604824.96
BH7/MW7	298.90	4910965.10	604808.75
BH8/MW8	294.50	4911044.03	604777.10
BH9	298.00	4910994.40	604737.80

4.2 LABORATORY TESTING

Soil samples were stored in moisture-tight containers and returned to our Markham laboratory for further examination and testing.

Geotechnical laboratory testing consisted of the following:

- Eight (8) hydrometer grain size distribution tests;
- Sixty-one (61) natural moisture content tests;

Two (2) soil samples were submitted to AGAT Laboratories, located in Mississauga, Ontario, for analysis of pH, soil resistivity, and concentrations of soluble sulphate and chloride. These analyses were carried out to assess the degradation potential of buried concrete in the presence of soluble sulphate (i.e. to determine the type of cement required) and to confirm the general corrosive characteristics of the predominant native soil type encountered in the boreholes.

The results of the geotechnical laboratory tests are discussed in the following report sections and are included in Appendix D. The results of the pH, soil resistivity, and concentrations of sulphate and chloride tests are included in Appendix E.

Soil samples will be stored for three (3) months after the issuance of the final report unless directed by the client.

5.0 SUBSURFACE CONDITIONS

5.1 SOIL CONDITIONS

Soil classification was based on the procedures described in ASTM D2487 (Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)) and ASTM D2488 (Standard Practice for Description and Identification of Soils, Visual-Manual Procedure).

The soil strata encountered at the site during the subsurface investigation program are described in detail on the attached Borehole Records and summarized in Table 5.1. The attached Symbols and Terms used on Borehole Records provide a brief explanation of the terminology and graphics used by Stantec.

Table 5.1: Borehole Summary

Test Location ID	Ground Elevation (m)	Total Depth (m)	Subsurface Stratigraphy Depths [m]				Depth to Groundwater Table (m)
			Topsoil (m)	FILL (m)	SAND (m)	CLAY (m)	
BH1/MW1	280.00	5.2	0.2	n/e	0.2 - ≥5.2	n/e	n/e
BH2	281.00	5.2	0.2	n/e	0.2 - ≥5.2	n/e	n/e
BH3/MW3	290.50	9.8	0.2	0.2 – 0.8	0.8 - ≥9.8	n/e	n/e
BH4/MW4	290.50	9.8	0.2	0.2 – 1.5	1.5 - ≥9.8	n/e	n/e
BH5	292.00	12.8	0.2	0.2 – 2.3	2.3 - ≥12.8	n/e	n/e
BH6	295.80	12.8	0.3	0.3 – 2.3	2.3 - ≥12.8	n/e	n/e
BH7/MW7	298.90	17.4	0.2	0.2 – 2.3	2.3 - ≥17.4	n/e	n/e
BH8/MW8	294.50	12.8	n/e	0.0 – 1.5	1.5 - ≥12.8	n/e	n/e
BH9	298.00	17.4	0.1	0.1 – 2.3	2.3 – 5.5 7.6 – ≥17.4	5.5 – 7.6	n/e

Notes:
n/e – not encountered

Subsurface soil conditions encountered generally include:

- TOPSOIL underlain by,
- FILL underlain by,
- SAND underlain by,
- Silty CLAY

5.2 TOPSOIL

Topsoil was observed at the surface of each test location, except for BH8/MW8. The total thickness was observed to range between 0.2 and 0.3 meters.

5.3 FILL

FILL layers were observed below the topsoil at BH3 to BH7 and BH9. The fill was observed to range between 0.7 m and 2.1 m in thickness and was visually classified as a brown silty sand with trace gravel. N values from SPT performed within the fill ranged from 1 to 27, with an average SPT of 9, indicating a predominantly loose compactness condition ranging from very loose to compact.

Table 5.2: FILL – Laboratory Testing Summary

Borehole ID, Sample ID	Sample Depth (m)	Moisture Content (%)
BH4/SS1	0.3	12.7
BH4/SS1	0.5	4.0
BH7/SS1	0.3	12.6
BH7/SS1	0.5	9.1
BH7/SS2	1.1	8.5
BH7/SS3	1.7	13.6
BH7/SS3	2.0	31.6
BH8/SS1	0.3	9.6
BH8/SS2	0.9	7.3
BH8/SS2	1.2	21.1

5.4 SAND

A layer of brown to light brown sand classified as sand with silt (SP-SM) to silty sand (SM) to sand with gravel (SP) was observed at all borehole locations. The gravel content was variable within the deposit and occasional layers of fine-grained silty sand were observed at BH3 and BH5. Stratified layers and seams of silt and clay were encountered within the sand deposit.

The boreholes were terminated within the sand layer, indicating a thickness greater than 3.0 to 15.0 meters at these test locations. N values from SPT performed within the sand deposit ranged from 6 to refusal, with an average SPT of 61, indicating a predominantly very dense compactness condition ranging from loose to very dense.

Representative samples were submitted for moisture and gradation testing; the results are presented in Table 5.3 and presented in Appendix D. The moisture contents are also presented on the Borehole Records located in Appendix C.

Table 5.3: SAND – Laboratory Testing Summary

Borehole ID, Sample ID	Depth (m)	Moisture Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH1/SS1b	0.5	18.1	-	-	-	-
BH1/SS2	1.1	12.0	-	-	-	-
BH1/SS3	1.8	3.0	4.0	86.0	4.0	6.0
BH1/SS4a	2.4	13.0	-	-	-	-
BH1/SS4b	2.7	4.0	-	-	-	-
BH1/SS5	3.4	5.8	-	-	-	-
BH1/SS6	4.1	4.9	-	-	-	-
BH1/SS7	4.9	4.7	-	-	-	-
BH2/SS5	3.4	4.4	4.0	86.0	5.0	5.0
BH4/SS2	1.1	3.2	-	-	-	-
BH4/SS3	1.8	2.8	-	-	-	-
BH4/SS4	2.6	2.2	-	-	-	-
BH4/SS5	3.4	3.0	-	-	-	-
BH4/SS6	4.1	4.5	-	-	-	-
BH4/SS7	4.9	4.9	-	-	-	-
BH4/SS8	5.6	3.8	-	-	-	-
BH4/SS9	6.4	6.4	4.0	81.0	9.0	6.0
BH4/SS10	7.9	5.7	-	-	-	-
BH4/SS11	9.4	6.5	-	-	-	-
BH6/SS5	3.4	3.1	19.0	74.0	3.0	4.0
BH7/SS4a	2.4	22.4	-	-	-	-
BH7/SS4b	2.7	23.5	-	-	-	-
BH7/SS5	3.4	15.1	-	-	-	-
BH7/SS6a	4	18.3	-	-	-	-
BH7/SS6b	4.3	2.6	-	-	-	-
BH7/SS7	4.9	2.6	19.0	73.0	3.0	5.0
BH7/SS8	5.6	2.0	-	-	-	-
BH7/SS9	6.4	2.3	-	-	-	-
BH7/SS10	7.9	2.2	-	-	-	-
BH7/SS11	9.4	1.9	-	-	-	-
BH7/SS12	11	1.0	-	-	-	-
BH7/SS13	12.5	1.5	-	-	-	-

Borehole ID, Sample ID	Depth (m)	Moisture Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH7/SS14	14	2.2	-	-	-	-
BH7/SS15	15.5	3.8	-	-	-	-
BH7/SS16	17.1	2.3	-	-	-	-
BH8/SS3a	1.7	14.8	-	-	-	-
BH8/SS3b	2	7.4	-	-	-	-
BH8/SS4	2.6	3.2	7.0	82.0	5.0	6.0
BH8/SS5	3.4	3.2	-	-	-	-
BH8/SS6	4.1	3.2	-	-	-	-
BH8/SS7	4.9	5.6	-	-	-	-
BH8/SS8	5.6	3.9	-	-	-	-
BH8/SS9	6.4	1.5	-	-	-	-
BH8/SS10	7.9	2.2	-	-	-	-
BH8/SS11	9.4	2.2	7.0	82.0	6.0	5.0
BH8/SS12	11	3.7	-	-	-	-
BH8/SS13	12.5	3.3	-	-	-	-
BH9/SS9	6.4	20.0	0.0	5.0	47.0	48.0

5.1 SILTY CLAY

A layer of light brown silty clay (ML-CL) underlain by sand with silt was encountered at BH9.

This layer was 2.3 meters thick at this test location. N values from SPT performed within the silty clay ranged from 44 to 59, with an average SPT of 51, indicating a predominantly hard consistency.

Representative samples were submitted for moisture and gradation testing; the results are presented in Table 5.4 and presented in Appendix D. The moisture contents are also presented on the Borehole Records located in Appendix C.

Table 5.4: CLAY – Laboratory Testing Summary

Borehole ID, Sample ID	Moisture Content (%)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH9/SS9	20.0	0.0	5.0	47	48

5.2 CORROSIVITY POTENTIAL

5.2.1 Soil Corrosivity Potential

Two (2) soils samples were submitted to AGAT Laboratories in Mississauga, Ontario, for analysis of pH, water-soluble sulphate and chloride concentrations, and resistivity. The analysis results are summarized in the table below.

Table 5.5: Results of Chemical Analysis

Borehole No.	Sample No.	Sample Median Depth (m)	pH	Chloride (µg/g)	Sulphate (µg/g)	Resistivity (Ohm-m)	Corrosivity
BH2	SS3	1.8	8.83	5	3	133	Slightly corrosive
BH7	SS2	1.1	8.10	11	<2	93.5	Moderately corrosive

The results of the tests are also shown in Appendix E.

The pH, resistivity and chloride concentration provide an indication of the degree of corrosiveness of the subsurface environment.

The neutral pH value is 7.0 and the normal range of soils is from 4.0 to 8.5. The pH value measured on the soil samples are within the normal range for BH7 and slightly above the normal range for BH2.

The chloride concentration threshold value of 500 µg/g is typically used to designate soil or water as being corrosive. The chloride concentration for samples is between 5 and 11 µg/g, indicating low corrosivity.

A scale of soil corrosiveness based on resistivity is as follows (British Standard BS-1377):

- resistivity > 100 Ω-m: slightly corrosive
- 50 < resistivity < 100 Ω-m: moderately corrosive
- 10 < resistivity < 50 Ω-m: corrosive
- resistivity < 10 Ω-m: severe

The degree of soil corrosiveness based on resistivity should be considered slightly to moderately corrosive.

The pH, chloride and resistivity values presented in the table above may be used by structural designers in assessing the potential for chemical attack on buried steel and as an aid in selecting coating and corrosion protection systems for buried steel objects.

