FINAL

Preliminary Geotechnical Investigation – Proposed Residential Development

100 Mapleview Drive, Barrie, Ontario

Prepared for:

North American Development Group
2851 John Street, Suite One
Markham, Ontario L3R 5R7

April 21, 2022

Pinchin File: 296908.005

Issued to: North American Development Group
Issued on: April 21, 2022
Pinchin File: 296908.005
Issuing Office: Barrie, ON

LICENSED PROFESSIONAL ENGINEER
K. RUNDLE DRAKE
100161775
2022-4-21
PROVINCE OF ONTARIO

Author:
Kyle Rundle Drake, P.Eng.
Senior Project Manager, Geotechnical Services
226.898.4682
krundledrake@pinchin.com

LICENSED PROFESSIONAL ENGINEER
V. M. MARSHALL
100079066
2022-04-21
PROVINCE OF ONTARIO

Reviewer:
Vanessa Marshall, M.Eng., P.Eng.
National Practice Leader, Geotechnical Services
519.904.4660
vmarshall@pinchin.com

TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION AND SCOPE

Pinchin Ltd. (Pinchin) was retained by North American Development Group (Client) to conduct a Preliminary Geotechnical Investigation and provide subsequent geotechnical design recommendations for the proposed residential development to be located at 100 Mapleview Drive, Barrie, Ontario (Site). The Site location is shown on Figure 1.

Based on information provided by the Client, it is Pinchin's understanding that the development will consist of two residential buildings (Phase 1 and Phase 2) which comprise the following:

- Phase 1: 5 to 6 storey residential buildings with a 16-storey tower and single-storey ground floor retail; and
- Phase 2: 5 to 6 storey residential buildings with a 12-storey tower and single-storey ground floor retail.

Both the Phase 1 and Phase 2 buildings are proposed to have two to three levels of underground parking.

Pinchin's geotechnical comments and recommendations are based on the results of the Preliminary Geotechnical Investigation and our understanding of the project scope.

The purpose of the Preliminary Geotechnical Investigation was to delineate the subsurface conditions and soil engineering characteristics by advancing a total of eleven (11) sampled boreholes (Boreholes MW1, MW2, BH3, MW4 to MW8, BH9, BH10, and MW11), at the Site. The information gathered from the Preliminary Geotechnical Investigation will allow Pinchin to provide geotechnical design recommendations for the proposed development.

Based on a desk top review and the results of the Preliminary Geotechnical Investigation, the following geotechnical data and engineering design recommendations are provided herein:

- A detailed description of the soil and groundwater conditions;
- Open cut excavations and shoring;
- Anticipated groundwater management;
- Lateral earth pressure coefficients and unit densities;
- Foundation design recommendations including soil bearing resistances at Ultimate Limit States (ULS) and Serviceability Limit States (SLS) design;
- Potential total and differential settlements;
- Foundation frost protection and engineered fill specifications and installation;
- Seismic Site classification for seismic Site response;
- Underground parking garage design;

- Concrete floor slab-on-grade support recommendations; and
- Potential construction concerns.

Abbreviations, terminology, and principal symbols commonly used throughout the report, borehole logs and appendices are enclosed in Appendix I.

2.0 CONCURRENT WORK

Pinchin is concurrently completing a Phase Two Environmental Site Assessment (ESA) at the Site. Additionally, Palmer Environmental Consulting Group (Palmer) is concurrently completing a Hydrogeological Assessment at the Site. The relevant geotechnical information from the concurrent investigations has been incorporated into this report. The results of the Phase Two ESA and Hydrogeological Assessment will be provided under separate cover.

3.0 SITE DESCRIPTION AND GEOLOGICAL SETTING

The Site is located within the Park Place shopping centre located at 100 Mapleview Drive in Barrie, Ontario. The Park Place shopping centre is located west of Highway 400, on the northwest corner of the intersection of Bayview Drive and Mapleview Drive and consists of numerous retail buildings, complete with asphalt surfaced parking areas and internal roadways. The Site is located within the southeast quadrant of the shopping centre. The west half of the Site consists of a vacant grassed area and the east half consists of an asphalt surfaced parking lot. A roadway, South Village Way, bisects the north and south halves of the Site. The Site is bordered by parking areas and retail buildings to the west and north, and by Live Eight Way to the east and south. The Site is relatively flat, with elevations general sloping slightly down towards the south and east. Elevations as measured at the borehole locations ranged from 292.3 to 294.4 metres above sea level (masl), a total elevation change of up to 2.1 m.

Data obtained from the Ontario Geological Survey Maps, as published by the Ontario Ministry of Energy, Northern Development and Mines, indicates that the Site is located primarily on a mix of ice-contact stratified deposits of sand and gravel, minor silt, clay, and till, as well as coarse-grained glaciolacustrine deposits of sand, gravel, minor silt and clay (Ontario Geological Survey 2010, Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV). The underlying bedrock at this Site is of the Lindsay formation, consisting of limestone (Armstrong, D.K. and Dodge, J.E.P. 2007, Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219).

4.0 GEOTECHNICAL FIELD INVESTIGATION AND METHODOLOGY

Pinchin completed field investigations at the Site between January 10 and 20, 2022, by advancing a total of eleven (11) sampled boreholes throughout the Site. The boreholes were advanced to depths of approximately 9.8 to 20.4 metres below existing ground surface (mbgs). The approximate spatial locations of the boreholes advanced at the Site are shown on Figure 2.

The boreholes were advanced with the use of a track mounted drill rig which was equipped with standard soil sampling equipment. Soil samples were collected at 0.76 and 1.52 m intervals using a 51 mm outside diameter (OD) split spoon barrel in conjunction with Standard Penetration Tests (SPT) “N” values (ASTM D1586). The SPT “N” values were used to assess the compactness condition of the non-cohesive soil.

Monitoring wells were installed in Boreholes MW1, MW2, MW4, MW5, MW6, MW7 (which includes both a shallow and deep installation), MW8, and MW11 to allow measurement of groundwater levels. The monitoring wells were constructed using flush-threaded 50 mm diameter Trilock pipe with 3.0 meter long 10-slot well screens, delivered to the Site in pre-cleaned individually sealed plastic bags. The screen and riser pipes were not allowed to come into contact with the ground or drilling equipment prior to installation.

A completed well record was submitted to the property owner and the Ministry of the Environment, Conservation and Parks for Ontario (MECP) as per Ontario Regulation 903, as amended. A licensed well technician must properly decommission the monitoring wells prior to construction according to Regulation 903 of the Ontario Water Resources Act.

Groundwater observations and measurements were obtained from the open boreholes during and upon completion of drilling. Groundwater levels were measured in the monitoring wells by Palmer on January 27, 2022 and the information was provided to Pinchin. The groundwater observations and measurements recorded are included on the appended borehole logs.

The borehole locations and ground surface elevations were surveyed by Pinchin using a Sokkia Model GCX3 Global Navigation Satellite System (GNSS) rover. The ground surface elevations are geodetic, based on GNSS and local base station telemetry with a precision static of less than 20 mm.

The field investigation was monitored by experienced Pinchin personnel. Pinchin logged the drilling operations and identified the soil samples as they were retrieved. The recovered soil samples were sealed into plastic bags and carefully transported to an independent and accredited materials testing laboratory for detailed analysis and testing. All soil samples were classified according to visual and index properties by the project engineer.

The field logging of the soil and groundwater conditions was performed to collect geotechnical engineering design information. The borehole logs include textural descriptions of the subsoil in accordance with a modified Unified Soil Classification System (USCS) and indicate the soil boundaries inferred from non-continuous sampling and observations made during the borehole advancement. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The modified USCS classification is explained in further detail in Appendix I. Details of the soil and groundwater conditions encountered within the boreholes are included on the Borehole Logs within Appendix II.

Select soil samples collected from the boreholes were submitted to Pinchin's materials testing laboratory to determine the grain size distribution of the soil. A copy of the laboratory analytical report is included in Appendix III. In addition, the collected samples were compared against previous geotechnical information from the area, for consistency and calibration of results.

5.0 SUBSURFACE CONDITIONS

5.1 Borehole Soil Stratigraphy

In general, the soil stratigraphy at the Site comprises fill material overlying native sand deposits which extend beyond the borehole termination depths of 9.8 to 20.4 mbgs (Elevation 284.1 to 271.9 masl). A thin silt and clay layer was present in several borehole near the ground surface. The appended borehole logs provide detailed soil descriptions and stratigraphies, results of SPT testing, moisture content profiles, and groundwater measurements.

Asphaltic concrete was encountered surficially at Boreholes MW1, MW2, BH3, MW8, BH9, BH10, and MW11, and was approximately 125 to 225 mm thick. Fill material was encountered below the asphaltic concrete in those boreholes, as well as surficially in the remaining boreholes and extended to depths ranging from 0.1 to 4.6 mbgs (Elevation 294.3 to 288.0 masl). The fill material varied in composition from sand to sand and gravel. Organics such as rootlets were present within the fill material at the Site. The fill material has a loose to very dense relative density based on SPT 'N' values of 6 to greater than 50 blows per 300 mm penetration of a split spoon sampler. At the time of sampling, the fill material was generally moist to wet.

Silt and clay deposits were encountered below the fill material at Boreholes MW1, MW2, BH3, MW5, MW6, and MW7 and were underlain by native sand deposits at depths of 1.5 to 4.6 mbgs (Elevation 289.2 to 291.7 masl). The silt and clay generally consisted of silt and clay with trace sand and gravel. The silt and clay deposits had a firm to stiff consistency based on SPT 'N' values of 10 to 21 blows per 300 mm penetration of a split spoon sampler. At the time of sampling, the silt and clay deposits were About the Plastic Limit (APL) to Wetter Than the Plastic Limit (WTPL). The results of two particle size distribution analyses completed on samples of the silt and clay deposits are provided in Appendix III and are also presented in the following table:

Borehole and Sample No.	Sample Depth (mbgs)	% Gravel	% Sand	% Silt	% Clay
MW1 SS4	2.3 – 2.9	0	1	59	40
MW5 SS4	2.3 – 2.9	3	2	47	48

Native sand deposits were encountered below the fill material and silt and clay deposits in all boreholes. The native sand deposits extended beyond the borehole termination depths of 9.8 to 20.4 mbgs (Elevation 284.1 to 271.9 masl) at all borehole locations. The sand deposits varied in composition from silty sand to sand with some gravel and trace silt. Occasional cobbles were encountered within the sand deposits at the Site. The sand generally increases in density with depth and generally has a compact to very dense relative density based on SPT 'N' values of 11 to greater than 50 blows per 300 mm penetration of a split spoon sampler. It should be noted that an anomalous localized area of very loose sand was encountered at Borehole BH9 at a depth of 6.1 mbgs (Elevation 286.5 masl). At the time of sampling, the granular deposits were generally damp to wet. The results of four particle size distribution analyses completed on samples of the sand deposits are provided in Appendix III and are also presented in the following table:

Borehole and Sample No.	Sample Depth (mbgs)	% Gravel	% Sand	% Silt	% Clay
MW2 SS5	3.0 – 3.7	9	77	14	
MW5 SS6	4.6 – 5.2	16	72	12	
MW8 SS4	2.3 – 2.9	14	55	21	10
MW11 SS11	12.2 – 12.8	0	91	9	

5.2 Groundwater Conditions

Groundwater observations and measurements were obtained in the open boreholes during and at the completion of drilling and are summarized on the appended borehole logs. No free groundwater was encountered at any of the boreholes advanced at the Site. In addition, groundwater levels were measured by Palmer in the monitoring wells installed in Boreholes MW1, MW2, MW4 to MW8, and MW11 on January 27, 2022 and the results were provided to Pinchin. The measured groundwater levels as provided by Palmer are summarized below:

Borehole No.	Water Level (mbgs)	Water Elevation (masl)
MW1	Dry	N/A
MW2	Dry	N/A
MW4	Dry	N/A
MW5	Dry	N/A
MW6	Dry	N/A
MW7 (Deep)	Dry	N/A
MW7 (Shallow)	Dry	N/A
MW8	Dry	N/A
MW11	Dry	N/A

Based on the measured water levels in the monitoring wells, the stabilized groundwater table is located below the maximum termination depths. Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions.

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

6.1 General Information

The recommendations presented in the following sections of this report are based on the information available regarding the proposed construction, the limited results obtained from the Preliminary Geotechnical Investigation, and Pinchin's experience with similar projects. Since the investigation only represents a portion of the subsurface conditions, it is possible that conditions may be encountered during construction that are substantially different than those encountered during the investigation. If these situations are encountered, adjustments to the design may be necessary.

As the design progresses, these preliminary results may need to be supplemented with a more detailed geotechnical field investigation and the design recommendations below should be revised based on the updated information. A qualified geotechnical engineer should be on-Site during the foundation preparation to ensure the subsurface conditions are the same/similar to what was observed during the investigation.

It is Pinchin's understanding that the development will consist of two residential buildings (Phase 1 and Phase 2) which comprise the following:

- Phase 1: 5 to 6 storey residential buildings with a 16-storey tower and single-storey ground floor retail; and
- Phase 2: 5 to 6 storey residential buildings with a 12-storey tower and single-storey ground floor retail.

Both the Phase 1 and Phase 2 buildings are proposed to have two to three levels of underground parking.

6.2 Excavations

Based on the proposed two to three levels of underground parking, it is assumed that excavations for the proposed buildings will extend to depths of 7.0 to 10.5 mbgs (Elevation 287.4 to 281.8 masl) based on current Site grades.

Based on the subsurface information obtained from within the boreholes, it is anticipated that the excavated material will predominately consist of fill, silt and clay, and sand. No free groundwater was encountered at the Site.

Where workers must enter trench excavations deeper than 1.2 m, the trench excavations should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/91, Construction Projects, July 1, 2011, Part III - Excavations, Section 226. Alternatively, the excavation walls may be supported by either closed shoring, bracing, or trench boxes complying with sections 235 to 239 and 241 under O. Reg. 231/91, s. 234(1).

Based on the OHSA, the existing material may be classified as Type 3 soil. Temporary excavations in these soils must be cut at an inclination of 1 horizontal to 1 vertical (H to V) or less from the base of the excavation.

In addition to compliance with the OHSA, the excavation procedures must also be in compliance with any potential other regulatory authorities, such as federal and municipal safety standards.

6.2.1 Shoring Requirements

It is anticipated that due to spatial limitations, it may not be feasible to slope the excavations back to a safe angle and therefore some temporary support will be required. Conventional support systems comprising soldier piles and lagging, sheet piles or concrete caisson wall may be considered for the Site. The shoring system may be designed as full cantilevers or the lateral loads can be taken up to the installation of internal bracing of rakers or tie back soil anchors.

No excavation shall extend below a line cast as one vertical and one horizontal from foundations of existing structures without adequate alternate support being provided. The temporary shoring design must include appropriate factors of safety, and any possible surcharge loading must be taken into account. The support system must comply with sections 234 to 239 and 241 of Ontario Regulation 213/91.

Resistance to sliding of retaining structures is developed by friction between the base of the footing and the soil. This friction (**R**) depends on the normal load on the soil contact (**N**) and the frictional resistance of the soil (**tan ϕ**) expressed as **R = N tan ϕ**. The factored geotechnical resistance at ULS is **0.8 R**.

Passive earth pressure resistance is generally not considered as a resisting force against sliding for conventional retaining structure design because a structure must deflect significantly to develop the full passive resistance.

Temporary protective structures, bracing, anchors, and sheeting are the responsibility of the contractors and shall be designed by a Professional Engineer licensed in Ontario, in accordance with the Canadian Foundation Engineering Manual. All shoring, bracing, sheetpiling and cribbing shall meet all requirements of the Ontario Occupational Health and Safety Act and Regulations for Construction Projects and the Trench Excavators Protection Act.

The following parameters (un-factored) should be used for the design of the shoring system. It should be noted that these earth pressure coefficients assume that the back of the wall is vertical; condition of the ground surface behind the wall is assumed to be flat.

Soil Layer	**Bulk Unit Weight (kN/m^3)**	**Angle of Internal Friction**	**Active Earth Pressure Coefficient**	**Passive Earth Pressure Coefficient**
Fill	17	27°	0.38	2.66
Silt and Clay	18	28°	0.36	2.77
Native Sand	19	32°	0.31	3.25

In addition to compliance with the OHSA, the excavation procedures must also be in compliance to any potential other regulatory authorities, such as federal and municipal safety standards.

If construction proceeds in winter months, the shoring system may require frost protection to prevent frost penetration behind the shoring system, which can result in unacceptable movements.

It is recommended that the contract have a performance specification, limiting movement. The presence of sensitive structures and infrastructure, anchor spacing, elevation, and the timing of the excavation and anchoring operations are critical in determining acceptable limits. A monitoring program for shored excavations is recommended.

6.3 Anticipated Groundwater Management

No free groundwater was encountered within the boreholes advanced at the Site. It is anticipated that no significant groundwater will be encountered during construction.

Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions. If construction commences during wet periods (typically spring or fall), there is a greater potential that perched groundwater may be present. Any potential precipitation of perched groundwater should be able to be controlled from pumping from filtered sumps, and should be pumped away immediately (not allowed to pond). Further information about groundwater and groundwater management can be found in Palmer's Hydrogeological Assessment.

Prior to commencing excavations, it is critical that all existing surface water and potential surface water is controlled and diverted away from the Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to precipitation and cause subgrade softening.

All collected water is to discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures, such as a silt fence should be installed at the discharge point of the dewatering system. The utmost care should be taken to avoid any potential impacts on the environment.

6.4 Foundation Design

6.4.1 Shallow Foundations Bearing on Native Sand Deposits

Conventional shallow strip footings established on the inorganic very dense native sand deposits (below Elevation 187.0 masl) may be designed using a bearing resistance for 25 mm of settlement at Serviceability Limit States (SLS) of 550 kPa, and a factored geotechnical bearing resistance of 700 kPa at Ultimate Limit States (ULS).

As the actual service loads were not known at the time of this report, there should be reviewed by the project structural engineer to determine if SLS or ULS governs the design.

It is noted that there is a potential for weaker subgrade soil to be encountered between the investigation locations. Pinchin presumes that any areas of weaker subgrade soil will consist of small pockets of soft/loose natural soil (such as the localized very loose sample encountered in Borehole BH9 at a depth of 6.1 mbgs (Elevation 286.5 masl)). Any soft/loose areas are to be removed and replaced with low strength concrete.

Pinchin notes that a qualified geotechnical engineering consultant should be on-Site during the foundation preparation activities to verify the design assumptions and recommendations. This is especially critical with respect to the recommended soil bearing pressures. If variations occur in the soil conditions between the borehole locations, site verification and site review by Pinchin is recommended to provide appropriate recommendations at that time.

The natural subgrade soil is sensitive to change in moisture content and can become loose/soft if subjected to additional water or precipitation. As well, it could be easily disturbed if travelled on during construction. Once it becomes disturbed it is no longer considered adequate to support the recommended design bearing pressures.

In addition, to ensure and protect the integrity of the subgrade soil during construction operations, the following is recommended:

- Prior to commencing excavations, it is critical that all existing surface water, potential surface water and groundwater are controlled and diverted away from the work Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to inclement weather conditions and cause subgrade softening;
- The subgrade should be sloped to a sump outside the excavation to promote surface drainage and the collected water pumped out of the excavation. Any potential precipitation or seepage entering the excavations should be pumped away immediately (not allowed to pond);
- The footing areas should be cleaned of all deleterious materials such as topsoil, organics, fill, disturbed, or caved materials;
- Any potential large cobbles or boulders (i.e. greater than 200 mm in diameter) within the subgrade material are to be removed and replaced with a similar soil type not containing particles greater than 200 mm in diameter. It is critical that particles greater than 200 mm in diameter are not in contact with the foundation to prevent point loading and overstressing; and

- If the excavated subgrade soil remains open to weather conditions and groundwater seepage, sidewall stability and suitability of the subgrade soil will need to be verified prior to construction.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided and maintained above freezing at all times.

6.4.2 Site Classification for Seismic Site Response & Soil Behaviour

The following information has been provided to assist the building designer from a geotechnical perspective only. These geotechnical seismic design parameters should be reviewed in detail by the structural engineer and be incorporated into the design as required.

The seismic site classification has been based on the 2012 Ontario Building Code (OBC). The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the OBC. The site classification is based on the average shear wave velocity in the top 30 m of the site stratigraphy. The seismic site classification has been based on the 2012 OBC. The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the OBC. The site classification is based on the average shear wave velocity in the top 30 m of the site stratigraphy.

The boreholes advanced at this Site extended to between approximately 9.8 to 20.4 mbgs and encountered native sand deposits with SPT “N’ values of 2 to greater than 50 blows per 300 mm penetration of a split spoon sampler. Based on Table 4.1.8.4.A of the OBC, this Site has been classified as Class C. A Site Class C has an average shear wave velocity (Vs) of 360 to 760 m/s. There is a potential that the Site Class may be higher; however, shear wave velocity measurements would be required for the determination of a higher Site Classification, as per the OBC.

6.4.3 Foundation Transition Zones

Excessive differential settlements can occur where the subgrade support material types differ below the underside of continuous strip footings. As such, where strip footings transition from one material to another the transition between the materials should be suitably sloped or benched to mitigate differential settlements.

Pinchin also recommends the following transition precautions to mitigate/accommodate potential differential settlements:

- For strip footings, the transition zones should be adequately reinforced with additional reinforced steel lap lengths or widened footings;
- Steel reinforced poured concrete foundation walls; and
- Control joints throughout the transition zone(s).

The above recommendations should be reviewed by the structural engineer and incorporated into the design as necessary.

Where strip footings are founded at different elevations, the subgrade soil is to have a maximum slope of 2 H to 1 V, with the concrete footing having a maximum rise of 600 mm and a minimum run of 600 mm between each step, as detailed in the 2012 Ontario Building Code (OBC). The lower footing should be installed first to mitigate the risk of undermining the upper footing.

Individual spread footings are to be spaced a minimum distance of one and a half times the largest footing width apart from each other to avoid stress bulb interaction between footings. This assumes the footings are at the same elevation.

6.4.4 Estimated Settlement

All individual spread footings should be founded on uniform subgrade soils, reviewed and approved by a licensed geotechnical engineer.

Foundations installed in accordance with the recommendations outlined in the preceding sections are not expected to exceed total settlements of 25 mm and differential settlements of 19 mm.

All foundations are to be designed and constructed to the minimum widths as detailed in the 2012 OBC.

6.4.5 Building Drainage & Frost Protection

To assist in maintaining the building dry from surface water seepage, it is recommended that exterior grades around the buildings be sloped away at a 2% gradient or more, for a distance of at least 2.0 m. Roof drains should discharge a minimum of 1.5 m away from the structure to a drainage swale or appropriate storm drainage system.

Experience suggests that the temperature in nominally unheated underground parking with two or more levels below grade and normal ventilation provisions is not as severe as the ambient open-air condition. In Barrie, the earth cover required to prevent frost effects on foundations in the lower parking levels need not be any greater than 1.4 metres, and unmonitored experience in a number of structures and industry practice indicate that perimeter foundations provided with a minimum of 600 mm of soil cover perform adequately as do the interior isolated foundations with 900 mm of soil cover.

Foundations located immediately adjacent to air shafts, entrance and exit doors shall be treated as exterior foundations and should be provided with a minimum of 1.4 m of soil cover or equivalent insulation to ensure that foundations are not affected by the cold air flow.

Where the foundations for heated buildings do not have the minimum 1.4 m of soil cover frost protection, they should be protected from frost with a combination of soil cover and rigid polystyrene insulation, such as Dow Styrofoam or equivalent product. If required, Pinchin can provide appropriate foundation frost protection recommendations as part of the design review.

6.5 Underground Parking Garage Design

It is understood that the buildings will be constructed with two to three levels of underground parking. It is assumed that excavations for the proposed buildings will extend to depths of 7.0 to 10.5 mbgs (Elevation 287.4 to 281.8 masl) based on current Site grades.

No free groundwater was encountered in the borehole advanced at the Site and therefore hydrostatic uplift is not a concern for the underground structures. Similarly, an underslab drainage system is also not required. All subsurface walls should be damp proofed.

To minimize potential frost movements from soil frost adhesion, the parking garage foundation backfill should consist of a free draining granular material, such as a Granular ‘B’ Type I (OPSS 1010) or an approved sand fill, extending a minimum lateral distance of 600 mm beyond the foundation. The backfill material used against the foundation must be placed so that the allowable lateral capacity is achieved. All granular material is to be placed in maximum 200 mm thick lifts compacted to a minimum of 100% SPMDD in hard landscaping areas and 95% SPMDD in soft landscaping areas. It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure compaction requirements are achieved.

The walls must also be designed to resist lateral earth pressure. For calculating the lateral earth pressure, the coefficient of at-rest earth pressure (K_0) may be assumed at 0.5 for non-cohesive sandy soil. The bulk unit weight of the retained backfill may be taken as 20 kN/m^3 for well compacted soil. An appropriate factor of safety should be applied.

6.6 Floor Slabs

The in-situ inorganic native granular material encountered within the boreholes is considered adequate for the support of the concrete floor slabs.

Once the subgrade soil is exposed it is to be inspected and approved by a qualified geotechnical engineering consultant to ensure that the material conforms to the soil type and consistency observed during the subsurface investigation work. Any soft area(s) encountered during the inspection should be excavated and replaced with a similar soil type.

Based on the in-situ soil conditions, it is recommended to establish the concrete floor slab on a minimum 200 mm thick layer of Granular “A” (OPSS 1010). Alternatively, consideration may also be given to using a 200 mm thick layer of uniformly compacted 19 mm clear stone placed over the approved subgrade. Any required up fill should consist of a Granular "B" Type I or Type II (OPSS 1010).

The installation of a vapour barrier may be required under the floor slab. If required, the vapour barrier should conform to the flooring manufacturer's and designer's requirements. Consideration may be given to carrying out moisture emission and/or relative humidity testing of the slab to determine the concrete condition prior to flooring installation. To minimize the potential for excess moisture in the floor slab, a concrete mixture with a low water-to-cement ratio (i.e. 0.5 to 0.55) should be used.

The following table provides the unfactored modulus of subgrade reaction values:

Material Type	Modulus of Subgrade Reaction (kN/m^3)
Granular A (OPSS 1010)	85,000
Granular "B" Type I (OPSS 1010)	75,000
Granular "B" Type II (OPSS 1010)	85,000
Native Sand	50,000

7.0 SITE SUPERVISION & QUALITY CONTROL

It is recommended that all geotechnical aspects of the project be reviewed and confirmed under the appropriate geotechnical supervision, to routinely check such items. This includes but is not limited to inspection and confirmation of the undisturbed natural subgrade material prior to subgrade preparation, pouring any foundations or footings, backfilling, or engineered fill installation to ensure that the actual conditions are not markedly different than what was observed at the borehole locations and geotechnical components are constructed as per Pinchin's recommendations. Compaction quality control of engineered fill material (full-time monitoring) is recommended as standard practice, as well as regular sampling and testing of aggregates and concrete, to ensure that physical characteristics of materials for compliance during installation and satisfies all specifications presented within this report.

8.0 TERMS AND LIMITATIONS

This Preliminary Geotechnical Investigation was performed for the exclusive use of North American Development Group (Client) in order to evaluate the subsurface conditions at 100 Mapleview Drive, Barrie, Ontario. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practises in the field of geotechnical engineering for the Site. Classification and identification of soil, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. No warranty or other conditions, expressed or implied, should be understood. Conclusions derived are specific to the immediate area of study and cannot be extrapolated extensively away from sample locations.

Performance of this Preliminary Geotechnical Investigation to the standards established by Pinchin is intended to reduce, but not eliminate, uncertainty regarding the subgrade soil at the Site, and recognizes reasonable limits on time and cost.

Regardless how exhaustive a Preliminary Geotechnical Investigation is performed, the investigation cannot identify all the subsurface conditions. Therefore, no warranty is expressed or implied that the entire Site is representative of the subsurface information obtained at the specific locations of our investigation. If during construction, subsurface conditions differ from then what was encountered within our test location and the additional subsurface information provided to us, Pinchin should be contacted to review our recommendations. This report does not alleviate the contractor, owner, or any other parties of their respective responsibilities.

This report has been prepared for the exclusive use of the Client and their authorized agents. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

Pinchin makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and these interpretations may change over time. Please refer to Appendix IV, Report Limitations and Guidelines for Use, which pertains to this report.

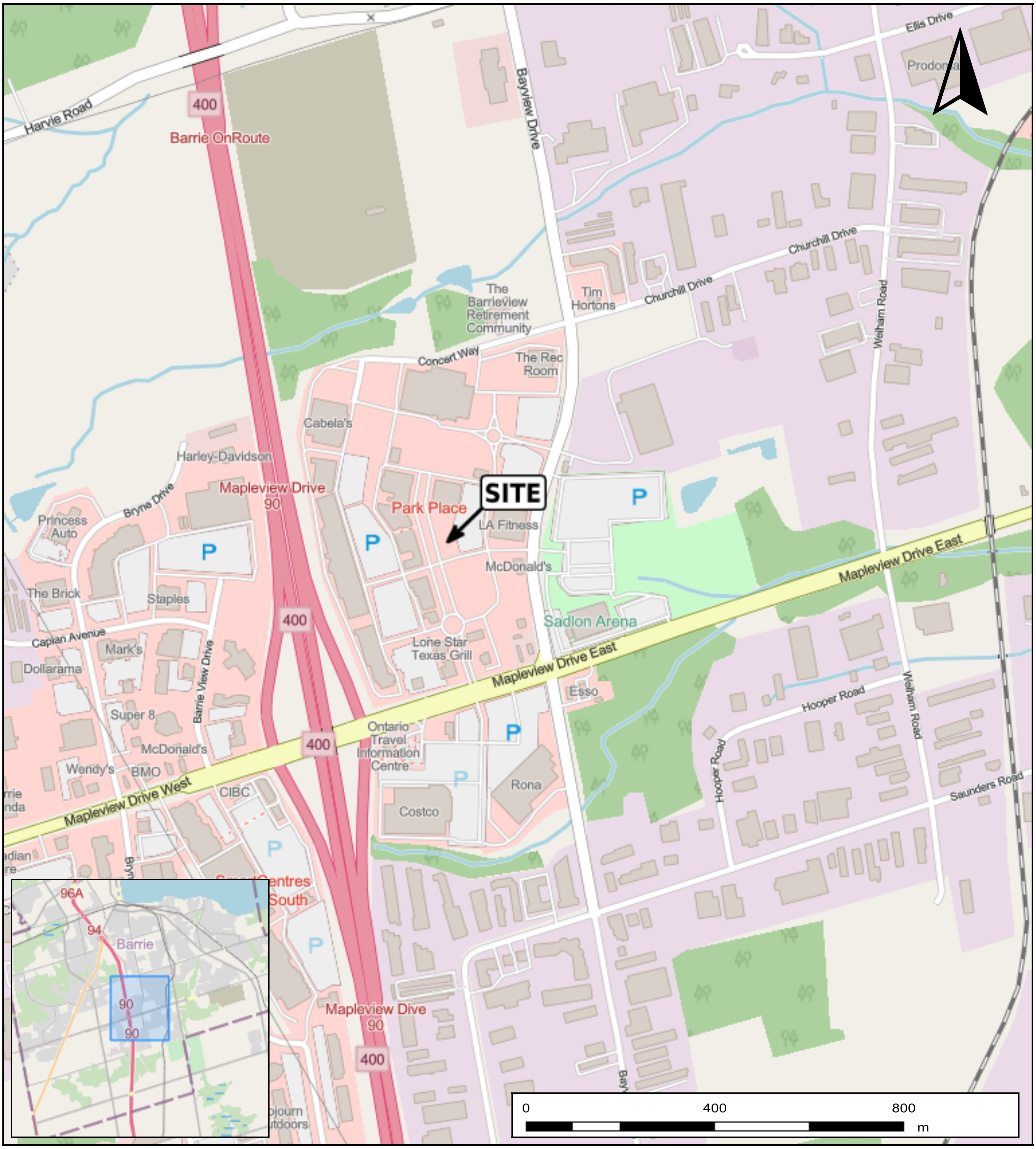
Specific limitations related to the legal and financial and limitations to the scope of the current work are outlined in our proposal, the attached Methodology and the Authorization to Proceed, Limitation of Liability and Terms of Engagement which accompanied the proposal.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

\\pinchin.com\ham\Job\296000s\0296908.000 NADG,100Mapleview,Barrie,EDR,HYDROGEO\0296908.005 NADG,100Mapleview,Barrie,EDR,GEO\Deliverables\FINAL\296908.005 FINAL PrelimGeotechReport,100 Mapleview Dr, Barrie,ON NADG Apr 2022.docx

Template: Master Geotechnical Investigation Report – Ontario, GEO, September 2, 2021

