REPORT
GEOTECHNICAL AND SLOPE STABILITY INVESTIGATIONS
PROPOSED TOWNHOUSES
66 THOMAS STREET
MISSISSAUGA, ONTARIO

Prepared for:

DE ZEN REALTY COMPANY LTD.

Prepared By:

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Project: SP18-306-10-REV. 02
January 31, 2023

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1. INTRODUCTION

Sirati & Partners Consultants Limited (SIRATI) was retained by De Zen Realty Company Ltd. to undertake a geotechnical and slope stability investigation at the property located at 66 Thomas Street in Mississauga, Ontario.

The property is bounded by Tannery Street from the North, Joymar Drive from the West, Thomas Street from the West and Mullet Creek from the East. There is a slope located along the eastern boundary of the property. The property is currently occupied by several industrial buildings.

It is understood that the existing property will be redeveloped with residential townhouses.

The purpose of this geotechnical investigation was to determine the subsurface conditions at twenty-two (22) borehole locations and from the findings in the boreholes make engineering recommendations for the following:

1. Foundations
2. Floor slab and permanent drainage
3. Excavations and backfill
4. Earthquake considerations
5. Earth pressures
6. Pavements
7. Underground Services
8. Slope Stability

The Phase I and Phase II environmental investigations were carried out by SIRATI and are reported under separate covers.

An erosion assessment of Mullet Creek along the eastern boundary of the property was carried out by Water’s Edge Environmental Solutions and is presented in **Appendix F** of this report.

This report is provided on the basis of the terms of reference presented above and, on the assumption, that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for De Zen Realty Company Ltd. and its architect and designers. Third party use of this report without Sirati & Partners Consultants Limited (SIRATI) consent is prohibited. The limitation conditions presented in **Appendix G** form an integral part of the report and they must be considered in conjunction with this report.

2. FIELD AND LABORATORY WORK

A total of seven boreholes (BH1 to BH7, see Drawing 1 for location plan) were drilled at the site for geotechnical and slope stability investigation purposes, to depths ranging from 4.0 m to 6.3 m. Boreholes were drilled with solid stem continuous flight auger equipment by a drilling sub-contractor under the direction and supervision of SIRATI personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the SIRATI laboratory for detailed examination by the project engineer and for laboratory testing.

Additional fifteen boreholes (BH-E1 to BH-E15, See **Appendix B**) were drilled at the site for Phase II environmental investigation purpose, to depths ranging from 2.4 m to 5.8 m. Except BH-E3 and BH-E7, the environmental boreholes were drilled with solid stem augers. Boreholes E3 and E7 were advanced with Pionjar drilling system.

As well as visual examination in the laboratory, all the soil samples were tested for moisture content. Selected soil samples were subjected to grain size analyses.

Water level observations were made during drilling and in the open boreholes upon the completion of the drilling operations. Monitoring wells were installed at four borehole locations (BH2, BH4, BH6, and BH7) for long-term (stabilized) groundwater level monitoring.

The elevations at the borehole locations were surveyed by SIRATI personnel using differential GPS system.

3. SUBSURFACE CONDITIONS

The borehole location plan is shown in **Drawing 1**. Notes on soil descriptions are presented in **Drawing 1A**. The subsurface conditions in the boreholes are presented in the individual borehole logs (Encl. 2 to 8 inclusive). The subsurface conditions in the boreholes are summarized in the following paragraphs.

3.1 Soil Conditions

Ground Cover:

A layer of asphalt pavement was encountered in BH3, BH4, BH6, BH7, BH-E1, BH-E2, BH-E4, BH-E5 and BH-E8 to BH-E11. The thickness of asphalt was observed to vary between 75 mm to 150 mm. The layer was observed to be underlain by 75 mm to 180 mm of granular material.

Borehole 2, E3 and E7 were advanced through 100 mm to 180 mm-thick concrete slabs. The slab was found underlain by 100 mm of granular material at BH-2.

Topsoil/Fill Material:

A layer of fill material was encountered in all boreholes, extending between 0.2 m to 4.6 m depth. The fill material was comprised of sand & gravel, clayey silt, construction debris and sandy silt with trace to some topsoil. Buried layers of topsoil were encountered locally in BH-E5 from 0.8 mbgs to 1.5mbgs, and BH-E15 from 2.3 mbgs to 3.0 mbgs.

The measured SPT ‘N’ values in the fill material ranged from 2 blows for 300 mm penetration to 50 blows for less than 300 mm penetration, more generally between 5 and 10 blows per 300 mm penetration, indicating its loosely compacted state.

Glacial Till Deposit:

Except BH1, BH-E9 and BH-E10, a layer of glacial till deposit, comprising sandy silt to clayey silt, was encountered in all boreholes underlying the fill material.

The SPT ‘N’ values were found ranging between 19 and 82 blows per 300 mm penetration, indicating a very stiff (compact) to hard (very dense) consistency.

Grain size analysis of two clayey silt samples (BH2/SS5, BH6/SS3, BH-E1/SS5, and BH-E12/SS3) were conducted and the results are presented in **Figure 8**, with the following fractions:

Clay:	23% to 33%
Silt:	43% to 45%
Sand:	20% to 26%
Gravel:	3% to 7%

Residual Soil/Weathered Shale:

A deposit of residual soil was encountered in BH1, BH2 and BH7, underlying the fill material in BH1 and the till deposit in BH2, BH7, BH-E4, and BH-E13. The deposit consists of clayey silt with till-like texture and contains varying amounts of siltstone/limestone and shale fragments. Residual soil is derived from weathering of the underlying shale bedrock.

The stratum was found to be in a hard consistency with SPT ‘N’ values of 50 blows for less than 300 mm penetration.

Shale bedrock (Georgian Bay Formation):

The presence of bedrock was inferred from auger/sampler refusal or confirmed by split spoon sampling in all boreholes at depths, generally varying between 4.0 m and 6.1 m. No bedrock was encountered in BH-E3, BH-E14 and BH-E15. An auger refusal was observed in BH-E7 at a depth of 2.4 m, which is much shallower than the other locations. This could be due to boulder obstruction and not necessarily a bedrock depth.

The bedrock is of Georgian Bay Formation. The upper portion of the bedrock is typically slightly to highly weathered, becomes less weathered with depth. No bedrock coring was carried out.

Table 1: Depth of inferred bedrock

BH No.	Depth of Inferred Bedrock (m)	Notes
BH1	6.1	Spoon Refusal
BH2	6.1	Spoon Refusal
BH3	6.1	Spoon Refusal
BH4	6.1	Spoon Refusal
BH5	6.1	Spoon Refusal
BH6	4.0	Auger Refusal
BH7	6.1	Spoon Refusal
BH-E1	5.6	Auger Refusal
BH-E2	5.5	Auger Refusal
BH-E3	-	Bedrock not Encountered
BH-E4	5.5	Auger Refusal
BH-E5	5.8	Spoon Refusal
BH-E6	4.9	Auger Refusal
BH-E7	2.4	Spoon Refusal
BH-E8	5.2	Auger Refusal
BH-E9	4.3	Auger Refusal
BH-E10	4.6	Spoon Refusal
BH-E11	5.8	Auger Refusal

BH No.	Depth of Inferred Bedrock (m)	Notes
BH-E12	5.3	Auger Refusal
BH-E13	5.0	Auger Refusal
BH-E14	-	Bedrock not Encountered
BH-E15	-	Bedrock not Encountered

3.2 GROUNDWATER CONDITIONS

During drilling and upon completion of drilling, the groundwater (unstabilized) was observed in boreholes at depths varying from 1.8 m to 5.8 m below the existing grade. The long-term (stabilized) groundwater levels observed in the monitoring wells are as listed on **Table 2**.

Table 2: Groundwater Levels Observed in Monitoring Wells

BH No.	Date of Drilling	Date of Observation	Depth of Groundwater below existing ground (m)	Elevation of Groundwater (m)
BH2	April 30, 2018	June 01, 2018	2.0	153.0
BH4	April 30, 2018	May 28, 2018	3.1	151.0
BH6	May 01, 2018	May 28, 2018	0.9	153.7
BH7	May 01, 2018	May 28, 2018	1.7	153.0
BH-E1	May 07, 2018	May 28, 2018	3.0	151.6
BH-E2	May 07, 2018	May 28, 2018	1.6	152.4
BH-E3	June 05, 2018	June 07, 2018	2.1	152.5
BH-E4	May 08, 2018	May 28, 2018	1.8	152.6
BH-E5	May 08, 2018	May 28, 2018	2.4	152.9
BH-E6	May 07, 2018	May 28, 2018	2.8	151.7
BH-E7	June 05, 2018	June 07, 2018	1.4	153.4
BH-E8	May 07, 2018	June 07, 2018	3.1	152.1
BH-E9	May 07, 2018	June 07, 2018	2.9	152.8
BH-E10	May 07, 2018	June 07, 2018	2.9	152.8
BH-E11	May 07, 2018	June 07, 2018	2.9	152.6
BH-E13	May 08, 2018	June 07, 2018	2.3	154.7

It should be noted that the groundwater level may vary and is subject to seasonal fluctuations in response to major weather events.

4. DISCUSSION AND RECOMMENDATIONS

It is understood that the property is proposed to be redeveloped with townhouses. It will therefore be serviced by a network of access roads, storm and sanitary sewers and watermains.

The subsurface includes a relatively thick layer of fill material that increases in thickness predominantly from Joymar Drive towards the creek. The thickness of fill is highly variable throughout the site and linear interpolation between the boreholes does not necessarily depict the actual stratigraphy pertinent to fill at the site.

4.1 ROADS

The investigation has shown that the predominant subgrade soil at the site, after stripping the topsoil and any other organic and otherwise unsuitable material will mainly consist of fill material extending between 0.2 m to 4.6 m depth.

Based on the above and assuming that traffic usage will be residential minor local or local, the following minimum pavement thickness is recommended:

40 mm HL3 Asphaltic Concrete
80 mm HL8 Asphaltic Concrete
150 mm Granular ‘A’
350 mm Granular ‘B’

These values may need to be adjusted according to the City of Mississauga Standards. The pavement structure recommended above assumes that the subgrade has sufficient bearing capacity to accommodate the applied pavement structure and local traffic. The site subgrade and weather conditions (i.e. if wet) at the time of construction may necessitate the placement of thicker granular sub-base layer in order to facilitate the construction. Furthermore, heavy construction equipment may have to be kept off the newly constructed roads before the placement of asphalt and/or immediately thereafter, to avoid damaging the weak subgrade by heavy truck traffic.

4.1.1 Stripping, Sub-excavation and Grading

The site should be stripped of all topsoil and any organic or otherwise unsuitable soils to the full depth of the roads, both in cut and fill areas.

Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof-rolled, in the presence of the Geotechnical Engineer, by at least several passes of a heavy compactor having a rated capacity of at least 10 tonnes. Any soft spots thus exposed should be removed and replaced by select fill material, similar to the existing subgrade soil and approved by the Geotechnical Engineer. The subgrade should then be recompacted from the surface to at least 98% of its Standard Proctor Maximum Dry Density (SPMDD). The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular materials by heavy construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material must be used.

Any fill required for re-grading the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 95% of its SPMDD. The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, as per Town Standards. The compaction of the new fill should be checked by frequent field density tests.

4.1.2 Construction

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to at least 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.1.3 Drainage

The City of Mississauga requires the installation of full-length subdrains on all roads. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

All paved surfaces should be sloped to provide satisfactory drainage towards catch basins. As discussed in Section 4.1.1, by means of good planning any water trapped in the granular sub-base materials should be drained rapidly towards subdrains or other interceptors.

4.2 SEWERS

As a part of the site development, a network of new storm and sanitary sewers is to be constructed.

4.2.1 Trenching

It is expected that the trenches will be dug through fill and till deposits. Groundwater table observed in the monitoring wells on May 28, June 1, and June 7, 2018 was at depths ranging from 0.9 to 3.0 mbgs, corresponding to elevations ranging from 151.6 m to 153.7 m. Positive dewatering such as well points may be required prior to any trenching/excavation in cohesionless fill soils below the groundwater table, otherwise it will result into flowing sides and unstable base. In such conditions, water table must be lowered to 1 m below the lowest excavation level. It is expected that a conventional pumping method should be sufficient to keep any perched water out of the trenches.

Further monitoring of the groundwater table is recommended to establish the seasonally high groundwater levels.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the fill material can be classified as Type 3 Soil above the groundwater table and Type 4 Soil below the groundwater table, and the glacial till and residual soils can be classified as Type 2 Soil.

4.2.2 Bedding

The boreholes show that, in their undisturbed state, native deposits will provide adequate support for the sewer pipes and allow the use of normal Class B type bedding. It is assumed that the groundwater will be lowered to at least 1.0 m below the lowest invert level of the pipe.

The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter. The bedding material should consist of well graded granular material such as Granular ‘A’ or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local Authority, should be placed.

To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the poorly graded bedding material.

4.2.3 Backfilling of Trenches

Based on visual and tactile examination, and the measured moisture contents of the soil samples, the onsite excavated soils from above the groundwater table will generally need to be brought to ±2% of the optimum moisture content whether by adding water or aerating. Soils excavated from below the groundwater table will be too wet to compact and will require significant aeration prior to their use as backfill material.

Unless the materials are properly pulverized and compacted in sufficiently thin lifts, post-construction settlements could occur. The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture content, and each layer should be compacted to at last 95% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling. Otherwise imported selected inorganic fill will be required for backfilling at this site.

The onsite excavated soils should not be used in confined areas (e.g. around catch basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of imported granular fill together with an appropriate frost taper would be preferable in confined areas and around structures, such as catch basins.

4.3 SITE GRADING AND ENGINEERED FILL

In the areas where earth fill is required for site grading purposes, an engineered fill may be constructed below house/building foundations, roads, boulevards, etc.

Prior to the construction of engineered fill, all topsoil, fill material, weak weathered/ disturbed and any other unsuitable materials must be removed in this area. After the removal of all unsuitable materials, the excavation base consisting of native soil deposits must be inspected and approved by a qualified geotechnical engineer prior to any placement of engineered fill. The base of the excavation should be compacted and proof rolled with heavy compactors (minimum 10,000 kg). During proof rolling, spongy, wet or soft/loose spots should be sub-excavated to stable subgrade and replaced with approved soil, compatible with subgrade conditions, as directed by the geotechnical engineer.

The material for engineered fill should consist of approved inorganic soil, compacted to 100 percent of Standard Proctor Maximum Dry Density (SPMDD). Recommendations regarding engineered fill placement are provided in **Appendix A** of this report.

To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential by SIRATI to certify the engineered fill. Despite full time supervision, it has been found that contractors frequently bulldoze loose fill into areas and compact only the surface. The inspector, either busy on other portions of the site or absent during “off hours” will be unaware of this condition. This potential problem must be recognized and discussed at a pre-construction meeting.

Depending upon the amount of grade raise, there will be consolidation settlement of the underlying soils. Additionally, there will be settlement of the engineered fill under its own weight, approximately 0.5% of the fill height. A waiting period of 3 to 6 months may be required prior to the construction of any structures on engineered fill. This should be confirmed during the detail design stage, once the grading plans for the proposed development are available.

4.4 FOUNDATION CONDITIONS

Since BH2, BH3 and BH4 were primarily drilled for slope stability analysis and are not located within the footprint of the proposed development, consideration is only given to BH1, BH5, BH6, BH7, as well as BH-E1, BH-E2, BH-E4, BH-E5, BH-E10, BH-E12, BH-E13, BH-E14 for the estimation of the bearing capacities of the shallow and deep foundations presented in this section.

The boreholes show that provided the foundation soil is undisturbed during the construction, in general, allowable soil bearing values of 80 kPa to 150 kPa at serviceability limit state and 120 kPa to 225 kPa at ultimate limit state are feasible in the undisturbed inorganic natural soils, at or below the depths provided in **Table 3**. The bearing value would be suitable for the use of normal spread footings to support the proposed developments.

Where the grade needs to be raised, the proposed structures can be supported by spread and strip footings founded on engineered fill for an allowable bearing pressure of 150 kPa. The engineered fill supporting footings should be constructed in accordance with the guidelines presented in **Appendix A**. Other requirements of engineered fill are given in Section 4.4.

Table 3: Bearing Values and Founding Levels of Spread Footings

BH No.	Material	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth Below Existing Ground (m)	Founding Level at or Below Elevation (m)
BH1	Residual Soil/ weathered shale	150	225	4.6	152.1
BH5	Clayey Silt Till	150	225	1.3	155.7
BH6	Clayey Silt Till	150	225	1.3	153.3
BH7	Clayey Silt Till	150	225	1.3	153.4
BH-E1	Clayey Silt Till	100 150	150 225	2.6 3.0	152.0 151.6
BH-E2	Clayey Silt Till	150	225	2.3	151.7
BH-E4	Clayey Silt Till	150	225	2.3	152.6
BH-E5	Clayey Silt Till	150	225	2.3	152.0
BH-E10	Inferred bedrock	150	225	4.6	151.1
BH-E12	Clayey Silt Till	150	225	1.3	156.3
BH-E13	Clayey Silt Till	150	225	1.3	155.7
BH-E14	Clayey Silt Till	150	225	1.3	156.3

All footings must be founded below a frost depth of 1.3 m.

Provided that the founding soil is undisturbed during construction, total and differential settlements of foundations designed and constructed in accordance with the specified design bearing values should not exceed 25 mm and 19 mm, respectively.

Variations in the soil conditions are expected in between the borehole locations, and during construction, the soil bearing pressures should be confirmed by the Geotechnical Engineer.

Alternatively, the proposed buildings can be supported by drilled piers founded on sound shale bedrock for a bearing pressure of 2500 kPa at the serviceability limit states (SLS), and for a factored geotechnical resistance of 3750 kPa at the ultimate limit states (ULS). The bearing values and the corresponding founding elevations at the borehole locations are summarized in **Table 3**. The depth at which sound bedrock could be encountered should be confirmed through rock coring.

Piers designed to the specified bearing capacity values at the serviceability limit states (SLS) are expected to settle less than 10 mm.

The piers will require temporary liners for installation to help prevent the soil from caving and to help control water seepage into the caisson hole.

All piers/caisson bases must be cleaned and must be proven to be founded in dry sound bedrock. All caissons bases must be inspected by this office. Concrete should be poured immediately after the caisson hole is complete and inspected. The caisson liners should be carefully withdrawn after the inspection and approval of the base material, while pouring the concrete.

It should be noted that the recommended bearing capacities have been calculated by SIRATI from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by SIRATI to validate the information for use during the construction stage.

5. FLOOR SLAB AND PERMANENT DRAINAGE

The floor slabs can be supported on grade provided the existing fill materials are removed to at least 1.0 m below the floor slab. Any soft or unstable areas must be removed and replaced with suitably compacted soils, as defined in Section 4.1.1 of this report. A granular layer consisting of at least 200 mm of 19 mm Crusher Run Limestone (CRL) or OPSS Granular A should be installed under the floor slab as a bedding layer. The CRL or the OPSS Granular A should be compacted to 100% of its SPMDD.

It is considered by SIRATI that completed excavations for floor slabs should not be left open before pouring concrete for any period longer than 24 hours. Particularly, if the floor construction works are being completed during the winter months or wet weather periods. The base of any floor slab excavation that is left exposed longer than 24 hours should be suitably covered and protected from water ponding, and/or protected to prevent degradation of the exposed founding stratum with the construction of a mud mat.

The perimeter drainage system shown on Drawings 10 and 11 are recommended for the basement walls with open cut or shored excavations, respectively. Underfloor drainages should be installed.

6. TEMPORARY SHORING

If required, retaining elements designed to resist earth pressure can be calculated based on the following parameters:

1) Earth Pressure Coefficient

    (a) Where movement must be minimal K=0.56

    (b) Where minor movement (0.002H) can be tolerated K=0.39

    (c) Passive earth pressure for soldier piles (unfactored) Kp=2.56

2) For stability check

    φ=28

    C=0

    γ=20

    Surcharge is to be determined by shoring contractor.

7. EARTHQUAKE CONSIDERATIONS

Based on the borehole information and according to Table 4.1.8.4.A of OBC 2012, the subject site for the proposed building can be classified as “Class D” for the seismic site response.

8. SLOPE STABILITY

The slope stability assessment in this report is based on subsurface conditions in the boreholes, the observations during our site visits, and the slope profiles provided by the client/derived from the topographic map. Stability analyses of the slopes are carried out using the program SLIDE 7 with the Bishop’s Method. The slope conditions and the results of stability analyses are presented as follows.

8.1 Site and Slope Conditions

A site visit was made by a senior geotechnical engineer of SIRATI on June 1, 2018. The existing slope conditions, including general topography of the slopes, vegetation cover, and any evidence of slope failure and erosion were examined during the site visit. Photographs of the site taken during our site visits are shown in **Appendix C** of this report.

A separate slope toe erosion study was undertaken by Water's Edge Environmental Solution (Appendix F), the findings of which were also used for the slope stability analysis.

The subject slope is located along the east property line. Based on our observations during the site visits, the slope conditions are summarized as follows:

- The height of the subject slope was about 3 m to 4 m from the top of the slope to the toe of the slope. The steepness of the slope generally ranged from about 1.0 H: 1.1 V to 2 H: 1V or gentler.
- The slope surface is covered with grass, shrubs and mature trees.
- During our site visit, tilting and bending of trees on the slope was observed, indicating that slow movement and creeping of the slope have occurred in the past and will continue to occur in future. No slope failure was observed at the site.
- There was no water seepage observed from the slope surface during our site visit.
- Fill material, garbage and construction debris were observed covering the slope surface in some areas.

Ten (10) slope profiles (Cross Sections A-A to J-J, see Drawing 1 for locations) were derived from the topographic drawing provided to by the client. Slope profiles are provided in **Appendix D** of this report.

8.2 Soil Parameters and Groundwater

Based on the borehole information as described in Section 3 of this report, soil parameters used in the slope stability analyses are given in **Table 4**.

Table 4: Soil Parameters for Slope Stability Analyses

Soil Type (See Section 3 for soil description)	Soil Density (kN/m^3)	Long-term Strength	
		c' (kPa)	ϕ' (degree)
Fill Material	19.0	0	28
Glacial Till/Residual Soil	20.0	0	34
Shale Bedrock	27.0	Infinite Strength	

Groundwater table observed in the monitoring wells on May 28, June 1, and June 7, 2018 was at depths ranging from 0.9 to 3.0 mbgs, corresponding to elevations ranging from 151.6 m to 153.7 m.

8.3 Stability Analyses of Existing Slope

Typical slope profiles at Sections A-A to J-J are presented in **Appendix D** of this report. According to BH1, BH2, BH3 and BH4, the fill layer is thicker than 2.5 m at close proximity to the slope. Therefore, the stability analysis of the slope was carried out with an assumption that the existing slope is comprised of loosely to moderately compacted fill material. Slope stability analysis of the existing slope at Section B-B was carried out using the soil conditions listed in **Table 3** and the results are presented in **Appendix E**. The result of the analysis showed that a factor of safety of 1.5 could be achieved on a 3H:1V slope in the fill material.

8.4 Long-term Stable Slope

According to the erosion assessment report (**Appendix F**) there is evidence of active erosion at the toe of the slope. This was also observed during the site visit on June 1, 2018. As such an 8.0 m toe erosion allowance was assumed in the calculation of the long-term stable slope, as per the CVC's Technical Guideline: "Slope Stability Definition & Determination Guidelines", October 2014m Figure 4a.

The long-term stable slopes for sections A-A' to J-J' are presented in **Appendix D**. Long-term stable top of slope line is drawn on **Drawing 1**.