5.2.2 Cement Type for Use in Buried Concrete

The concentration of soluble sulphate provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater. Soluble sulphate concentrations less than 1000 µg/g (0.1%) generally indicates that a low degree of sulphate attack is expected for concrete in contact with soil and groundwater.

The results of the tests for soluble sulphate in samples referenced in the preceding section yielded concentrations between <2 and 3 µg/g.

For concentrations less than 1000 µg/g, there is a low degree of potential sulphate attack for concrete in contact with the soil. Type GU Portland Cement can therefore be considered suitable for use in buried concrete.

Based on the results provided in Table 5, sulphate resistant cements would not be required for the foundations of the buildings in accordance with CSA A23.1:19, Table 3.

5.3 GROUNDWATER

Groundwater levels were not encountered during the drilling activities. Personnel from Palmer Environmental Consulting Group Inc. (Palmer) returned to site on May 2 and May 16, 2022, to measure groundwater levels in the monitoring wells and the monitoring wells were dry.

It should be noted that groundwater levels can be expected to fluctuate during periods of heavy precipitation associated with seasonal weather trends, or a particular event, site use, adjacent site use, and construction activity.

6.0 DISCUSSION AND RECOMMENDATIONS

As previously discussed, the subsurface conditions encountered at the site generally include topsoil, underlain by fill, underlain by sand. The groundwater table was not observed.

This section provides engineering input related to the geotechnical design aspects of the proposed development foundation based on our interpretation of the available subsurface information described herein and our understanding of the project requirements.

The discussion and recommendations presented in the following sections of this letter report are intended to provide the designers with information for planning and design purposes only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the factual information for construction, and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, safety, and equipment capabilities.

6.1 SITE GRADING

A Preliminary Grading Plan, Project 02138.44; Drawing SG dated April 29, 2022 prepared by Sabourin Kimble and Associates Ltd, provided to Stantec for the use in the preparation of this report. The grading plan indicates Finished Floor Elevations (FFE) ranging from 283.75 at Building 4 situated close to Bayview Drive to 289.6 at Building 1 situated at the west end of the site.

A Storm Water Management Pond (SWMP) is located at the north east corner of the site. The existing ground surface elevations in the area of the pond range from 280.0 to 282.0 m with a bottom of pond elevation of 277.5 m.

The existing site grades range from 282.1 at the east limit of the site to 299.0 m at the west limit of the site. Several large stockpiles of soil are located within the envelopes of buildings 3 and 4.

Based on our review of the grading plan all of the existing soil stockpiles will have to be removed from the site. The area of the SWMP will require an overall cut in the order of 3.0 m to 5.0 m with minor grading required for the construction of the berms. A minor cut and fill operation will be required at the location of building 4, where significant cuts will be required for the remainder of the site. The overall cut will be in the order of 2.0 m to 11.0 m across the extent of the site.

6.2 SITE PREPARATION

Existing topsoil and fill are not suitable for the support of foundations and should be removed in their entirety within the structural areas of the site such as buildings, retaining walls and pavement structures. stress zone of influence. All existing fill soils should be removed from structural areas and replaced with structural fill where grades need to be raised to support the site infrastructure. Following excavation of the topsoil and fill materials, the exposed subgrade should be compacted and proof rolled prior to the placement of structural fill. Soft or loose zones identified should be excavated and replaced with approved structural fill. The exposed subgrade should be maintained in a dry, non-frozen condition.

The native sand observed at the site is susceptible to loosening in the presence of moisture and construction traffic. We recommend excavation activities be completed in dry conditions immediately prior to structural fill placement. The excavated subgrade surfaces should be sloped to prevent ponding of water on the approved subgrade surfaced. Surface runoff should be directed away from open excavations and exposed subgrades. Minimizing exposed subgrades in lieu of mass excavation will limit subgrade disturbance from precipitation.

6.3 ENGINEERED FILL

The native sand to sand with silt soils will be suitable for use as engineered fill. The engineered fill should be placed and compacted within 2% of the soils optimum moisture content in lifts in the order of 150 mm to 200 mm in thickness compacted with large vibratory rollers to 98% of the materials maximum Standard Proctor dry density (MSPDD). All placement of engineered fill must be monitored by qualified geotechnical personnel.

Soils more than 2% below their optimum moisture content will require the addition of water during placement and compaction. Soils wetter than 2% above the optimum moisture content will require drying or mixing with dryer soils during placement.

6.4 REUSE OF EXISTING SOIL

The topsoil and any existing fill materials that contain rootlets/organics should only be used for landscaping applications.

The existing fill materials that do not contain any deleterious materials or rootlets/organics, and the native sand soils, may be reused as engineered fill. Based on the conditions encountered in the boreholes and the results of laboratory testing, it is anticipated that reuse of these materials should be practical for general engineered fill to develop design grades and elevations, for use in backfilling service trenches or any localized sub-excavations as described herein.

Portions of the fill materials consisted of silty sand and silty clay be considered to have a moderate to high frost susceptibility and should therefore not be used as perimeter foundations backfill, as granular base and sub-base materials, or for similar applications where development of frost could jeopardize the serviceability of the planned infrastructure.

Based on the results of the Grain Size Tests, the bulk of the native sand soil should be considered to have a low frost susceptibility. Portions of the native sand consisted of high percentage of silt and clay size particles, hence, can be considered to have a moderate frost susceptibility and similar constraint should considered as stated above.

6.5 SHALLOW FOUNDATIONS

Existing fill is not suitable for the support of foundations and loads would need to be supported on undisturbed sand or structural fill placed above the undisturbed sand. In accordance with the Ontario Building Code (OBC) requirements for limit states design, footings larger than 450 millimeters and less than 3.0 meters in width may be designed with a factored geotechnical resistance provided in Table 6.1 Below:

Table 6.1: Factored Geotechnical Resistance

Building Location	Design Finished Floor Elevation	Factored ULS Bearing Reaction (kPa)	SLS Bearing Reaction (kPa)
Building 1	289.6	550	250
Building 2	287.0	580	290
Building 3	286.4	550	250
Building 4	283.8	500	180

Footings are assumed to be vertically loaded without eccentricity and constructed on flat ground away from crest of slopes.

Footings should have a minimum of 1.4 m of soil cover for frost protection.

Any soil that becomes disturbed as a result of construction activity and/or water should be removed from the bearing surface prior to concrete or fill placement. Footing bearing surfaces should be reviewed by experienced geotechnical personnel prior to concrete placement to confirm the design bearing pressure.

6.6 BUILDING FLOOR SLAB

Subject to the conditions across the building envelope, the sub-grade is likely to consist of either the engineered fill or dense sand. These materials will provide adequate support for a conventional slab-on-grade unreinforced floor slab (e.g. beyond any reinforcing required for control of shrinkage).

The exposed surface of the native overburden or engineered fill should be proof rolled and compacted to achieve 100% of the material's Standard Proctor Maximum Dry Density.

Based on the preliminary groundwater monitoring data indicating that groundwater is located below the maximum investigated depths of the investigation and underfloor drainage system will not be required provided the slab on grade is constructed a minimum of 150 mm above the exterior grades. For slabs below grade an underfloor drainage system will be required.

The moisture break consisting of 300 mm of OPSS Granular A should be placed beneath the floor slab. The material should be compacted to a minimum of 100% of the materials SPMDD.

Provided the conditions and recommendations referenced above prevail, a modulus of sub-grade reaction, k_s, of 30 MPa/m can be used for the design of the floor slab. This value is for a loaded area of 0.3 m x 0.3 m.

The floor slabs should not be tied to any load-bearing walls or columns.

6.7 RETAINING WALL

We understand retaining wall structures are required for this site. The following section provides recommendations for the design of retaining structures.

Retaining wall structures should be designed to resist the combined lateral forces resulting from soil pressures, surcharges, and additional pressures under earthquake events. Surcharge loads should be considered where they are located within 1.5 times the height of the wall.

Retaining wall structures should be designed with a factored geotechnical resistance of 225 kPa at ULS and 150 kPa at SLS.

To reduce hydrostatic pressure build up, backfill against retaining wall structures should consist of a clean, free-draining granular material such as OPSS Granular B or equivalent. The free-draining granular materials should be at least 0.5 meters wide and sloped at 1 horizontal / 1 vertical from 0.5 m behind the base of the wall to the ground surface and be connected to a drainage system at the base of the wall leading to a positive form of dewatering.

The base of the retaining wall should be supported as per the wall manufacturer's recommendations or on a minimum of 300-millimeters of compacted OPSS Granular A or equivalent to provide a stable base and level working surface.

Retaining wall geotechnical design parameters are provided in Table 6.2.

Table 6.2: Geotechnical Design Parameters

Parameter	Value		
	Undisturbed Native Soil	**Reworked Native Soil**	**Imported Granular Material OPSS Granular B Type 1**
Effective angle of Internal friction (degrees)	30	28	32
Cohesion (kPa)	-	-	-
Total unit weight (kN/m^3)	21	20	22
Submerged unit weight (kN/m^3)	9.8	10.0	12.0
Coefficient of Active Earth Pressure (horizontal ground)	0.33	0.36	0.31
Coefficient of Passive Earth Pressure (horizontal ground)	3.00	2.77	3.25
Coefficient of Earth Pressure at Rest (horizontal ground)	0.50	0.53	0.47
Base friction factor, soil/concrete (cast in place)	0.35	0.35	0.45

6.8 PAVEMENT RECOMMENDATIONS

Following excavation to the design subgrade elevation, we recommend the undisturbed sand or structural fill subgrades be proof rolled with a fully loaded tandem truck under the observation of experience geotechnical personnel. Where deflections are observed, the subgrade should be remediated by excavation and replacement with structural fill meeting the requirements of Section 5.2.

The table below provides recommended thickness of the pavement structure for design of the asphalt paved areas. Details of traffic conditions were not provided to use at the time of preparation of this report, therefore the following pavement structure has been provided for heavy duty truck traffic and light duty parking conditions.

Table 6.3: Pavement Section Recommendations

Material Type	Light Duty Pavement Structure Thickness (mm)	Heavy Duty Pavement Structure Thickness
HL-3/SP 12.5	50	50
HL-8/SP 19	50	80
Granular A	150	150
Granular B Type II	300	500

6.9 SEISMIC SITE CLASSIFICATION

The subsurface conditions encountered were reviewed in accordance with the NBCC requirements. The site classification for seismic site response is Site Class C in accordance with Table 4.1.8.4-A of the 2015 NBCC.

For design purposes the 2015 National Building Code Seismic Hazard Calculation Sheet has been provided in Appendix F.