FIGURES



PROJECT NAME
PRELIMINARY GEOTECHNICAL INVESTIGATION

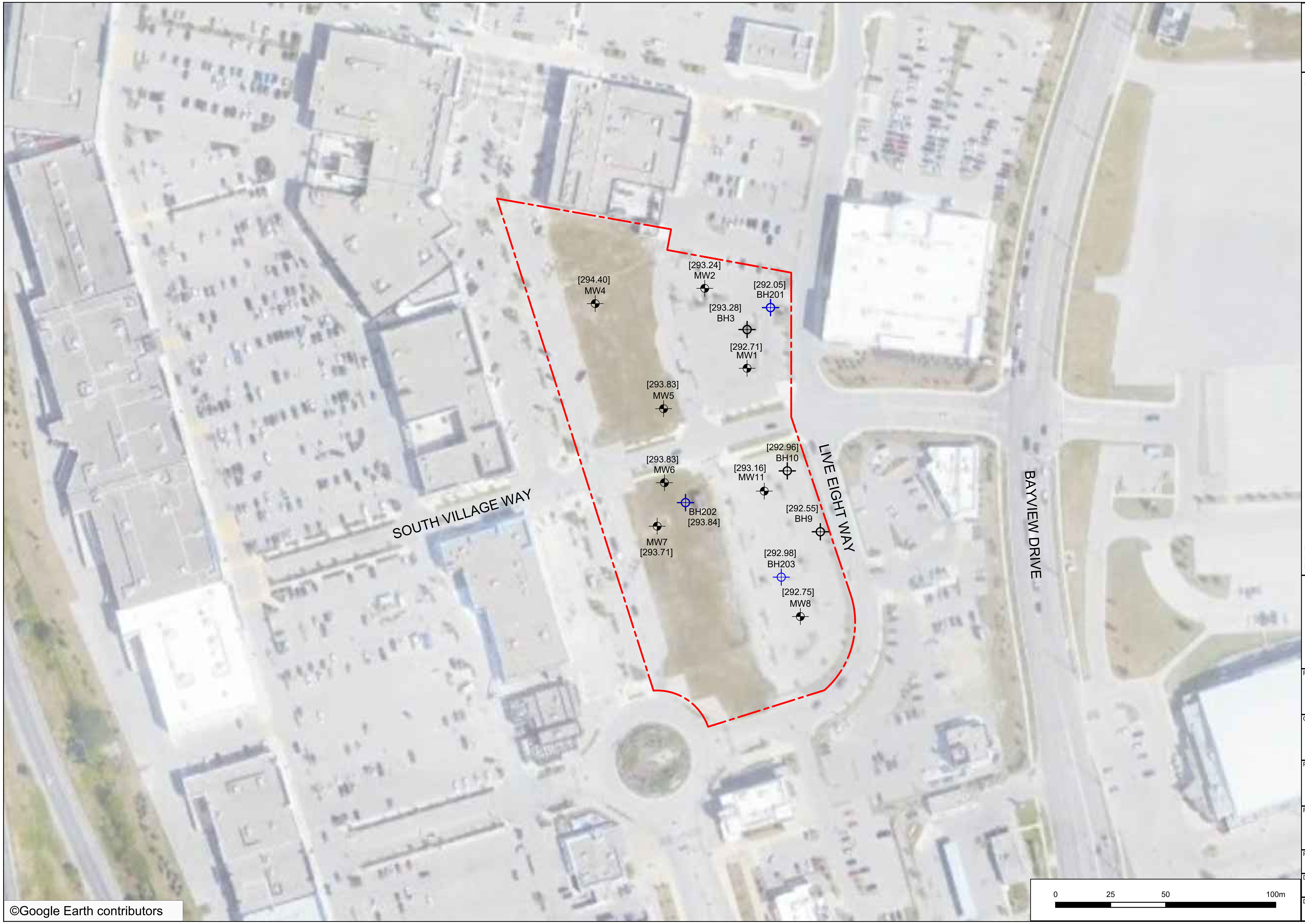
CLIENT NAME
NORTH AMERICAN DEVELOPMENT GROUP

PROJECT LOCATION
100 MAPLEVIEW DRIVE, BARRIE, ONTARIO

FIGURE NAME
KEY MAP

FIGURE NUMBER
1

PROJECT NUMBER	SCALE	DRAWN BY	REVIEWED BY	DATE
296908.005	1:15000	SR	KS	APRIL 2022



LEGEND

-·-	SITE BOUNDARY
⊕	BOREHOLE LOCATION
⊕	PHASE TWO ESA BH LOCATION
●	MONITORING WELL LOCATION
[#]	GROUND ELEVATION (masl)
masl	METRES ABOVE MEAN SEA LEVEL

LEGEND IS COLOUR DEPENDENT. NON-COLOUR COPIES MAY ALTER INTERPRETATION.

PINCHIN

PROJECT NAME:
PRELIMINARY GEOTECHNICAL INVESTIGATION

CLIENT NAME:
NORTH AMERICAN DEVELOPMENT GROUP

PROJECT LOCATION:
100 MAPLEVIEW DRIVE,
BARRIE, ONTARIO

FIGURE NAME:
BOREHOLE AND MONITORING WELL LOCATION PLAN

PROJECT NUMBER: 296908.005	SCALE: AS SHOWN
DRAWN BY: SR	REVIEWED BY: KS
DATE: APRIL 2022	FIGURE NUMBER: 2

APPENDIX I

Abbreviations, Terminology and Principle Symbols used in Report and Borehole Logs

ABBREVIATIONS, TERMINOLOGY & PRINCIPAL SYMBOLS USED

Sampling Method

AS	Auger Sample	**w**	Washed Sample
SS	Split Spoon Sample	**HQ**	Rock Core (63.5 mm diam.)
ST	Thin Walled Shelby Tube	**NQ**	Rock Core (47.5 mm diam.)
BS	Block Sample	**BQ**	Rock Core (36.5 mm diam.)

In-Situ Soil Testing

Standard Penetration Test (SPT), “N” value is the number of blows required to drive a 51 mm outside diameter spilt barrel sampler into the soil a distance of 300 mm with a 63.5 kg weight free falling a distance of 760 mm after an initial penetration of 150 mm has been achieved. The SPT, “N” value is a qualitative term used to interpret the compactness condition of cohesionless soils and is used only as a very approximation to estimate the consistency and undrained shear strength of cohesive soils.

Dynamic Cone Penetration Test (DCPT) is the number of blows required to drive a cone with a 60 degree apex attached to “A” size drill rods continuously into the soil for each 300 mm penetration with a 63.5 kg weight free falling a distance of 760 mm.

Cone Penetration Test (CPT) is an electronic cone point with a 10 cm2 base area with a 60 degree apex pushed through the soil at a penetration rate of 2 cm/s.

Field Vane Test (FVT) consists of a vane blade, a set of rods and torque measuring apparatus used to determine the undrained shear strength of cohesive soils.

Soil Descriptions

The soil descriptions and classifications are based on an expanded Unified Soil Classification System (USCS). The USCS classifies soils on the basis of engineering properties. The system divides soils into three major categories; coarse grained, fine grained and highly organic soils. The soil is then subdivided based on either gradation or plasticity characteristics. The classification excludes particles larger than 75 mm. To aid in quantifying material amounts by weight within the respective grain size fractions the following terms have been included to expand the USCS:

Soil Classification		Terminology	Proportion
Clay	< 0.002 mm		
Silt	0.002 to 0.06 mm	“trace”, trace sand, etc.	1 to 10%
Sand	0.075 to 4.75 mm	“some”, some sand, etc.	10 to 20%
Gravel	4.75 to 75 mm	Adjective, sandy, gravelly, etc.	20 to 35%
Cobbles	75 to 200 mm	And, and gravel, and silt, etc.	>35%
Boulders	>200 mm	Noun, Sand, Gravel, Silt, etc.	>35% and main fraction

Notes:

- Soil properties, such as strength, gradation, plasticity, structure, etcetera, dictate the soils engineering behaviour over grain size fractions; and
- With the exception of soil samples tested for grain size distribution or plasticity, all soil samples have been classified based on visual and tactile observations. The accuracy of visual and tactile observation is not sufficient to differentiate between changes in soil classification or precise grain size and is therefore an approximate description.

The following table outlines the qualitative terms used to describe the compactness condition of cohesionless soil:

Cohesionless Soil	
Compactness Condition	**SPT N-Index (blows per 300 mm)**
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

The following table outlines the qualitative terms used to describe the consistency of cohesive soils related to undrained shear strength and SPT, N-Index:

Cohesive Soil

Consistency	Undrained Shear Strength (kPa)	SPT N-Index (blows per 300 mm)
Very Soft	<12	<2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

Note: Utilizing the SPT, N-Index value to correlate the consistency and undrained shear strength of cohesive soils is only very approximate and needs to be used with caution.

Soil & Rock Physical Properties

General

W	Natural water content or moisture content within soil sample
γ	Unit weight
γ'	Effective unit weight
γ_d	Dry unit weight
γ_{sat}	Saturated unit weight
ρ	Density
ρ_s	Density of solid particles
ρ_w	Density of Water
ρ_d	Dry density
ρ_{sat}	Saturated density e Void ratio
n	Porosity
S_r	Degree of saturation
E_{50}	Strain at 50% maximum stress (cohesive soil)

Consistency

W_L	Liquid limit
W_P	Plastic Limit
I_P	Plasticity Index
W_S	Shrinkage Limit
I_L	Liquidity Index
I_C	Consistency Index
e_{max}	Void ratio in loosest state
e_{min}	Void ratio in densest state
I_D	Density Index (formerly relative density)

Shear Strength

C_u, S_u	Undrained shear strength parameter (total stress)
C'_d	Drained shear strength parameter (effective stress)
r	Remolded shear strength
τ_p	Peak residual shear strength
τ_r	Residual shear strength
ø’	Angle of interface friction, coefficient of friction = tan ø’

Consolidation (One Dimensional)

C_C	Compression index (normally consolidated range)
C_r	Recompression index (over consolidated range)
C_S	Swelling index
m_V	Coefficient of volume change
c_V	Coefficient of consolidation
T_V	Time factor (vertical direction)
U	Degree of consolidation
σ'_o	Overburden pressure
σ’p	Preconsolidation pressure (most probable)
OCR	Overconsolidation ratio

Permeability

The following table outlines the terms used to describe the degree of permeability of soil and common soil types associated with the permeability rates**:**

Permeability (k cm/s)	Degree of Permeability	Common Associated Soil Type
$> 10^{-1}$	Very High	Clean gravel
10^{-1} to 10^{-3}	High	Clean sand, Clean sand and gravel
10^{-3} to 10^{-5}	Medium	Fine sand to silty sand
10^{-5} to 10^{-7}	Low	Silt and clayey silt (low plasticity)
$>10^{-7}$	Practically Impermeable	Silty clay (medium to high plasticity)

Rock Coring

Rock Quality Designation (RQD) is an indirect measure of the number of fractures within a rock mass, Deere et al. (1967). It is the sum of sound pieces of rock core equal to or greater than 100 mm recovered from the core run, divided by the total length of the core run, expressed as a percentage. If the core section is broken due to mechanical or handling, the pieces are fitted together and if 100 mm or greater included in the total sum**.**

RQD is calculated as follows:

$$\text{RQD (\%)} = \frac{\Sigma \text{ Length of core pieces} > 100 \text{ mm} \times 100}{\text{Total length of core run}}$$

The following is the Classification of Rock with Respect to RQD Value:

RQD Classification	RQD Value (%)
Very poor quality	**<25**
Poor quality	25 to 50
Fair quality	50 to 75
Good quality	75 to 90
Excellent quality	90 to 100

APPENDIX II

Pinchin's Borehole Logs

Log of Borehole: MW1

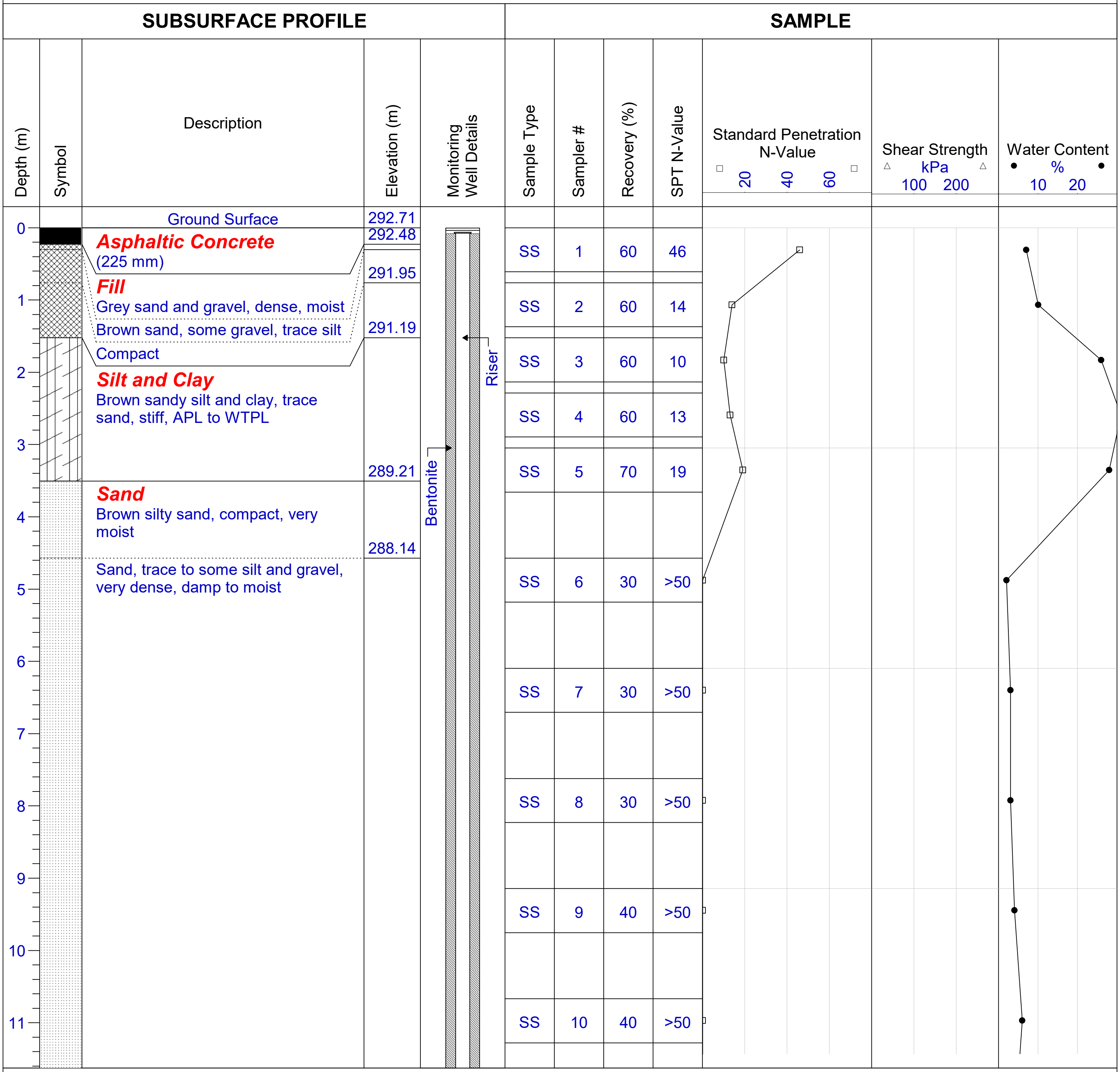
Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 10, 2022 **Project Manager:** KRD



SUBSURFACE PROFILE

Description	Elevation (m)
Ground Surface	292.71
Asphaltic Concrete (225 mm)	292.48
Fill Grey sand and gravel, dense, moist	291.95
Brown sand, some gravel, trace silt Compact	291.19
Silt and Clay Brown sandy silt and clay, trace sand, stiff, APL to WTPL	289.21
Sand Brown silty sand, compact, very moist	288.14
Sand, trace to some silt and gravel, very dense, damp to moist	

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	60	46
SS	2	60	14
SS	3	60	10
SS	4	60	13
SS	5	70	19
SS	6	30	>50
SS	7	30	>50
SS	8	30	>50
SS	9	40	>50
SS	10	40	>50

Contractor: Pontil Drilling Ltd. **Grade Elevation:** 292.71 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** 292.60 masl

