Geotechnical Engineering Report

Proposed Acorn Valley Development
83 Christie Drive, Dorchester, Ontario

Cyril J. Demeyere Limited (CJDL)
Revised Report

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1 Introduction

Englobe Corp. (Englobe) was retained by Cyril J. Demeyere Ltd (hereinafter referred to as the “Client”) to undertake a geotechnical investigation in support of the proposed residential subdivision development at 83 Christie Drive in Dorchester, Ontario (herein after referred to as the ‘Site’). A site location plan is provided on Drawing 1 in Appendix A. This work was authorized by Mr. Deren Lyle of Cyril J. Demeyere Ltd.

It is our understanding that the project in general involves the proposed construction of a new residential subdivision in an approximately 44 ha plot that is currently used for agricultural purposes. The purpose of the work was to investigate and report on the subsurface soil and groundwater conditions at fourteen (14) borehole locations drilled at the site. Based on this information, advice is provided with respect to the geotechnical aspects of the proposed project, including the design of foundations and other elements. The anticipated construction conditions pertaining to excavation, backfill and temporary ground water control is also discussed, but only regarding how these might influence the design.

It should be noted that with this report, Englobe is providing an updated Hydrogeological Investigation Report for the site. The results are provided in Report No. 160-P-0019257-0-01-300-HD-R-0001-0B.

Ongoing liaison with Englobe during the final design and construction phase of the project is recommended to ensure that the recommendations in this report are applicable and/or correctly interpreted and implemented. It should be noted that we are not aware of any changes regarding governing criteria/policies (MECP, UTRCA, Thames Centre, PPS) since the last report.

The recommendations and opinions in this report are applicable only to the proposed development as described above and the Limitations of the Investigation found in Section 8 is an integral part of this report.

2 Site and Project Description

2.1 Existing Site Conditions

The site was examined by a senior geotechnical engineer from our staff on August 18, 2023 in order to obtain general information regarding the existing slope features such as slope profile, slope drainage, water course features, vegetation cover, and structures in the vicinity of the slope. Drawing 1 presents the general arrangement of the subject property as derived from a 2023 Google Earth image.

The Site is located in Dorchester, Municipality of Thames Centre, Middlesex County, Ontario (Drawings 1, 2 and 3, Appendix A). The Site is currently used for agricultural purposes. The Site is bounded by a variety of land uses including a Provincially Significant Wetland (Tamarack Swamp) to the immediate north, an existing subdivision to the east, woodland and rural residential to the west and agricultural and woodland to the south. Recent environmental studies also identified an additional wetland area is located on the southwestern border of the site.

In addition to the wetlands, surface water features are also present in/near the west-central portion of the Site (the Shaw Drain) and in the southeastern portion of the Site (Rath Harris Drain).

The overall inclinations of the slopes were typically in the range of about 2.1 to 5.0 horizontal to 1 vertical. The slopes appeared to be relatively stable at their present configuration. Drawings 2A, 2B, 3A and 3B presents eight (8) representative cross-sections of the slopes, Section 1-1’ to 8-8’.

2.2 Site Geology

Based on published geological information for the general area of the site, the near surface overburden soil at and in the vicinity of the subject property consists of Late Wisconsin stratified drift, predominately silt (some gravel, sand and till)[1]. The stratified drift is underlain by the Dundee Formation, a fine grained dark cherty limestone of Devonian Age[2]. The geological mapping and regional well records indicates that the bedrock beneath the site is about 20 to 28 metres below existing grade.

2.3 Slope Stability Rating

The results of the site inspection and the general setting of the site are described above, and cross sections developed from the topographical survey are shown on Drawings 2 and 3. This information was used to complete the Slope Stability Rating Chart as shown in Table 4.2 of the Technical Guide of the River and Stream Systems: Erosion and Hazard Limit, by the Ontario Ministry of Natural Resources (MNR Guide). The results of the rating are shown in Appendix B. A slope stability rating of about 14 to 26 has been indicated for the slopes within the study area. As per MNR guideline, slope stability rating value of in the range of 14 to 26 indicates a low to slight potential for unstable slopes. The level of effort for this assessment is consistent with the approach outlined in the MNR guidelines.

2.4 Proposed Development

As noted previously, Drawings 1 presents the general arrangement of the subject property as derived from a proposed site development plan prepared by CJDL Consulting Engineers, dated August 2023. In this design it is proposed to construct a residential subdivision. The development will also include a public park and public roads. The subdivision would be serviced by sanitary sewers, storm sewers and a stormwater management (SWM) pond.

3 Investigation Procedures

3.1 Field Program

The fieldwork for this investigation was completed during the period of July 16 to August 13, 2019, and involved the drilling of fourteen boreholes (Boreholes BH-01-19 to BH-14-19) to depths ranging from 4.3 to 14.2 m. The borehole locations are shown on Drawing 1 in Appendix A.

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[1] Quaternary Geology, Lucan Area, Southern Ontario; Ontario Division of Mines; Map No. P.1048; 1975.

[2] Bedrock Topography of the Lucan Area, Southern Ontario; Ministry of Natural Resources; Map No. P.0291; 1980.