6.10 STORM WATER MANAGEMENT POND

The preliminary Grading Plan Drawing SG prepared by Sabourin Kimble and Associates indicates that the Storm Water Management Pond (SWMP) will be located in the north east cormer of the site and the existing ground surface elevation in the area of the pond ranges from 280.0 to 281.8 m. The drawing also indicates that the bottom of pond elevation will be 277.5 m with a permanent pool elevation of 279.5 m and a top of berm elevation of 281.75 m.

Upon review of boreholes BH 1 and BH 2 which were advanced within the SWMP footprint, the existing ground surface elevation in the area of the proposed Storm Water Management Pond (SWMP) ranges from 280.0 m to 281.0 m. The soil conditions encountered in the boreholes indicated a layer of sandy topsoil 10 to 20 cm in thickness overlying a stratum of loose to very dense sand with silt deposit which extended to the maximum investigated depths of 274.8 and 275.8 m respectively. The boreholes remained dry on completion and were also dry on April 22, May 2 and May 16, 2022.

Based on the elevations presented in the preliminary grading plans the majority of the SWMP will be in a cut condition with grades being lowered between 2.8 m and 2.9 m respectively. The exposed subgrade will consist of dense to very dense sand with site soils. The sand with silt soils are considered to be moderately permeable and will not maintain a permanent pool within the extend of the pond. In this regard the use of an impermeable liner will likely be required. It is recommended that the liner be designed and constructed as follows:

- The pond bottom and side slopes (to 1.0 m above the permanent pool elevation) should be excavated to a depth of 1.0 m and replaced with soils exhibiting a hydraulic conductivity of 10^{-6} cm/sec or less compacted to 95% of the materials MSPDD.
- The pond bottom can be lined with a commercial synthetic liner such as Bentofix Clay Liner or Geosynthetic Liner systems.

All topsoil should be stripped from the pond limits prior to grading. Fill used to construct the berms above the existing grades can consist of selected on site soils as described in section 6.4 and should be compacted to a minimum of 98% of the soils MSPDD.

Side slopes of the SWMP should be sloped at 5 horizontal:1 vertical below the permanent pool elevation and at 3 horizintal:1 vertical above the permanent pool elevation. Slopes less than 5 horizontal : 1

vertical may be possible were geosynthetic liners are used but will be based on the manufacturers specification of the various products.

All slopes must be vegetated and provided with erosion protection upon completion.

7.0 GENERAL CONSTRUCTION CONSIDERATIONS

7.1 TEMPORARY EXCAVATIONS

Side slopes for temporary excavations in the fill materials and native soils should conform to the Occupational Health & Safety Act & Regulations (OH&S Act).

With respect to open-cut excavations, the soils encountered in the boreholes have been classified as follows with respect to the soil types described in the OH&S Act.

All fill materials and loose to compact native soils encountered in the boreholes above the groundwater level should be considered as Type 3 soils. The maximum excavation side slope for a Type 3 soil is 1:1 (Horizontal: Vertical) in accordance with the OHSA Regulation.

The native very dense sand and silt, silty sand and hard clay soils encountered in the boreholes can be classified as Type 2 soils. The maximum excavation side slope for a Type 2 soil is 1:1 (Horizontal: Vertical) in accordance with the OHSA Regulation.

Where any of the fill materials and/or native soils are excavated below the groundwater table and in loose/soft conditions, these must be considered Type 4 soils. The OH&S Act requires that excavations in Type 4 soils be excavated to a maximum of 3:1 (Horizontal: Vertical) slope where workers enter the trench. Further comment with respect to the presence of groundwater is provided in a subsequent section below.

Where Type 2, Type 3 and Type 4 soils are encountered, the maximum excavation side slope should be consistent with that of a Type 4 soil, in accordance with the OH&S Act.

The side slopes of the excavations in soils should be protected from exposure to precipitation and associated ground surface runoff, to prevent further softening and loss of strength of these fill materials and soils that could lead to additional sloughing and caving.

If space is restricted such that the side slope cannot be safely cut back in accordance with the OHSA & Regulations, if sloughing and cave-in are encountered in the excavations, or if the excavations are to remain open for a longer period, a trench box system can be used for shallow localized excavations (such as for service trenches), or a shoring system can be used for large or deeper excavations (building excavations), to maintain safe working conditions.

If localized instability is noted at the time of excavation or while an excavation remains open, or if wet conditions are encountered, the side slopes of the excavations should be flattened as required to maintain safe working conditions.

Stockpiling of any materials adjacent to excavations should be avoided. Similarly, traffic should not be permitted in proximity to open excavations. For this purpose, it is recommended that all storage of materials and traffic be restricted from a 3 m wide strip around the excavations, measured from the crest of the excavation designed and constructed in accordance with the OHSA.

7.2 EARTHWORKS IN WET AND COLD ENVIRONMENTS

The native soils are susceptible to softening in the presence of water and construction traffic. We recommend limiting construction traffic on the subgrade surfaces to the extent possible. The contractor should also take precautions to protect the placed and stockpiled soils when the weather forecast calls for precipitation. Subgrades becoming disturbed/softened during construction should be replaced with approved fill. For winter construction, the potential exists for the onset of frost if exposed subgrade soils are not insulated during cold weather construction. Frost can occur in fine-grained soils and produce displacement due to the expansion of water during the freezing process and during seasonal thaw. In addition, the compaction effort applied to frozen soil cannot be accurately verified with a nuclear density gauge. Proof rolling inspection of frozen soil may suggest subgrades are temporarily stable but still soften during seasonal thaw.

During cold-weather construction, fill imported to the site should be newly quarried, and placed and compacted immediately following delivery to the site. Compaction testing and proof rolling activities should be completed immediately following the initial compactive effort. Failing areas should be remediated before the onsite of frost.

Fill should not be placed on frozen, snow or ice-covered subgrades. In excavations, subgrade surfaces should be covered with insulating blankets of heated tarps if the forecast calls for below freezing conditions.

7.3 CONSTRUCTION DEWATERING

As previously mentioned, groundwater was not observed therefore construction dewatering is not anticipated. A hydrogeological assessment and design report is being completed by Parker Engineering Consultants and is being provided under separate cover.

8.0 CLOSING COMMENTS

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of NADG., identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec 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
- Planning, design, or construction

Should you have any questions or if we can be of further service, please contact us at your convenience.

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.

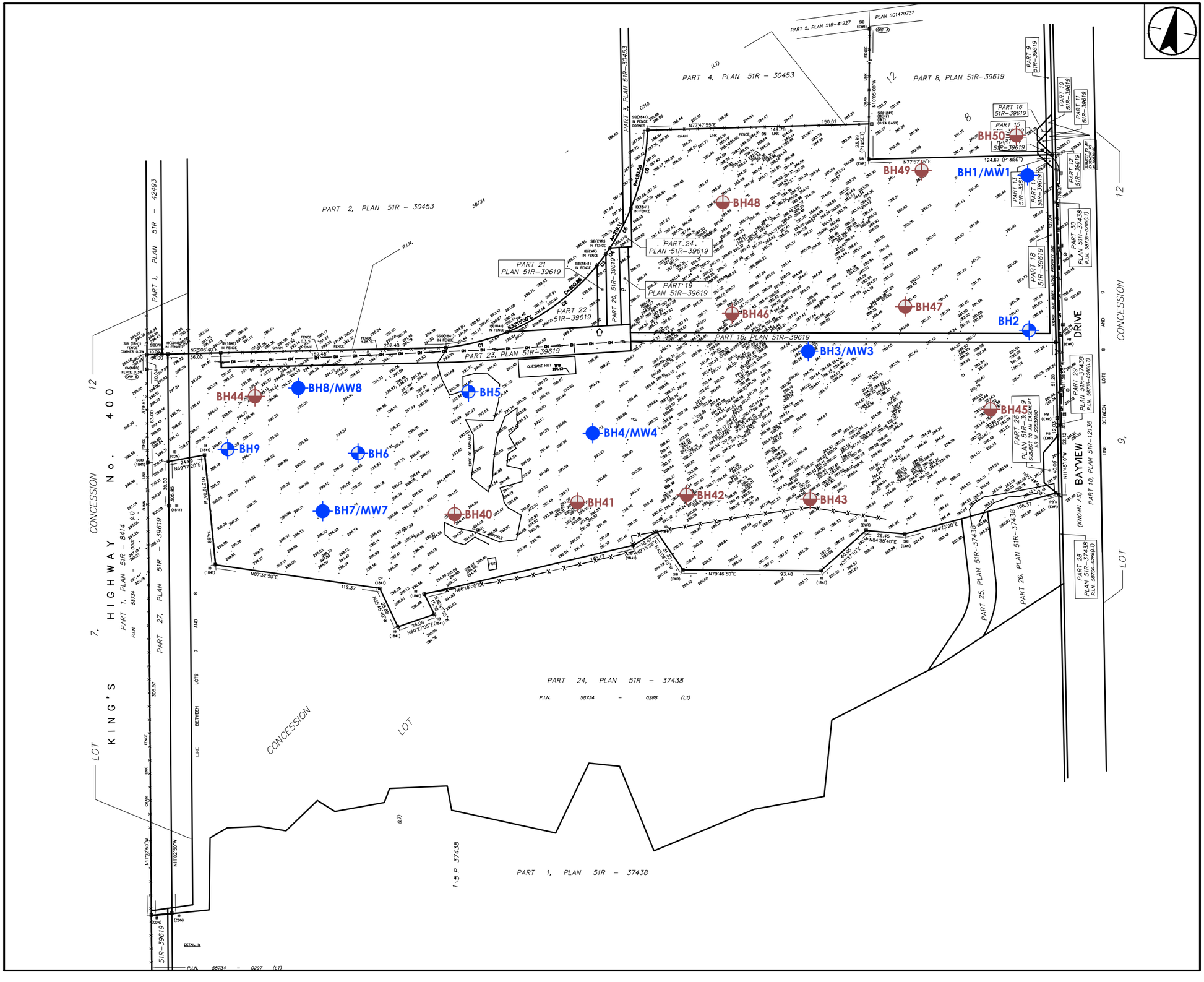
INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications 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 DRAWING



C:\CAD Drawings\Acad2019 Drawings\2022\121624148\121624148_Park Place.dwg
2022/05/10 9:22 AM By: Briones, Gliceria

Stantec

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LEGEND

- BOREHOLE (STANTEC)
- BOREHOLE WITH MONITORING WELL (STANTEC)
- BOREHOLE (TERRAPROBE)

NOTES

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. BASEPLAN FROM PDF COPY OF A SURVEY PLAN PROVIDED BY RUDY MARK SURVEYING LTD., FILE No. 14874, DATED FEB. 8, 2021.