Well Casing Size: 51 mm **Sheet:** 1 of 2

Log of Borehole: MW1

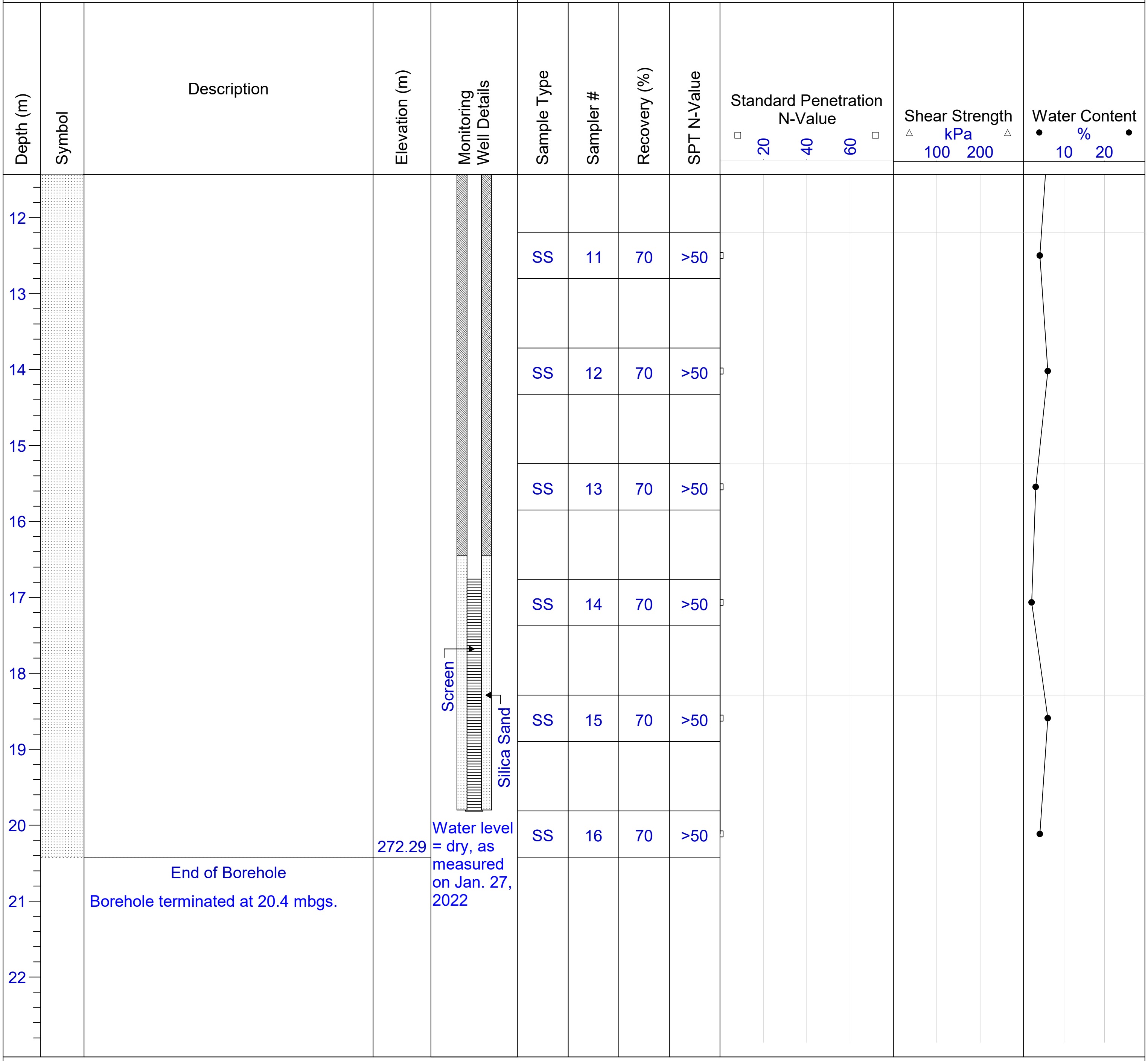
Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 10, 2022 **Project Manager:** KRD



SUBSURFACE PROFILE			SAMPLE				
Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	
			SS	11	70	>50	
			SS	12	70	>50	
			SS	13	70	>50	
			SS	14	70	>50	
			SS	15	70	>50	
	272.29	Water level = dry, as measured on Jan. 27, 2022	SS	16	70	>50	
End of Borehole Borehole terminated at 20.4 mbgs.							

Contractor: Pontil Drilling Ltd.

Grade Elevation: 292.71 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: 292.60 masl

Well Casing Size: 51 mm

Sheet: 2 of 2

Log of Borehole: MW2

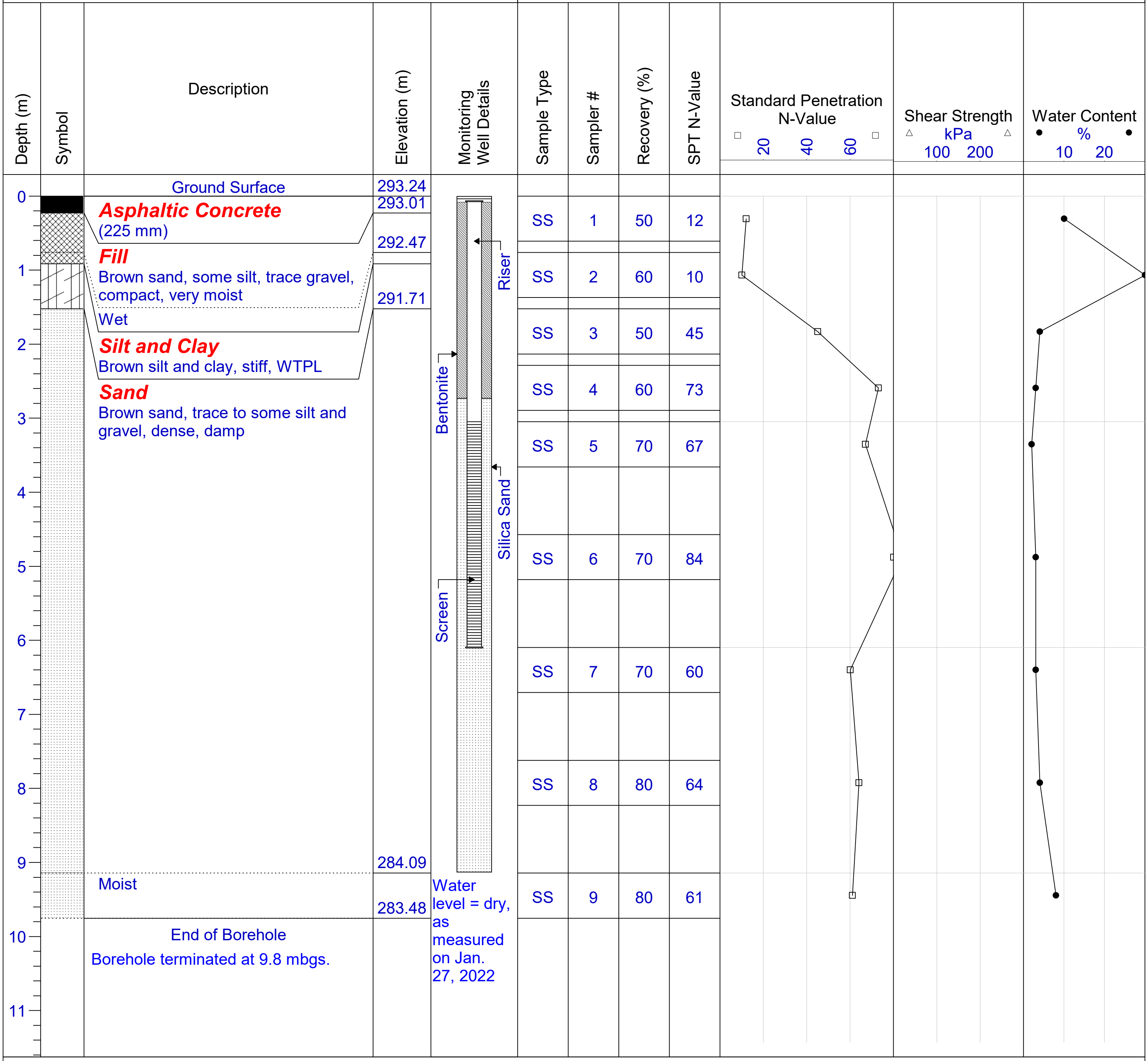
Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 10, 2022 **Project Manager:** KRD



Elevation (m)	Description
293.24	Ground Surface
293.01	**Asphaltic Concrete** (225 mm)
292.47	**Fill** Brown sand, some silt, trace gravel, compact, very moist
	Wet
291.71	**Silt and Clay** Brown silt and clay, stiff, WTPL
	Sand Brown sand, trace to some silt and gravel, dense, damp
284.09	Moist
283.48	End of Borehole Borehole terminated at 9.8 mbgs.

Water level = dry, as measured on Jan. 27, 2022

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	50	12
SS	2	60	10
SS	3	50	45
SS	4	60	73
SS	5	70	67
SS	6	70	84
SS	7	70	60
SS	8	80	64
SS	9	80	61

Contractor: Pontil Drilling Ltd. **Grade Elevation:** 293.24 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** 293.14 masl

Well Casing Size: 51 mm **Sheet:** 1 of 1

Log of Borehole: BH3

Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 12, 2022 **Project Manager:** KRD

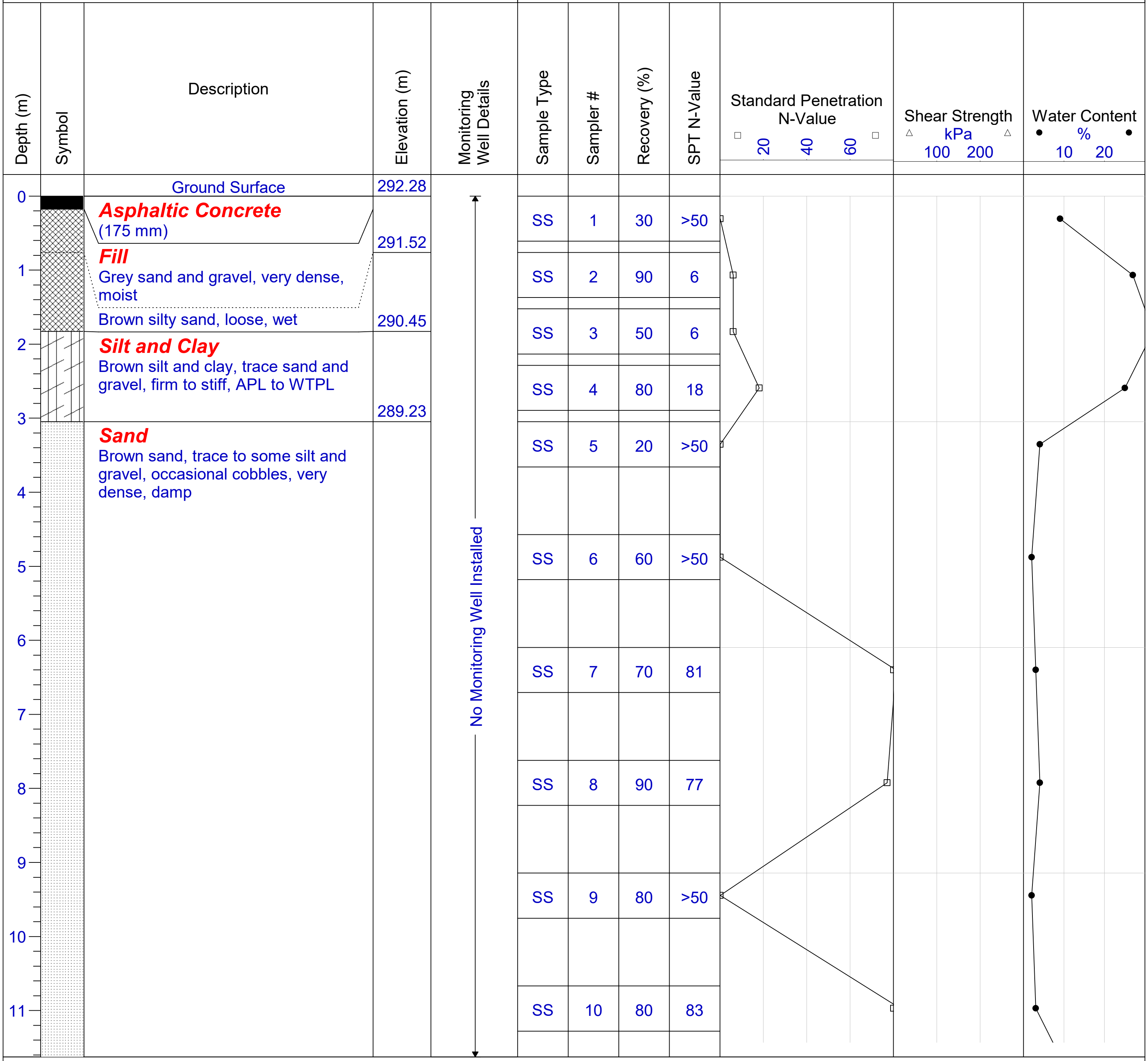
SUBSURFACE PROFILE

Description	Elevation (m)
Ground Surface	292.28
Asphaltic Concrete (175 mm)	
Fill Grey sand and gravel, very dense, moist	291.52
Brown silty sand, loose, wet	290.45
Silt and Clay Brown silt and clay, trace sand and gravel, firm to stiff, APL to WTPL	289.23
Sand Brown sand, trace to some silt and gravel, occasional cobbles, very dense, damp	

Monitoring Well Details: No Monitoring Well Installed

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	30	>50
SS	2	90	6
SS	3	50	6
SS	4	80	18
SS	5	20	>50
SS	6	60	>50
SS	7	70	81
SS	8	90	77
SS	9	80	>50
SS	10	80	83



Contractor: Pontil Drilling Ltd. **Grade Elevation:** 292.28 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** N/A

Well Casing Size: N/A **Sheet:** 1 of 2

Log of Borehole: BH3

Project #: 296908.005 **Logged By:** KS

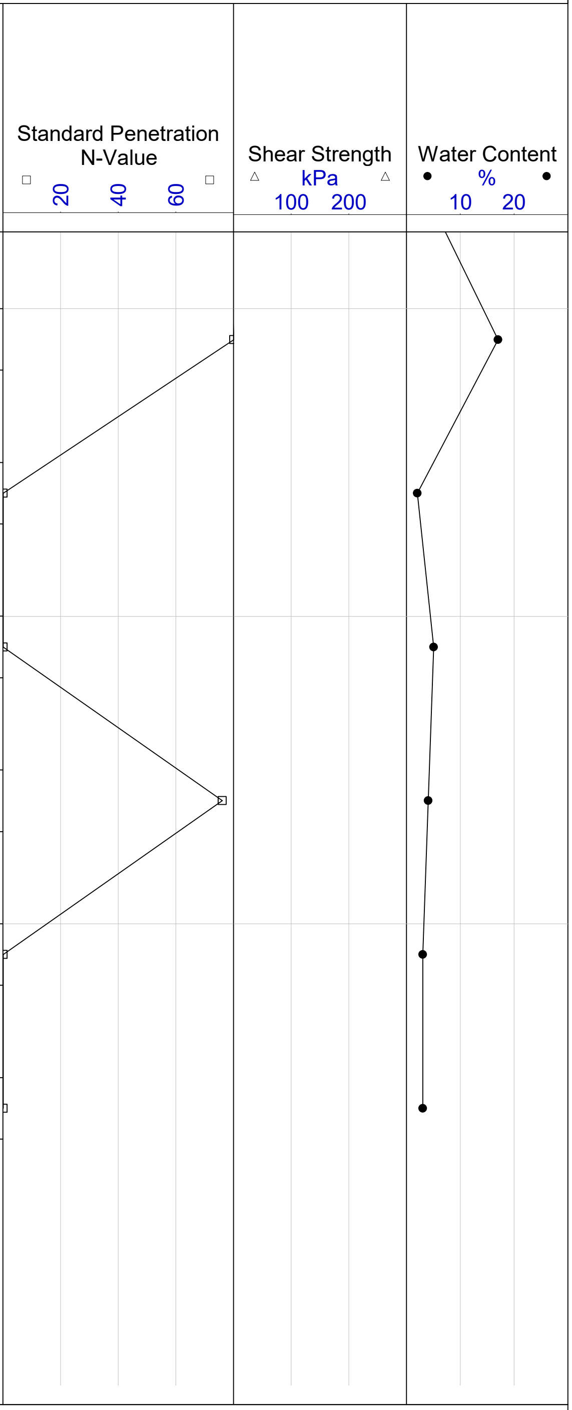
Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 12, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE					SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value
12								
		Wet	280.09		SS	11	80	80
13								
14		Damp	278.57		SS	12	80	>50
15					SS	13	80	>50
16								
17					SS	14	80	76
18					SS	15	50	>50
19								
20			271.86		SS	16	80	>50
21		End of Borehole Borehole terminated at 20.4 mbgs. At drilling completion a dry cave was measured at 19.5 mbgs.						
22								



Contractor: Pontil Drilling Ltd.