8.5 General Comments on Slope Stability

Additional comments related to the slope stability at the site are as follows:

- Generally, in order to prevent soil erosion at the slope surface, the vegetation and trees on the existing slopes must be preserved.
- Surface water must be directed away from the slope or carried down the slope in suitable conduits. Based on the provided information from the Client, the latest grading plan includes a swale for local drainage on the upside of the 3:1 slope which will collect runoff (from a portion of Catchment 202)) and direct it away from draining over the 3:1 slope and into catchment 201.Runoff captured in this swale is received by an on-site catch basin and conveyed to Thomas Street.
- Allow for the placement of sediment controls measure and limit of working easement.
- Snow or garden waste must not be piled near the top of the slope.
- Keep heavy equipment and loads away from the slope.

9. GENERAL COMMENTS ON REPORT

Sirati & Partners Consultants Limited should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Sirati & Partners Consultants Ltd. will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

Yours truly,
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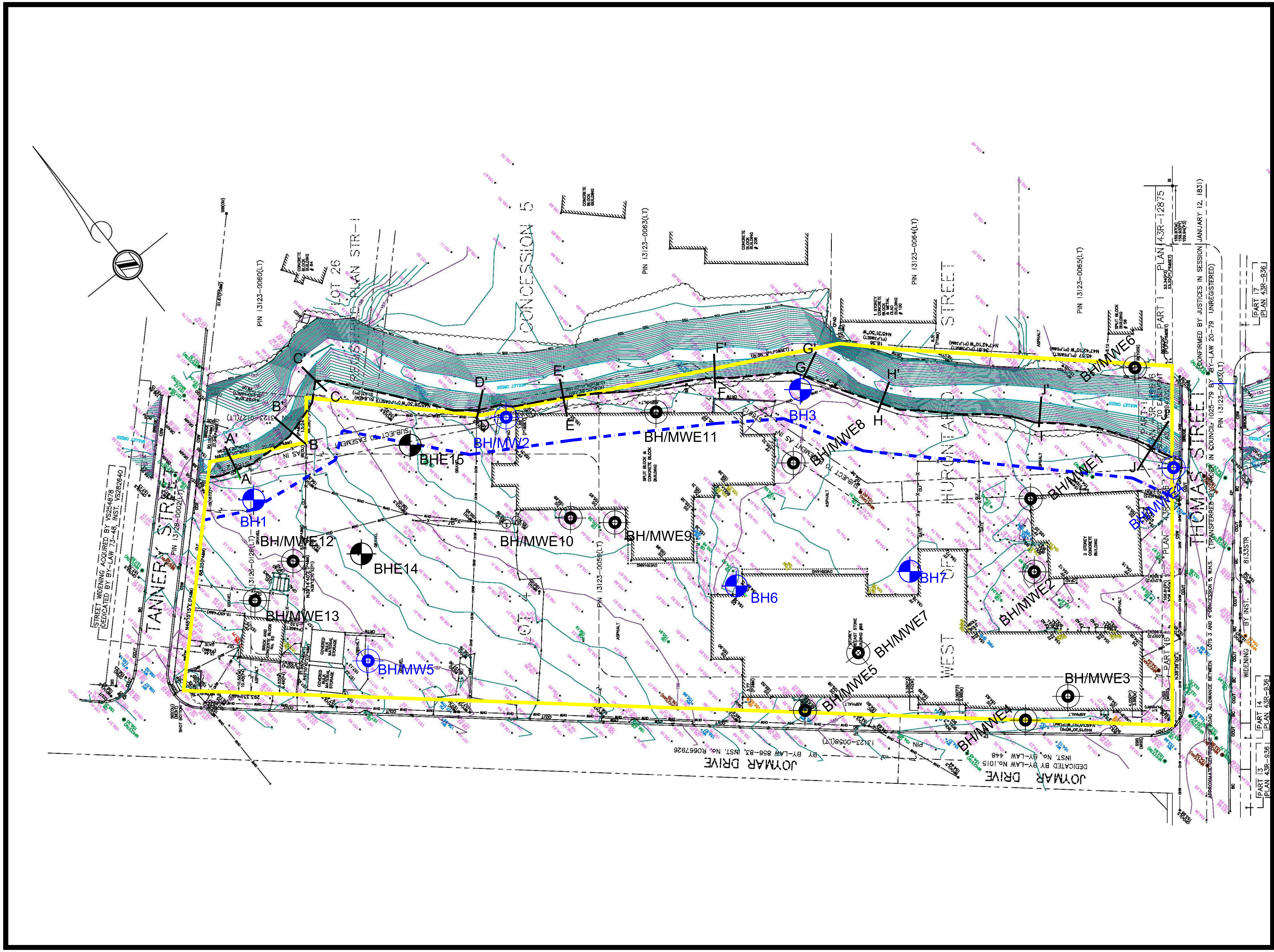
Jan. 31/2023
PROVINCE OF ONTARIO

Archie Sirati, Ph.D., P.Eng.

Drawings



SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

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North:

Legend:

🟨	Property Boundary
– – –	Phisycal TOS as staked by Credit Valley Conservation
– · –	Long-term Stable Top of Slope
◐	Borehole
⊙	Bore Hole/Monitroing Well

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

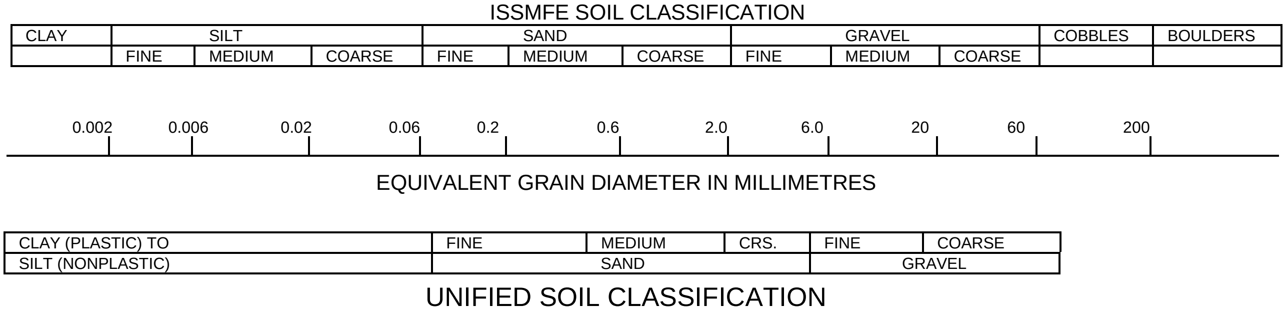
Figure Title:

Borehole Location Plan / LTSTOS

Scale: As Shown	**Project Number:** SP18-306-10
Date: November 2018	**Figure Number:** 1

Drawing 1A: Notes on Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Sirati & Partners Consultants Limited also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

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LOG OF BOREHOLE BH1

1 OF 1

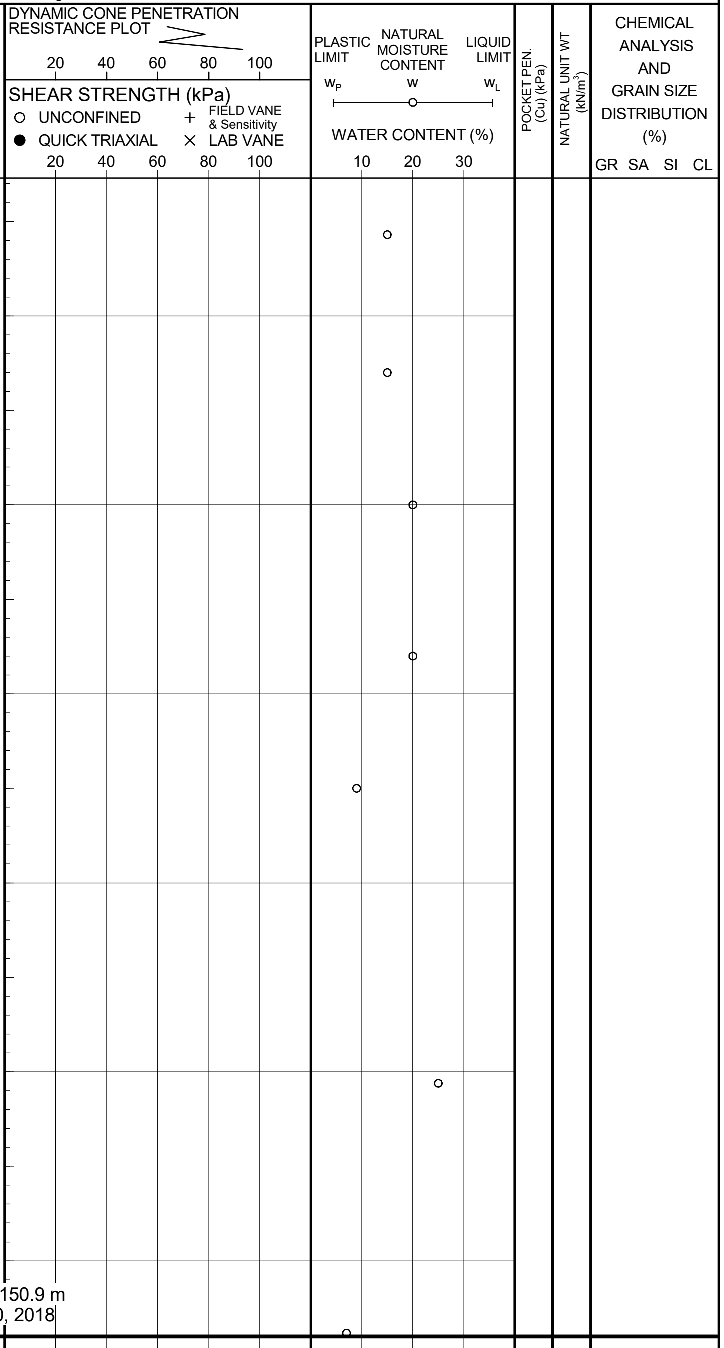
PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Apr/30/2018
Drilling Contractor:

REF. NO.: SP18-306-10
ENCL NO.: 2

SOIL PROFILE			SAMPLES				
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION
156.7 0.0	**FILL:** sand and gravel to clayey silt, trace construction debris and topsoil, dark brown, moist		1	SS	22		
							156
	becoming clayey silt , some sand, trace gravel, trace topsoil, dark brown		2	SS	12		
			3	SS	5		155
			4	SS	4		154
			5	SS	5		
	at 3.8 m, grinding noise						153
152.1 4.6	**RESIDUAL SOIL/WEATHERED SHALE BEDROCK:** grey, moist		6	SS	96/ 228 mm		152
						∇	151
150.6						W. L. 150.9 m Apr 30, 2018	
150.6 6.1	**INFERRED BEDROCK** Shale, Georgian Bay Formation, grey		7	SS	50/ 25 mm		
	END OF BOREHOLE:						

Notes:
1. Borehole open upon completion of drilling.
2. Auger refusal at 6.13 m Depth.
3. Water encountered at 5.84 m upon completion of drilling.



GROUNDWATER ELEVATIONS
Measurement 1st ∇ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

SIRATI & PARTNERS

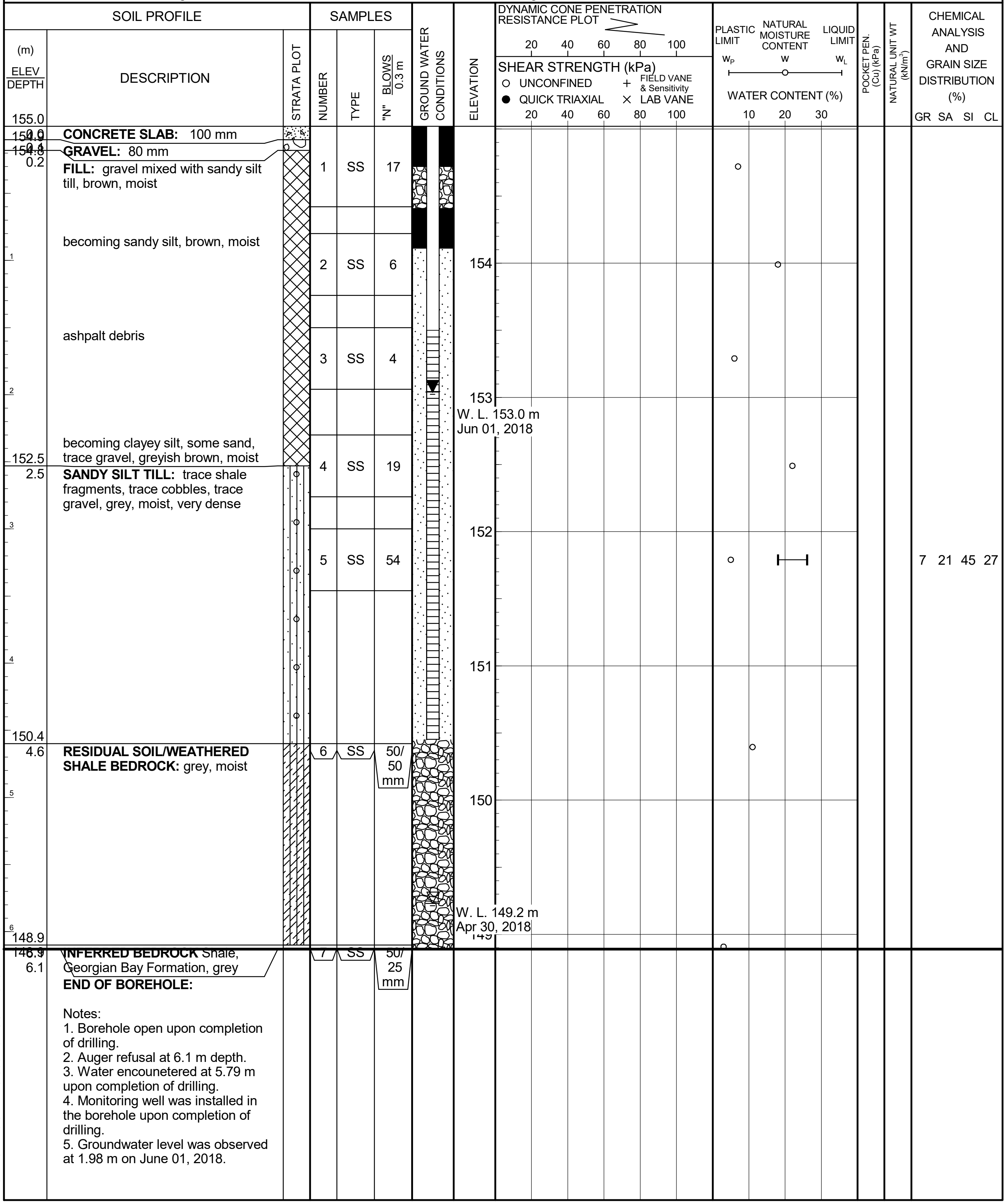
LOG OF BOREHOLE BH2

1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Apr/30/2018
Drilling Contractor:

REF. NO.: SP18-306-10
ENCL NO.: 3



ELEV DEPTH (m)	DESCRIPTION
155.0	
154.9 0.1	**CONCRETE SLAB:** 100 mm
154.8 0.2	**GRAVEL:** 80 mm
	FILL: gravel mixed with sandy silt till, brown, moist
	becoming sandy silt, brown, moist
	ashpalt debris
	becoming clayey silt, some sand, trace gravel, greyish brown, moist
152.5 2.5	**SANDY SILT TILL:** trace shale fragments, trace cobbles, trace gravel, grey, moist, very dense
150.4 4.6	**RESIDUAL SOIL/WEATHERED SHALE BEDROCK:** grey, moist
148.9 6.1	**INFERRED BEDROCK** Shale, Georgian Bay Formation, grey
	END OF BOREHOLE:

NUMBER	TYPE	"N" BLOWS/0.3 m	GR	SA	SI	CL
1	SS	17				
2	SS	6				
3	SS	4				
4	SS	19				
5	SS	54	7	21	45	27
6	SS	50/ 50 mm				
7	SS	50/ 25 mm				

Notes:
1. Borehole open upon completion of drilling.
2. Auger refusal at 6.1 m depth.
3. Water encounetered at 5.79 m upon completion of drilling.
4. Monitoring well was installed in the borehole upon completion of drilling.
5. Groundwater level was observed at 1.98 m on June 01, 2018.

SPCL SOIL LOG SP18-306-10 - COPY.GPJ SPCL.GDT 6/14/18

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3$, $\times^3$: Numbers refer to Sensitivity ○ $^{\varepsilon}$=3% Strain at Failure

SIRATI & PARTNERS

LOG OF BOREHOLE BH3

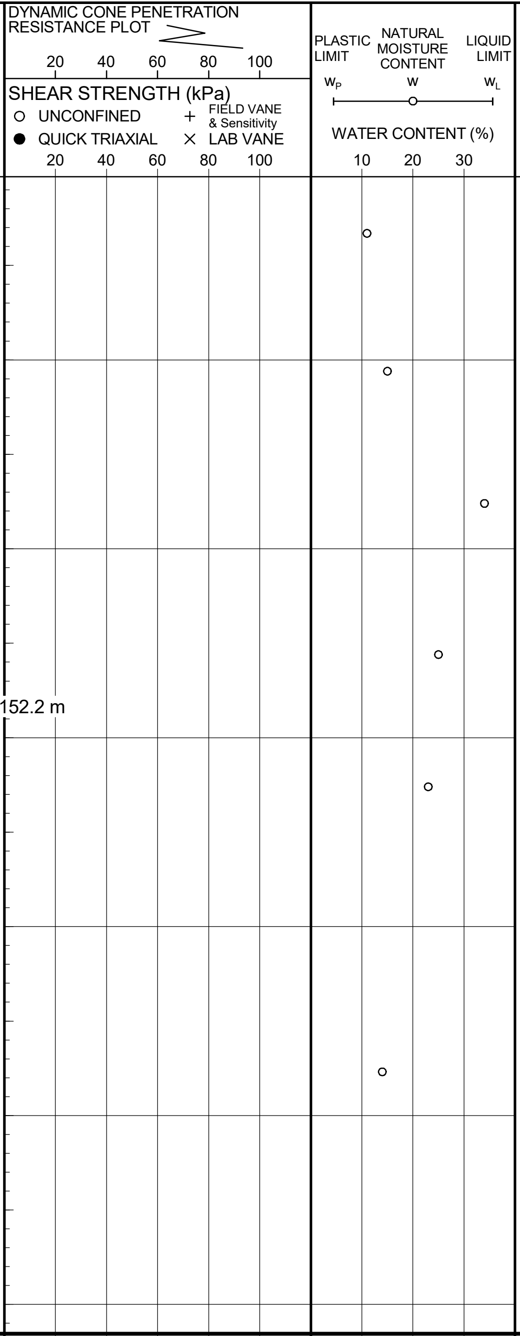
1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Apr/30/2018
Drilling Contractor:

REF. NO.: SP18-306-10
ENCL NO.: 4

SOIL PROFILE			SAMPLES								
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
155.0										
154.9 0.0	**ASPHALT:** 130 mm	■								
154.7 0.1	**GRAVEL:** 130 mm									
0.3	**FILL:** topsoil mixed with sand and gravel to sandy silt, moist	▨	1	SS	7					
154.2 0.8	**FILL:** clayey silt, trace topsoil, brown, moist	▨	2	SS	9		154			
	seam of sandy silt wet	▨	3	SS	11		153			
	becoming very moist	▨	4	SS	5	▽	W. L. 152.2 m			
	trace shale fragments, trace gravel, grey, wet	▨	5	SS	4		152 151			
150.4 4.6	**SANDY SILT TILL:** trace shale, greyish brown, wet, very dense		6	SS	44-50/ 125 mm		150 149			
148.9 6.1	**END OF BOREHOLE:**		7	NR	50/ 25 mm					



Notes:
1. Borehole open upon completion of drilling.
2. Auger refusal at 6.1 m depth.
3. Water Encountered at 2.74 mbgs upon completion of drilling.

SPCL SOIL LOG SP18-306-10 - COPY.GPJ SPCL.GDT 6/14/18

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

SIRATI & PARTNERS

LOG OF BOREHOLE BH4

1 OF 1

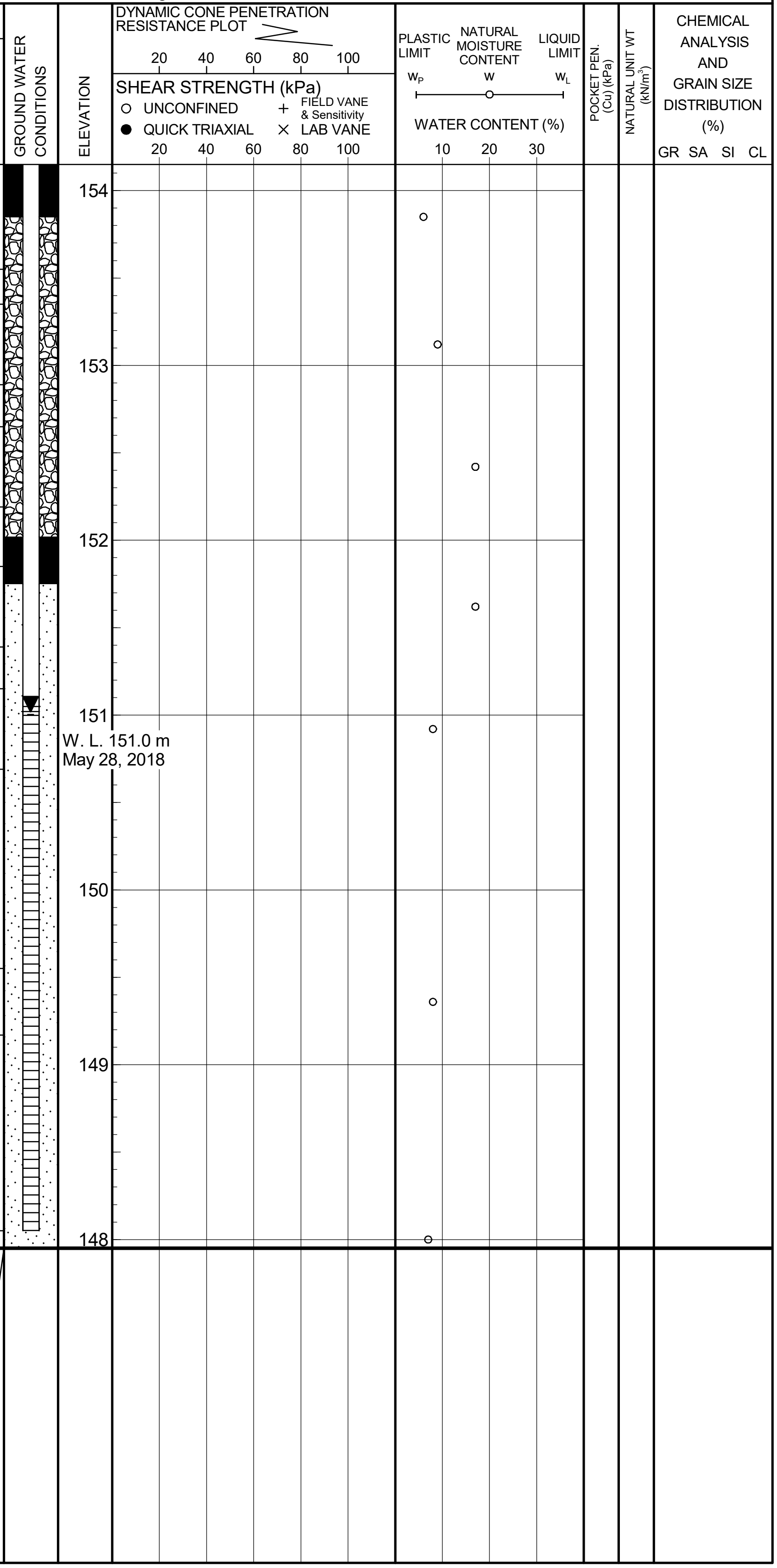
PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: Apr/30/2018
Drilling Contractor:

REF. NO.: SP18-306-10
ENCL NO.: 5

SOIL PROFILE		SAMPLES		
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
154.2				
154.0 0.0	**ASPHALT:** 150 mm			
153.9 0.2	**GRAVEL:** 125 mm			
0.3	**FILL:** clayey silt mixed with topsoil, trace gravel, reddish brown, moist	1	SS	12
		2	SS	10
	trace sand, trace topsoil, trace rootlets	3	SS	9
		4	SS	6
		5	SS	6
149.6 4.6	**SANDY SILT TILL:** trace shale fragments, trace gravel, grey, moist, very dense	6	SS	96/ 228 mm
148.1 148.0 6.1	**INFERRED BEDROCK** Shale. Georgian Bay Formation, grey	7	SS	50/ 100 mm
6.2	**END OF BOREHOLE:**			

Notes:
1. Borehole open and dry upon completion of drilling.
2. Auger Refusal at 6.2 m depth.
3. Monitoring Well was Installed in teh borehole upon completion of drilling.
4. Groundwater level was obsereved at 3.13 m in the well on May 28, 2018.