25m 0 25 50m
1 : 2500

MAY 2022
Project No. 121624148

Client/Project
NORTH AMERICAL DEVELOPMENT GROUP
PARK PLACE INDUSTRIAL DEVELOPMENT
BARRIE, ONTARIO

Drawing No.
1

Title
BOREHOLE LOCATION PLAN

APPENDIX C

C.1 SYMBOLS AND TERMS USED ON BOREHOLE LOGS

C.2 BOREHOLE LOGS

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

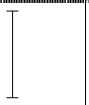
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals 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

BH1/MW1

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

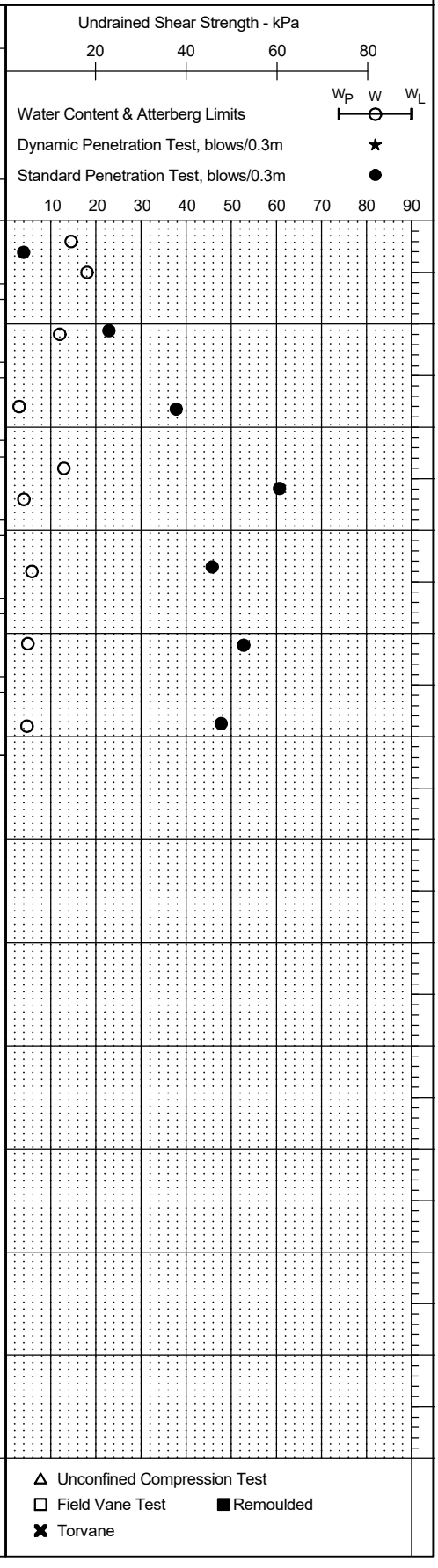
BOREHOLE No. BH1/MW1

DATES: BORING 2022/04/18

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	280.00						mm	
0	279.9	TOPSOIL			SS	1	584	4
1		Loose to dense brown SAND with SILT (SP-SM) - trace gravel, moist, poorly graded			SS	2	610	23
2	278.2	Dense to very dense, light brown to brown SAND with SILT (SP-SM) - trace gravel, moist, poorly graded			SS	3	559	38
3					SS	4	533	61
4					SS	5	457	46
5	274.8				SS	6	432	53
6		End of Borehole at 5.18 m - Monitoring well MW1 installed with screen interval between 2.1 and 5.2 mbgs - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected			SS	7	584	48
7								
8								
9								
10								
11								
12								



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BOREHOLE RECORD

BH2

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

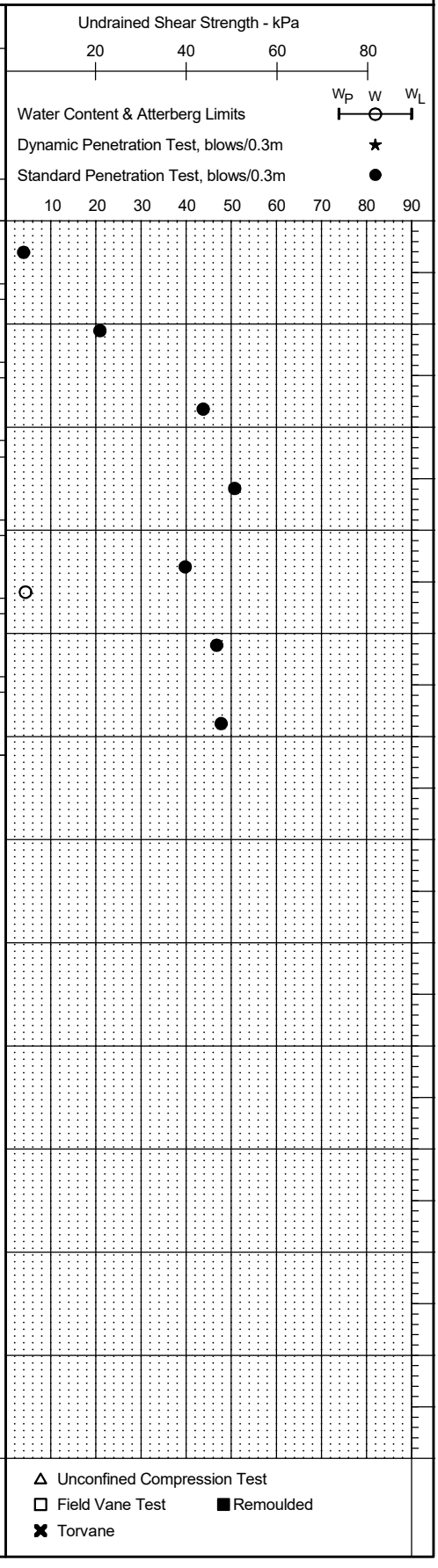
BOREHOLE No. BH2

DATES: BORING 2022/04/18

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	281.00						mm	
0	280.8	TOPSOIL			SS	1	508	4
		Loose to very dense brown SAND with SILT (SP-SM) - trace gravel, moist, poorly graded			SS	2	610	21
1					SS	3	483	44
2					SS	4	457	51
3					SS	5	457	40
4					SS	6	508	47
5	275.8				SS	7	559	48
		End of Borehole at 5.18 m - Dry upon completion, no groundwater was observed during drilling						
6								
7								
8								
9								
10								
11								
12								



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BOREHOLE RECORD

BH3/MW3

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

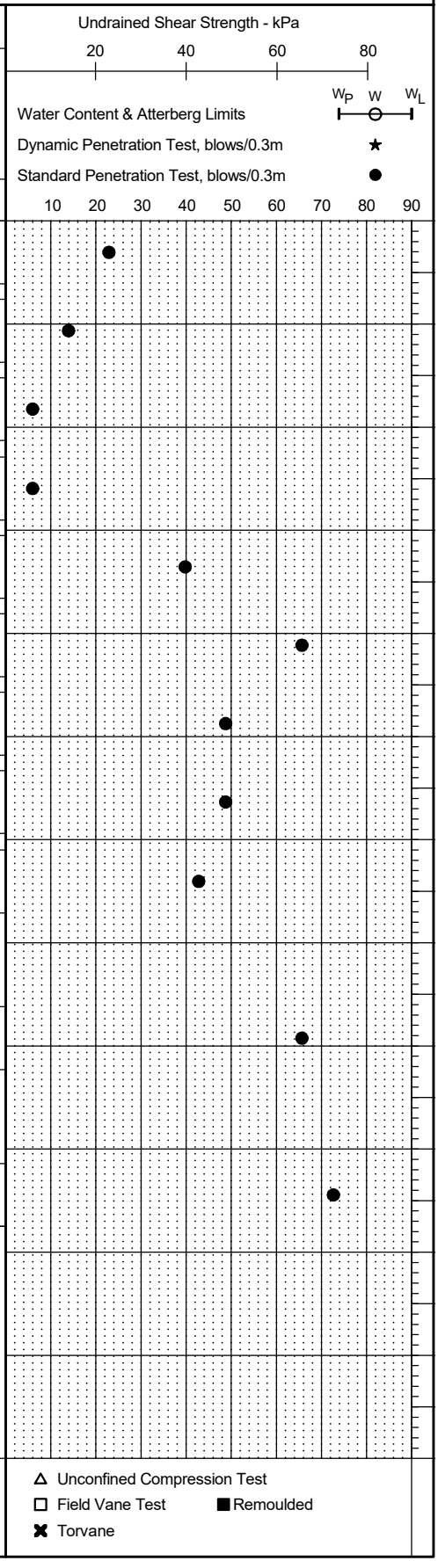
BOREHOLE No. BH3/MW3

DATES: BORING 2022/04/18

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	290.50						mm	
0	290.4	TOPSOIL			SS	1	457	23
	289.7	Compact brown silty sand FILL - trace gravel, moist						
1		Loose to very dense light brown SAND with SILT (SP-SM) - trace gravel, moist, poorly graded			SS	2	457	14
2					SS	3	381	6
					SS	4	483	6
3					SS	5	584	40
4					SS	6		66
5					SS	7	610	49
		- At 5.3 m: moisture content observed to change from mosit to dry			SS	8	610	49
6					SS	9	610	43
7								
8					SS	10	610	66
9		- At 9.1 m: occasional layers of fine grained silty sand			SS	11	610	73
	280.8							
10		End of Borehole at 9.75 m - Monitoring well MW3 installed with screen interval between 6.1 and 9.1 mbgs - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected						
11								
12								