Drilling Method: Split Spoon / Hollow Stem Auger

Well Casing Size: N/A

Grade Elevation: 292.28 masl

Top of Casing Elevation: N/A

Sheet: 2 of 2

Log of Borehole: MW4

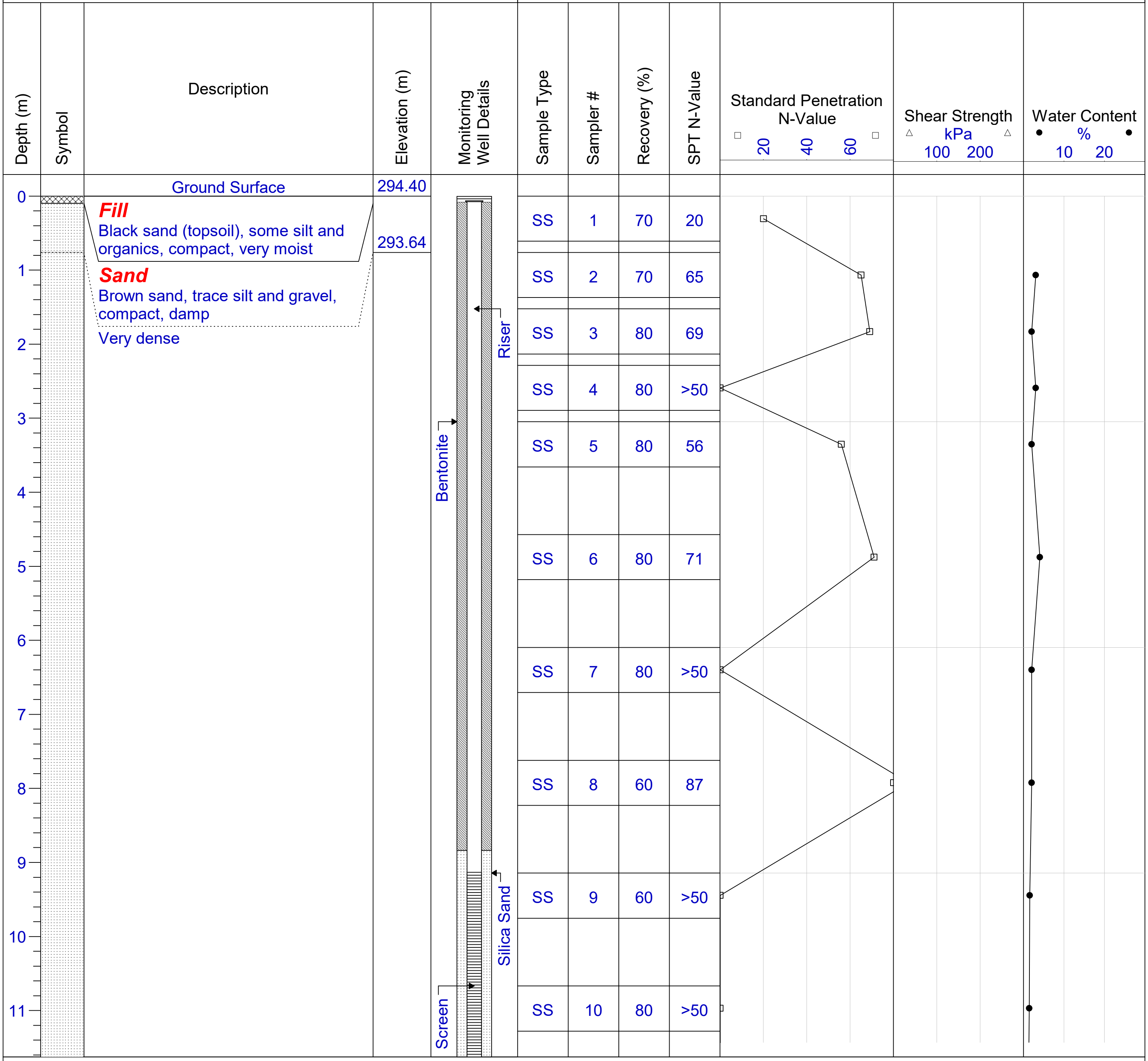
Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 12, 2022 **Project Manager:** KRD



SUBSURFACE PROFILE		SAMPLE			
Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value
Ground Surface	294.40				
Fill Black sand (topsoil), some silt and organics, compact, very moist		SS	1	70	20
Sand Brown sand, trace silt and gravel, compact, damp	293.64	SS	2	70	65
		SS	3	80	69
Very dense		SS	4	80	>50
		SS	5	80	56
		SS	6	80	71
		SS	7	80	>50
		SS	8	60	87
		SS	9	60	>50
		SS	10	80	>50

Contractor: Pontil Drilling Ltd.

Drilling Method: Split Spoon / Hollow Stem Auger

Well Casing Size: 51 mm

Grade Elevation: 294.40 masl

Top of Casing Elevation: 295.23 masl

Sheet: 1 of 2

Log of Borehole: MW4

Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 12, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE					SAMPLE						
Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value □ 20 40 60 □	Shear Strength △ kPa △ 100 200	Water Content ● % ● 10 20
12			281.60	Water level = dry, as measured on Jan. 27, 2022.	SS	11	80	>50			●
13		End of Borehole Borehole terminated at 12.8 mbgs.									
14											
15											
16											
17											
18											
19											
20											
21											
22											

Contractor: Pontil Drilling Ltd. **Grade Elevation:** 294.40 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** 295.23 masl

Well Casing Size: 51 mm **Sheet:** 2 of 2

Log of Borehole: MW5

Project #: 296908.005
Logged By: KS
Project: Preliminary Geotechnical Investigation
Client: North American Development Group
Location: 100 Mapleview Drive East, Barrie, Ontario
Drill Date: January 12, 2022
Project Manager: KRD

SUBSURFACE PROFILE

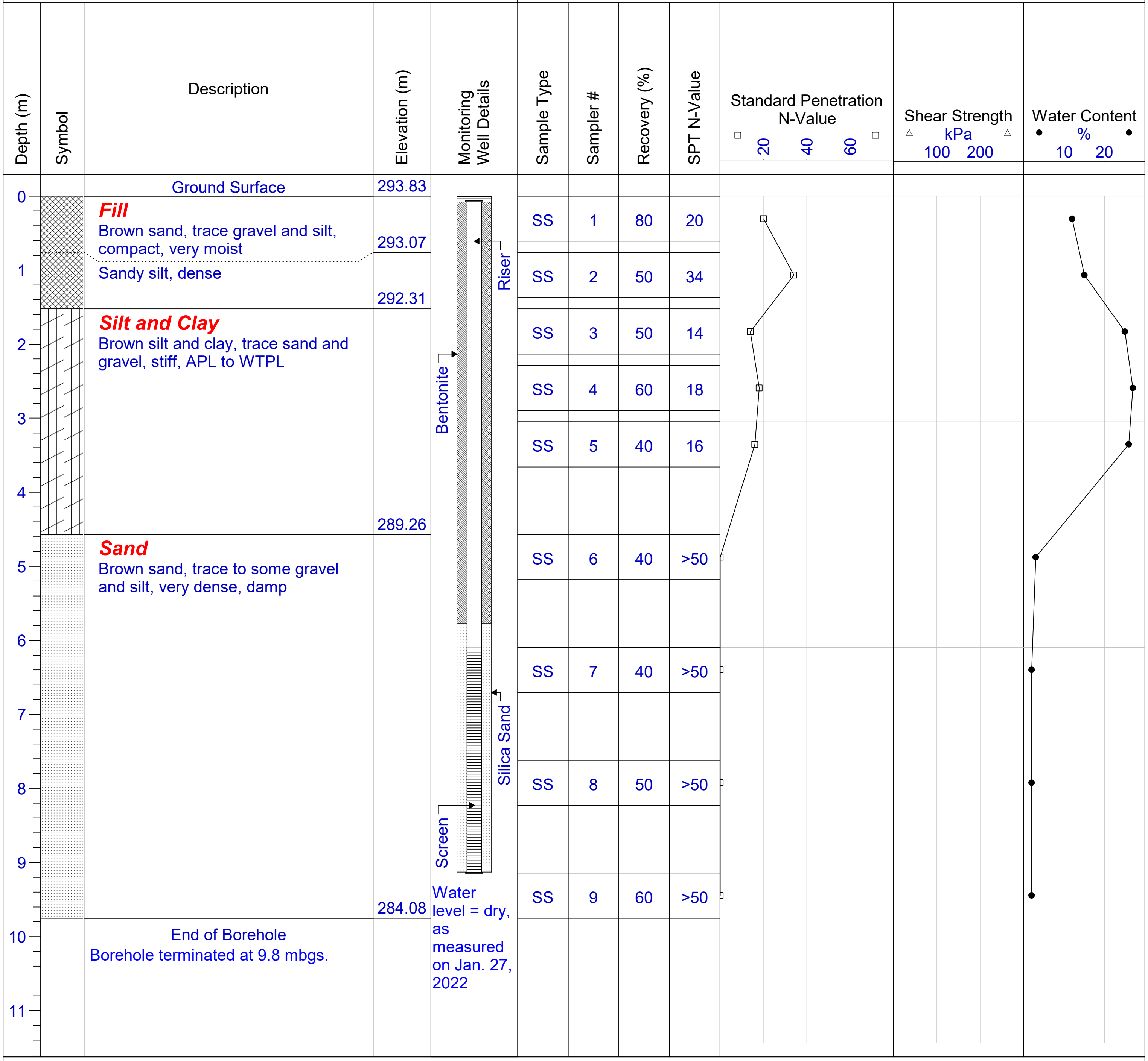
Depth (m)	Description	Elevation (m)
0	Ground Surface	293.83
0 – 0.76	**Fill** Brown sand, trace gravel and silt, compact, very moist	293.07
0.76 – 1.52	Sandy silt, dense	292.31
1.52 – 4.57	**Silt and Clay** Brown silt and clay, trace sand and gravel, stiff, APL to WTPL	289.26
4.57 – 9.75	**Sand** Brown sand, trace to some gravel and silt, very dense, damp	284.08
	End of Borehole Borehole terminated at 9.8 mbgs.	

Monitoring Well Details: Riser; Bentonite; Silica Sand; Screen

Water level = dry, as measured on Jan. 27, 2022

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	80	20
SS	2	50	34
SS	3	50	14
SS	4	60	18
SS	5	40	16
SS	6	40	>50
SS	7	40	>50
SS	8	50	>50
SS	9	60	>50



Contractor: Pontil Drilling Ltd.
Grade Elevation: 293.83 masl
Drilling Method: Split Spoon / Hollow Stem Auger
Top of Casing Elevation: 294.63 masl
Well Casing Size: 51 mm
Sheet: 1 of 1

Log of Borehole: MW6

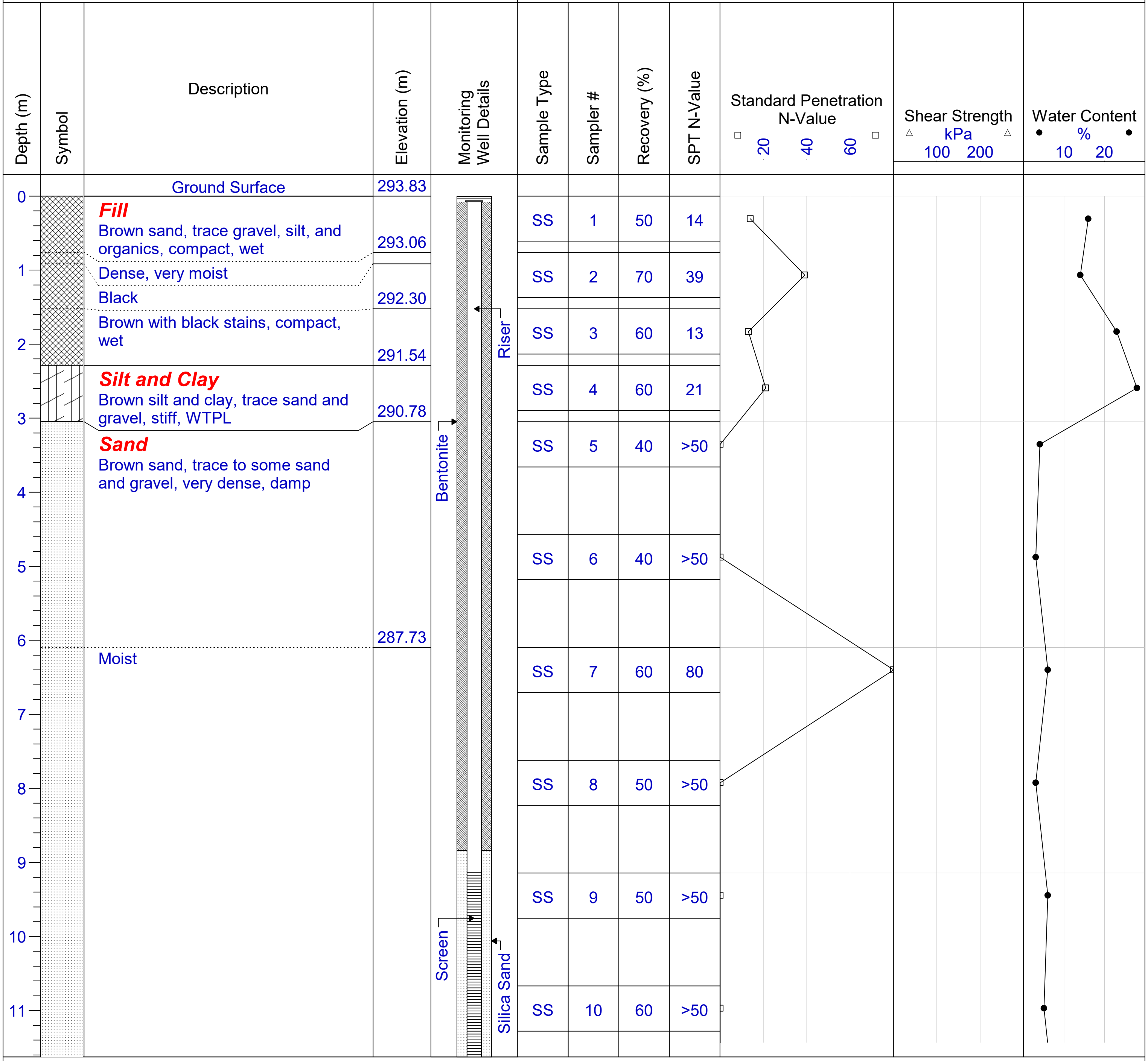
Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 13, 2022 **Project Manager:** KRD



Description	Elevation (m)
Ground Surface	293.83
Fill Brown sand, trace gravel, silt, and organics, compact, wet	293.06
Dense, very moist	
Black	292.30
Brown with black stains, compact, wet	291.54
Silt and Clay Brown silt and clay, trace sand and gravel, stiff, WTPL	290.78
Sand Brown sand, trace to some sand and gravel, very dense, damp	287.73
Moist	

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	50	14
SS	2	70	39
SS	3	60	13
SS	4	60	21
SS	5	40	>50
SS	6	40	>50
SS	7	60	80
SS	8	50	>50
SS	9	50	>50
SS	10	60	>50

Contractor: Pontil Drilling Ltd. **Grade Elevation:** 293.83 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** 294.61 masl

Well Casing Size: 51 mm **Sheet:** 1 of 2

Log of Borehole: MW6

Project #: 296908.005 **Logged By:** KS

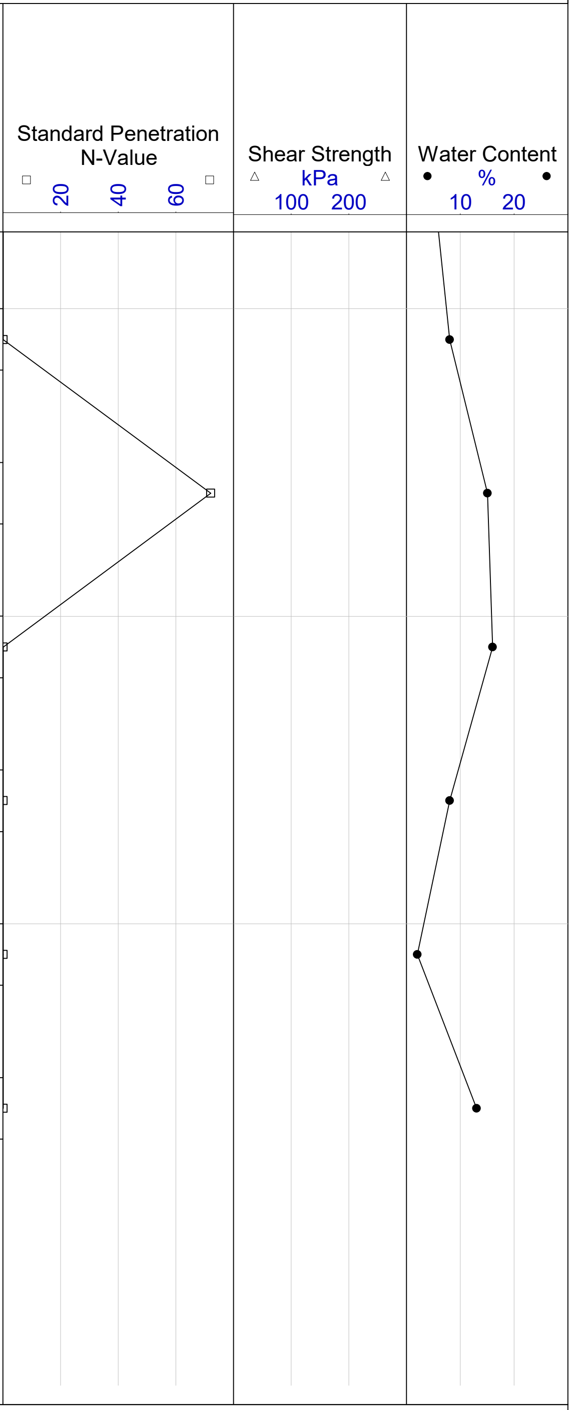
Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 13, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE					SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value
12–13			280.11	Water level = dry, as measured on Jan. 27, 2022	SS	11	50	>50
14–15		Very moist	278.59		SS	12	70	72
15–16		Wet	277.06		SS	13	70	>50
17–18		Moist	275.54		SS	14	70	>50
18–19		Damp	274.01		SS	15	50	>50
20		Wet	273.41		SS	16	60	>50
21–22		End of Borehole Borehole terminated at 20.4 mbgs.						