The field investigation was carried out in general conformance with the professional standards set out in the Canadian Foundation Engineering Manual (CFEM 2023, 5th Edition), applicable Ontario Regulations and ASTM International. The following is a summary of field investigation tasks:

- Local utility companies were contacted prior to the start of drilling activities to demarcate underground utilities on site.
- The boreholes were advanced to sampling depth ranging from 4.3 to 14.2 m BGS using a Diedrich D 50-T drill rig equipped with hollow stem augers. The borehole was logged by our geotechnical supervisor.
- Using an SXblue Platinum GNSS+MFREQ RTK GPS unit, the Englobe representative determined the geodetic ground surface elevation of the borehole.
- Soil samples were recovered from the boreholes at regular depth intervals using a 50 mm outside diameter split spoon sampler in accordance with ASTM D1586 Standard Penetration Test (SPT).
- Six monitoring wells were installed at Boreholes BH-03-19, BH-04-19, BH-05-19, BH-08-19, BH-10-19 and BH-14-19 by inserting a 50 mm diameter screen and pipe into the hollow stem augers. Sand filter material was added to pack the screen in place until the level of the sand was approximately 300 mm above the top of the screen. A bentonite seal was placed above the sand pack at the well location to prevent the infiltration of surface water. An above ground steel protector was installed at existing grade and concreted in place. The top of the riser pipe was vented to allow accurate measurement of the stabilized groundwater levels.
- Details of the groundwater observations and measurements are provided on the appended borehole logs (and summarized in Groundwater, Section 4.2 below).
- The boreholes were backfilled with bentonite in accordance with Ontario Regulation 903 as amended, under the Ontario Water Resources Act.

3.2 Laboratory Testing

All soil samples recovered during this investigation were returned to our laboratory for visual examination and moisture content testing. The moisture content values are shown on the appended borehole logs. Selected soil samples were submitted for Particle Size Analysis and Atterberg limits test. A list of laboratory tests completed are summarized in Table 1.

Table 1: List of Laboratory Tests Conducted as per ASTM Standards

Test	Standard	Number of Samples
Natural Moisture Content	ASTM D2216	83
Particle Size Analysis (sieve and Hydrometer)	ASTM D7298	9
Atterberg Limits Test	ASTM D4318	2

Detailed description and the results of the laboratory tests are provided on the appended boreholes log in Appendix C, Laboratory test result data sheets in Appendix D and Section 4 of this report.

It is important to note that as per the standard policy of Englobe, the soil samples will be stored for a period of three months from the date of sampling. These soil samples will be discarded after the three-month period unless prior arrangements have been made for longer storage.

4 Subsurface Conditions

The subsurface soil and groundwater conditions encountered in the boreholes, and the results of the field and laboratory testing, are shown on the Log of Borehole sheets in Appendix C. A list of abbreviations and symbols are provided to assist in the interpretation of the borehole logs. It should be noted that the boundaries between the strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent exact planes of geological change. Further, conditions will vary beyond the locations investigated.

4.1 Soil Conditions

4.1.1 Topsoil

Topsoil was encountered at all the borehole locations and has thicknesses ranging from 230 to 500 mm. The topsoil comprises silty sand or sandy silt with some gravel. It is important to note that the topsoil thickness might differ significantly beyond the areas where the boreholes were drilled. Variations in topsoil thickness could also be attributed to prior earthwork activities conducted on-site.

4.1.2 Sand

Sand deposits were encountered in all the Boreholes except BH-12-19. The composition of native sand ranges from sand and gravel with trace silt to silty sand. SPT N-values within the sand ranged from 1 to 42 blows per 300 mm of penetration indicating very loose to dense relative densities. At the time of fieldwork, native sand was found to be moist to wet.

4.1.3 Silt

Native silt deposits were noted in Boreholes BH-01-19, BH-04-19, BH-05-19, BH-09-19, BH-10-19 and BH-13-19 that ranges in composition from silt with some sand, clay and gravel to clayey silt with traces of sand and gravel. SPT N-values within silt deposits ranged from 9 to 29 blows per 300 mm of penetration indicating loose to compact relative density. At the time of sampling, silt deposits were found to be moist to very moist to wet.

The grain size distribution analyses test results, shown graphically on Figures 1, 2 and 3 in Appendix D, indicate samples tested from Boreholes BH-03-19, BH-05-19, BH-06-19, BH-08-19, BH-09-19, BH-12-19 and BH-13-19 respectively.

Table 2: Particle Size Distribution Analyses

Borehole and Sample Number	Sample Depth (m)	Sample Descriptions
BH-03-19, SS - 3	2.3 - 2.7	SAND, trace silt
BH-05-19, SS - 2	3.1 - 3.5	SILT and CLAY
BH-06-19, SS - 3	2.3 - 2.7	SAND, trace silt

Borehole and Sample Number	Sample Depth (m)	Sample Descriptions
BH-08-19, SS - 3	2.3 - 2.7	Silty SAND, some Gravel, trace Clay
BH-09-19, SS - 2	1.5 - 2.0	SAND, trace Silt and Clay
BH-09-19, SS - 5	3.8 - 4.3	SAND, trace Silt and Clay
BH-12-19, SS - 2	1.5 - 2.0	SAND and SILT, trace Clay
BH-12-19, SS - 3	2.3 - 2.7	SILT and CLAY, trace Sand
BH-13-19, SS - 2	1.5 - 2.0	SAND, some Silt, trace Clay

4.2 Groundwater

Groundwater observations and measurements carried out in the open boreholes are summarized on the appended borehole logs. Water level measurements carried out in the monitoring wells were taken on the 30th of August and 13th of September 2019. It can be noted that the stabilized water levels measured on both these days did not show any major variation. It should be noted that the latest groundwater level is included in the hydrogeology Report No. 160-P-0019257-0-01-300-HD-R-0001-0B.