Stantec

BOREHOLE RECORD

BH4/MW4

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

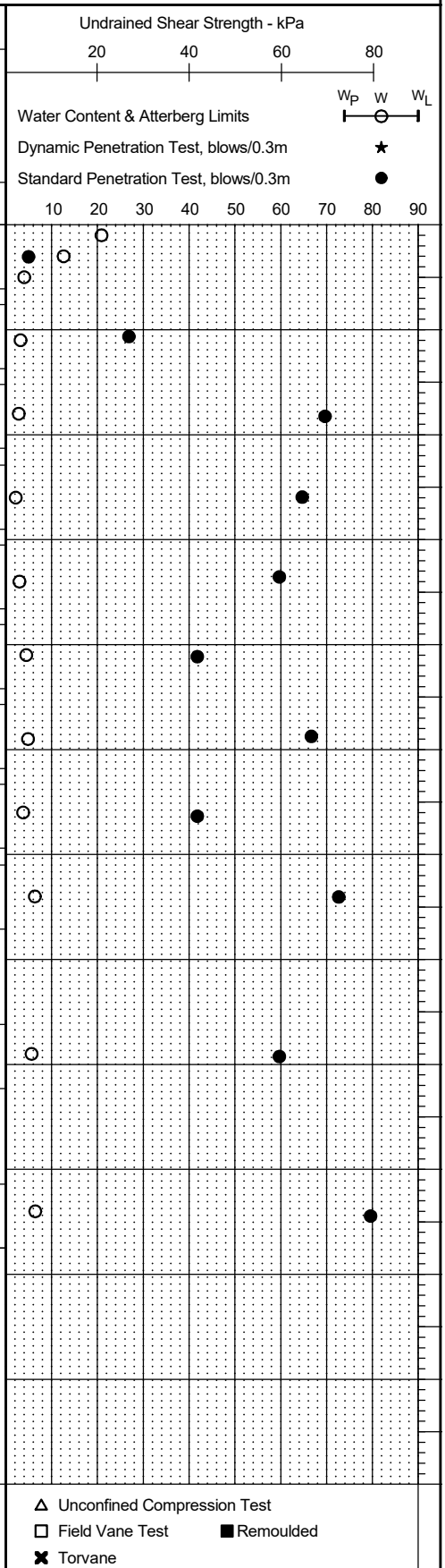
BOREHOLE No. BH4/MW4

DATES: BORING 2022/04/18

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	290.50						mm	
0	290.3	TOPSOIL			SS	1	508	5
		Loose to compact brown silty sand FILL - trace gravel, dry						
1					SS	2	610	27
	289.0							
		Dense to very dense light brown silty SAND (SM) - trace gravel, moist			SS	3	610	70
2								
					SS	4	508	65
3								
					SS	5	533	60
4					SS	6	610	42
5					SS	7	508	67
6					SS	8	483	42
					SS	9	559	73
7								
8					SS	10	610	60
9								
					SS	11	610	80
	280.8							
10		End of Borehole at 9.75 m - Monitoring well MW4 installed with screen interval between 6.1 and 9.1 mbgs - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected						
11								
12								



Stantec

BOREHOLE RECORD

BH5

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

BOREHOLE No. BH5

DATES: BORING 2022/04/19

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	292.00						mm	
0	291.8	TOPSOIL			SS	1	610	12
		Loose to compact brown silty sand FILL - trace gravel, moist						
1					SS	2	406	8
2					SS	3	432	16
	289.7							
		Dense to very dense light brown silty SAND (SM) - trace gravel, moist			SS	4	559	36
3					SS	5	483	48
4					SS	6	483	37
5					SS	7	610	64
					SS	8	483	77
6					SS	9	533	75
7								
		- At 7.6 m: occasional layers of fine grained silty sand			SS	10	559	70
8								
9					SS	11	610	83
10								
11					SS	12	610	160/584
12								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Continued Next Page

Stantec

BOREHOLE RECORD

BH5

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

BOREHOLE No. BH5

DATES: BORING 2022/04/19

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
							mm	
12								
	279.2				SS	13	559	152/584
13		End of Borehole at 12.8 m - Dry upon completion, no groundwater was observed during drilling						
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH6

CLIENT North American Development Corporation

LOCATION **Park Place Industrial Development Project Barrie, ON**

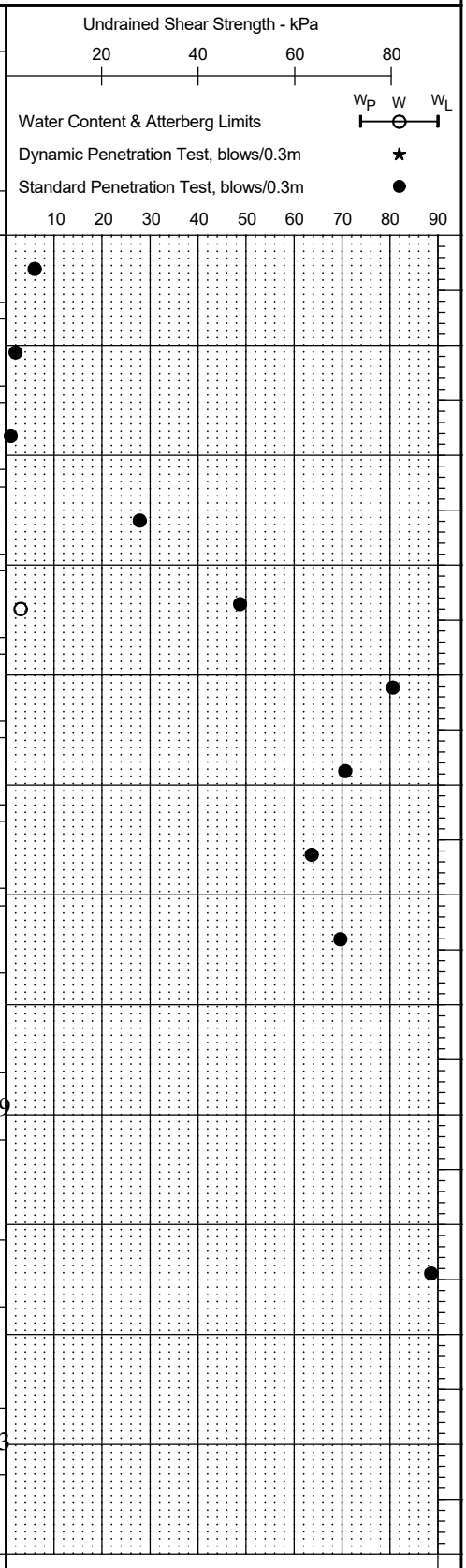
DATES: BORING **2022/04/20** WATER LEVEL **Not Observed**

PROJECT No. **121624148**

BOREHOLE No. **BH6**

DATUM **GEODETIC**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY	N-VALUE OR RQD
	295.80						mm	
0	295.6	TOPSOIL			SS	1	610	6
		Very loose to loose brown silty sand FILL - trace gravel, moist			SS	2	330	2
1					SS	3	483	1
2	293.5							
		Compact to very dense light brown SAND with GRAVEL (SP) - trace gravel, moist, poorly graded			SS	4	356	28
3					SS	5	508	49
4					SS	6	533	81
					SS	7	584	71
5	290.5							
		Very dense light brown silty SAND (SM) - trace gravel, moist			SS	8	533	64
6					SS	9	610	70
7								
					SS	10	432	189/559
8								
9					SS	11	610	89
10								
					SS	12	533	194/533
11								
12								



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BOREHOLE RECORD

BH6

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

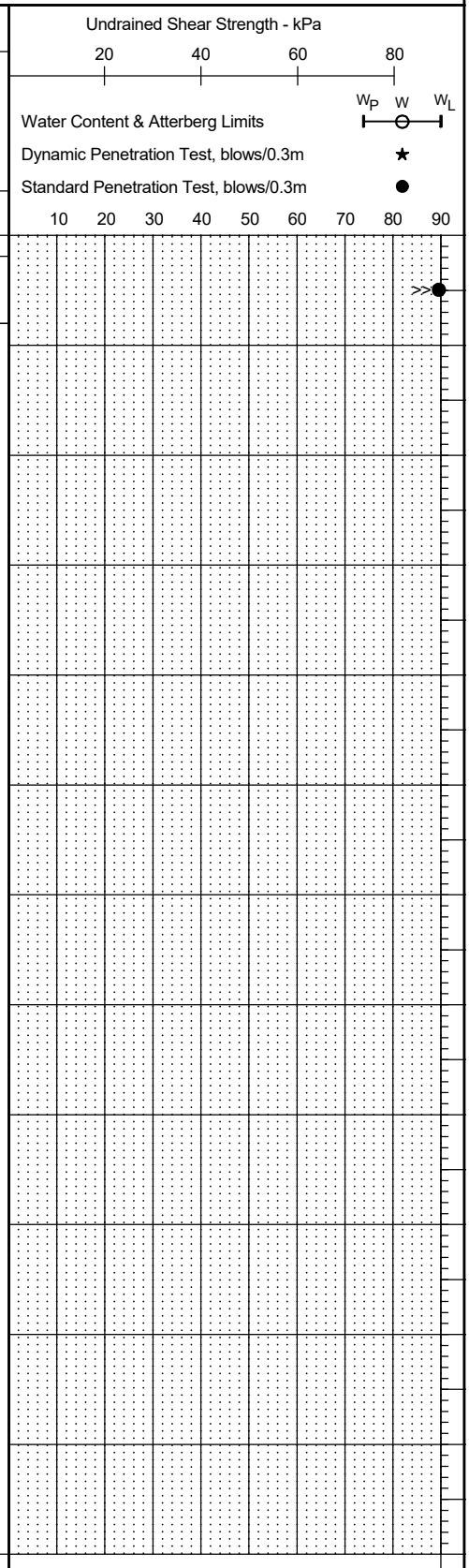
BOREHOLE No. BH6

DATES: BORING 2022/04/20

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
							mm	
12	283.0				SS	13	610	116
13		End of Borehole at 12.8 m - Dry upon completion, no groundwater was observed during drilling						
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								



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BOREHOLE RECORD

BH7/MW7

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

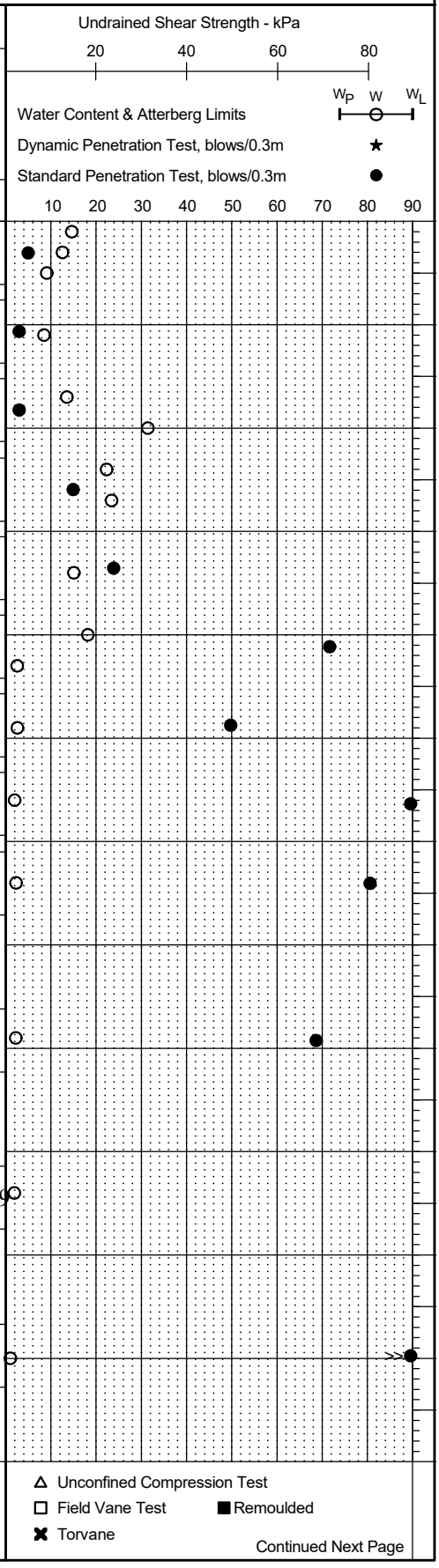
BOREHOLE No. BH7/MW7

DATES: BORING 2022/04/20

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	298.90						mm	
0	298.7	TOPSOIL			SS	1	610	5
1		Very loose to loose brown silty sand FILL - trace gravel, moist			SS	2	610	3
2					SS	3	559	3
	296.6							
3		Compact light brown SAND with SILT (SP-SM) - moist, poorly graded			SS	4	610	15
					SS	5	610	24
	295.1							
4		Dense to very dense light brown SAND with GRAVEL (SP) - moist, poorly graded			SS	6	508	72
5					SS	7	533	50
6					SS	8	406	90
					SS	9	610	81
7								
8					SS	10	610	69
9								
					SS	11	610	184/559
10								
11					SS	12	483	95
12								