Contractor: Pontil Drilling Ltd.

Drilling Method: Split Spoon / Hollow Stem Auger

Well Casing Size: 51 mm

Grade Elevation: 293.83 masl

Top of Casing Elevation: 294.61 masl

Sheet: 2 of 2

Log of Borehole: MW7 (Shallow)

Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

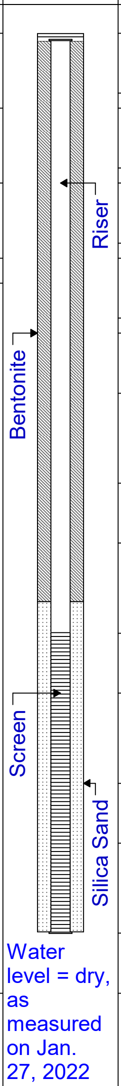
Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 14, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE

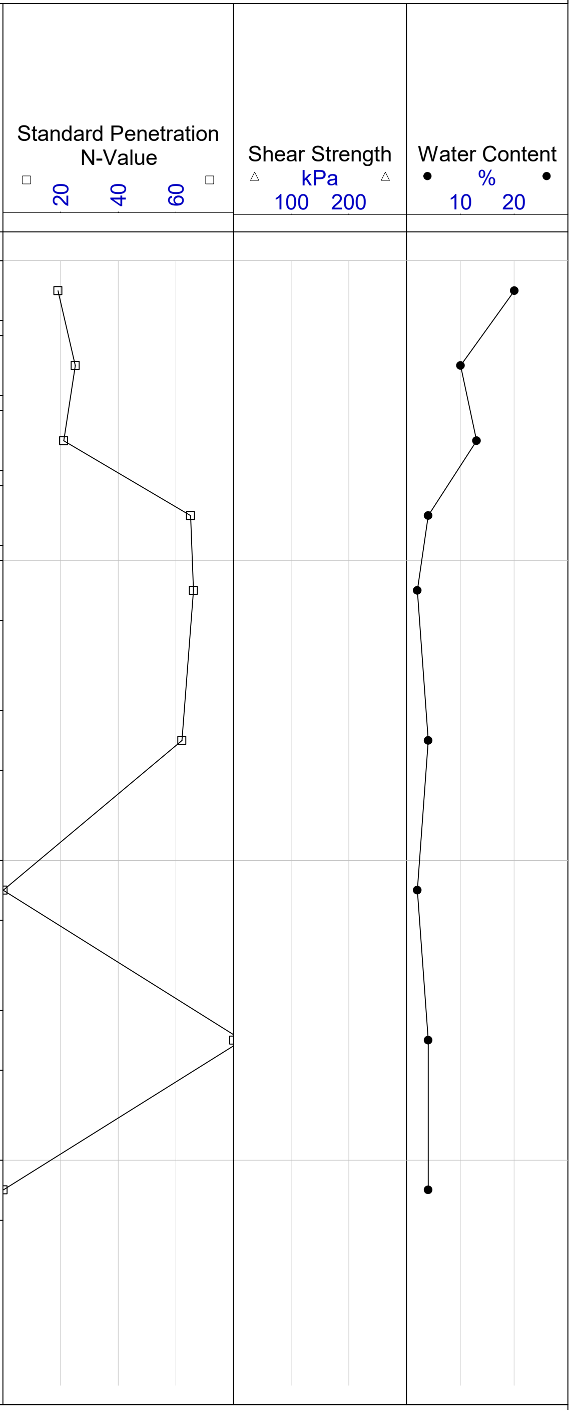
Description	Elevation (m)
Ground Surface	293.71
Fill Brown sand, some gravel, trace silt, compact, wet	292.95
Grey, very moist	292.19
Brown silty sand	291.42
Silt and Clay Brown silt and clay, trace sand and gravel, stiff, APL	291.17
Sand Brown sand, trace to some silt and gravel, very dense, damp	283.96
End of Borehole Borehole terminated at 9.8 mbgs.	



Water level = dry, as measured on Jan. 27, 2022

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	20	19
SS	2	50	25
SS	3	60	21
SS	4	60	65
SS	5	70	66
SS	6	70	62
SS	7	70	>50
SS	8	80	83
SS	9	80	>50



Contractor: Pontil Drilling Ltd. **Grade Elevation:** 293.71 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** 294.52 masl

Well Casing Size: 51 mm **Sheet:** 1 of 1

Log of Borehole: MW7 (Deep)

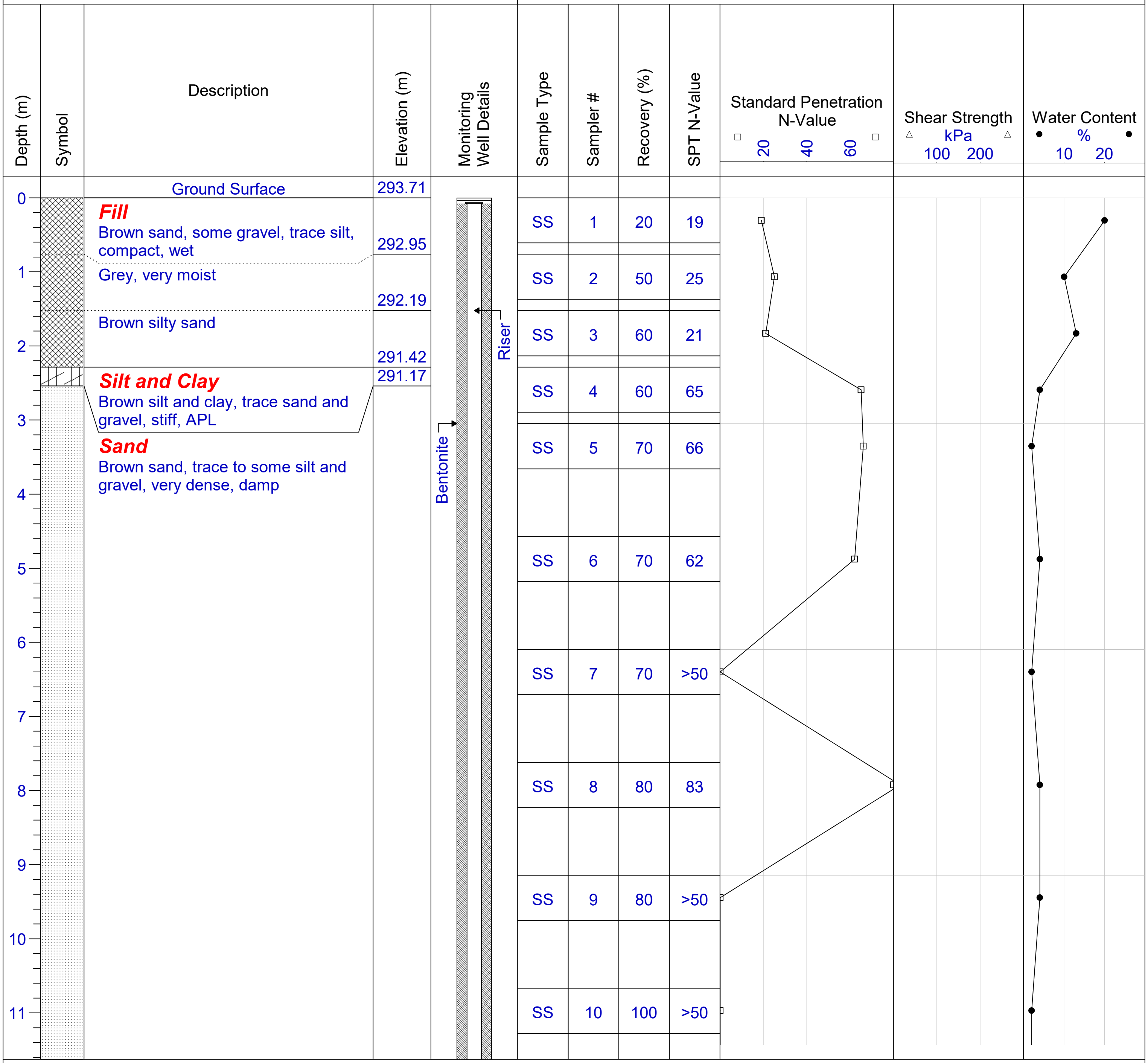
Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 14, 2022 **Project Manager:** KRD



SUBSURFACE PROFILE

Description	Elevation (m)
Ground Surface	293.71
Fill Brown sand, some gravel, trace silt, compact, wet	292.95
Grey, very moist	292.19
Brown silty sand	291.42
Silt and Clay Brown silt and clay, trace sand and gravel, stiff, APL	291.17
Sand Brown sand, trace to some silt and gravel, very dense, damp	

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	20	19
SS	2	50	25
SS	3	60	21
SS	4	60	65
SS	5	70	66
SS	6	70	62
SS	7	70	>50
SS	8	80	83
SS	9	80	>50
SS	10	100	>50

Contractor: Pontil Drilling Ltd.

Drilling Method: Split Spoon / Hollow Stem Auger

Well Casing Size: 51 mm

Grade Elevation: 293.71 masl

Top of Casing Elevation: 294.56 masl

Sheet: 1 of 2

Log of Borehole: MW7 (Deep)

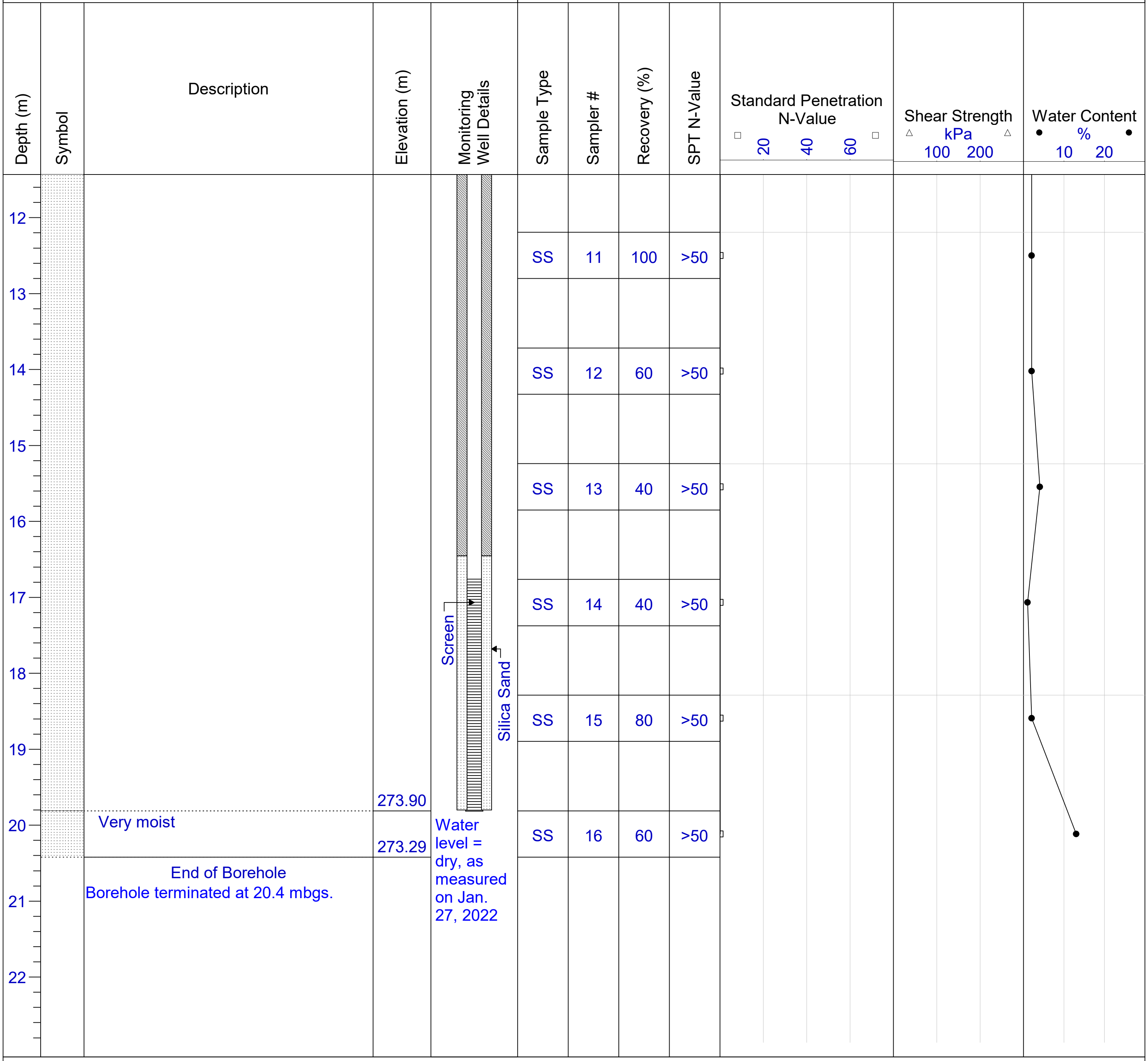
Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 14, 2022 **Project Manager:** KRD



Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value
			SS	11	100	>50
			SS	12	60	>50
			SS	13	40	>50
			SS	14	40	>50
			SS	15	80	>50
Very moist	273.90	Water level = dry, as measured on Jan. 27, 2022	SS	16	60	>50
End of Borehole Borehole terminated at 20.4 mbgs.	273.29					

Contractor: Pontil Drilling Ltd. **Grade Elevation:** 293.71 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** 294.56 masl

Well Casing Size: 51 mm **Sheet:** 2 of 2

Log of Borehole: MW8

Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

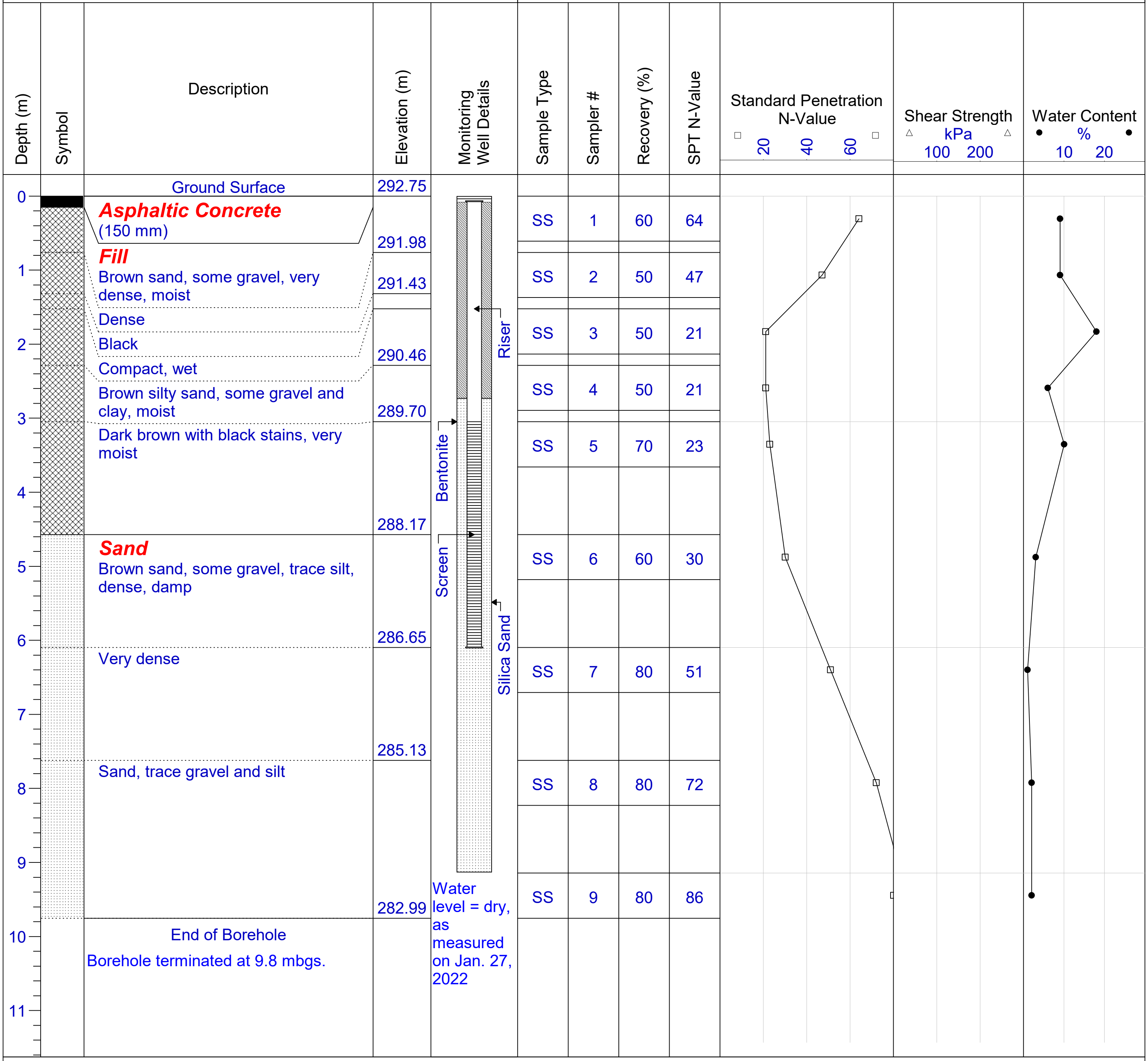
Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 14, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE

SAMPLE



Ground Surface 292.75

Asphaltic Concrete (150 mm)

291.98

Fill
Brown sand, some gravel, very dense, moist

291.43

Dense

Black

290.46

Compact, wet

Brown silty sand, some gravel and clay, moist

289.70

Dark brown with black stains, very moist

288.17

Sand
Brown sand, some gravel, trace silt, dense, damp

286.65

Very dense

285.13

Sand, trace gravel and silt

282.99

End of Borehole

Borehole terminated at 9.8 mbgs.