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

SPCL SOIL LOG SP18-306-10 - COPY.GPJ SPCL.GDT 6/14/18

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LOG OF BOREHOLE BH5

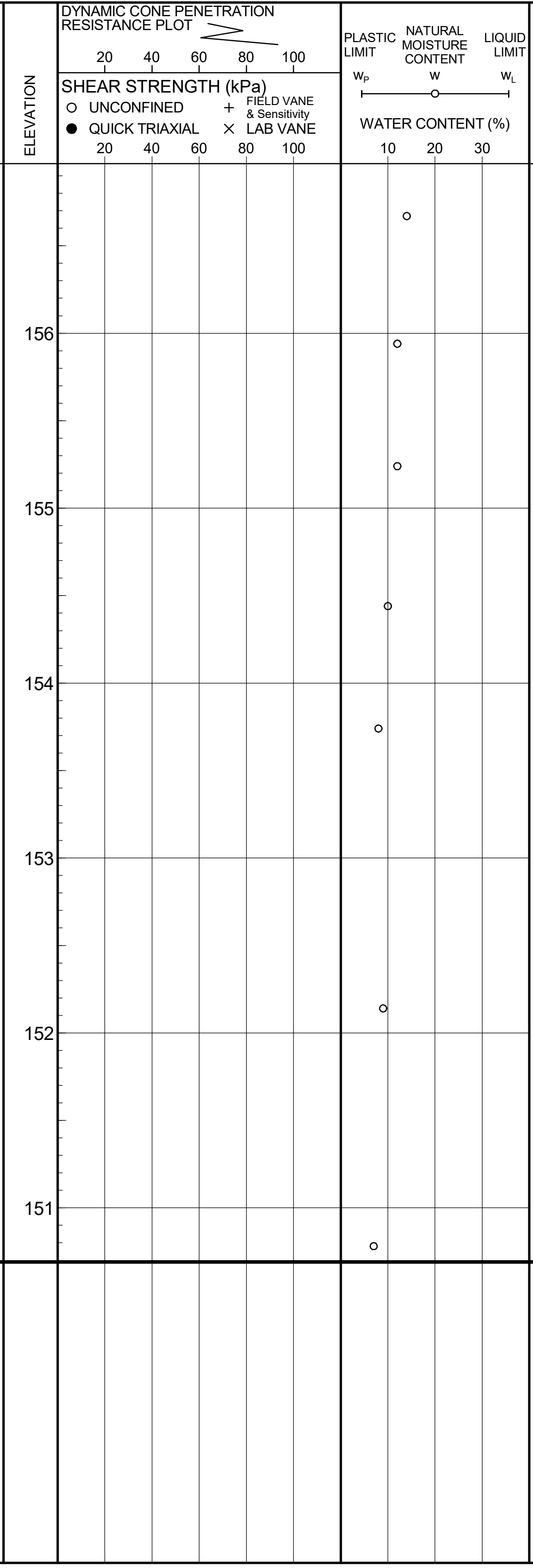
PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/01/2018
Drilling Contractor:

REF. NO.: SP18-306-10
ENCL NO.: 6

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m				
157.0 0.0	**CLAYEY SILT TILL:** some sand, trace cobbles, trace gravel, brown, moist, firm to hard	1	SS	15				
		2	SS	26				
		3	SS	36				
	at 2.6 m, becoming grey	4	SS	39				
154.0 3.0	**SANDY SILT TILL:** some sand, trace cobbles, trace gravel, brown, moist, compact to very dense	5	SS	69				
	trace shale fragments	6	SS	82				
150.9 6.1	**INFERRED BEDROCK** Shale, Georgian Bay Formation, grey	7	SS	24-50/ 25 mm				
150.7 6.3	**END OF BOREHOLE:**							

Notes:
1. Borehole open and dry upon completion of drilling.



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH6

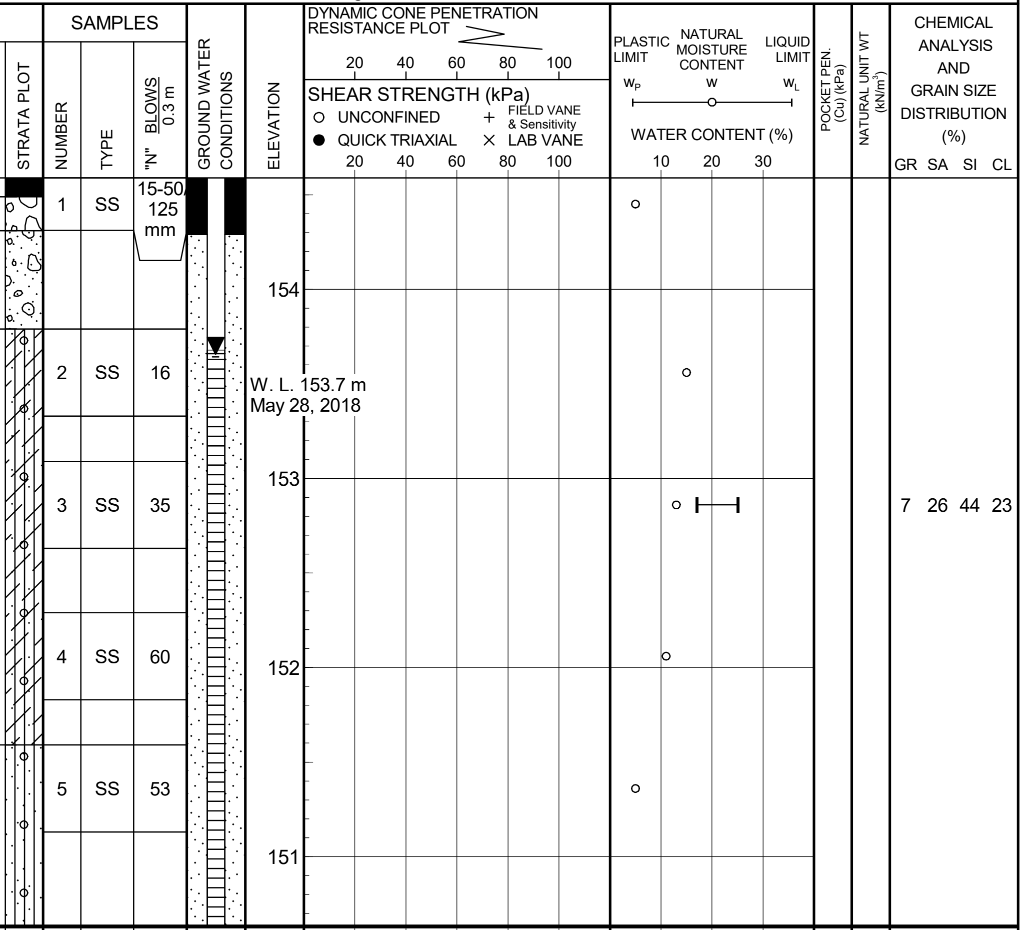
1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/01/2018
Drilling Contractor:

REF. NO.: SP18-306-10
ENCL NO.: 7

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
154.6 0.0	**ASPHALT:** 100 mm	1	SS	15-50/125 mm	
154.5 0.1	**GRAVEL:** 180 mm				
154.3 0.3	**SAND AND GRAVEL:** brown, moist				
153.8 0.8	**CLAYEY SILT TILL:** trace gravel, light brown, moist, stiff to hard	2	SS	16	
	trace cobbles	3	SS	35	7 26 44 23
		4	SS	60	
151.6 3.0	**SANDY SILT TILL:** trace gravel, trace clay, trace cobbles, grey, moist, very dense	5	SS	53	
150.6 4.0	**END OF BOREHOLE:**				



Notes:
1. Borehole open and dry upon completion of drilling.
2. Auger Refusal at 3.96 m depth.
3. Groundwater level was observed at 0.93 m in the well on May 28, 2018.

SPCL SOIL LOG SP18-306-10 - COPY.GPJ SPCL.GDT 6/14/18

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

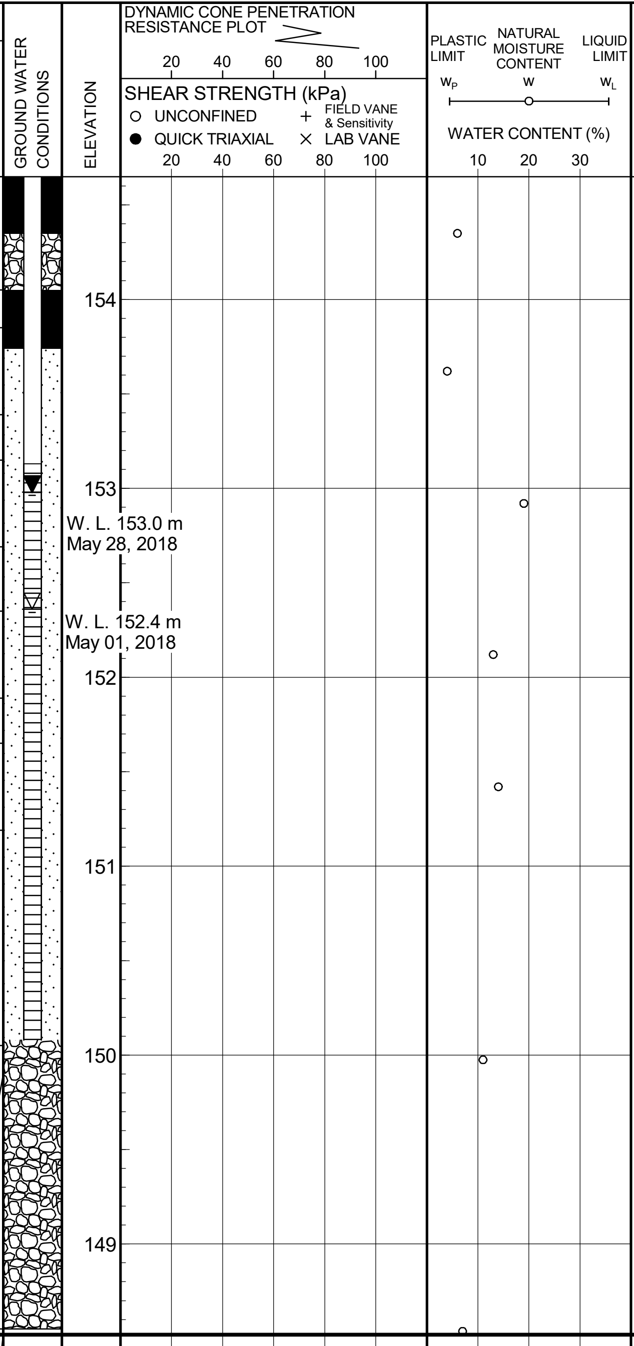
LOG OF BOREHOLE BH7

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/01/2018
Drilling Contractor:

REF. NO.: SP18-306-10
ENCL NO.: 8

SOIL PROFILE		SAMPLES		
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
154.7				
154.5 0.0	**ASPHALT:** 150 mm			
154.4 0.2	**GRAVEL:** 125 mm			
0.3	**FILL:** silty sand mixed with construction debris, brown, moist	1	SS	8
	becoming clayey silt, trace gravel,trace sand, reddish brown	2	SS	31
	becoming sandy silt, trace topsoil, greyish brown, moist	3	SS	36
152.4 2.3	**CLAYEY SILT TILL:** trace sand, trace cobbles, brown, moist	4	SS	53
151.7 3.0	**SANDY SILT TILL** trace gravel, trace clay, grey, very moist, dense to very dense	5	SS	38
150.1 4.6	**RESIDUAL SOIL/WEATHERED SHALE BEDROCK:** grey, moist	6	SS	50/ 150 mm
148.6				
148.5 6.1	**INFERRED BEDROCK** Shale, Georgian Bay Formation, Grey	7	SS	50/ 25 mm
	END OF BOREHOLE:			

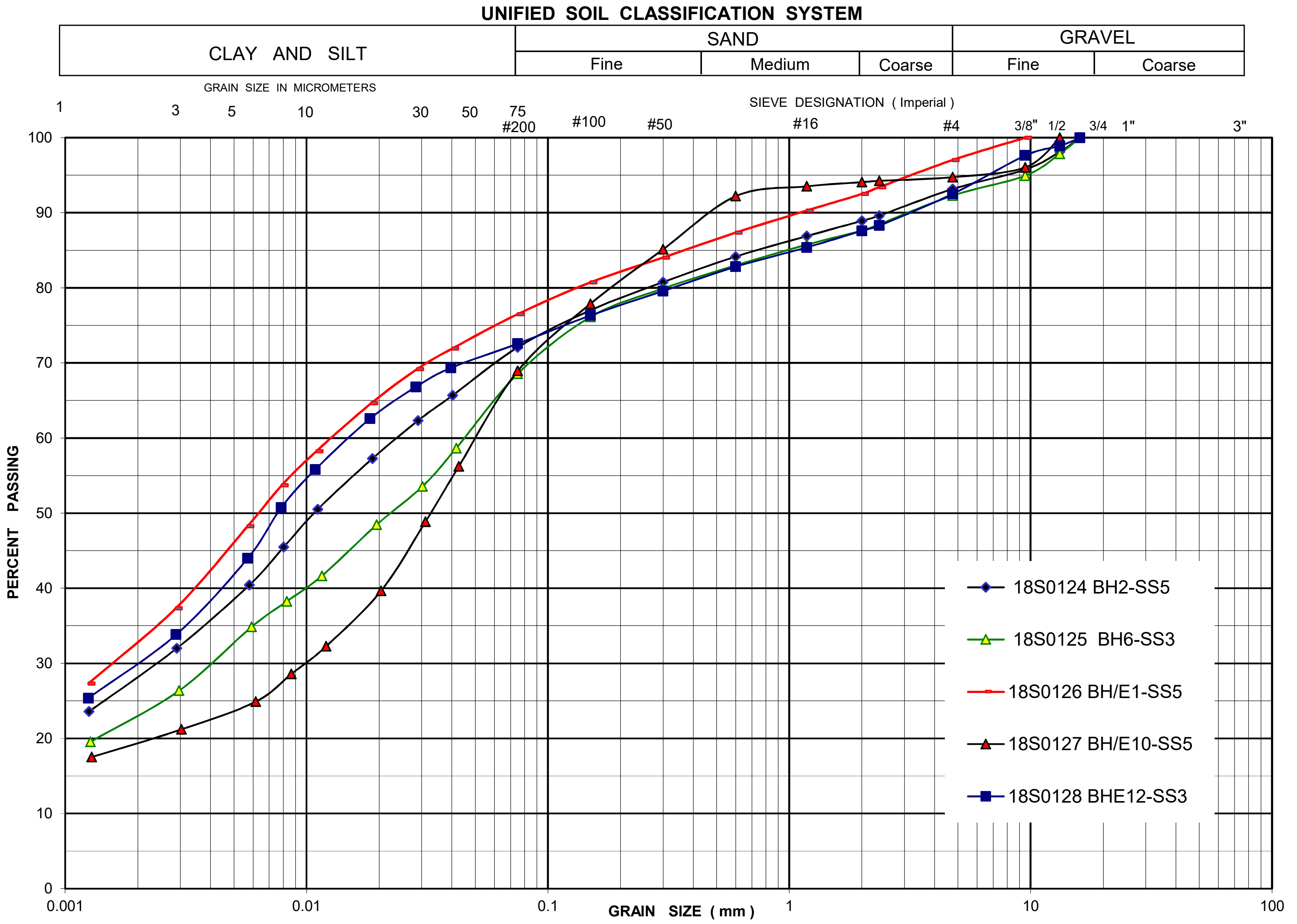


POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m^3) | CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Notes:
1. Borehole open upon completion of drilling.
2. Water encountered at 2.29 mbgs upon completion of drilling.
3. Monitoring well was Installed in the Borehole upon Completion of Drilling.
4. Groundwater level was observed at 1.67 m in the well on May 28, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure



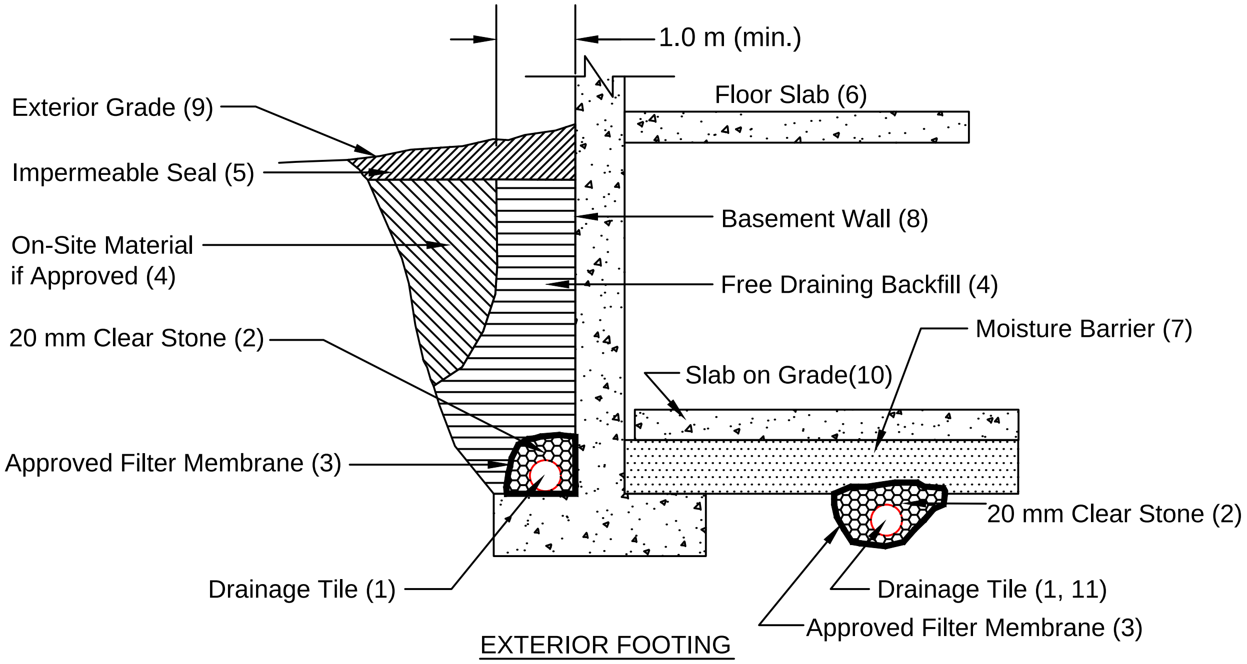
Sirati & Partners Consultants Ltd.
Geotechnical & Environmental Services
Engineering Solutions

GRAIN SIZE DISTRIBUTION

Fig:9

Project: SP18-306-10

Date: June, 2018

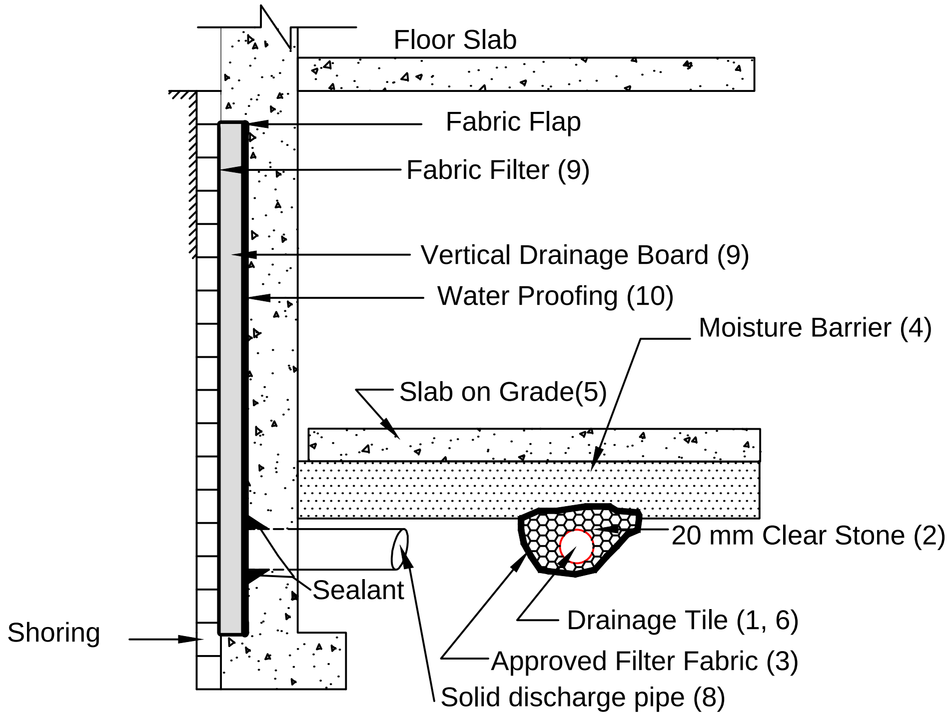


Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed /water proofed.
9. Exterior grade to slope away from building.
10. Slab on grade should not be structurally connected to the wall or footing.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minium of 1.2 m below exterior finished grade.
10. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
11. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System

(not to scale)

APPENDIX A

SIRATI & PARTNERS

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows; however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and Sirati & Partners Consultants Limited. Without this confirmation, no responsibility for the performance of the structure can be accepted by Sirati & Partners Consultants Limited (SPCL). Survey drawing of the pre-and post-fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a SPCL engineer prior to placement of fill.

5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by SPCL during placement of engineered fill is required. Work cannot commence or continue without the presence of the SPCL representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

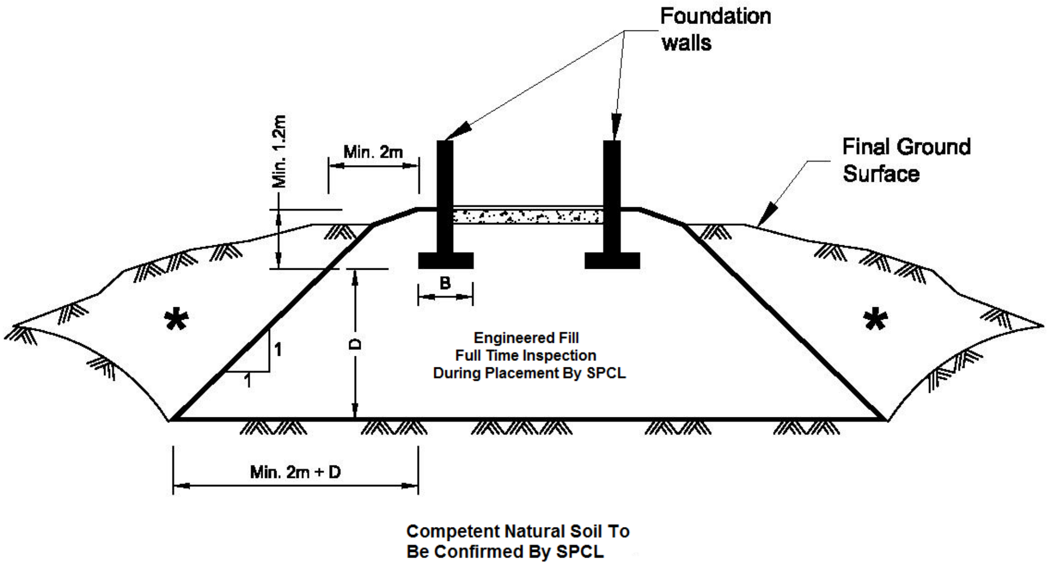
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from SPCL prior to footing concrete placements. All excavations must be backfilled under full time supervision by SPCL to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of SPCL.