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BOREHOLE RECORD

BH7/MW7

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

BOREHOLE No. BH7/MW7

DATES: BORING 2022/04/20

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
							mm	
12					SS	13	508	83
13								
14					SS	14	483	103
15								
16					SS	15	559	181/533
17								
	281.5				SS	16	559	194/559
18		End of Borehole at 17.37 m - Monitoring well MW7 installed with screen interval between 13.7 and 16.8 mbgs - Borehole cave in below 15 m after well installation - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected						
19								
20								
21								
22								
23								
24								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

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BOREHOLE RECORD

BH8/MW8

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

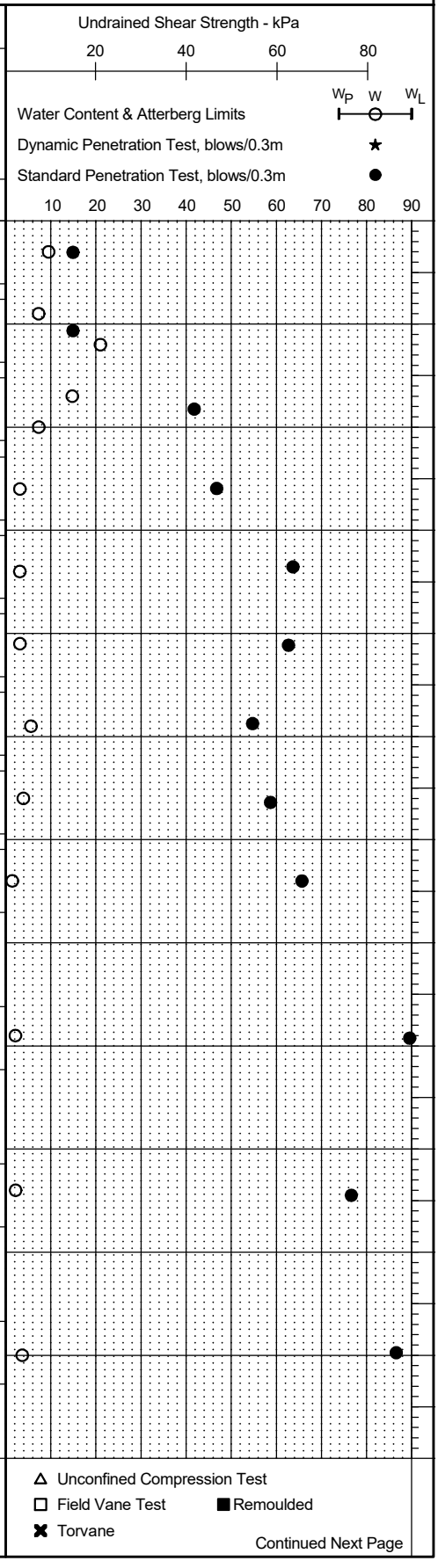
BOREHOLE No. BH8/MW8

DATES: BORING 2022/04/21

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	294.50						mm	
0		Compact brown silty sand FILL - trace gravel, trace clay, moist			SS	1	432	15
1					SS	2	533	15
	293.0	Dense to very dense light brown SAND with SILT (SP-SM) - trace gravel, moist, poorly graded						
2					SS	3	610	42
					SS	4	457	47
3					SS	5	483	64
4					SS	6	483	63
					SS	7	457	55
5					SS	8	508	59
6					SS	9	508	66
7								
					SS	10	610	90
8								
9					SS	11	610	77
10								
					SS	12	610	87
11								
12								



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BOREHOLE RECORD

BH8/MW8

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

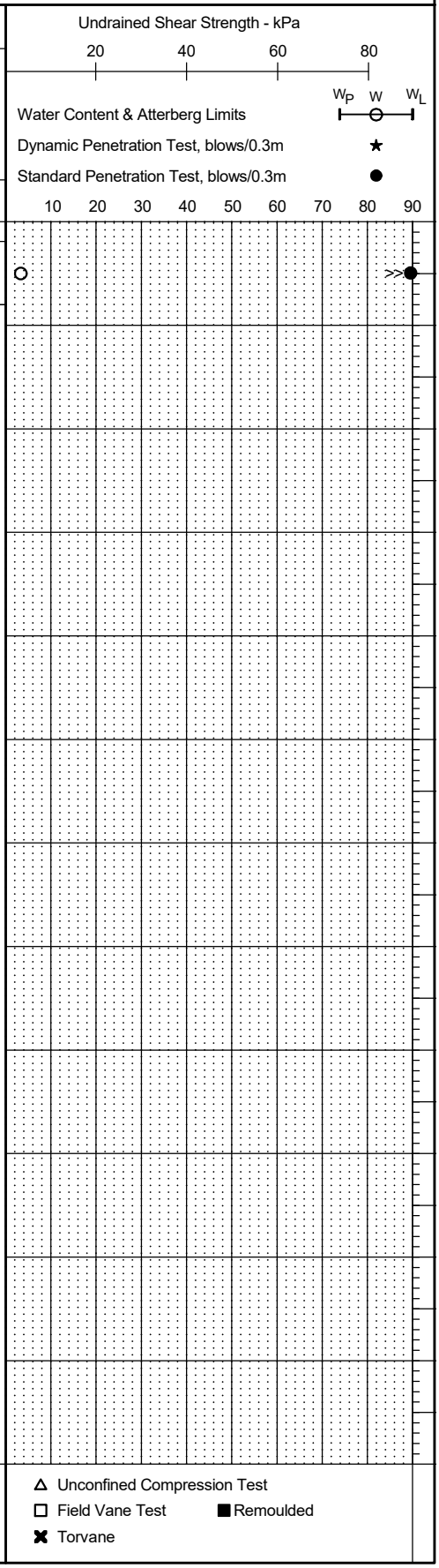
BOREHOLE No. BH8/MW8

DATES: BORING 2022/04/21

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
							mm	
12								
	281.7				SS	13	610	97
13		End of Borehole at 12.8 m - Monitoring well MW8 installed with screen interval between 9.1 and 12.2 mbgs - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected						
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								



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BOREHOLE RECORD

BH9

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

BOREHOLE No. BH9

DATES: BORING 2022/04/19

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	298.00						mm	
0	297.9	TOPSOIL			SS	1	533	10
1		Very loose to loose light brown silty sand FILL - moist			SS	2	610	1
2					SS	3	610	2
	295.7							
3		Compact to dense light brown SAND with SILT (SP-SM) - moist, poorly graded			SS	4	533	23
					SS	5	610	38
4					SS	6	610	44
5					SS	7	559	45
	292.7							
6		Hard light brown silty CLAY (CL-ML)			SS	8	610	59
					SS	9	610	44
7								
	290.4							
8		Dense to very dense light brown SAND with SILT (SP-SM) - moist, trace gravel, poorly graded			SS	10	533	64
9								
					SS	11	610	95
10								
11					SS	12	610	65
12								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Continued Next Page

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BOREHOLE RECORD

BH9

CLIENT North American Development Corporation

PROJECT No. 121624148

LOCATION Park Place Industrial Development Project Barrie, ON

BOREHOLE No. BH9

DATES: BORING 2022/04/19

WATER LEVEL Not Observed

DATUM GEODETIC

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
							mm	
12					SS	13	610	80
13								
14					SS	14	432	131/432
15								
15					SS	15	559	166/559
16								
17					SS	16	584	167/584
	280.6	End of Borehole at 17.37 m - Dry upon completion, no groundwater was observed during drilling						
18								
19								
20								
21								
22								
23								
24								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

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MONITORING WELL RECORD

MW1

CLIENT **North American Development Group**

PROJECT No. **121624148**

LOCATION **Park Place Industrial Development Project Barrie, ON**

BOREHOLE No. **MW1**

DATES: BORING **2022-04-18** WATER LEVEL **Not Observed**

DATUM **GEODETIC**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	WELL CONSTRUCTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD	VOC CONCENTRATION (ppm or % LEL)
	280.00							mm		
0	279.9	TOPSOIL				SS	1	584	4	
		Loose to dense brown SAND with SILT (SP-SM) - trace gravel, moist, poorly graded				SS	2	610	23	
1	278.2					SS	3	559	38	
2		Dense to very dense, light brown to brown SAND with SILT (SP-SM) - trace gravel, moist, poorly graded				SS	4	533	61	
3						SS	5	457	46	
4						SS	6	432	53	
5	274.8					SS	7	584	48	
		End of Borehole at 5.18 m - Monitoring well MW1 installed with screen interval between 2.1 and 5.2 mbgs - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected								
6										
7										
8										
9										
10										
11										
12										