Water level = dry, as measured on Jan. 27, 2022

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	60	64
SS	2	50	47
SS	3	50	21
SS	4	50	21
SS	5	70	23
SS	6	60	30
SS	7	80	51
SS	8	80	72
SS	9	80	86

Contractor: Pontil Drilling Ltd. **Grade Elevation:** 292.75 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** 292.65 masl

Well Casing Size: 51 mm **Sheet:** 1 of 1

Log of Borehole: BH9

Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

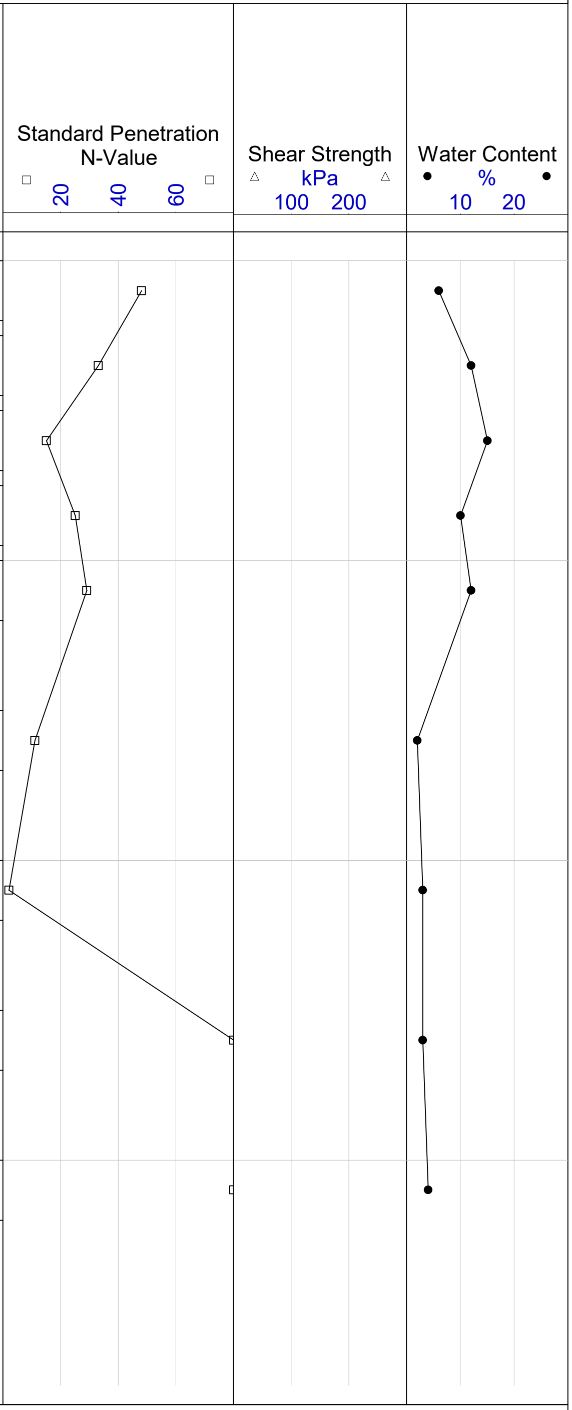
Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 14, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE | SAMPLE

Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value
Ground Surface	292.55	No Monitoring Well Installed				
Asphaltic Concrete (175 mm)	291.78		SS	1	60	48
Fill Brown sand, some gravel, trace silt, dense, moist	291.02		SS	2	60	33
Very moist Wet	290.26		SS	3	60	15
Black, very moist	289.50		SS	4	60	25
Brown silty sand, trace gravel and organics	287.97		SS	5	60	29
Sand Brown sand, some gravel, compact, damp	286.45		SS	6	40	11
Sand, trace to some silt and gravel, very loose	284.93		SS	7	80	2
Very dense	282.79		SS	8	70	80
			SS	9	80	87
End of Borehole Borehole terminated at 9.8 mbgs.						



Contractor: Pontil Drilling Ltd. **Grade Elevation:** 292.55 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** N/A

Well Casing Size: N/A **Sheet:** 1 of 1

Log of Borehole: BH10

Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 18, 2022 **Project Manager:** KRD

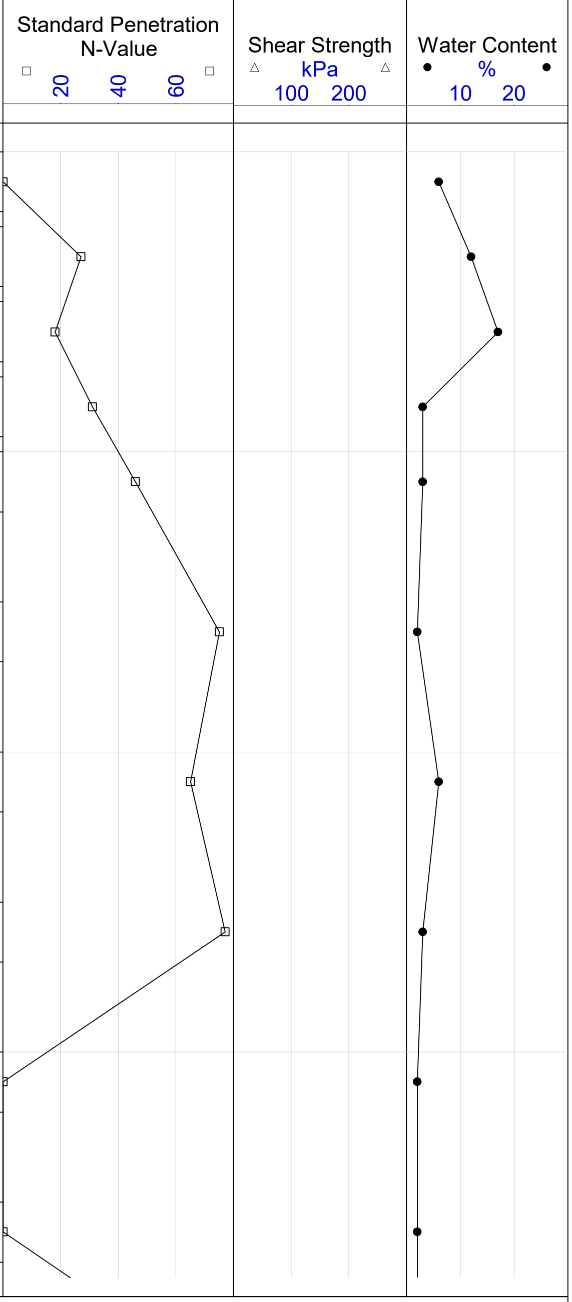
SUBSURFACE PROFILE

Description	Elevation (m)
Ground Surface	292.96
Asphaltic Concrete (125 mm)	292.50
Fill	292.20
Brown sand, some gravel, very dense, moist	291.44
Dark grey/black	
Brown, compact, very moist	
Sand, some gravel and silt, wet	290.52
Sand Brown sand, some gravel, trace silt, dense, damp	289.91
Sand, trace gravel	288.39
Very dense	286.87
Moist	285.34
Damp	

Monitoring Well Details: No Monitoring Well Installed

SAMPLE

Depth (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value
0	SS	1	60	>50
1	SS	2	80	27
2	SS	3	80	18
	SS	4	60	31
3	SS	5	70	46
5	SS	6	70	75
6	SS	7	70	65
8	SS	8	60	77
9	SS	9	70	>50
11	SS	10	80	>50



Contractor: Pontil Drilling Ltd. **Grade Elevation:** 292.96 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** N/A

Well Casing Size: N/A **Sheet:** 1 of 2

Log of Borehole: BH10

Project #: 296908.005 **Logged By:** KS

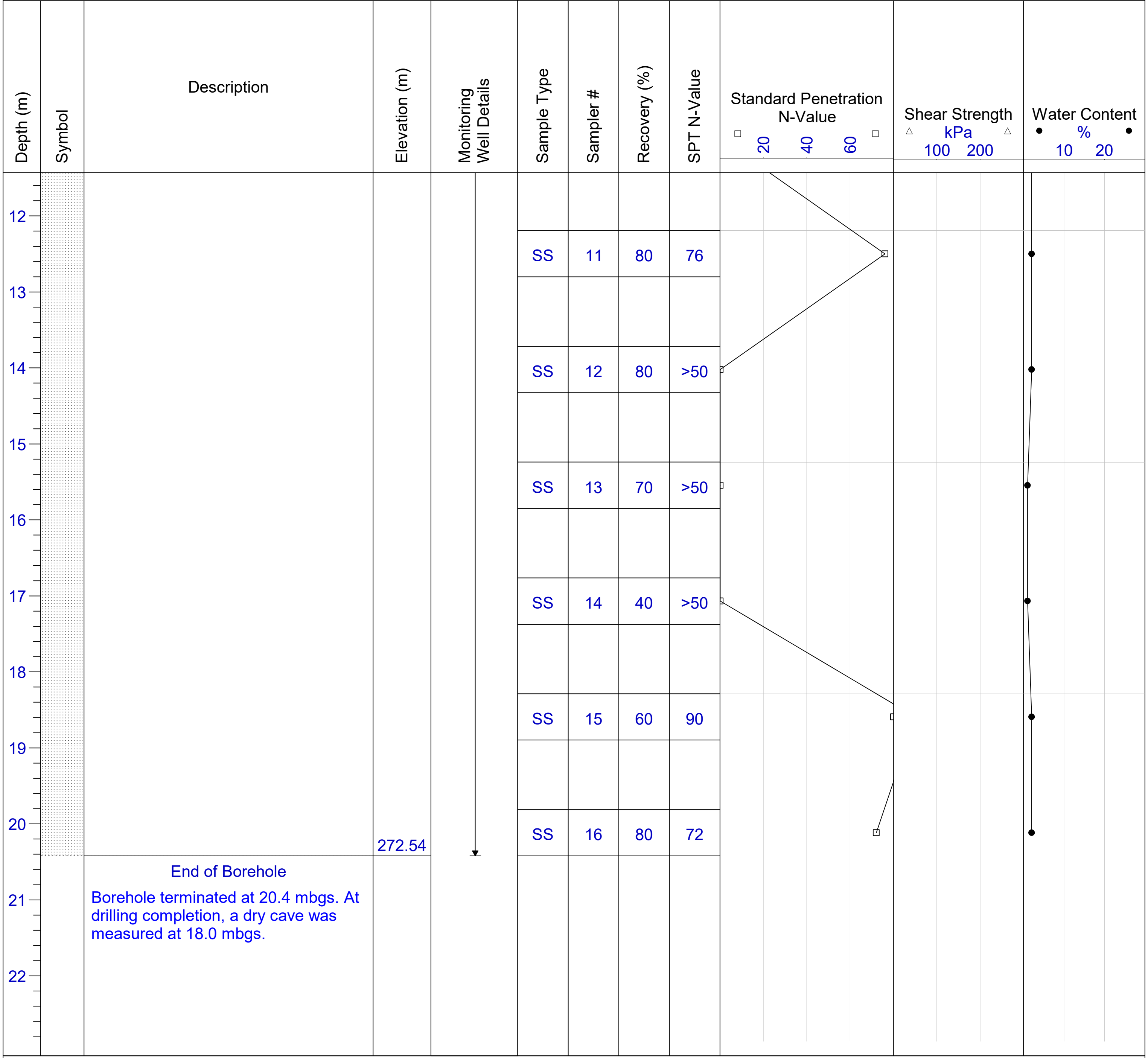
Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 18, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE					SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value
					SS	11	80	76
					SS	12	80	>50
					SS	13	70	>50
					SS	14	40	>50
					SS	15	60	90
			272.54		SS	16	80	72
		End of Borehole Borehole terminated at 20.4 mbgs. At drilling completion, a dry cave was measured at 18.0 mbgs.						



Contractor: Pontil Drilling Ltd.

Drilling Method: Split Spoon / Hollow Stem Auger

Well Casing Size: N/A

Grade Elevation: 292.96 masl

Top of Casing Elevation: N/A

Sheet: 2 of 2

Log of Borehole: MW11

Project #: 296908.005 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: North American Development Group

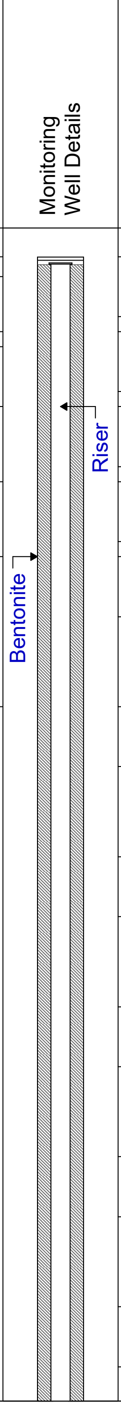
Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 18, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE

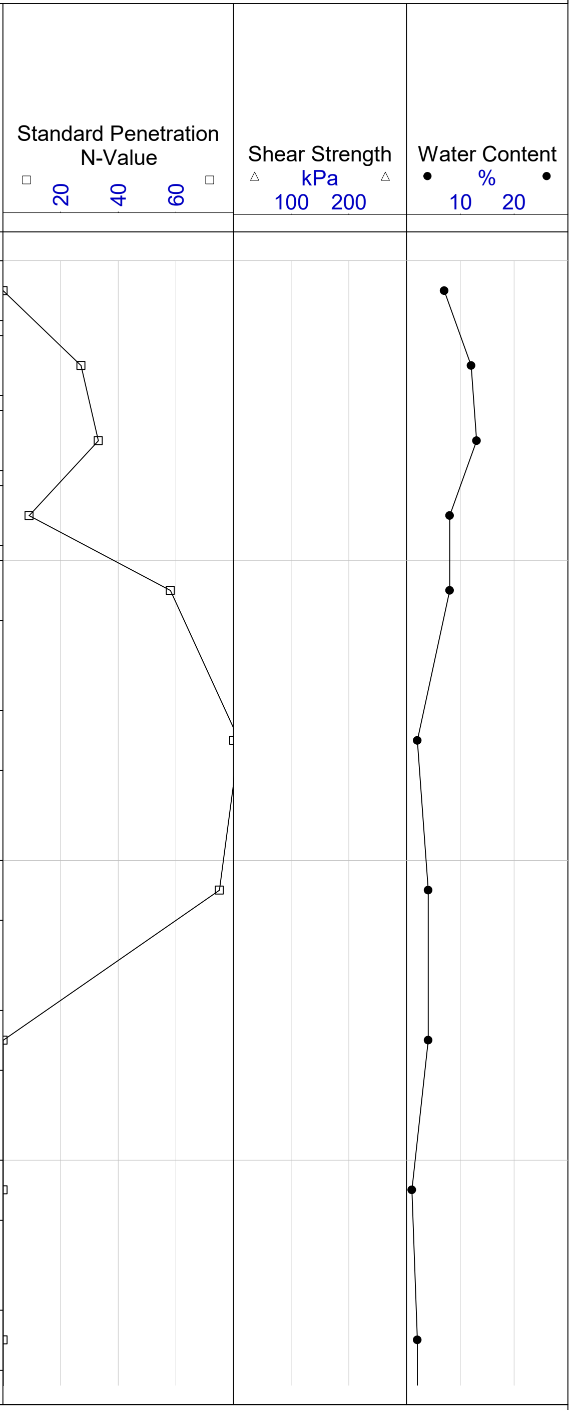
Depth (m)	Description	Elevation (m)
0	Ground Surface	293.16
0–0.2	**Asphaltic Concrete** (200 mm)	
		292.39
	Fill Brown sand, some gravel, trace silt, very dense, moist	
		291.63
	Sand, trace gravel and silt, compact, very moist	
		290.87
	Black	
	Dark brown, dense	
	Brown, loose, moist	290.11
	Sand Brown sand, trace to some gravel and silt, very dense, moist	
		288.58
	Damp	