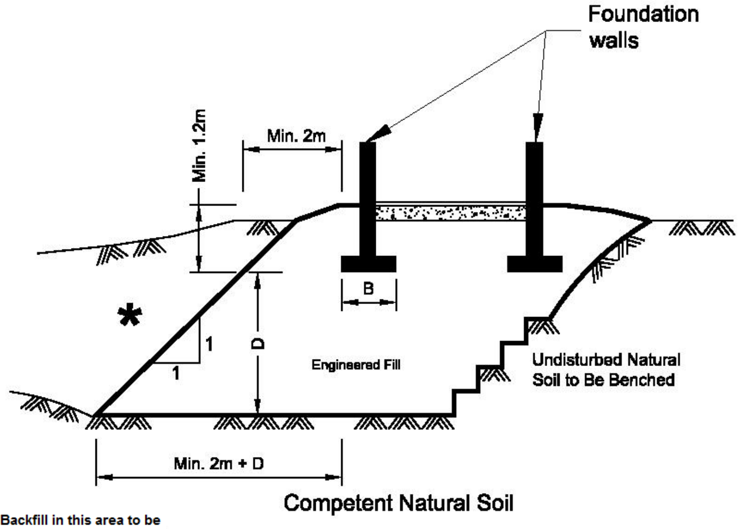
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with Sirati & Partners Consultants Limited (SPCL) report attached.





*Backfill in this area to be
as per the SPCL report

APPENDIX B

SIRATI & PARTNERS

SIRATI & PARTNERS

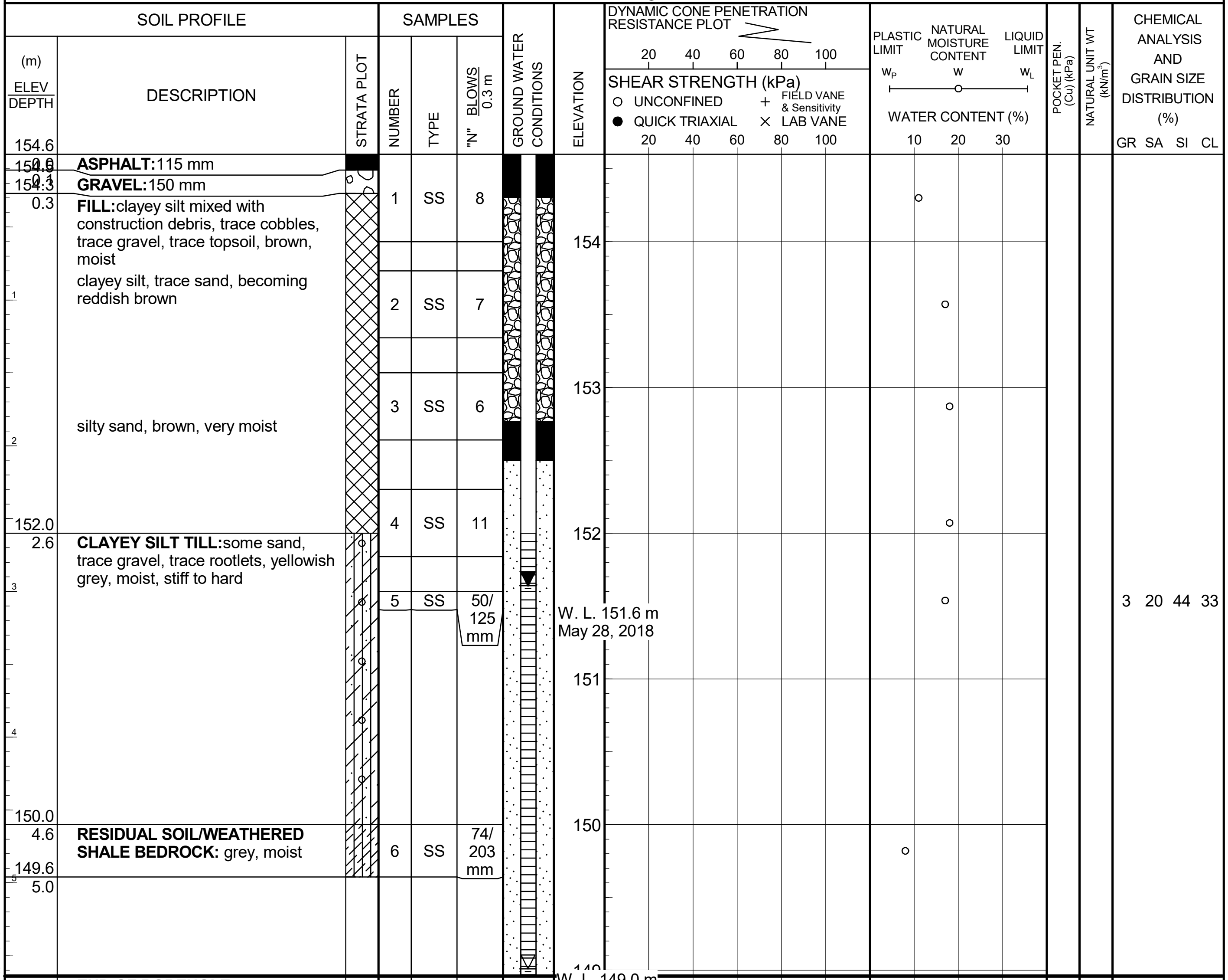
LOG OF BOREHOLE BH-E1

1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/07/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 2



SOIL PROFILE		SAMPLES			CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m	GR SA SI CL
154.6					
154.5 0.0	**ASPHALT:**115 mm				
154.3 0.1	**GRAVEL:**150 mm				
0.3	**FILL:**clayey silt mixed with construction debris, trace cobbles, trace gravel, trace topsoil, brown, moist	1	SS	8	
	clayey silt, trace sand, becoming reddish brown	2	SS	7	
	silty sand, brown, very moist	3	SS	6	
		4	SS	11	
152.0 2.6	**CLAYEY SILT TILL:**some sand, trace gravel, trace rootlets, yellowish grey, moist, stiff to hard				
		5	SS	50/ 125 mm	3 20 44 33
150.0 4.6	**RESIDUAL SOIL/WEATHERED SHALE BEDROCK:** grey, moist	6	SS	74/ 203 mm	
149.6 5.0					

W. L. 151.6 m
May 28, 2018

W. L. 149.0 m
May 07, 2018

END OF BOREHOLE:

Notes:
1. Borehole Open upon Completion of Drilling.
2. Auger Refusal at 5.64 m Depth.
3. Water Encountered at 5.59 m upon Completion of Drilling.
4. Monitoring Well was Installed in the Borehole upon Completion of Drilling.
5. Groundwater Level was Observed at 2.96 m in the Well on May 28, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity
○ $^{\varepsilon}$=3% Strain at Failure

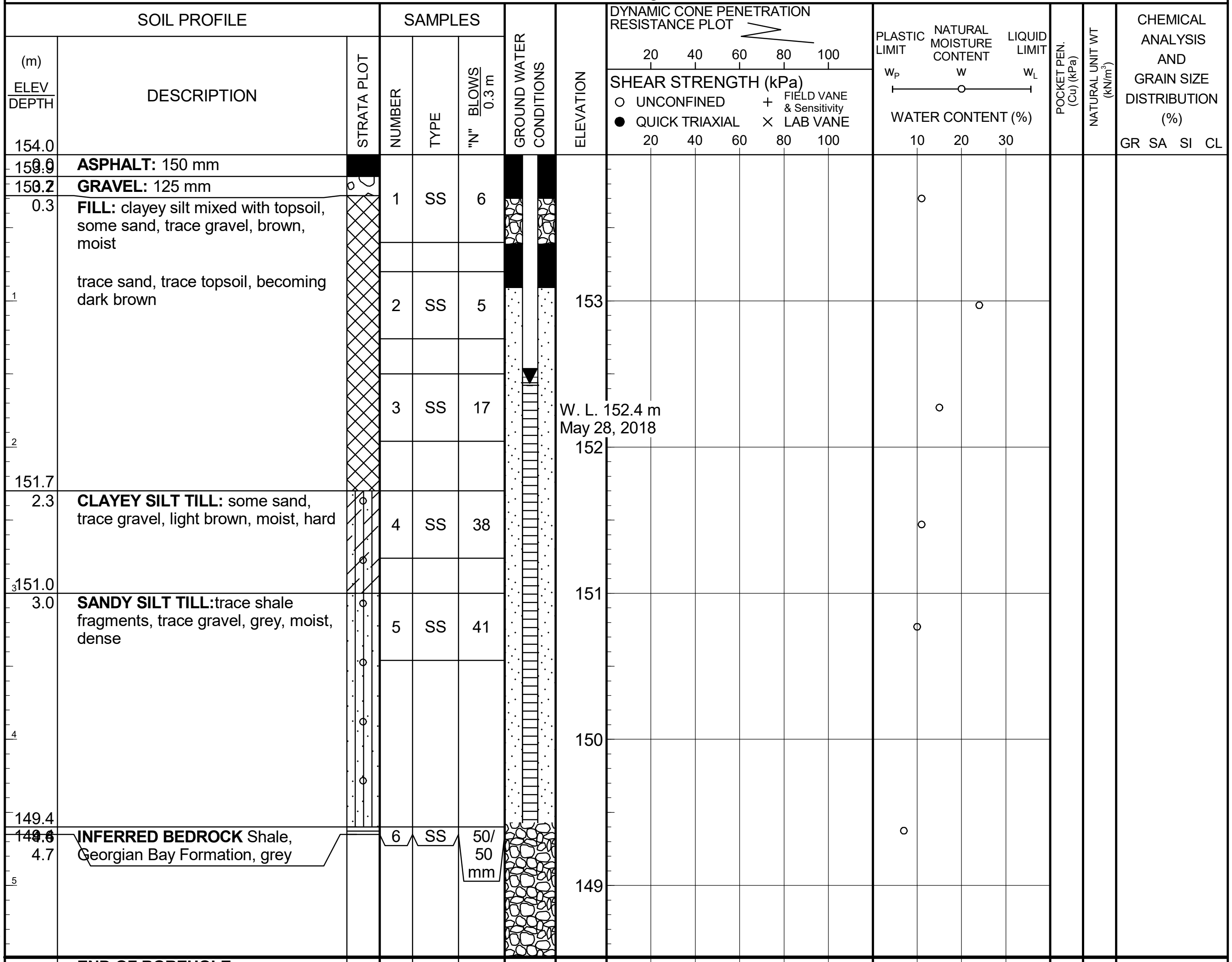
LOG OF BOREHOLE BH-E2

1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/07/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 3



ELEV / DEPTH (m)	DESCRIPTION
154.0	
153.9 0.0	**ASPHALT:** 150 mm
153.7 0.2	**GRAVEL:** 125 mm
0.3	**FILL:** clayey silt mixed with topsoil, some sand, trace gravel, brown, moist trace sand, trace topsoil, becoming dark brown
151.7 2.3	**CLAYEY SILT TILL:** some sand, trace gravel, light brown, moist, hard
151.0 3.0	**SANDY SILT TILL:**trace shale fragments, trace gravel, grey, moist, dense
149.4 149.4 4.6 4.7	**INFERRED BEDROCK** Shale, Georgian Bay Formation, grey

NUMBER	TYPE	"N" BLOWS / 0.3 m
1	SS	6
2	SS	5
3	SS	17
4	SS	38
5	SS	41
6	SS	50/ 50 mm

END OF BOREHOLE:

Notes:
1. Borehole Open and Dry upon Completion of Drilling.
2. Auger Refusal at 5.49 m Depth.
3. Monitoring Well was Installed in the Borehole upon Completion of Drilling.
4. Groundwater Level was Observed at 1.56 m in the Well on May 28, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ 3 =3% Strain at Failure

SPCL SOIL LOG SP18-306-20-WITHOUT GAS READINGS.GPJ SPCL.GDT 6/14/18

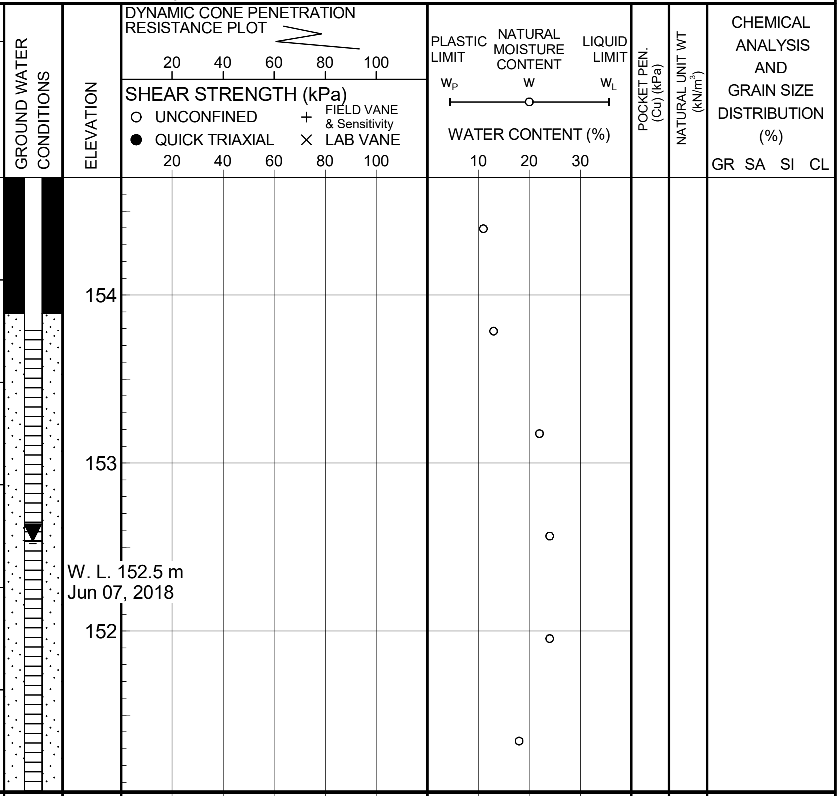
LOG OF BOREHOLE BH-E3

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Pionjar
Diameter:
Date: Jun/05/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 4

SOIL PROFILE		SAMPLES		
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
154.7 0.0	**CONCRETE:** 180 mm			
154.5 0.2	**FILL:** silty sand to clayey silt, trace cobbles, trace gravel, brown, moist	1	DO	
	trace construction debris	2	DO	
	trace topsoil, brown to grey	3	DO	
	becoming brown	4	DO	
152.6 2.1	**SANDY SILT TILL:** brown, wet, very moist			
152.3 2.4	**CLAYEY SILT TILL:** clayey silt till to native sandy silt till, brown, wet to very moist	5	DO	
	at 3.04 m, layers of wet sand	6	DO	
151.0 3.7	**END OF BOREHOLE:** Notes: 1. Monitoring Well was Installed in the Borehole upon Completion of Drilling. 2. Groundwater Level was Observed at 2.16 m in the Well on June 7, 2018.			



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

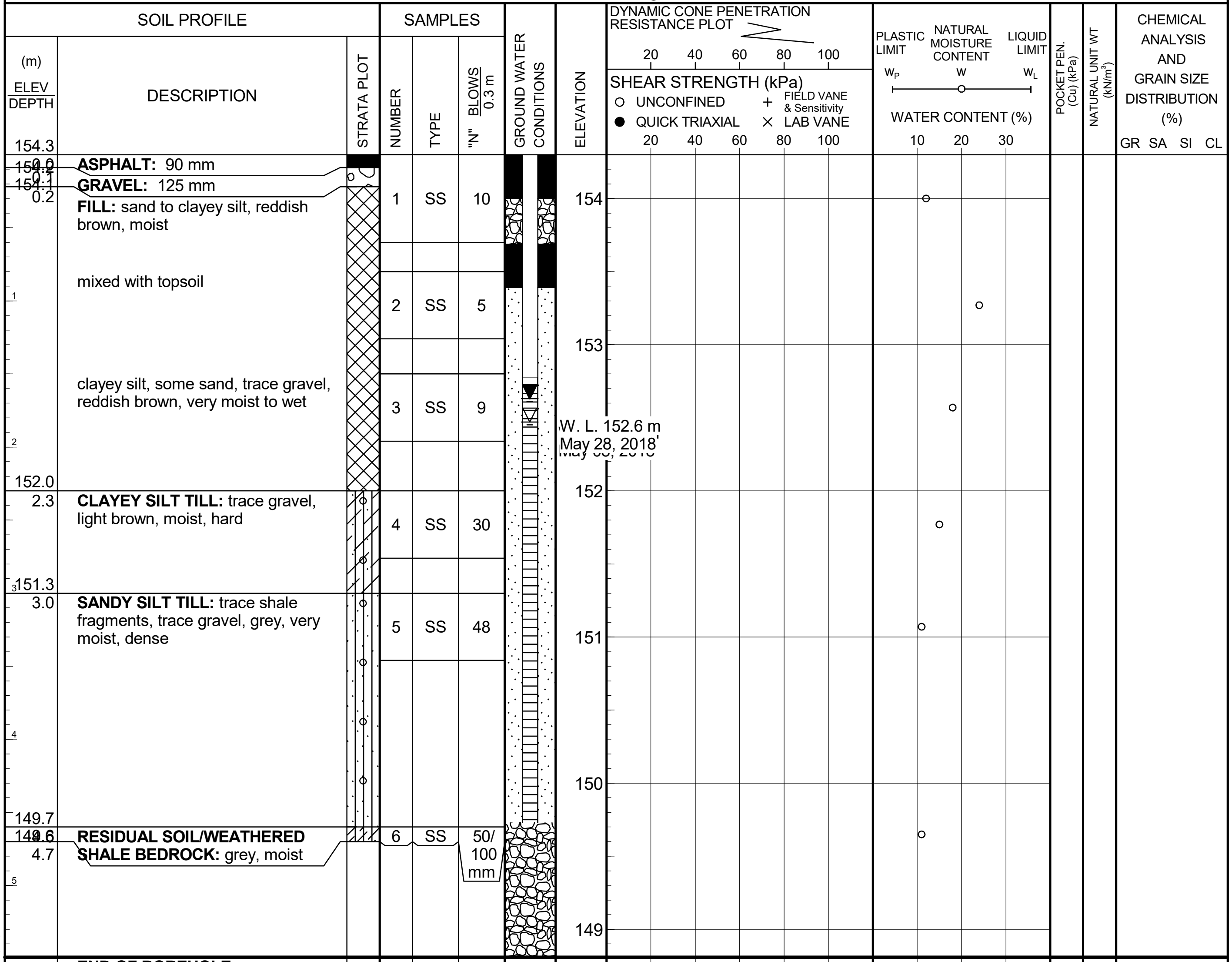
GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH-E4

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/08/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 5



(m) ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m
154.3				
154.2 0.1	**ASPHALT:** 90 mm			
154.1 0.2	**GRAVEL:** 125 mm			
0.2	**FILL:** sand to clayey silt, reddish brown, moist	1	SS	10
	mixed with topsoil	2	SS	5
	clayey silt, some sand, trace gravel, reddish brown, very moist to wet	3	SS	9
152.0 2.3	**CLAYEY SILT TILL:** trace gravel, light brown, moist, hard	4	SS	30
151.3 3.0	**SANDY SILT TILL:** trace shale fragments, trace gravel, grey, very moist, dense	5	SS	48
149.7 4.6				
149.6 4.7	**RESIDUAL SOIL/WEATHERED SHALE BEDROCK:** grey, moist	6	SS	50/ 100 mm

END OF BOREHOLE:

Notes:
1. Borehole Open upon Completion of Drilling.
2. Water Encountered at 1.83 m upon Completion of Drilling.
3. Auger Refusal at 5.49 m.
4. Monitoring Well was Installed in the Borehole upon completion of Drilling.
5. Groundwater Level was Observed at 1.67 m in the Well on May 28, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

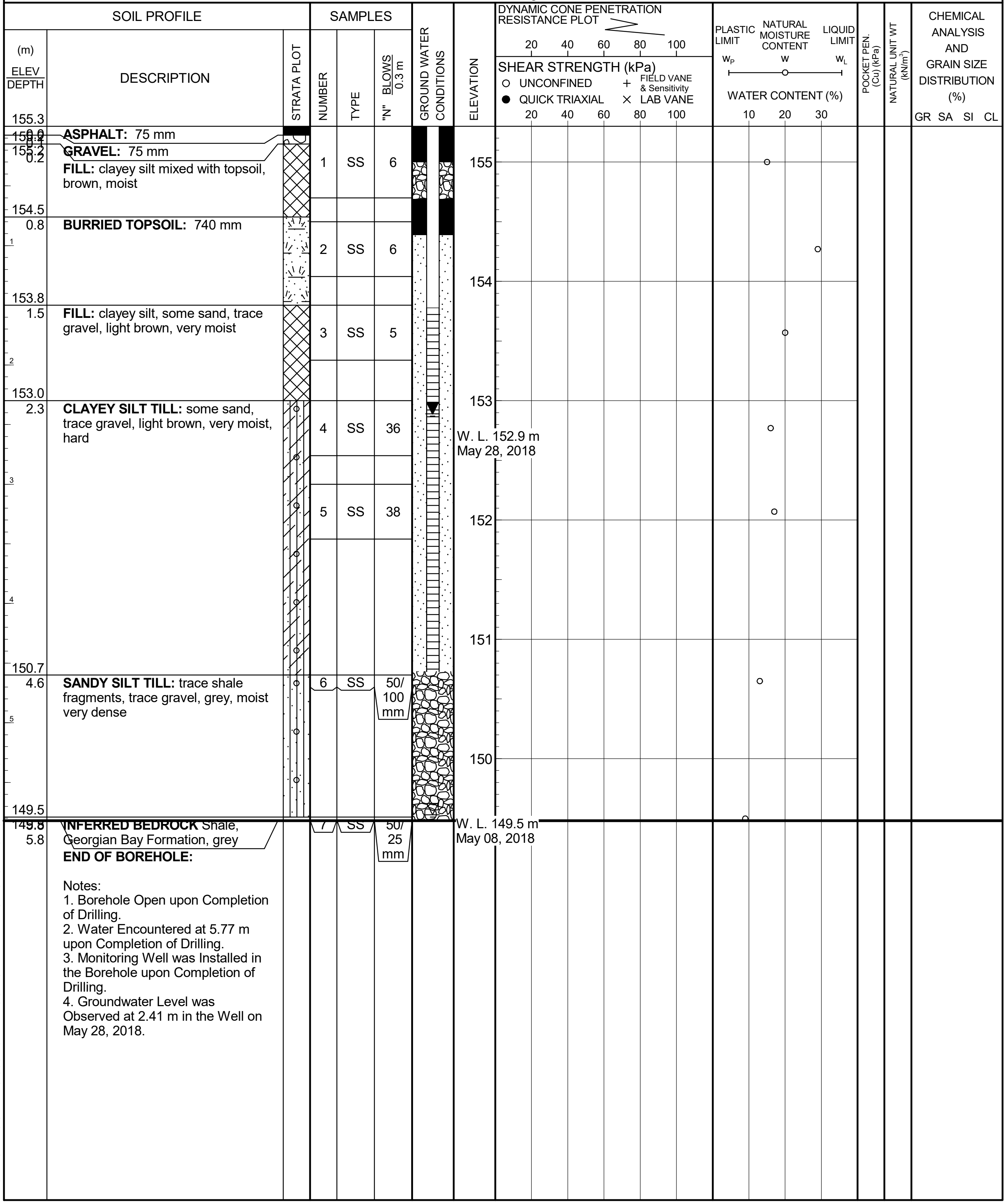
GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH-E5