Stantec

MONITORING WELL RECORD

MW3

CLIENT **North American Development Group**

PROJECT No. **121624148**

LOCATION **Park Place Industrial Development Project Barrie, ON**

BOREHOLE No. **MW3**

DATES: BORING **2022-04-18** WATER LEVEL **Not Observed**

DATUM **GEODETIC**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	WELL CONSTRUCTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD	VOC CONCENTRATION (ppm or % LEL)
	290.50							mm		
0	290.4	TOPSOIL				SS	1	457	23	
		Compact brown silty sand FILL								
	289.7	- trace gravel, moist								
1		Loose to very dense light brown SAND with SILT (SP-SM)				SS	2	457	14	
		- trace gravel, moist, poorly graded								
2						SS	3	381	6	
						SS	4	483	6	
3										
						SS	5	584	40	
4						SS	6		66	
						SS	7	610	49	
5										
		- At 5.3 m: moisture content observed to change from mosit to dry				SS	8	610	49	
6						SS	9	610	43	
7										
						SS	10	610	66	
8										
9		- At 9.1 m: occasional layers of fine grained silty sand				SS	11	610	73	
	280.8									
10		End of Borehole at 9.75 m								
		- Monitoring well MW3 installed with screen interval between 6.1 and 9.1 mbgs								
11		- Dry upon completion, no groundwater was observed during drilling								
		- MW readings collected April 22nd, 2022 and groundwater was not detected								
12										

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MONITORING WELL RECORD

MW4

CLIENT **North American Development Group**

PROJECT No. **121624148**

LOCATION **Park Place Industrial Development Project Barrie, ON**

BOREHOLE No. **MW4**

DATES: BORING **2022-04-18** WATER LEVEL **Not Observed**

DATUM **GEODETIC**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	WELL CONSTRUCTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD	VOC CONCENTRATION (ppm or % LEL)
	290.50							mm		
0	290.3	TOPSOIL				SS	1	508	5	
		Loose to compact brown silty sand FILL - trace gravel, dry								
1						SS	2	610	27	
	289.0									
		Dense to very dense light brown silty SAND (SM) - trace gravel, moist				SS	3	610	70	
2										
						SS	4	508	65	
3										
						SS	5	533	60	
4										
						SS	6	610	42	
5										
						SS	7	508	67	
6										
						SS	8	483	42	
7										
						SS	9	559	73	
8										
						SS	10	610	60	
9										
	280.8					SS	11	610	80	
10		End of Borehole at 9.75 m - Monitoring well MW4 installed with screen interval between 6.1 and 9.1 mbgs - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected								
11										
12										

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MONITORING WELL RECORD

MW7

CLIENT **North American Development Group**

PROJECT No. **121624148**

LOCATION **Park Place Industrial Development Project Barrie, ON**

BOREHOLE No. **MW7**

DATES: BORING **2022-04-20** WATER LEVEL **Not Observed**

DATUM **GEODETIC**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	WELL CONSTRUCTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD	VOC CONCENTRATION (ppm or % LEL)
	298.90							mm		
0	298.7	TOPSOIL				SS	1	610	5	
		Very loose to loose brown silty sand FILL - trace gravel, moist				SS	2	610	3	
1										
						SS	3	559	3	
2	296.6									
		Compact light brown SAND with SILT (SP-SM) - moist, poorly graded				SS	4	610	15	
3						SS	5	610	24	
	295.1									
4		Dense to very dense light brown SAND with GRAVEL (SP) - moist, poorly graded				SS	6	508	72	
						SS	7	533	50	
5										
						SS	8	406	90	
6						SS	9	610	81	
7										
						SS	10	610	69	
8										
9						SS	11	610	184/559	
10										
						SS	12	483	95	
11										
12										

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MONITORING WELL RECORD

MW7

CLIENT **North American Development Group**

PROJECT No. **121624148**

LOCATION **Park Place Industrial Development Project Barrie, ON**

BOREHOLE No. **MW7**

DATES: BORING **2022-04-20** WATER LEVEL **Not Observed**

DATUM **GEODETIC**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	WELL CONSTRUCTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD	VOC CONCENTRATION (ppm or % LEL)
12										
12						SS	13	508	83	
13										
14						SS	14	483	103	
15										
15						SS	15	559	181/533	
16										
17						SS	16	559	194/559	
	281.5	End of Borehole at 17.37 m - Monitoring well MW7 installed with screen interval between 13.7 and 16.8 mbgs - Borehole cave in below 15 m after well installation - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected								
18										
19										
20										
21										
22										
23										
24										

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MONITORING WELL RECORD

MW8

CLIENT **North American Development Group**

PROJECT No. **121624148**

LOCATION **Park Place Industrial Development Project Barrie, ON**

BOREHOLE No. **MW8**

DATES: BORING **2022-04-21** WATER LEVEL **Not Observed**

DATUM **GEODETIC**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	WELL CONSTRUCTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD	VOC CONCENTRATION (ppm or % LEL)
	294.50							mm		
0		Compact brown silty sand FILL - trace gravel, trace clay, moist				SS	1	432	15	
1						SS	2	533	15	
	293.0									
2		Dense to very dense light brown SAND with SILT (SP-SM) - trace gravel, moist, poorly graded				SS	3	610	42	
						SS	4	457	47	
3						SS	5	483	64	
4						SS	6	483	63	
						SS	7	457	55	
5						SS	8	508	59	
6						SS	9	508	66	
7										
8						SS	10	610	90	
9										
						SS	11	610	77	
10										
11						SS	12	610	87	
12										

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MONITORING WELL RECORD

MW8

CLIENT **North American Development Group**

PROJECT No. **121624148**

LOCATION **Park Place Industrial Development Project Barrie, ON**

BOREHOLE No. **MW8**

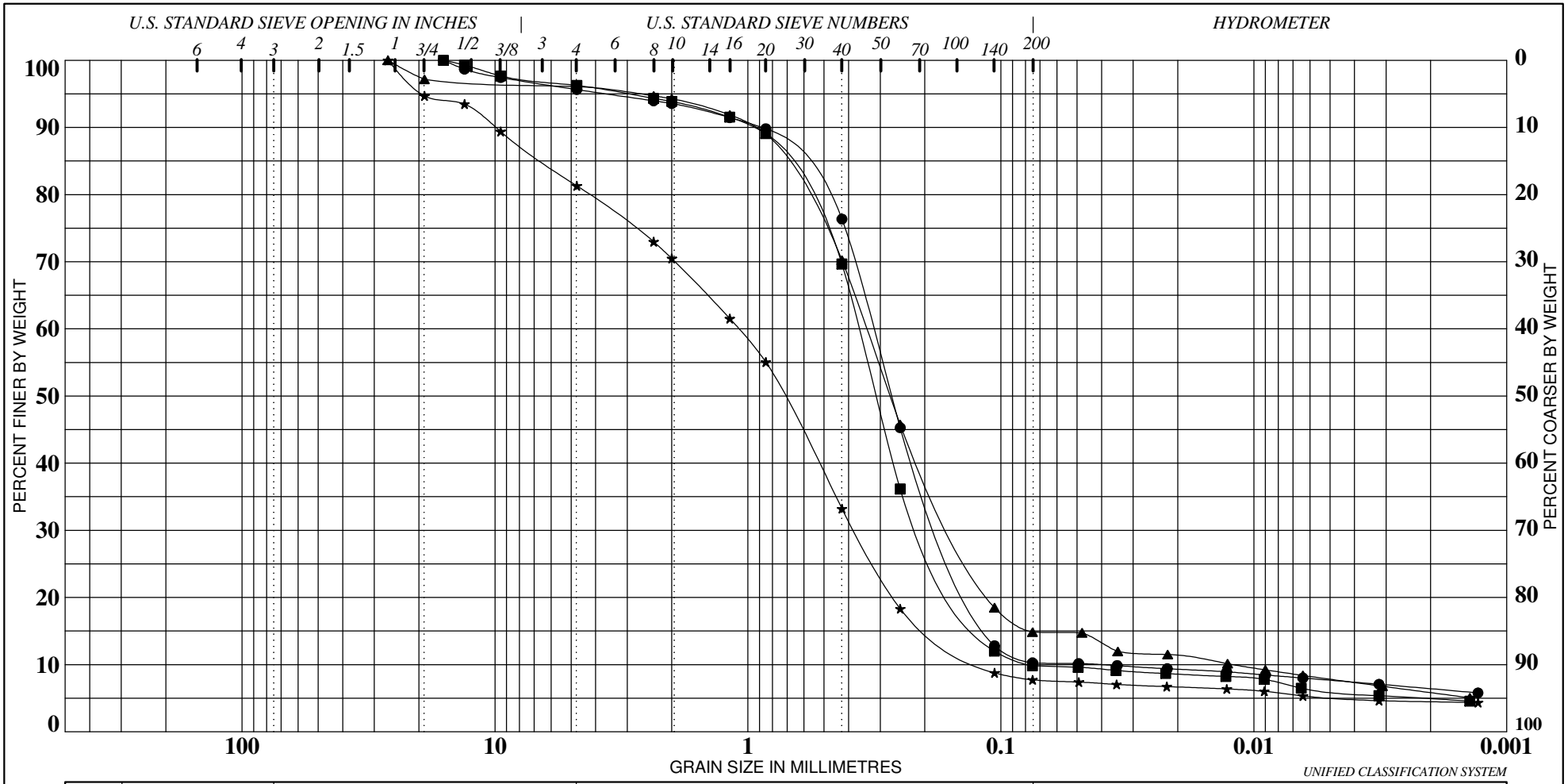
DATES: BORING **2022-04-21** WATER LEVEL **Not Observed**

DATUM **GEODETIC**

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	WELL CONSTRUCTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD	VOC CONCENTRATION (ppm or % LEL)
								mm		
12	281.7					SS	13	610	97	
13		End of Borehole at 12.8 m - Monitoring well MW8 installed with screen interval between 9.1 and 12.2 mbgs - Dry upon completion, no groundwater was observed during drilling - MW readings collected April 22nd, 2022 and groundwater was not detected								
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										

APPENDIX D

D.1 GRADATION CURVES



UNIFIED CLASSIFICATION SYSTEM

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

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH1	1.8	POORLY-GRADED SAND with SILT (SP-SM)	3				4	86	4	6
■ BH2	3.4	POORLY-GRADED SAND with SILT (SP-SM)	4				4	86	5	5
▲ BH4	6.4	SILTY SAND (SM)	6				4	81	9	6
★ BH6	3.4	POORLY-GRADED SAND with GRAVEL (SP)	3				19	74	3	4

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Project: Park Place Industrial