Monitoring Well Details



SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	30	>50
SS	2	70	27
SS	3	60	33
SS	4	70	9
SS	5	70	58
SS	6	70	82
SS	7	80	75
SS	8	70	>50
SS	9	60	>50
SS	10	50	>50



Contractor: Pontil Drilling Ltd. **Grade Elevation:** 293.16 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** 293.02 masl

Well Casing Size: 51 mm **Sheet:** 1 of 2

Log of Borehole: MW11

Project #: 296908.005 **Logged By:** KS

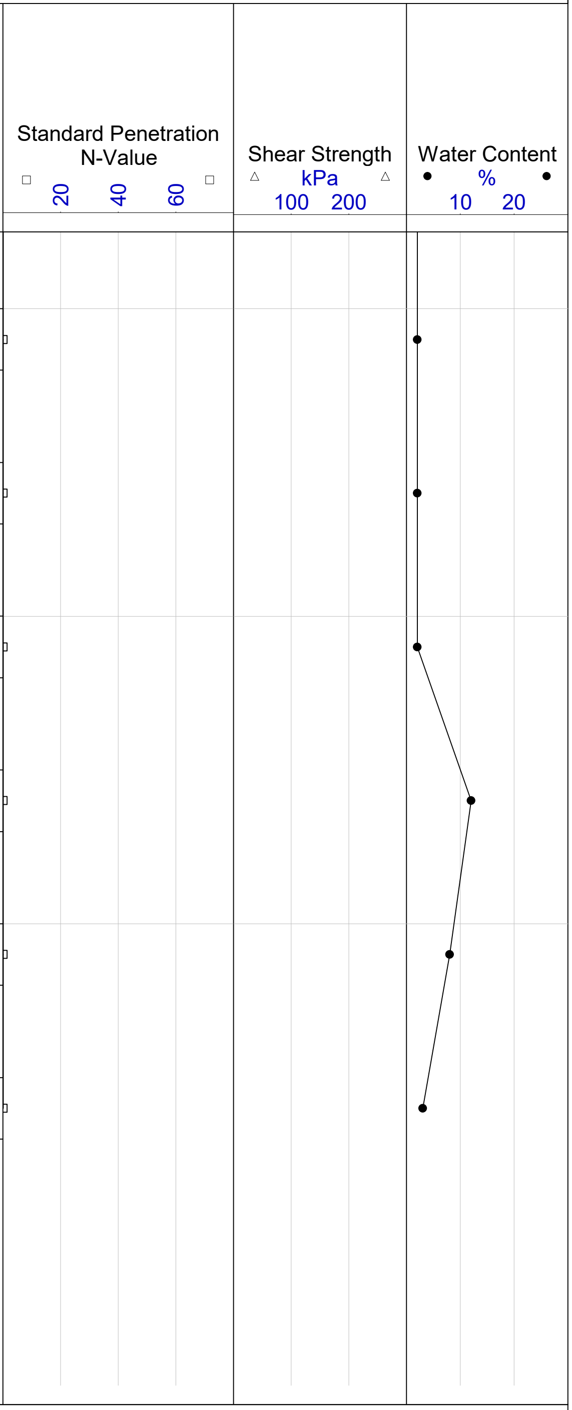
Project: Preliminary Geotechnical Investigation

Client: North American Development Group

Location: 100 Mapleview Drive East, Barrie, Ontario

Drill Date: January 18, 2022 **Project Manager:** KRD

SUBSURFACE PROFILE					SAMPLE			
Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value
12					SS	11	80	>50
13–14					SS	12	60	>50
15–16			276.39	Screen Silica Sand	SS	13	65	>50
17		Very moist	274.87		SS	14	40	>50
18–19		Moist	273.34		SS	15	60	>50
20		Damp	272.74	Water level = dry, as measured on Jan. 27, 2022	SS	16	65	>50
21–22		End of Borehole Borehole terminated at 20.4 mbgs.						



Contractor: Pontil Drilling Ltd.

Drilling Method: Split Spoon / Hollow Stem Auger

Well Casing Size: 51 mm

Grade Elevation: 293.16 masl

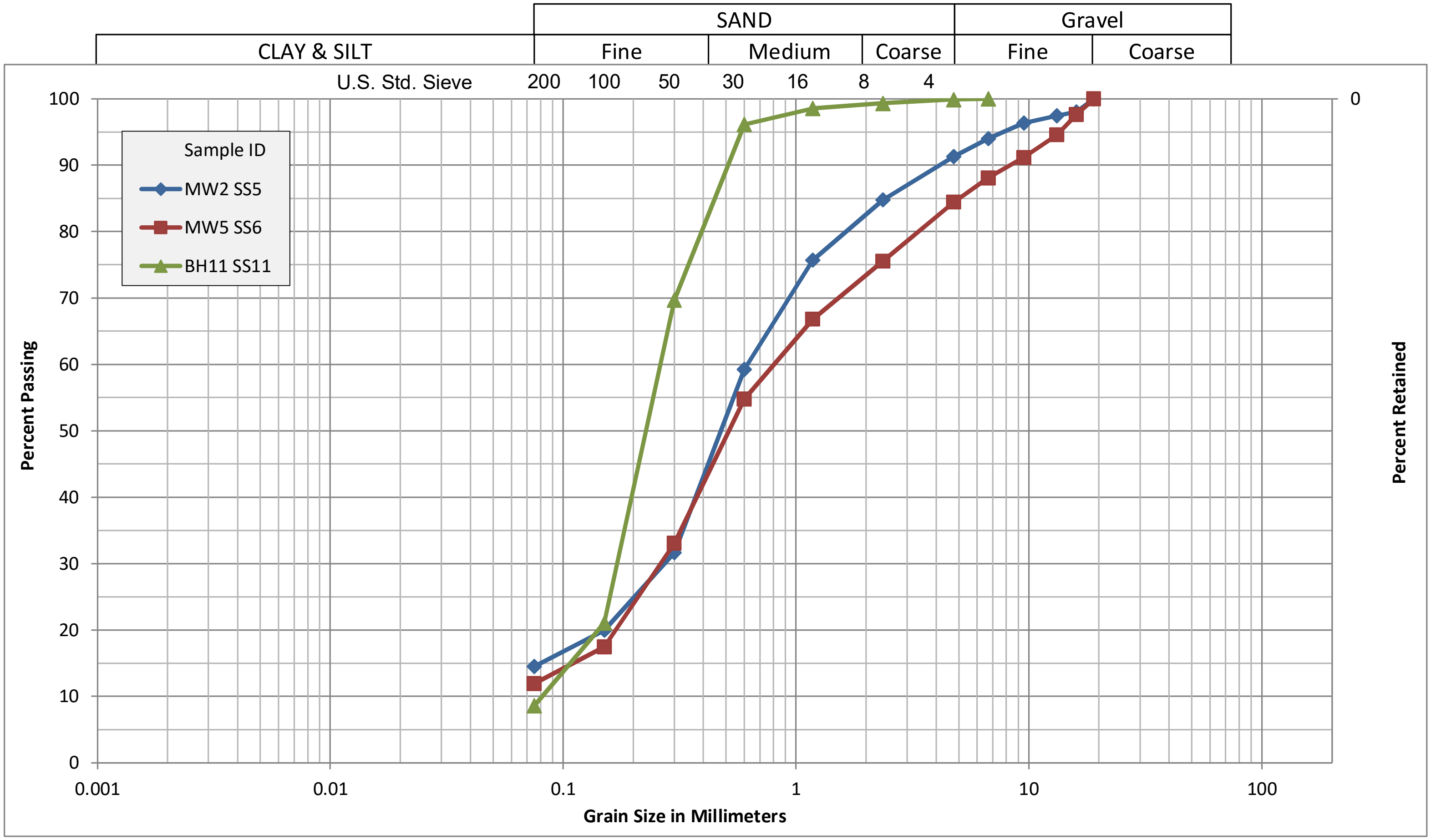
Top of Casing Elevation: 293.02 masl

Sheet: 2 of 2

APPENDIX III

Laboratory Testing Reports for Soil Samples

Unified Soil Classification System



Sample ID	Depth (ft)	% Gravel	% Sand	% Silt and Clay
MW2 SS5	10.0-12.0	8.7	76.8	14.5
MW5 SS6	15.0-17.0	15.6	72.5	11.9
BH11 SS11	40.0-42.0	0.1	91.2	8.6

PINCHIN

Pinchin Waterloo - 225 Labrador Drive,
Unit 1, Waterloo, Ontario N2K 4M8

PARTICLE SIZE DISTRIBUTION ANALYSIS

Preliminary Geotechnical Investigation
100 Mapleview Drive, Barrie, ON
North American Development Group

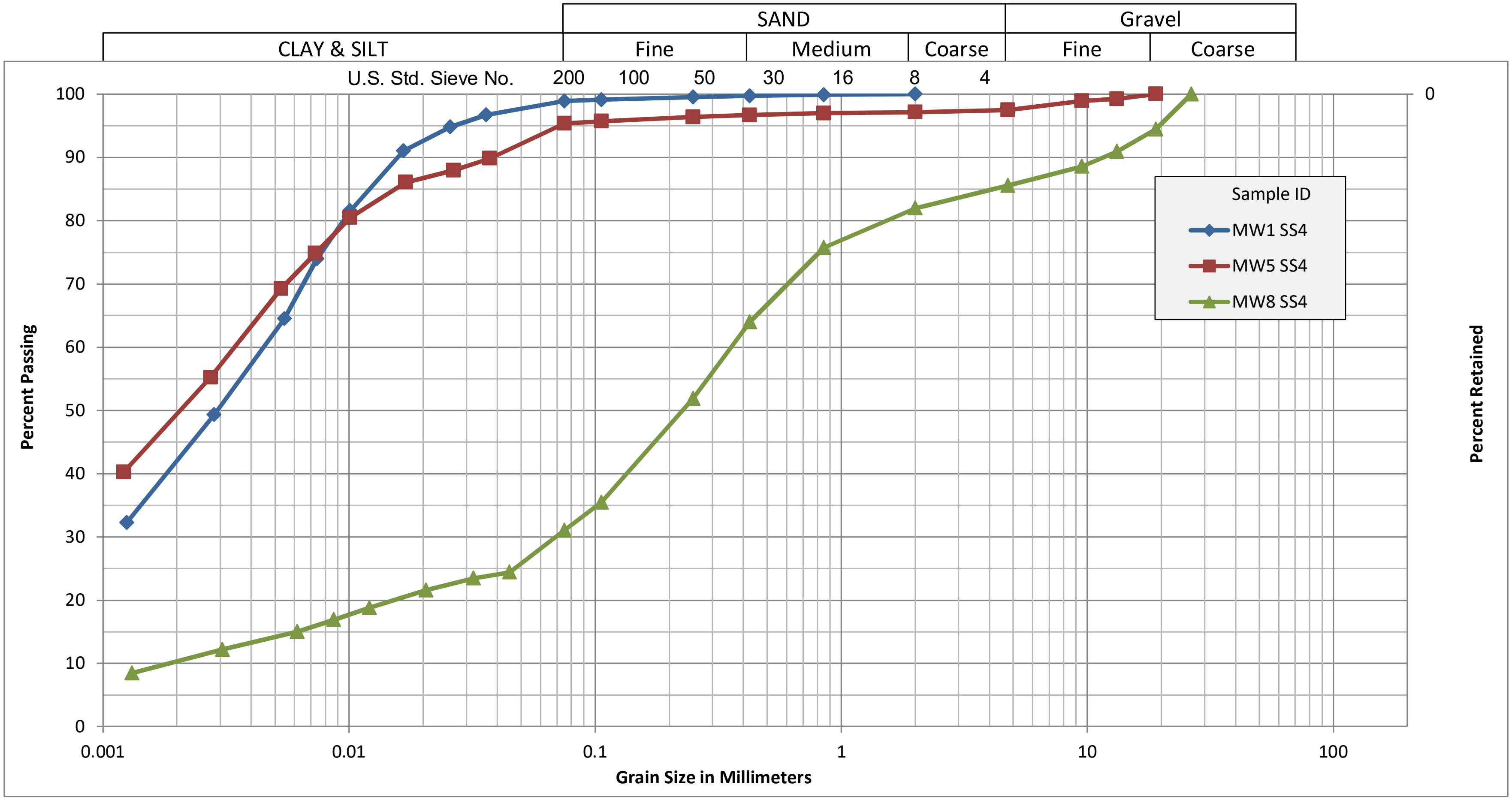
Figure No. 1

296908.005

Reviewed By :

More information available upon request

Unified Soil Classification System



Sample ID	Depth (ft)	% Gravel	% Sand	% Silt	% Clay
MW1 SS4	7.5-9.5	0.0	1.1	58.9	40.0
MW5 SS4	7.5-9.5	3.0	1.6	47.4	48.0
MW8 SS4	7.5-9.5	14.0	55.0	21.0	10.0

PINCHIN

Pinchin Waterloo - 225 Labrador Drive, Unit 1, Waterloo, Ontario N2K 4M8

PARTICLE SIZE DISTRIBUTION ANALYSIS

Preliminary Geotechnical Investigation at 100 Mapleview Drive, Barrie, ON
North American Development Group

Figure No. 2

296908.005

Reviewed By:

More information available upon request

APPENDIX IV

Report Limitations and Guidelines for Use

REPORT LIMITATIONS & GUIDELINES FOR USE

This information has been provided to help manage risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report was prepared for the exclusive use of the Client and their authorized agents, subject to the conditions and limitations contained within the duly authorized work plan. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical report is based on the existing conditions at the time the study was performed, and Pinchin's opinion of soil conditions are strictly based on soil samples collected at specific test hole locations. The findings and conclusions of Pinchin's reports may be affected by the passage of time, by manmade events such as construction on or adjacent to the Site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations.

LIMITATIONS TO PROFESSIONAL OPINIONS

Interpretations of subsurface conditions are based on field observations from test holes that were spaced to capture a 'representative' snap shot of subsurface conditions. Site exploration identifies subsurface conditions only at points of sampling. Pinchin reviews field and laboratory data and then applies professional judgment to formulate an opinion of subsurface conditions throughout the Site. Actual subsurface conditions may differ, between sampling locations, from those indicated in this report.

LIMITATIONS OF RECOMMENDATIONS

Subsurface soil conditions should be verified by a qualified geotechnical engineer during construction. Pinchin should be notified if any discrepancies to this report or unusual conditions are found during construction.

Sufficient monitoring, testing and consultation should be provided by Pinchin during construction and/or excavation activities, to confirm that the conditions encountered are consistent with those indicated by the test hole investigation, and to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated. In addition, monitoring, testing and consultation by Pinchin should be completed to evaluate whether or not earthwork activities are completed in accordance with our recommendations.   Retaining Pinchin for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions. However, please be advised that any construction/excavation observations by Pinchin is over and above the mandate of this geotechnical evaluation and therefore, additional fees would apply.

MISINTERPRETATION OF GEOTECHNICAL ENGINEERING REPORT

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Pinchin confer with appropriate members of the design team after submitting the report. Also retain Pinchin to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having Pinchin participate in pre-bid and preconstruction conferences, and by providing construction observation. Please be advised that retaining Pinchin to participation in any ‘other’ activities associated with this project is over and above the mandate of this geotechnical investigation and therefore, additional fees would apply.

CONTRACTORS RESPONSIBILITY FOR SITE SAFETY

This geotechnical report is not intended to direct the contractor's procedures, methods, schedule or management of the work Site. The contractor is solely responsible for job Site safety and for managing construction operations to minimize risks to on-Site personnel and to adjacent properties. It is ultimately the contractor’s responsibility that the Ontario Occupational Health and Safety Act is adhered to, and Site conditions satisfy all ‘other’ acts, regulations and/or legislation that may be mandated by federal, provincial and/or municipal authorities.

SUBSURFACE SOIL AND/OR GROUNDWATER CONTAMINATION

This report is geotechnical in nature and was not performed in accordance with any environmental guidelines. As such, any environmental comments are very preliminary in nature and based solely on field observations. Accordingly, the scope of services do not include any interpretations, recommendations, findings, or conclusions regarding the, assessment, prevention or abatement of contaminants, and no conclusions or inferences should be drawn regarding contamination, as they may relate to this project. The term "contamination" includes, but is not limited to, molds, fungi, spores, bacteria, viruses, PCBs, petroleum hydrocarbons, inorganics, pesticides/insecticides, volatile organic compounds, polycyclic aromatic hydrocarbons and/or any of their by-products.

Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be held liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered within the meaning of the Limitations Act, 2002 (Ontario), to commence legal proceedings against Pinchin to recover such losses or damage.