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/08/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 6



(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
155.3				
0.0	**ASPHALT:** 75 mm			
155.2 / 0.1	**GRAVEL:** 75 mm			
155.2 / 0.2	**FILL:** clayey silt mixed with topsoil, brown, moist	1	SS	6
154.5 / 0.8	**BURRIED TOPSOIL:** 740 mm	2	SS	6
153.8 / 1.5	**FILL:** clayey silt, some sand, trace gravel, light brown, very moist	3	SS	5
153.0 / 2.3	**CLAYEY SILT TILL:** some sand, trace gravel, light brown, very moist, hard	4	SS	36
		5	SS	38
150.7 / 4.6	**SANDY SILT TILL:** trace shale fragments, trace gravel, grey, moist very dense	6	SS	50/ 100 mm
149.5 / 5.8	**INFERRED BEDROCK** Shale, Georgian Bay Formation, grey	7	SS	50/ 25 mm
149.5 / 5.8	**END OF BOREHOLE:**			

Notes:
1. Borehole Open upon Completion of Drilling.
2. Water Encountered at 5.77 m upon Completion of Drilling.
3. Monitoring Well was Installed in the Borehole upon Completion of Drilling.
4. Groundwater Level was Observed at 2.41 m in the Well on May 28, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

SIRATI & PARTNERS

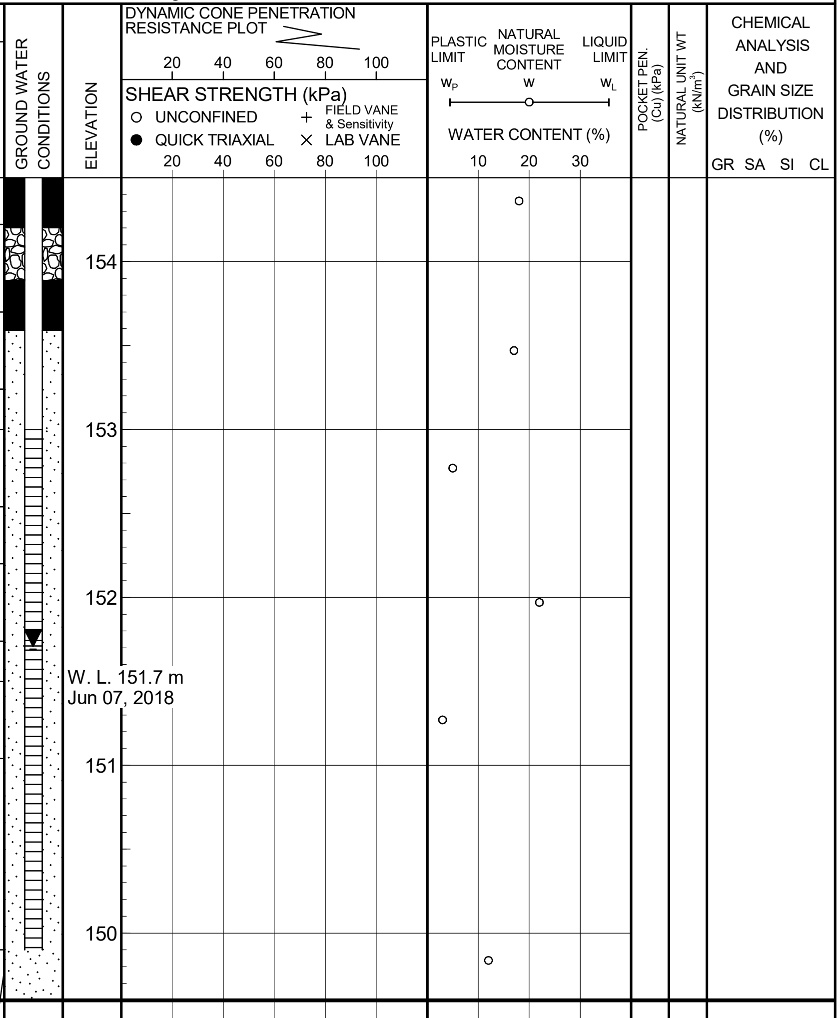
LOG OF BOREHOLE BH-E6

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/07/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 7

SOIL PROFILE		SAMPLES		
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m
154.5				
0.0	**FILL:** CONSTRUCTION DEBRIS MIXED WITH TOPSOIL	1	SS	13
154.0 0.5	**FILL:** Sandy silt mixed with topsoil, moist			
153.6 1.0	**FILL:** clayey silt, reddish brown, moist	2	SS	14
		3	SS	12
	mixed with topsoil	4	SS	6
151.5 3.0	**CLAYEY SILT TILL:** some sand, trace shale fragments, trace cobbles, trace gravel, grey, moist, very stiff to hard	5	SS	22
149.8 4.7	trace shale	6	SS	50/ 125 mm



END OF BOREHOLE:

Notes:
1. Borehole Open and Dry upon Completion of Drilling.
2. Auger Refusal at 4.9 m Depth.
3. Monitoring Well was Installed in the Borehole upon completion of Drilling.
4. Groundwater Level was Observed at 2.79 m in the well on June 7, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3$, $\times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SIRATI & PARTNERS

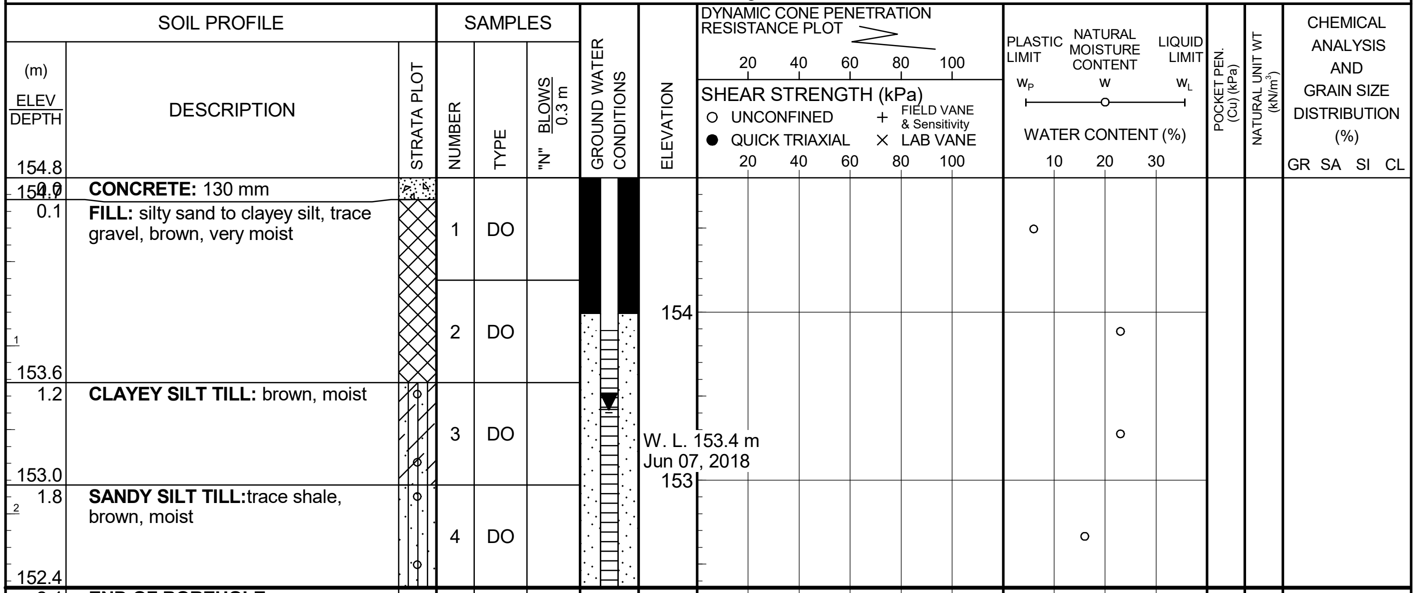
LOG OF BOREHOLE BH-E7

1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Pionjar
Diameter:
Date: Jun/05/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 8



(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
154.8				
0.0 154.7	**CONCRETE:** 130 mm			
0.1	**FILL:** silty sand to clayey silt, trace gravel, brown, very moist	1	DO	
		2	DO	
153.6 1.2	**CLAYEY SILT TILL:** brown, moist	3	DO	
153.0 1.8	**SANDY SILT TILL:** trace shale, brown, moist	4	DO	
152.4 2.4	**END OF BOREHOLE:**			

Notes:

1. Auger refusal at 2.44 m depth.
2. Monitoring Well was Installed in the Borehole upon Completion of Drilling.
3. Groundwater Level was Observed at 1.38 m in the Well on June 7, 2018.

SPCL SOIL LOG SP18-306-20-WITHOUT GAS READINGS.GPJ SPCL.GDT 6/14/18

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

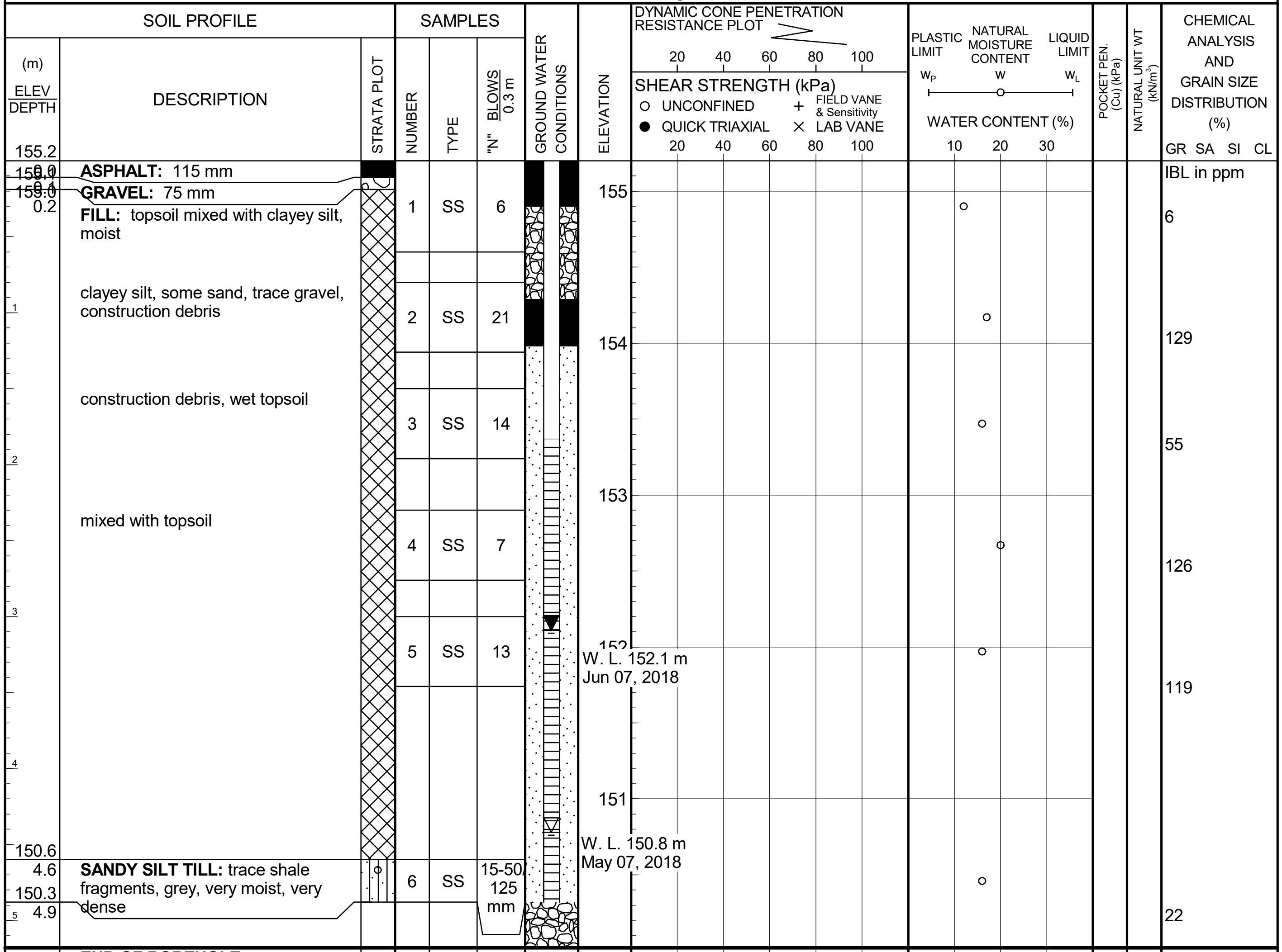
GRAPH NOTES: + 3 , × 3 : Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH-E8

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/07/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 9



(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m	CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
155.2 0.0	**ASPHALT:** 115 mm				IBL in ppm
155.1 0.1	**GRAVEL:** 75 mm				
155.0 0.2	**FILL:** topsoil mixed with clayey silt, moist	1	SS	6	6
	clayey silt, some sand, trace gravel, construction debris	2	SS	21	129
	construction debris, wet topsoil	3	SS	14	55
	mixed with topsoil	4	SS	7	126
		5	SS	13	119
150.6 4.6	**SANDY SILT TILL:** trace shale fragments, grey, very moist, very dense	6	SS	15-50/ 125 mm	22
150.3 4.9					

END OF BOREHOLE:

Notes:
1. Borehole Open upon Completion of Drilling.
2. Water was Encountered at 4.42 m upon Completion of Drilling.
3. Auger Refusal at 5.18 m Depth.
4. Monitoring Well was Installed in the Borehole upon completion of Drilling.
5. Groundwater Level was Observed at 3.09 m in the well on June 7, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH-E9

1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/07/2018
Drilling Contractor:

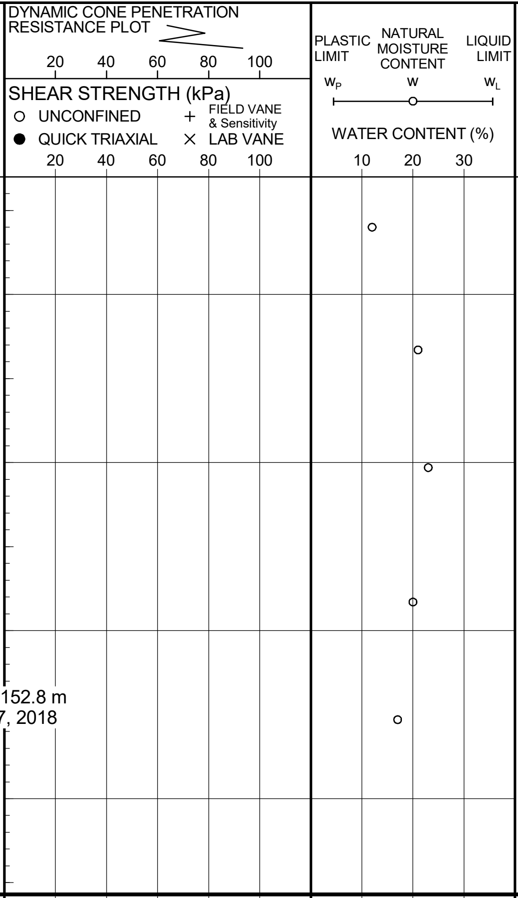
REF. NO.: SP18-306-20
ENCL NO.: 10

SOIL PROFILE		SAMPLES		
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
155.7				
155.7 0.0	**ASPHALT:** 75 mm			
155.6 0.1	**GRAVEL:** 125 mm			
155.5 0.2	**FILL:** sandy silt mixed with construction debris, trace topsoil, brown, moist	1	SS	10
154.9 0.8	**FILL:** clayey silt mixed with topsoil, trace gravel, trace sand, greyish brown, very moist	2	SS	6
		3	SS	5
	trace gravel	4	SS	8
152.7 3.0	**POSSIBLE FILL** silty sand, grey, wet	5	SS	22
152.2 3.5				

GROUND WATER CONDITIONS

ELEVATION: 155, 154, 153, 152

W. L. 152.8 m
Jun 07, 2018



POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

END OF BOREHOLE:

Notes:
1. Borehole Open and Dry upon Completion of Drilling.
2. Auger Refusal at 4.27 m Depth.
3. Monitoring Well was Installed in the Borehole upon completion of Drilling.
4. Groundwater Level was Observed at 2.91 m on June 7, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+³, ×³: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

SIRATI & PARTNERS

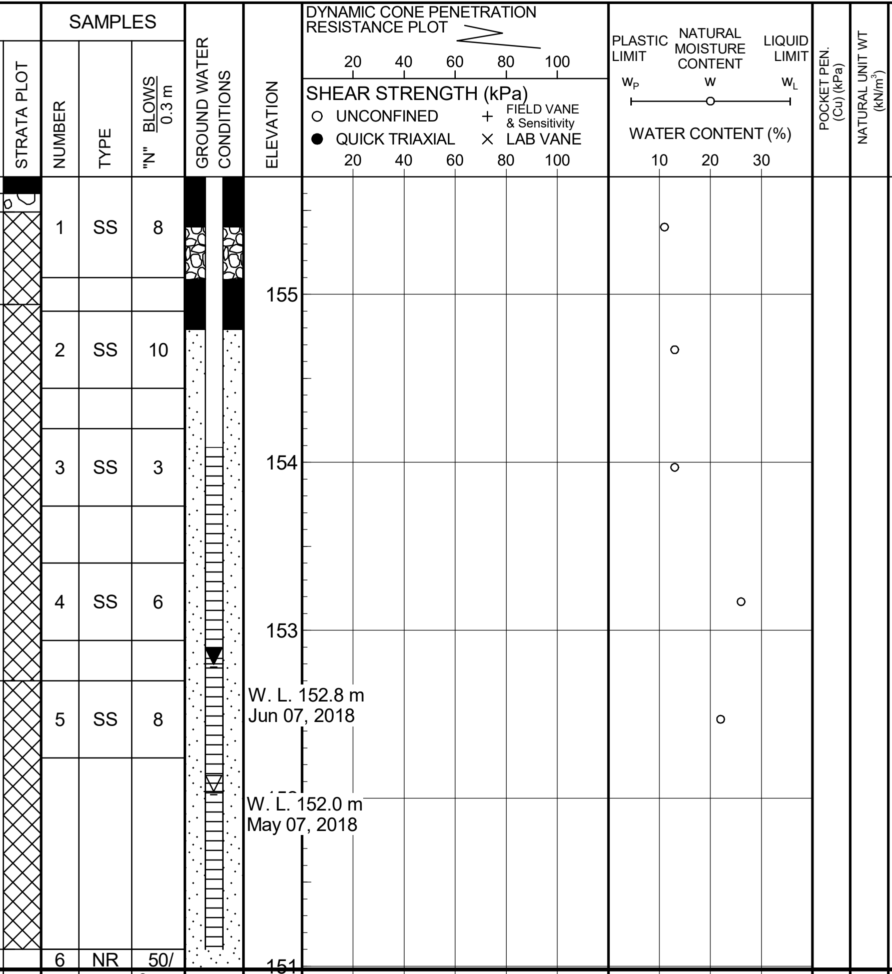
LOG OF BOREHOLE BH-E10

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/07/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 11

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m	GR	SA	SI	CL
155.7								
0.0	**ASPHALT:** 100 mm							
155.6 0.1	**GRAVEL:** 115 mm							
155.5 0.2	**FILL:** sandy silt, trace cobbles, moist	1	SS	8				
154.9 0.8	**FILL:** clayey silt, some sand, trace gravel, trace topsoil, brown, moist	2	SS	10				
		3	SS	3				
		4	SS	6				
152.7 3.0	**POSSIBLE FILL:** sandy silt, brown, moist	5	SS	8	5	26	49	20
151.1 4.6	**END OF BOREHOLE:**	6	NR	50/ 0 mm				



CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%)

Notes:
1. Borehole Open upon Completion of Drilling.
2. Water Encountered at 3.66 m upon Completion of Drilling.
2. Auger Refusal at 4.72 m Depth.
3. Monitoring Well was Installed in the Borehole upon completion of Drilling.
5. Groundwater Level was Observed at 2.9 m on June 7, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▽ 4th ▼

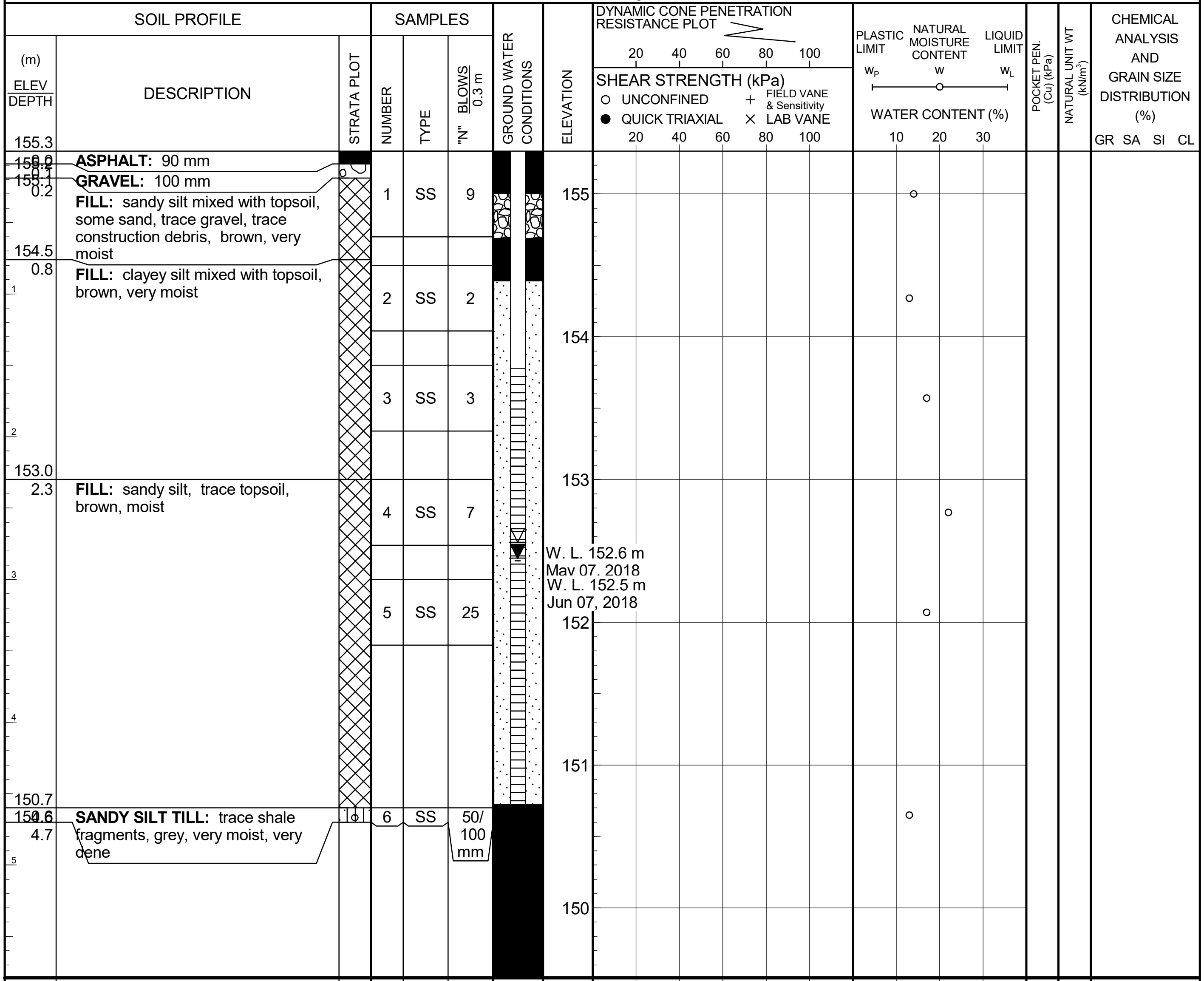
GRAPH NOTES +3, ×3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH-E11