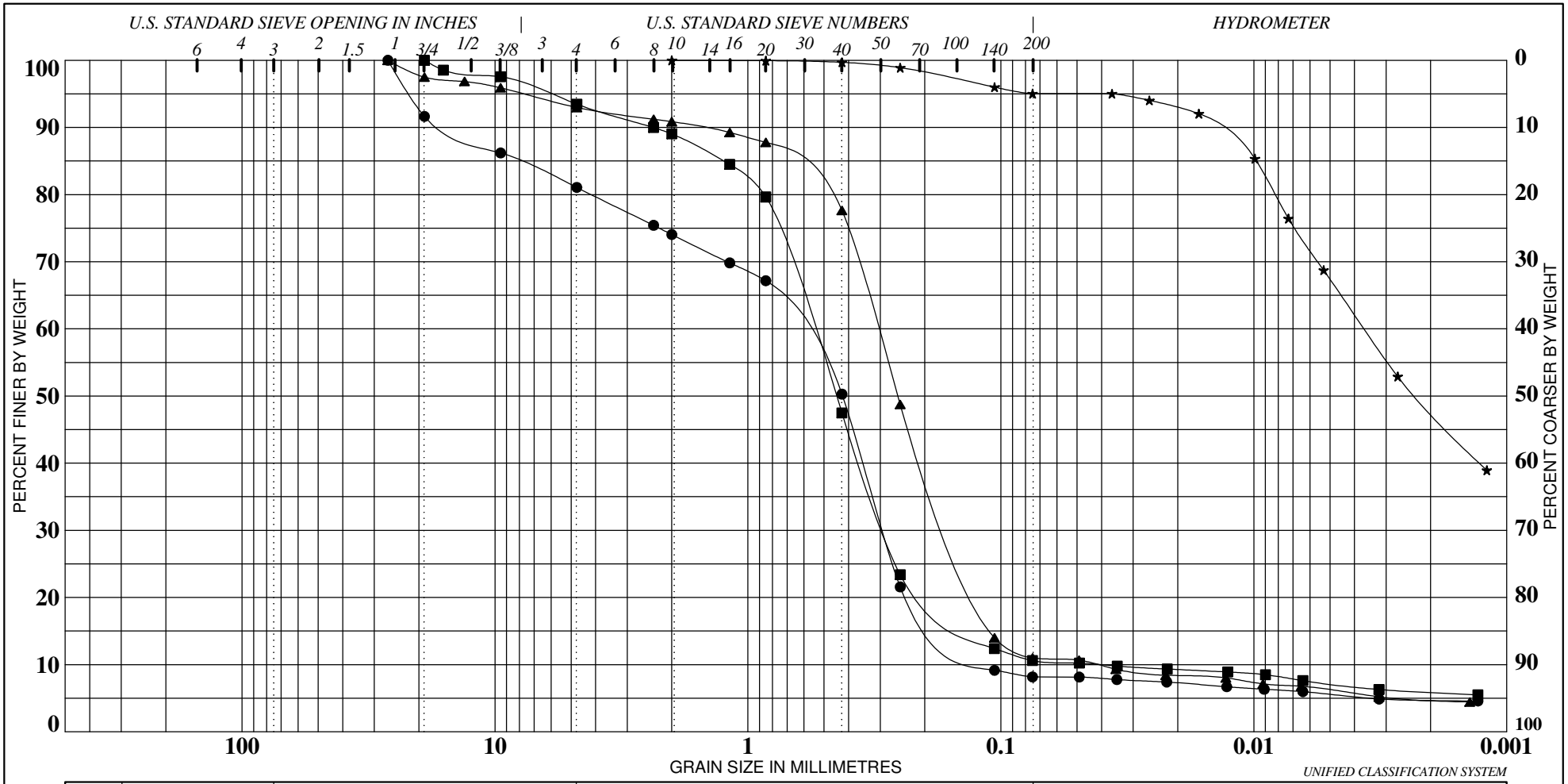
Location: 400 Bayview Drive, Barrie, Ontario

Project No.: 121624148

GRADATION CURVE (ASTM D422)

Figure: 1

Remarks:



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

Sample		Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH7	4.9	POORLY-GRADED SAND with GRAVEL (SP)	3				19	73	3	5
■	BH8	2.6	POORLY-GRADED SAND with SILT (SP-SM)	3				7	82	5	6
▲	BH8	9.4	POORLY-GRADED SAND with SILT (SP-SM)	2				7	82	6	5
★	BH9	6.4	SILTY CLAY (CL-ML)	20				0	5	47	48

Stantec

Project: Park Place Industrial

Location: 400 Bayview Drive, Barrie, Ontario

Project No.: 121624148

GRADATION CURVE (ASTM D422)

Figure: 2

Remarks:

APPENDIX E

E.1 CHEMICAL ANALYSES

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

CLIENT NAME: STANTEC CONSULTING LTD
300-675 Cochrane Drive
MARKHAM, ON L3R0B8
(905) 444-7777

ATTENTION TO: Bahram Siavash

PROJECT: 121624148.200

AGAT WORK ORDER: 22T892428

ROCK ANALYSIS REVIEWED BY: Heather Offord, Client Service Representative

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Lab Manager

DATE REPORTED: May 17, 2022

PAGES (INCLUDING COVER): 7

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*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

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Certificate of Analysis

AGAT WORK ORDER: 22T892428

PROJECT: 121624148.200

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

(283-042) Sulfide (CGY)

DATE RECEIVED: 2022-05-06

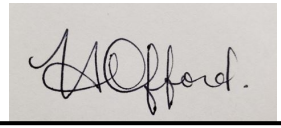
DATE REPORTED: 2022-05-17

SAMPLE DESCRIPTION:				BH2, SS-3	BH7, SS-2
SAMPLE TYPE:				Soil	Soil
DATE SAMPLED:				2022-04-18	2022-04-20
Parameter	Unit	G / S	RDL	3829536	3829538
Sulfide	%		0.01	<0.01	<0.01

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

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:



AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 22T892428

PROJECT: 121624148.200

CLIENT NAME: STANTEC CONSULTING LTD

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2022-05-06

DATE REPORTED: 2022-05-17

		SAMPLE DESCRIPTION:		BH2, SS-3	BH7, SS-2
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2022-04-18	2022-04-20
Parameter	Unit	G / S	RDL	3829536	3829538
Chloride (2:1)	µg/g		2	5	11
Sulphate (2:1)	µg/g		2	3	<2
pH (2:1)	pH Units		NA	8.83	8.10
Electrical Conductivity (2:1)	mS/cm		0.005	0.075	0.107
Resistivity (2:1) (Calculated)	ohm.cm		1	13300	9350
Redox Potential 1	mV		NA	358	428
Redox Potential 2	mV		NA	356	428
Redox Potential 3	mV		NA	356	425

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

3829536-3829538 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 performed at AGAT Toronto (unless marked by *)

Certified By: Amanjot Bhela

AGAT Laboratories

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Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 22T892428

PROJECT: 121624148.200

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Rock Analysis

RPT Date: May 17, 2022			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
(283-042) Sulfide (CGY)															
Total Sulfur	3829536	3829536	<0.01	<0.01	0.0%	< 0.01		90%	110%						
Sulfate	3817363	3817363	<0.01	<0.01	0.0%	< 0.01	94%	80%	120%						

Certified By:

AGAT Laboratories

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Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 22T892428

PROJECT: 121624148.200

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: May 17, 2022			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)	3832151		35	34	2.9%	< 2	100%	70%	130%	98%	80%	120%	100%	70%	130%
Sulphate (2:1)	3832151		14	14	0.0%	< 2	104%	70%	130%	99%	80%	120%	103%	70%	130%
pH (2:1)	3829536	3829536	8.83	8.85	0.2%	NA	96%	80%	120%	NA			NA		
Electrical Conductivity (2:1)	3829536	3829536	0.075	0.075	0.0%	< 0.005	108%	80%	120%	NA			NA		
Redox Potential 1	3829536						100%	90%	110%	NA			NA		

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:

AGAT Laboratories

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Method Summary

CLIENT NAME: STANTEC CONSULTING LTD

AGAT WORK ORDER: 22T892428

PROJECT: 121624148.200

ATTENTION TO: Bahram Siavash

SAMPLING SITE:

SAMPLED BY:

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-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
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
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www.agatlabs.com · webearth.agatlabs.com

Ph.: 905.712.5100 · Fax: 905.712.5122 · Toll Free: 800.856.6261

Chain of Custody Record

Laboratory Use Only

Arrival Temperature:
AGAT WO #: 22T892428
Lab Temperature: 17.2/17.3
Notes: No Bot

Client Information:

Company: Stantec Consulting Ltd.
Contact: Nabeel Basheer
Address: 300-675 Cochran Drive West Tower
Phone: 905-479-9345 Fax: 905-944-9889
Project: 121624148.200 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements:

☐ Regulation 153/09 (reg. 511 Amend.)
Table ____ *Indicate one*
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture *(check one)*
☐ Coarse ☐ Fine

☐ Sewer Use
Region ____ *Indicate one*
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other *(specify)*
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☑ 5 to 7 Working Days
Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day
OR
Date Required (Rush surcharges may apply):
**TAT is exclusive of weekends and statutory holidays*

Invoice To:

Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample?
(potable water intended for human consumption)
☐ Yes ☐ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

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

Legend Matrix

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

Report Information – reports to be sent to:

1. Name: Nabeel Basheer
   Email: nabeel.basheer@stantec.com
2. Name:
   Email:

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ NO_3/NO_2 ☐ N- Total ☐ Hg ☐ pH	Nutients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_3	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	TCLP:	Sewer Use	Corrosivity Pckg (pH, Redox Potential)	sulphates and sulphides contents,	chlorides contents and resistivity)
BH2, SS-3	2022-04-18			1	5'-7'																	X	
BH7, SS-2	2022-04-20			1	2'6"-4'6"																	X	

'22MAY 6 9:57AM

Samples Relinquished by (print name & sign):	Date/Time	Samples Received by (Print name & sign): Amanda Rice	Date/Time	Pink Copy – Client Yellow + Golden Copy – AGAT White Copy – AGAT	Page 1 of 1
Samples Relinquished by (print name & sign):	Date/Time	Samples Received by (Print name & sign):	Date/Time		NO:

APPENDIX F

F.1 SEISMIC HAZARD CALCULATION SHEET

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 44.339N 79.682W **User File Reference:** Barrie 2022-05-25 15:02 UT

Requested by: Stantec Consulting Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.081	0.050	0.033	0.011
Sa (0.1)	0.112	0.072	0.048	0.017
Sa (0.2)	0.109	0.072	0.049	0.019
Sa (0.3)	0.093	0.063	0.043	0.017
Sa (0.5)	0.077	0.052	0.036	0.013
Sa (1.0)	0.047	0.031	0.021	0.006
Sa (2.0)	0.025	0.016	0.010	0.003
Sa (5.0)	0.006	0.004	0.002	0.001
Sa (10.0)	0.003	0.002	0.001	0.000
PGA (g)	0.064	0.041	0.027	0.009
PGV (m/s)	0.064	0.040	0.026	0.008

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information