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/07/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 12



ELEV (m) / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS / 0.3 m
155.3 / 0.0				
155.2 / 0.1	**ASPHALT:** 90 mm			
155.1 / 0.2	**GRAVEL:** 100 mm			
	FILL: sandy silt mixed with topsoil, some sand, trace gravel, trace construction debris, brown, very moist	1	SS	9
154.5 / 0.8	**FILL:** clayey silt mixed with topsoil, brown, very moist	2	SS	2
		3	SS	3
153.0 / 2.3	**FILL:** sandy silt, trace topsoil, brown, moist	4	SS	7
		5	SS	25
150.7 / 4.6	**SANDY SILT TILL:** trace shale fragments, grey, very moist, very dene	6	SS	50/ 100 mm
150.6 / 4.7				

END OF BOREHOLE:

Notes:
1. Borehole Open upon Completion of Drilling.
2. Water Encountered at 2.7 mbgs upon Completion of Drilling.
3. Auger Refusal at 5.79 m Depth.
4. Monitoring Well was Installed in the Borehole upon completion of drilling.
5. Groundwater Level was Observed at 2.85 m on June 7, 2018.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

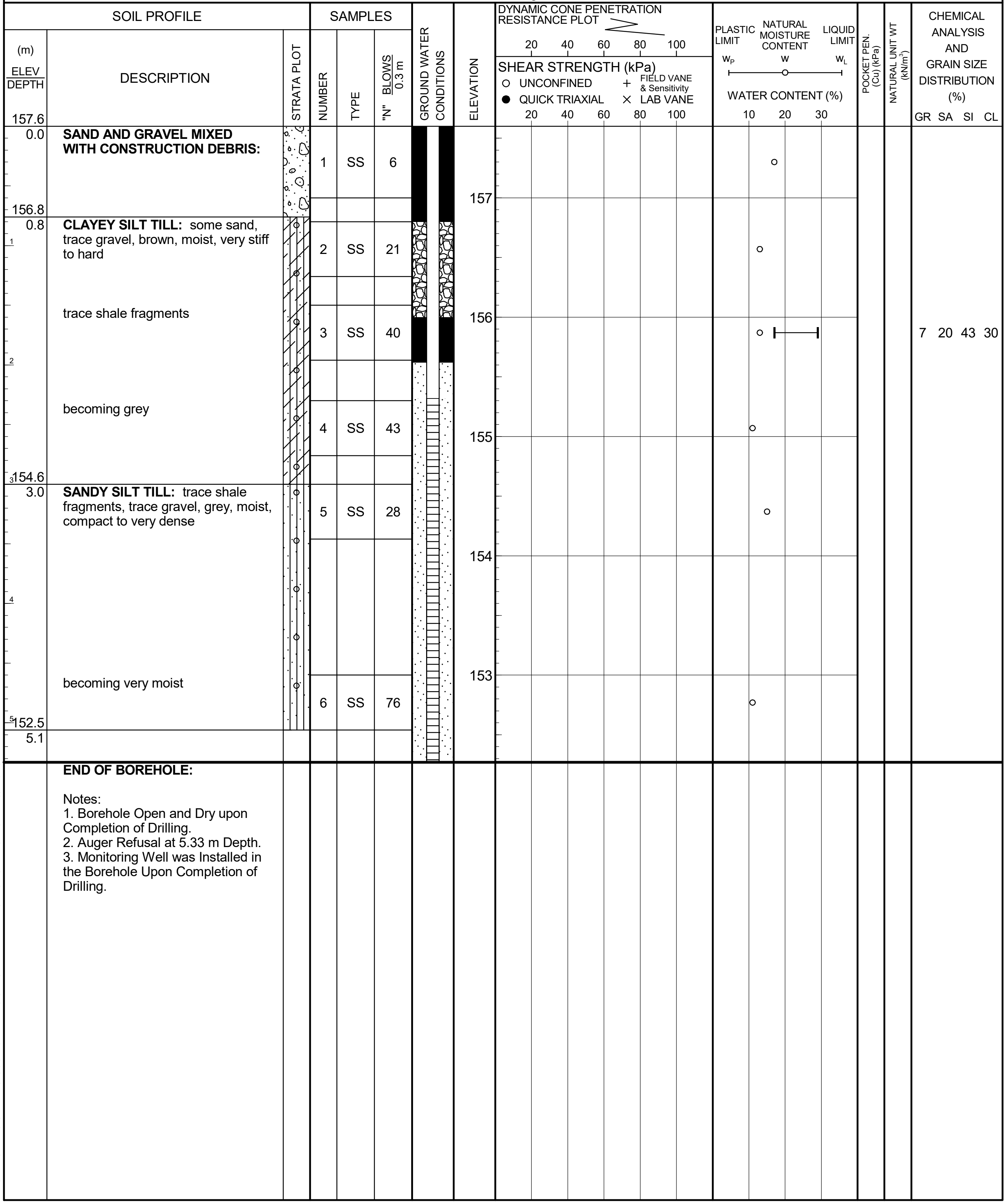
SIRATI & PARTNERS

LOG OF BOREHOLE BH-E12

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/08/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 13



ELEV DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m	GR	SA	SI	CL
157.6 0.0	**SAND AND GRAVEL MIXED WITH CONSTRUCTION DEBRIS:**	1	SS	6				
156.8 0.8	**CLAYEY SILT TILL:** some sand, trace gravel, brown, moist, very stiff to hard	2	SS	21				
	trace shale fragments	3	SS	40	7	20	43	30
	becoming grey	4	SS	43				
154.6 3.0	**SANDY SILT TILL:** trace shale fragments, trace gravel, grey, moist, compact to very dense	5	SS	28				
	becoming very moist	6	SS	76				
152.5 5.1								

END OF BOREHOLE:

Notes:
1. Borehole Open and Dry upon Completion of Drilling.
2. Auger Refusal at 5.33 m Depth.
3. Monitoring Well was Installed in the Borehole Upon Completion of Drilling.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

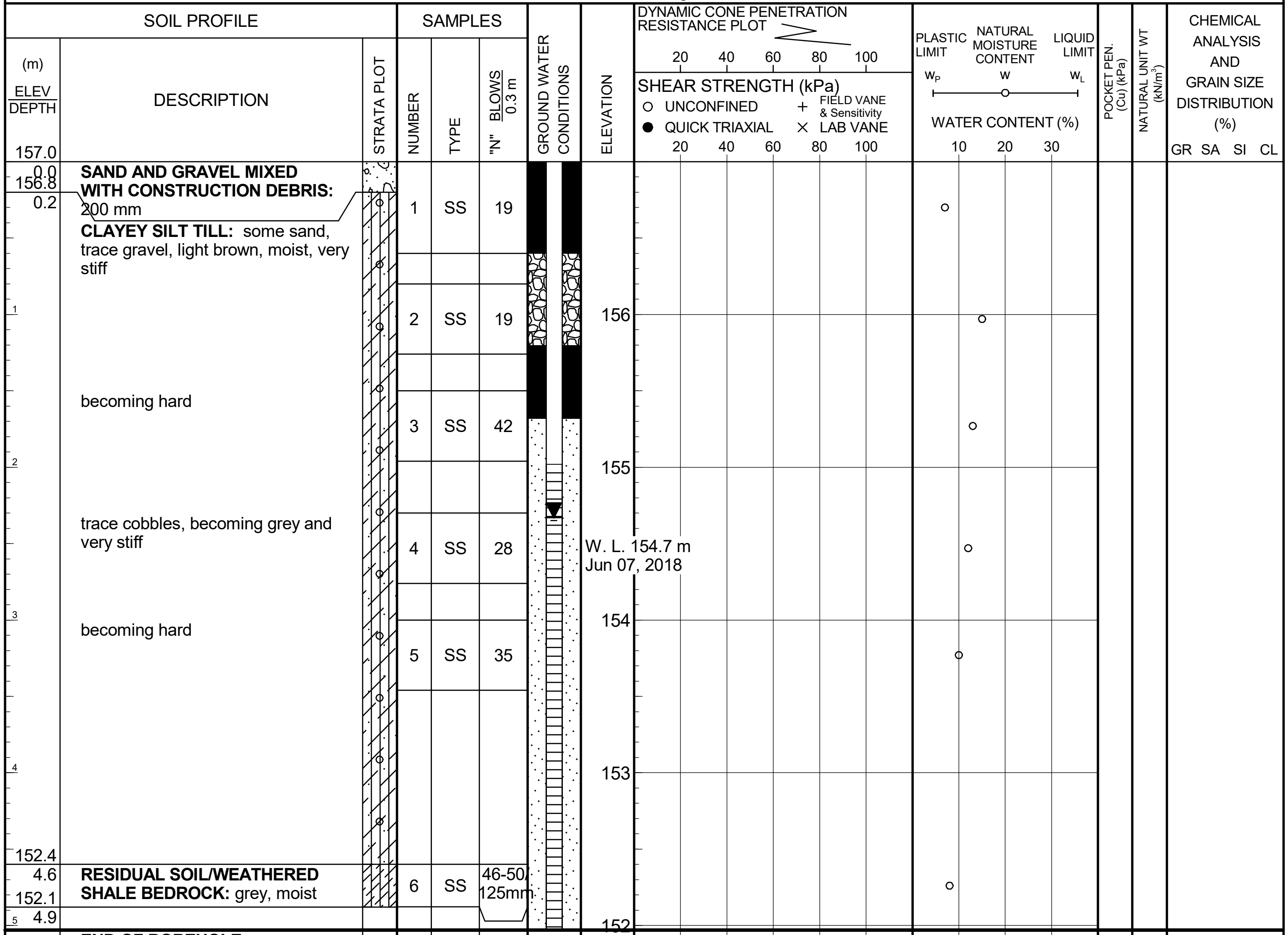
LOG OF BOREHOLE BH-E13

1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/08/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 14



(m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m
157.0 0.0	**SAND AND GRAVEL MIXED WITH CONSTRUCTION DEBRIS:** 200 mm			
156.8 0.2	**CLAYEY SILT TILL:** some sand, trace gravel, light brown, moist, very stiff	1	SS	19
		2	SS	19
	becoming hard	3	SS	42
	trace cobbles, becoming grey and very stiff	4	SS	28
	becoming hard	5	SS	35
152.4 4.6	**RESIDUAL SOIL/WEATHERED SHALE BEDROCK:** grey, moist	6	SS	46-50/125mm
152.1 4.9	**END OF BOREHOLE:**			

Notes:
1. Borehole Open and Dry upon Completion of Drilling.
2. Auger Refusal at 5.03 m Depth.
3. Monitoring Well was Installed in the Borehole Upon Completion of Drilling.
4. Groundwater Level was Observed at 2.33 m in the Well on June 7, 2018.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SIRATI & PARTNERS

LOG OF BOREHOLE BH-E14

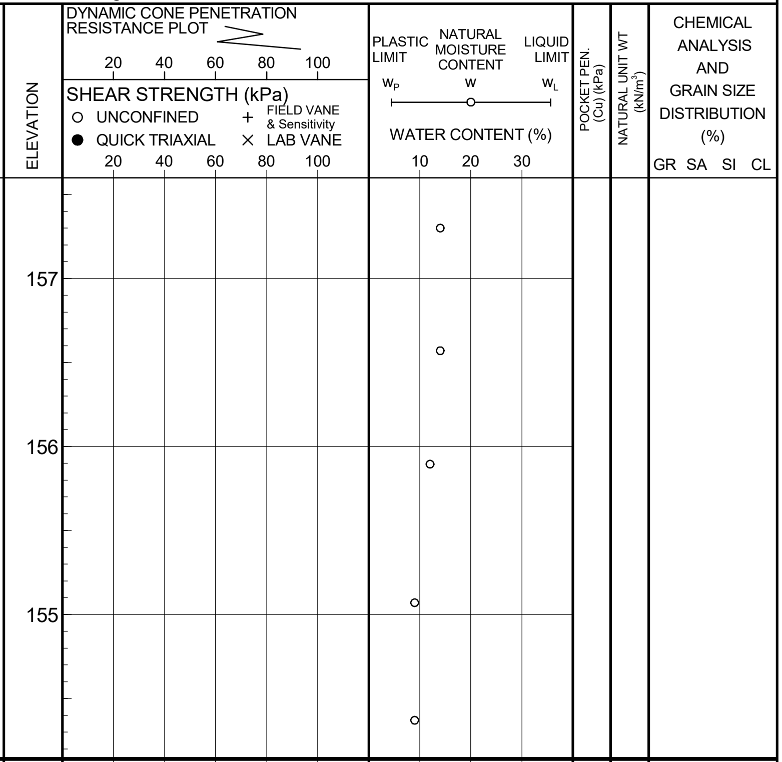
1 OF 1

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/08/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 15

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS
157.6					
0.0	**SAND AND GRAVEL MIXED WITH CONSTRUCTION DEBRIS:**	1	SS	33	
156.8 0.8	**CLAYEY SILT TILL:** some sand, trace gravel, brown, moist, very stiff to hard	2	SS	22	
		3	SS	64/ 253 mm	
155.3 2.3	**SANDY SILT TILL:** trace shale fragments, trace gravel, moist, grey, dense	4	SS	38	
		5	SS	43	
154.1 3.5	**END OF BOREHOLE:** Notes: 1. Borehole Open and Dry upon Completion of Drilling.				



GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

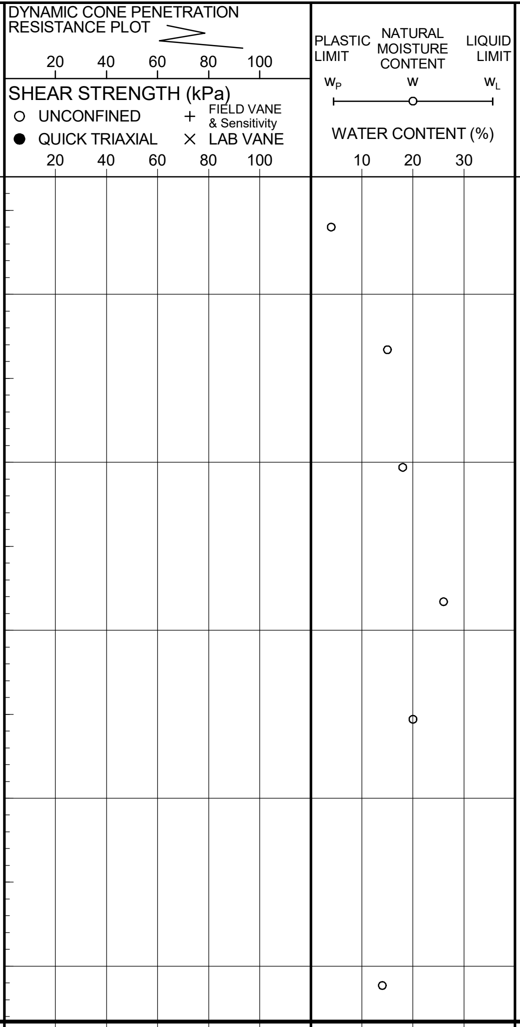
LOG OF BOREHOLE BH-E15

PROJECT: Proposed Slope Stability & Erosion Assessment Study
CLIENT: DE SEN REALTY COMPANY LTD.
PROJECT LOCATION: 66 Thomas Street, Mississauga, ON
DATUM: Geodetic
BH LOCATION:

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150 mm
Date: May/08/2018
Drilling Contractor:

REF. NO.: SP18-306-20
ENCL NO.: 16

SOIL PROFILE			SAMPLES					
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	POCKET PEN. (Cu) (kPa) / NATURAL UNIT WT (kN/m³) / CHEMICAL ANALYSIS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
155.7								
0.0	**SAND AND GRAVEL MIXED WITH CONSTRUCTION DEBRIS:** 700 mm		1	SS	61			
154.9 0.8	**FILL:** clayey silt, some sand, trace gravel, trace topsoil, brown, moist		2	SS	10		155	
			3	SS	5		154	
153.4 2.3	**BURRIED TOPSOIL:** 750 mm		4	SS	8		153	
152.7 3.0	**POSSIBLE FILL:** sand and gravel, wet		5	SS	14		152	
151.1 4.6	**SANDY SILT TILL:** trace gravel, grey, moist, very dense		6	SS	67/ 278 mm		151	
150.7 5.0	**END OF BOREHOLE:** Notes: 1. Borehole Open and Dry upon Completion of Drilling.							



GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

APPENDIX C

SIRATI & PARTNERS

Photo 1: Slope Area at Section B-B' (looking south)

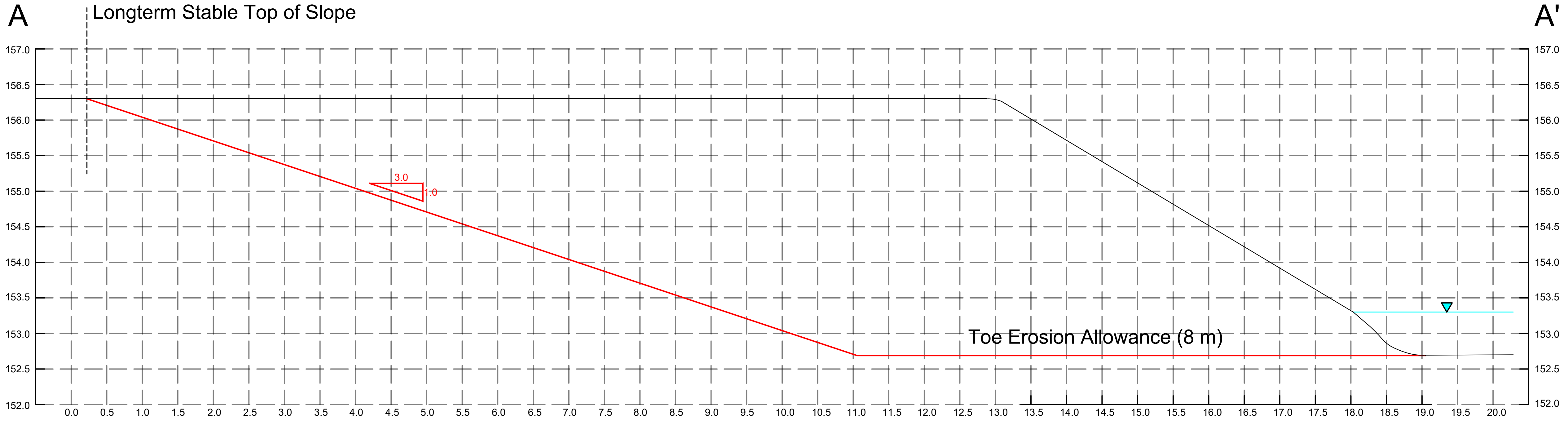
Photo 2: Slope Area at Section E-E' (looking north)

Photo 3: Slope Area at Section H-H' (looking north)

Photo 4: Slope Area at Section J-J' (looking south)

APPENDIX D

SIRATI & PARTNERS



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

— Existing Topography

— Water Level

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

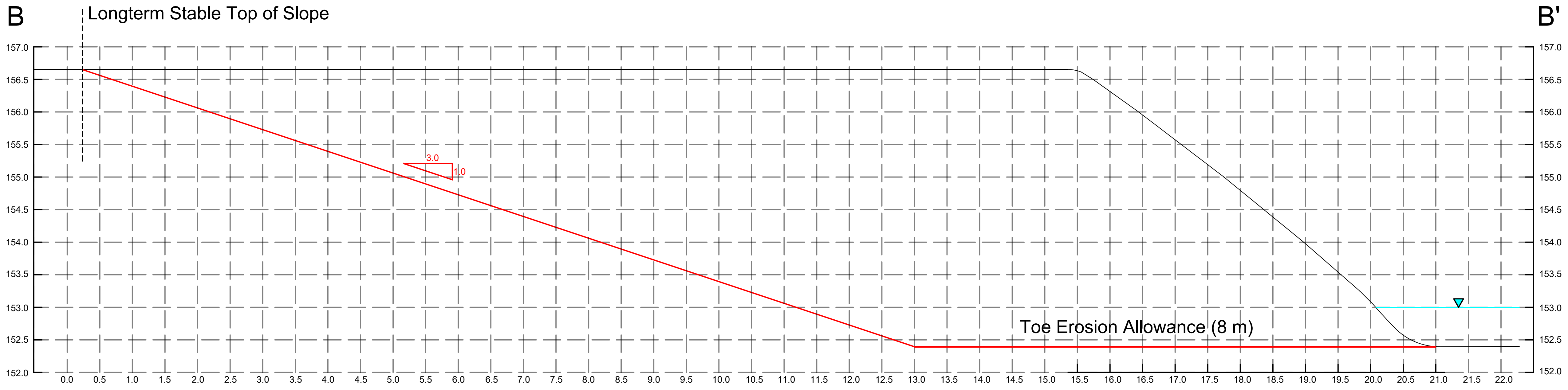
LTSTOS for Cross section AA'

Scale: As Shown

Project Number: SP18-306-10

Date: August 2018

Figure Number: D-1



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

—	Existing Topography
—	Water Level

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

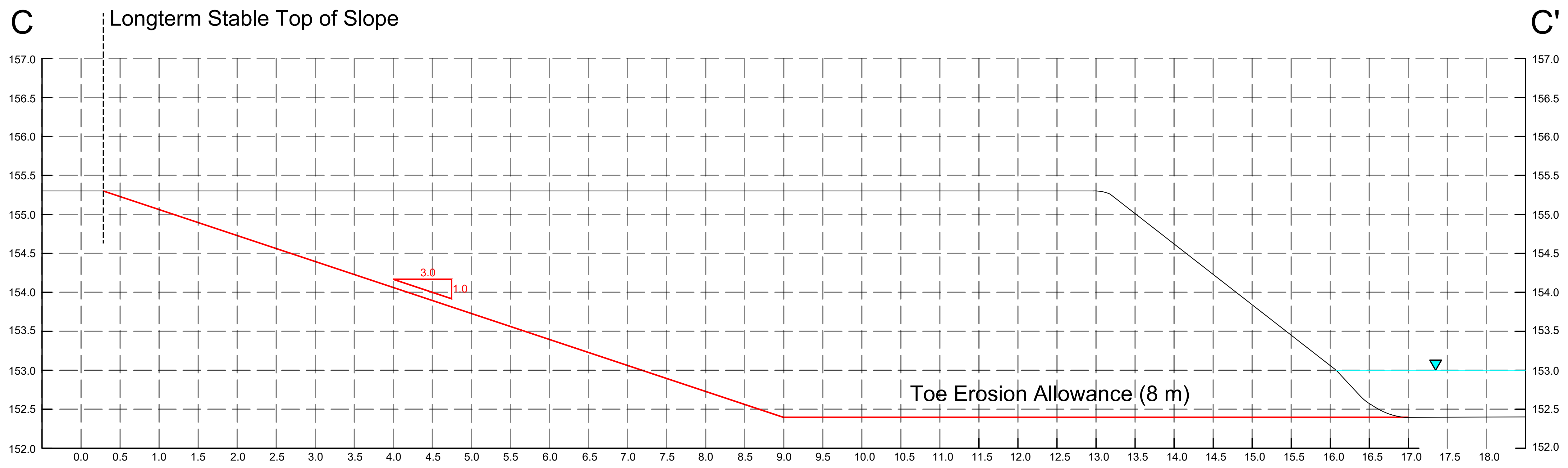
LTSTOS for Cross section BB'

Scale: As Shown

Project Number: SP18-306-10

Date: August 2018

Figure Number: D-2



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

— Existing Topography

— Water Level

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

LTSTOS for Cross section CC'

Scale:

As Shown

Project Number:

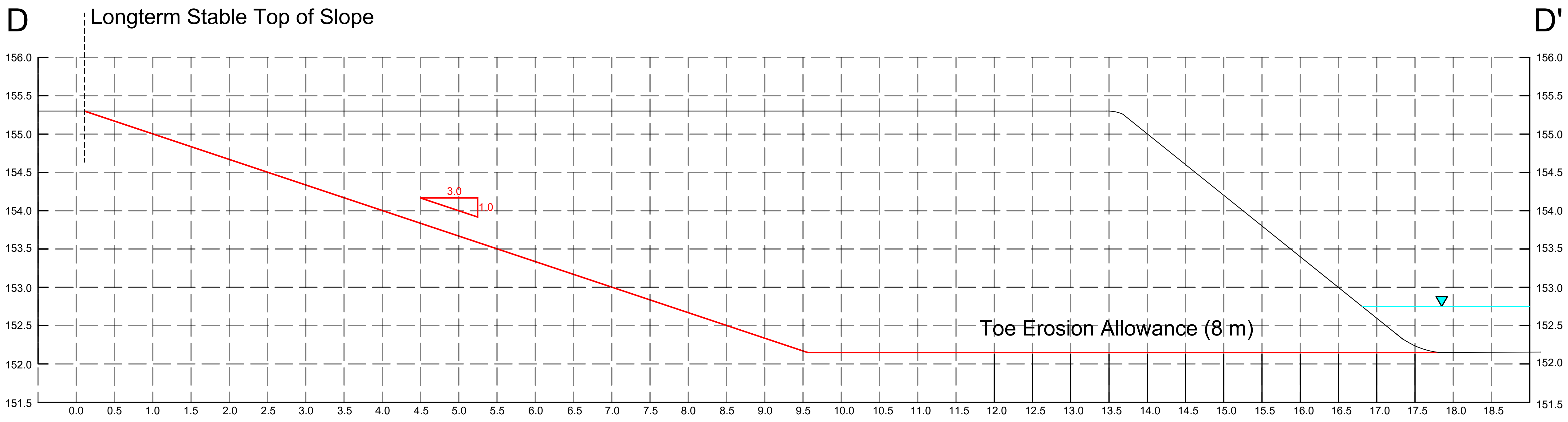
SP18-306-10

Date:

August 2018

Figure Number:

D-3



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

—	Existing Topography
—	Water Level

Project Title:

Slope Stability Investigation

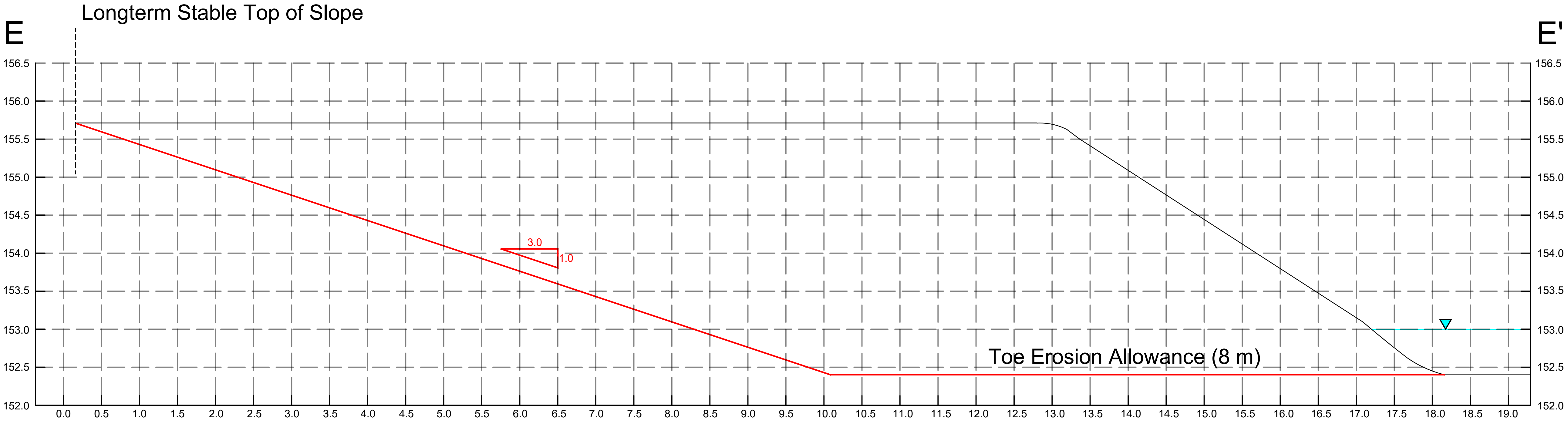
Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

LTSTOS for Cross section DD'

Scale: As Shown	**Project Number:** SP18-306-10
Date: August 2018	**Figure Number:** D-4



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

— Existing Topography

— Water Level

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

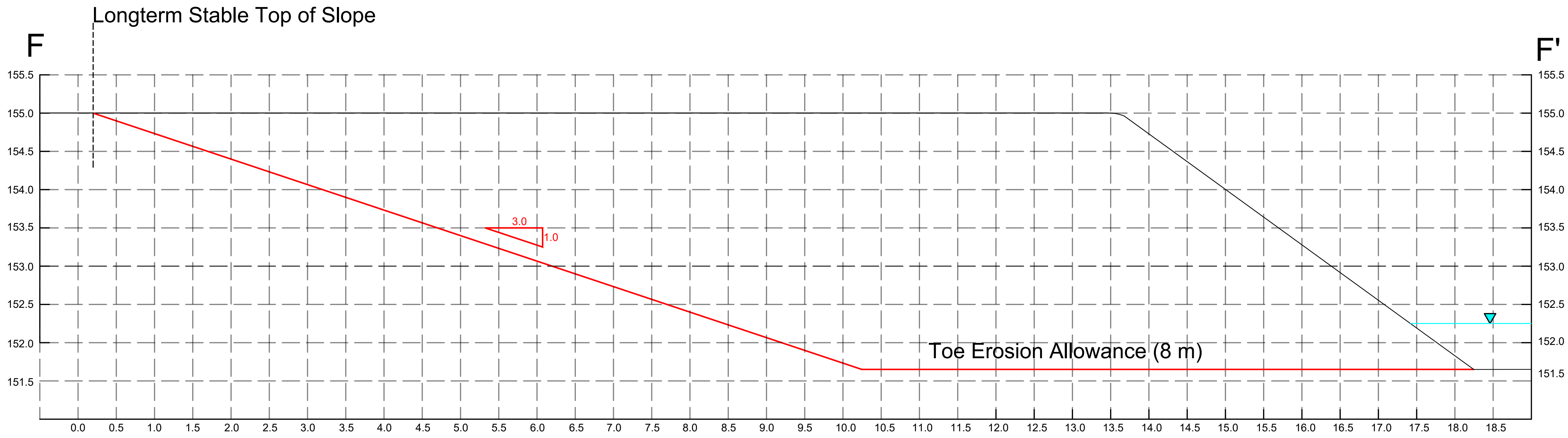
LTSTOS for Cross section EE'

Scale: As Shown

Project Number: SP18-306-10

Date: August 2018

Figure Number: D-5



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

— Existing Topography

— Water Level

Project Title:

Slope Stability Investigation

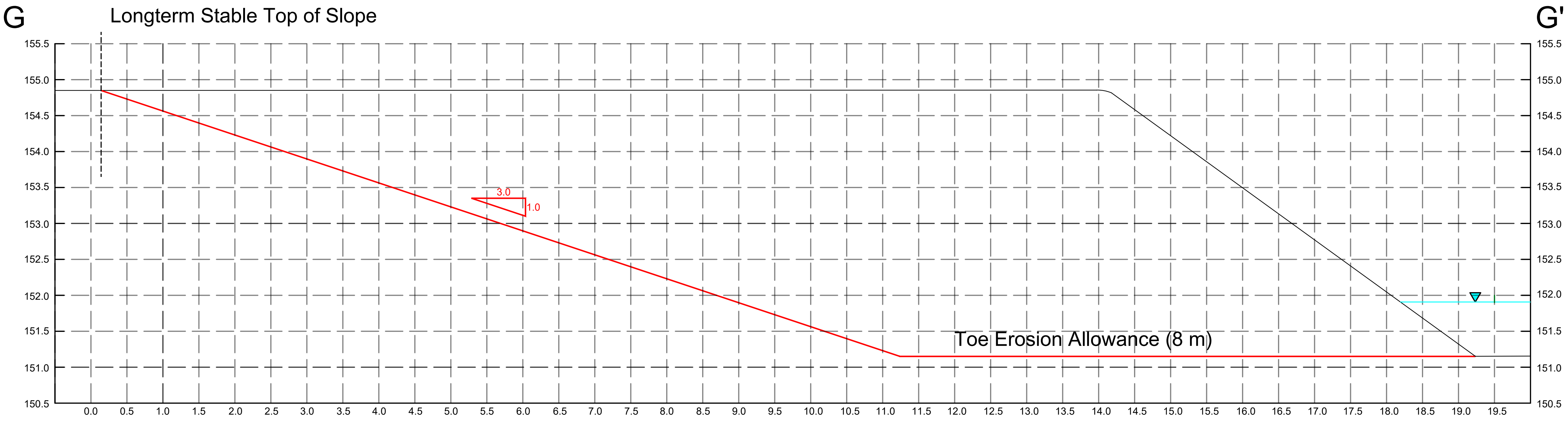
Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

LTSTOS for Cross section FF'

Scale: As Shown	**Project Number:** SP18-306-10
Date: August 2018	**Figure Number:** D-6



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

— Existing Topography

— Water Level

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

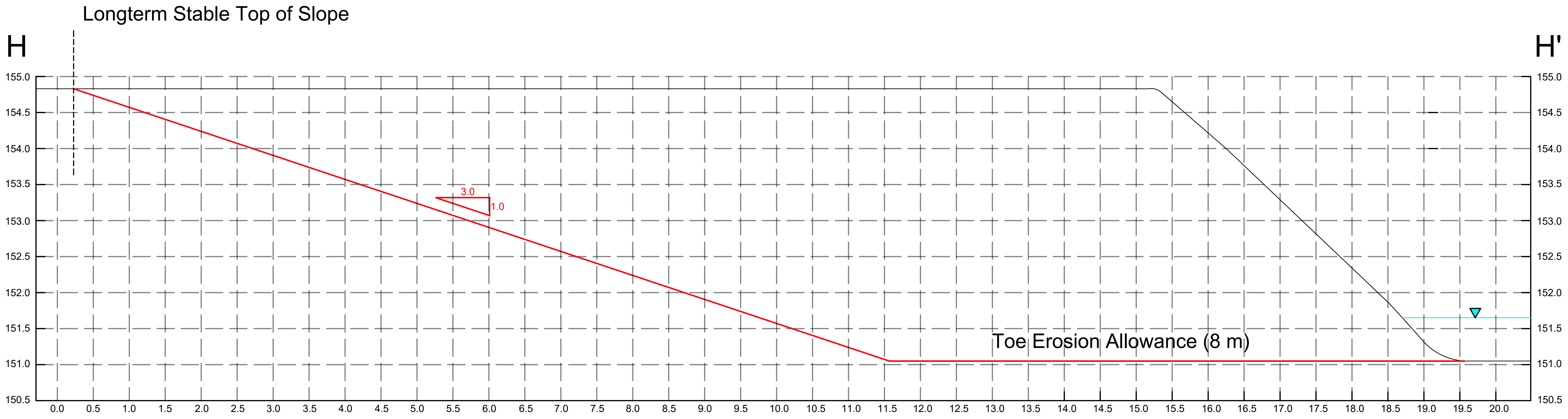
LTSTOS for Cross section GG'

Scale: As Shown

Project Number: SP18-306-10

Date: August 2018

Figure Number: D-7



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

— Existing Topography

— Water Level

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

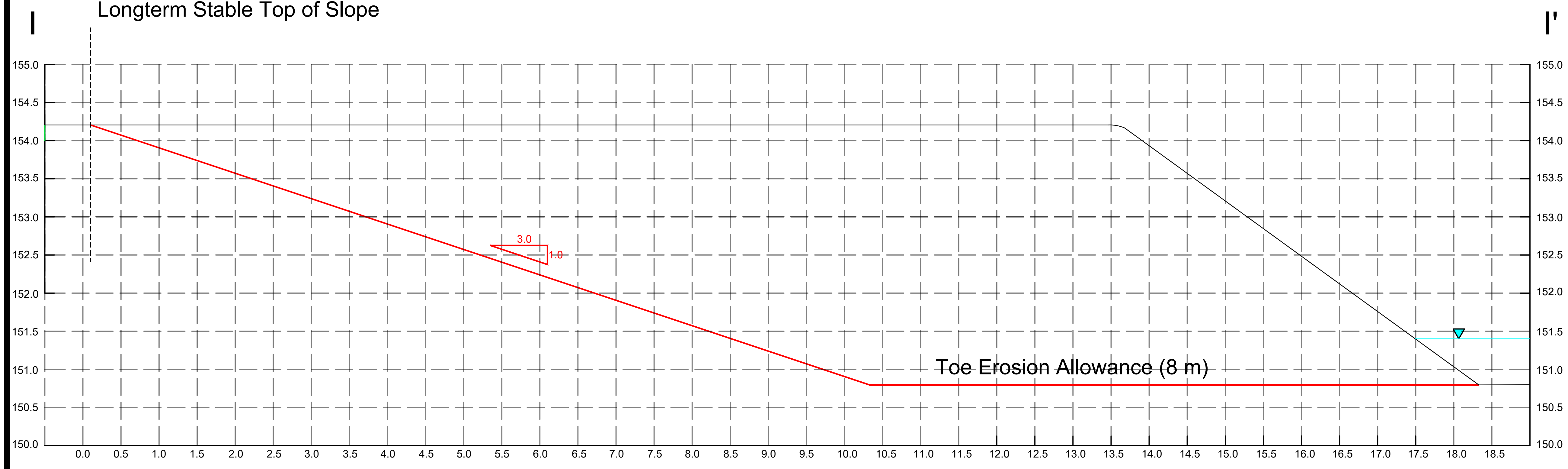
LTSTOS for Cross section HH'

Scale: As Shown

Project Number: SP18-306-10

Date: August 2018

Figure Number: D-8



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

— Existing Topography

— Water Level

Project Title:

Slope Stability Investigation

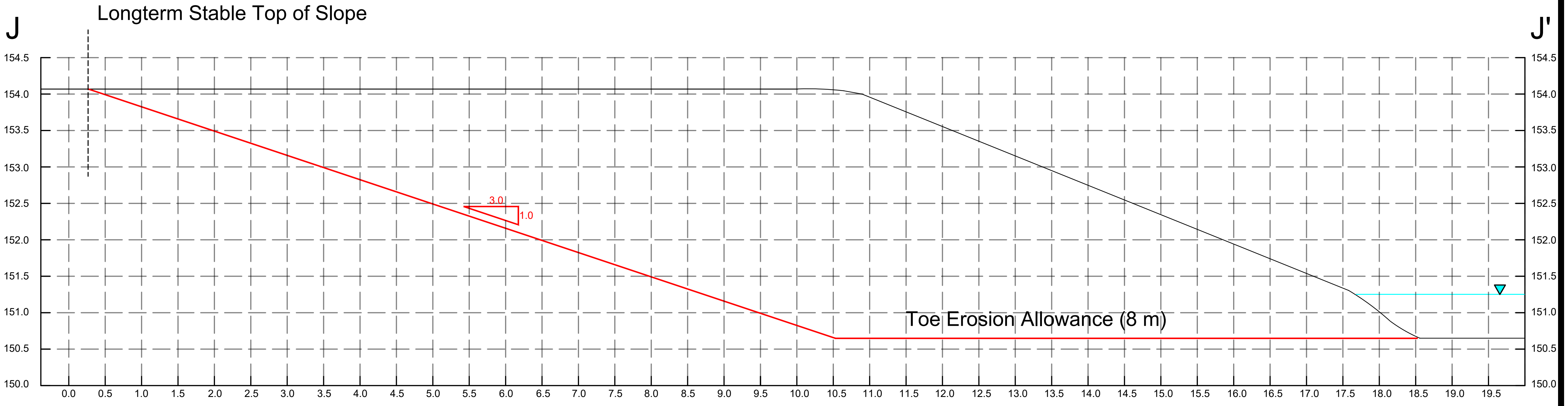
Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

LTSTOS for Cross section II'

Scale: As Shown	**Project Number:** SP18-306-10
Date: August 2018	**Figure Number:** D-9



SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

— Existing Topography

— Water Level

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

LTSTOS for Cross section JJ'

Scale: As Shown

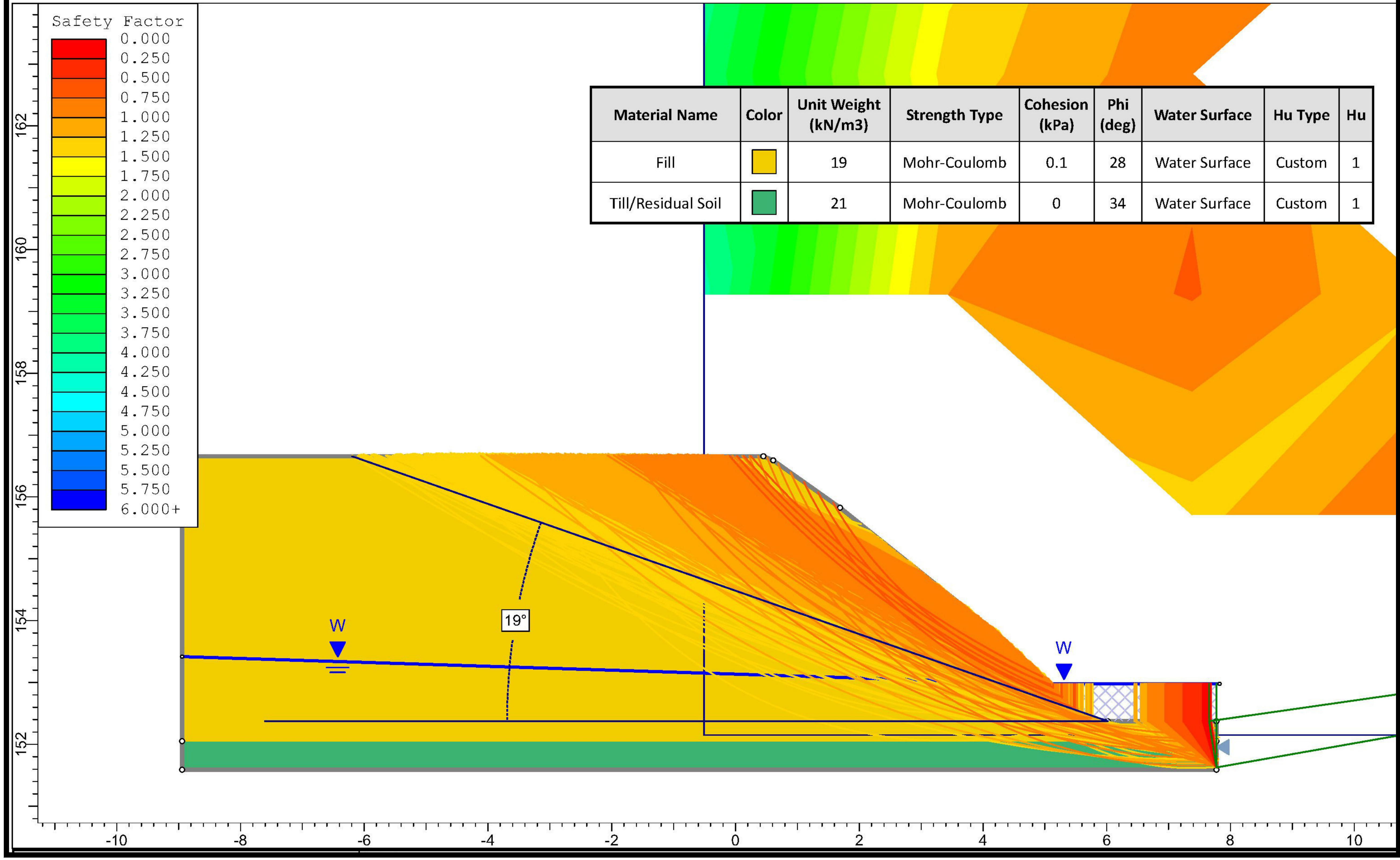
Project Number: SP18-306-10

Date: August 2018

Figure Number: D-10

APPENDIX E

SIRATI & PARTNERS



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Fill	🟨	19	Mohr-Coulomb	0.1	28	Water Surface	Custom	1
Till/Residual Soil	🟩	21	Mohr-Coulomb	0	34	Water Surface	Custom	1

SIRATI & PARTNERS

12700- Keele Street
King City, ON. L7B 1H5
Phone# 905 833 1582, Fax#905 833 5360

North:

Legend:

—	Existing Topography
—	Water Level

Project Title:

Slope Stability Investigation

Site Location:

66 Thomas Street, Mississauga, ON.

Figure Title:

Results of Stability Analysis on section B-B'

Scale: As Shown

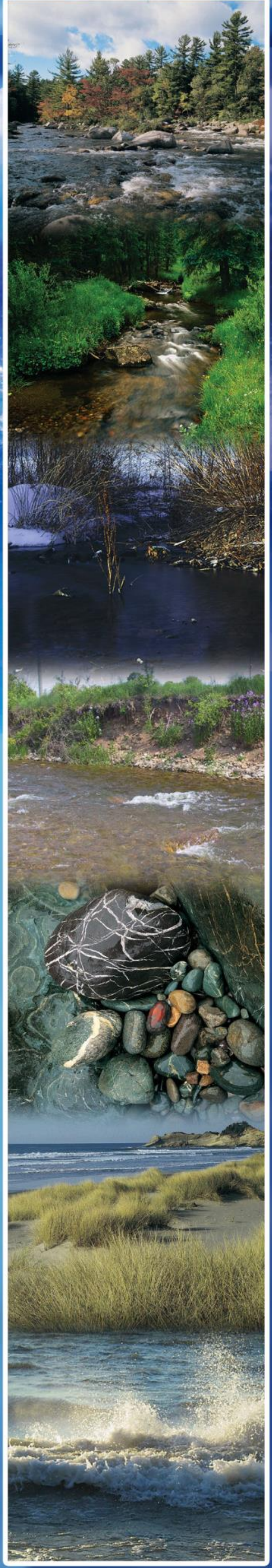
Project Number: SP18-306-10

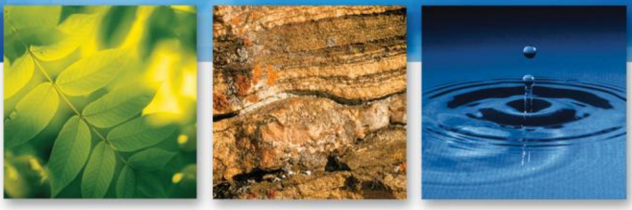
Date: August 2018

Figure Number: E-1

APPENDIX F

SIRATI & PARTNERS





66 Thomas Street
Erosion Assessment

Mississauga, Ontario

August 23, 2018

water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

May 11, 2018
WE 18019

Mr. Meysam Najari
Manager, Geotechnical Department
Sirati & Partners Consultants Ltd.
750 Millway Ave., Unit 8
Vaughan, ON L4K 3T7

Dear Mr. Najari

RE: 66 Thomas Street Erosion Assessment- Mississauga, ON

1.0 INTRODUCTION

Water's Edge was authorized by Sirati & Partners Consultants Ltd. to complete an erosion assessment for Mullet Creek adjacent to 66 Thomas Street in Mississauga, Ontario. Specifically, the work entails providing a meander Belt Width Assessment (MBW) to identify the boundary for further development on the property.

We have completed our assessment of the creek in accordance with the approved project terms of reference. Data sources for the analysis include:

- Historic and current aerial photography the National Earth Observation Data Framework Catalogue (NEODF-Cat), Airbus, and Google Earth;
- Ontario Flow Assessment Tool (OFAT) (digital data from the Ministry of Natural Resources and Forestry);
- Physiography of Southern Ontario by Chapman & Putnam (digital data from Ministry of Northern Development and Mines (MNDM)); and,
- Site inspections and surveys.

Site inspections and surveys were performed in May 2018 and were used to gain a synoptic level understanding of the site following a review of the available literature and maps and to collaborate features identified in the desktop assessment. A historic Meander Belt Width Assessment using historic aerial photography was completed to identify the historic migration through the reach.

The Study Area, as seen in **Map 1** (attached)**,** extends for most of the length between Tanner and Thomas Street, specifically alongside the property at 66 Thomas Street. The reach is approximately 250 m long with multiple drainage culverts contributing towards the flow. The channel is found in a steep-banked valley that is mostly straight through the study reach to accommodate for property lines. There is evidence of bank erosion in locations where the bank is lightly vegetated, indicating locations where further channel migration might occur.

2.0 INITIAL DESKTOP ASSESSMENT

2.1 Study Area

The site under investigation is in Mullet Creek, a tributary of the Credit River, and is found upstream from the Thomas Street crossing, near the Streetsville GO Station. The water flows from north-west to south-east and at the downstream end of the channel the river has an average bankfull width of 6.08 m with an average depth of 0.56 m. The watershed for Mullet Creek is 23.5 km^2, and drains predominately infrastructure (72.3%), followed by rural (24.2%), forest (2.9%) and wetland (0.6%) (OFAT, 2017). The channel is in a confined, steep-banked valley with clear riffle-pool sequences with little room to migrate due to existing infrastructure through this reach.

2.2 Physiography and Surficial Geology

Geology influences channel form and function, rates of bank migration and incision, and defines the type and amount of sediment through the watercourse. For example, a river flowing through alluvial (river) sediments deposited on its floodplain may show more regular pool and riffle sequences as compared to a bedrock or semi-alluvial channel that may have less regularity resulting from contact with more erosion-resistant bedrock or glacial till. The entire study area is located on a till moraine in the South Slope Physiographic Region (Chapman and Putnam, 2007). The bank sediment is composed of silty clay, and the bed is filled with loose cobbles, indicating that the channel will attempt to adjust if not in alignment.

2.3 Historic Assessment

Aerial photography dating back to 1960 was acquired from various sources, with modern 2013 imagery from Airbus, and 1960, 1974 and 1988 imagery from the National Earth Observation Data Framework Catalogue (NEODF-Cat).

Figures 1, 2, 3 and 4 show the aerial photos of the study site obtained for 1960, 1974, 1988 and 2013 respectively. The creek is outlined in blue between Tannery and Thomas Street. As can be observed, prior to the development of the infrastructure at 66 Thomas, the creek had much larger meanders and was likely less incised than it is currently. The stream was subsequently straightened between 1960 and 1974 to allow for infrastructure development. The historic channel geometry was delineated from air photos that had different water surface elevation, resolution, shadow orientation and overhanging vegetation, so only the meander geometry could be identified for historic analysis.

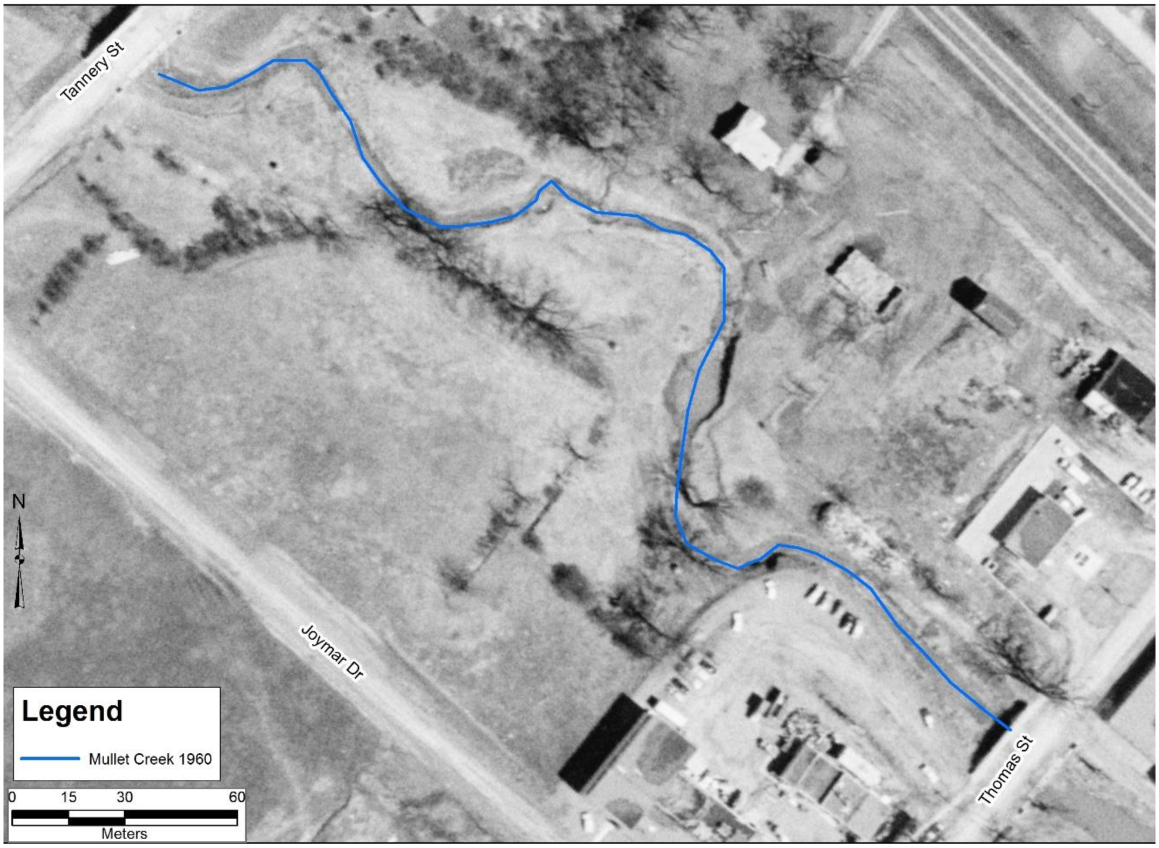


Figure 1: Aerial Photography – 1960. Image from NEODF-Cat

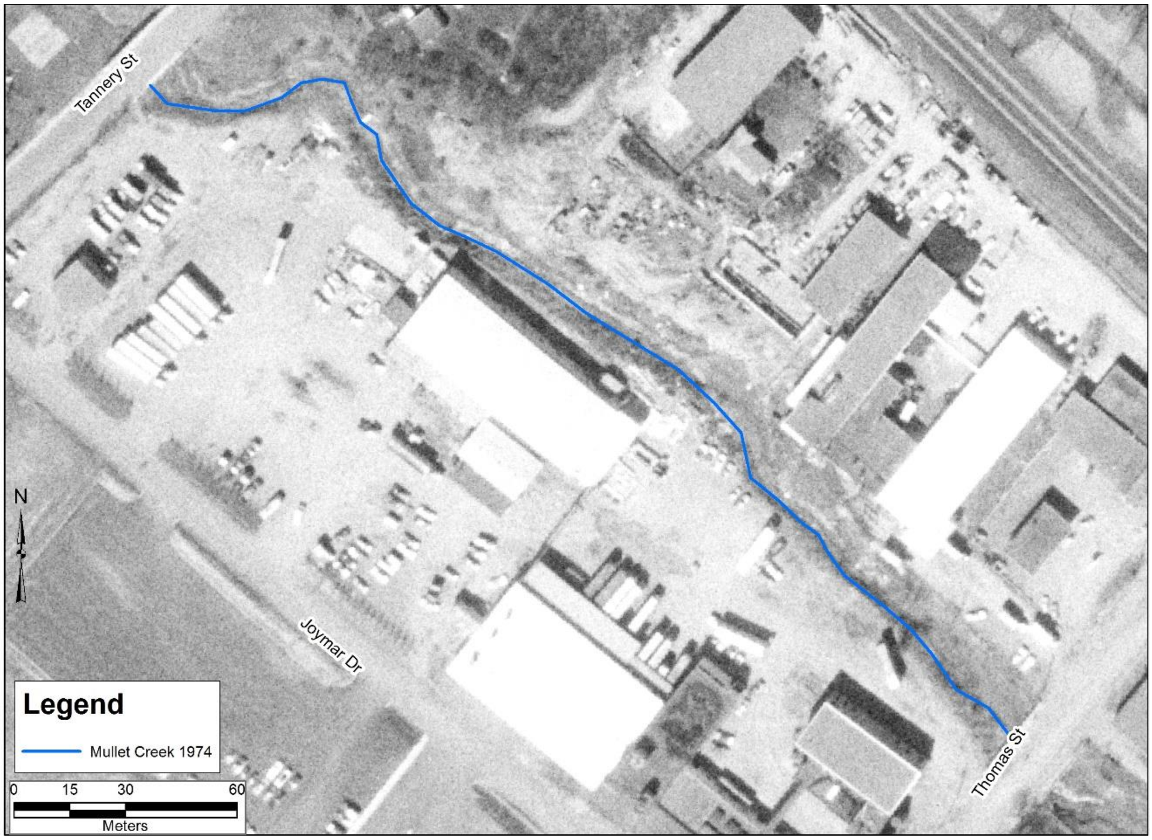


Figure 2: Aerial Photography – 1974. Image from NEODF-Cat.

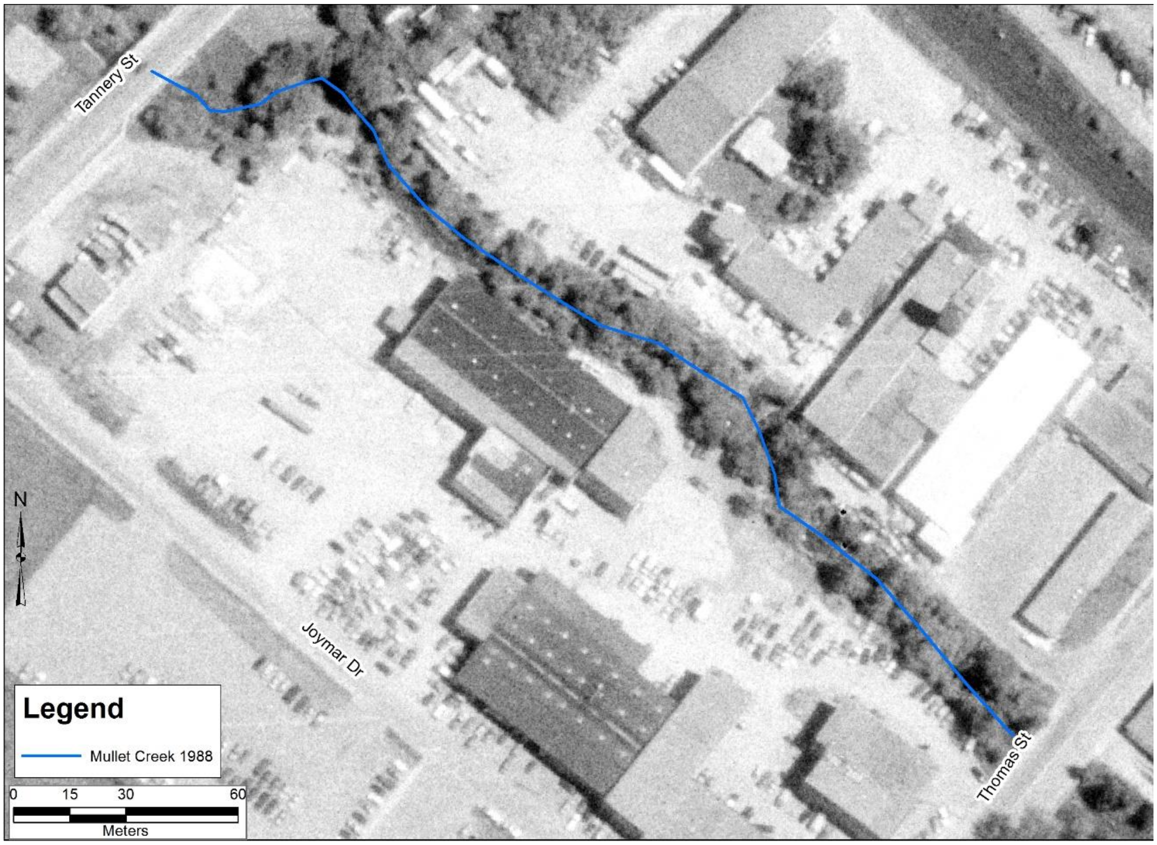


Figure 3: Aerial Photography – 1988. Image from NEODF-Cat.

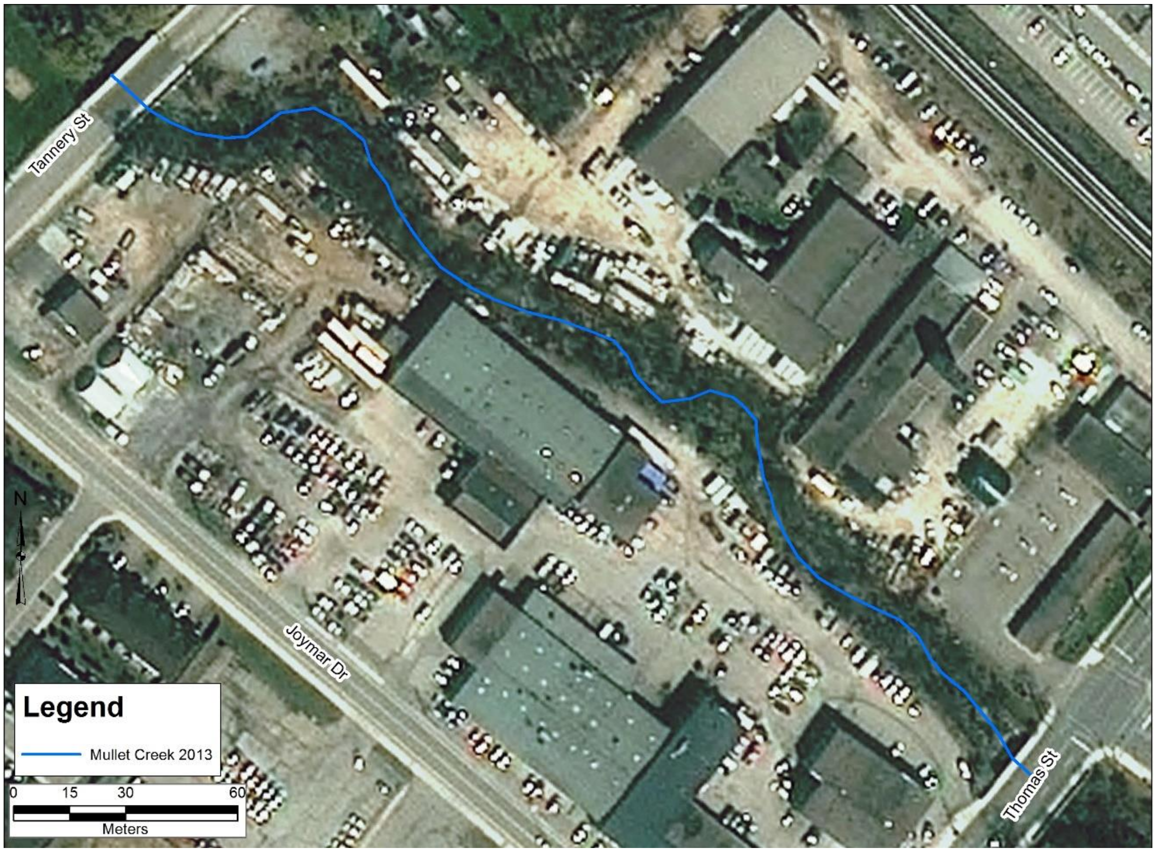


Figure 4: Aerial Photography – 2013. Image from Airbus

2.4 Delineation of Meander Belt Axis

The meander belt axis is a line that follows the general down-valley orientation of a meander pattern. This feature needs to be delineated since the meander belt is centered on the meander belt axis. The meander belt axis was delineated for the reach using the topographic survey data from the May 2018 site visit. Following this delineation, the other delineated stream geometries were considered, and it was determined that there has not been a significant change in the meander belt axis for the other years, except for when the channel was straightened between 1960 and 1974. As a result, the 1960 imagery will not be used for the MBW analysis. **Figure 5** also shows the meander belt axis and the overlain river outlines from each year used to determine the belt width.

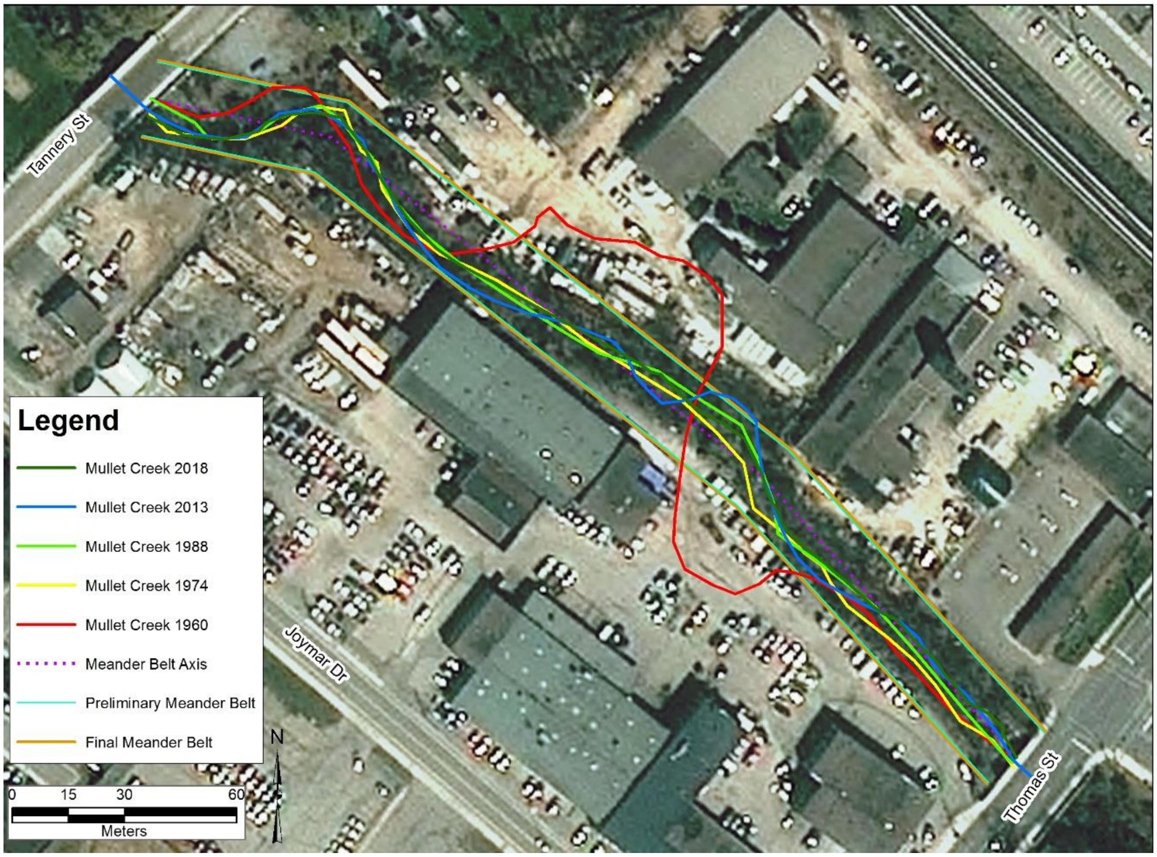


Figure 5: Overlain bank outlines from all aerial photography. The Meander Belt Axis for the reach is the dashed grey line and the Preliminary Meander Belt Width is the solid grey line (2013 imagery from CNES/Airbus).

3.0 FINAL DESKTOP ASSESSMENT

Meander belt width assessments are used to determine the acceptable allowances for the erosion risk boundary associated with stream migration. As was noted in the aerial photography, there is limited space for Mullet Creek to adjust due to existing infrastructure, and therefore the channel has incised into its bed over time rather than meandering, resulting in steep, semi-stable banks. There are a few points where erosion was noted in the system, including at the Thomas Street Bridge where the gabion that was installed to protect the bridge footings is beginning to slump. Based on this, identifying the 100-year rate of erosion will be necessary to identify the extent to which 66 Thomas Street can be safely developed.

It is important to note the changes to the landuse in the Mullet Creek watershed over the period that the MBW analysis investigates. The 1960 air photo reveals primarily rural landuse within the watershed, and over time that has increased to be predominately infrastructure based. This changes the hydrology of a system due to the increase in impermeable surfaces that result in high, flashy discharges following storm events which can result in channel scour, and eventual migration in the creek.

The procedures used in this analysis were performed as per the *Belt Widths Delineation Procedure* (TRCA, 2015). It assumes that the meander migration and evolution processes that occur within the study reaches will continue to occur into the future and that no change in the hydrologic regime is anticipated (e.g., the discharge will remain the same). While in the past the discharge has been increasing, an emphasis on improved stormwater control in the City of Mississauga will likely see discharges remain similar to what is already observed. The procedure also assumes that the meander belt encompasses the area in which all future meandering and channel migration is expected to occur.

3.1 Meander Belt Width Allowance

The meander belt width defines the lateral extent that a channel may occupy. It serves to provide an active channel zone beyond which development and infrastructure may be free from associated erosion and depositional risk. The NVCA (2013) guide requires that the meander belt width determination be undertaken in one of the following ways:

- An allowance based on the bankfull width applied on the axis of the watercourse as per the MNR Technical Guide (20 times bankfull width); or
- As per the methodology outlined in the Belt Widths Delineation Procedure (TRCA 2015)

The former method for an unconfined system results in a belt width of 122 m which vastly overestimates the meandering and migration tendencies of the creek since it was straightened. Therefore, the later method was used. Following the field confirmation of the location of the river banks, the meander belt was delineated. The limits of the meander belt are parallel lines and are tangential to the outside meander bends. The belt is drawn such that it is centered on the meander belt axis. **Figure 5** shows the delineated preliminary belt width, which was determined to be 20 m.

The final belt width allowance adds additional factors of safety to the preliminary belt width to make provisions for any variation not accounted for in the initial delineation. The factor of safety used depends on the size of the preliminary belt width. For preliminary belt widths less than 50 m, the factor of safety (FS) includes 5% of the preliminary belt width plus the migration rate and meander axis shift for a 100-year migration. In this study, no change in meander axis was noted over the study period. The 100-year migration rate is calculated by measuring the extent of the outside meander for each of the ortho-rectified aerial photos. However, due to overhanging vegetation and the river size relative to the photo resolution, while the geometry and migration rate could be identified, the banks could not be accurately digitized, and therefore the erosion rate could not be calculated. Due to the lack of channel migration since 1974, it is unlikely to being doing so in the future.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our fieldwork and analysis, we can conclude the following:

1 The meander belt has not significantly adjusted since it was straightened between 1960 and 1972;
2 The final MBW was identified as being 21 m (**Figure 5**);
3 Overhanging vegetation and the small stream size mean that while the meander geometry can be identified, it was insufficient to measure an erosion rate;
4 Leaning vegetation and exposed roots indicate that erosion is occurring through this reach; and,
5 While the creek has not adjusted horizontally, it has incised, resulting in high, steep semi-stable banks. Any development that occurs adjacent to the river will need to take this into account.

Should you have further questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,

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Appendix G: Limitations of Report

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to Sirati & Partners Consultants Limited (SIRATI) at the time of preparation. Unless otherwise agreed in writing by SIRATI, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the borehole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the borehole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc. Professional judgement was exercised in gathering and analyzing data and formulation of recommendations using current industry guidelines and standards. Similar to all professional persons rendering advice, SIRATI cannot act as absolute insurer of the conclusion we have reached. No additional warranty or representation, expressed or implied, is included or intended in this report other than stated herein the report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

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