Table 3: Water Level Measurements – August 30 and September 13, 2019

Borehole No.	Ground Surface Elevation (m)	August 30, 2019			September 13, 2019		
		Groundwater Depth (m)	Groundwater Elevation (m)	Bottom of the Pipe Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Bottom of the Pipe Elevation (m)
BH/MW-03-19	262.3	11.40	250.9	248.0	11.42	250.9	248.0
BH/MW-04-19	259.1	3.47	255.6	252.5	3.52	255.6	252.5
BH/MW-05-19	260.1	4.44	255.7	254.0	4.51	255.6	254.0
BH/MW-08-19	266.4	8.92	257.5	255.2	8.96	257.4	255.2
BH/MW-10-19	257.3	3.23	254.1	250.8	3.23	254.1	250.8
BH/MW-14-19	265.6	6.71	258.3	256.3	6.79	258.8	256.3

5 Slope Stability Assessment

5.1 Erosion Hazard Limit

An erosion hazard means the potential loss of land, due to human or natural process, that poses a threat to life and property. The erosion hazard limit for river and stream systems is determined based on the potential for creek bank erosion to impact on the stability of the slope (toe erosion allowance), the stability of the slopes (stable slope allowance), and a need for access during emergencies (erosion access allowance). The following presents an assessment of each component to determine the erosion hazard limit:

5.2 Toe Erosion Allowance

A toe erosion allowance is recommended in areas where the water course position is within 15 m to the slope toe. A guideline table recommended for estimating the erosion allowance is presented as follows:

Table 4: MINIMUM TOE EROSION ALLOWANCE – River within 15 m of Slope Toe*

Type of Material	Evidence of active erosion** or bankfull flow velocity>competent flow velocity***	No evidence of active erosion**or flow velocity<<competent flow velocity***		
		Bankfull Width		
		<5 m	5-30 m	>30 m
Hard Rock (granite)	0 - 2 m	0 m	0 m	1 m
Soft Rock (shale, limestone), Cobbles, Boulders	2 - 5 m	0 m	1 m	2 m
Stiff / Hard Cohesive Soil (clays, clayey silt)	5 - 8 m	1 m	2 m	4 m
Soft/Firm Cohesive Soil Fine Granular (sand, silt) Fills	8 - 15 m	1 - 2 m	5 m	7 m

Notes:

** Active Erosion is defined as: bank material is bare and exposed directly to stream flow under normal or flood flow conditions and, where undercutting, over steepening, slumping of a bank or high down stream sediment loading is occurring. An area may be exposed to river flow but may not display “active erosion” (i.e., is not bare or undercut) either as a result of well rooted vegetation or as a result of shifting of the channel or because flows are relatively low velocity. The toe erosion allowances presented in the right half of Table 4 are suggested for sites with this condition.

*** Competent Flow velocity; the flow velocity that the bed material in the stream can support without resulting in erosion or scour.

Consideration must also be given to potential future meandering of the watercourse channel.

Source: ‘*Geotechnical Principles for Stable Slopes’* (Terraprobe, June 1998), prepared for: Ontario Ministry of Natural Resources, Lands and Natural Heritage Branch.

In consideration of the prevailing site conditions, as described in Section 2.1, a minimum toe erosion allowance of 5 m is recommended.

5.3 Stable Slope Allowance

A detailed engineering analyses of slope stability was carried out utilizing a commercially available slope stability program i.e., slope/W from GeoStudio version 2021.4. The slope stability assessment was based on an effective stress limiting equilibrium analysis for long term slope stability. The methods of analysis allow for the calculation of Factors of Safety for hypothetical or assumed failure surfaces through the slope. The analysis method is used to assess potential for movements of large masses of soil over a specific failure surface which is often curved or circular.

For a specific failure surface, the Factor of Safety is defined as the ratio of available strength resisting movement, divided by the gravitational forces tending to cause movement. The Factor of Safety of 1.0 represents a ‘limiting equilibrium’ condition where the slope is at the point of pending failure since the soil resistance is equal to the forces tending to cause movement. The analysis involves dividing the sliding mass into many thin slices and calculating the forces on each slice. The normal and shear forces acting on the slides and base of each slice are calculated. It is an iterative process that converges on a solution.

The typical Factor of Safety used for engineering design of slopes for stability in building applications, ranges from about 1.3 to 1.5. The Ministry of Natural Resources (MNR) Policy Guidelines allow a minimum Factor of Safety for slope stability as follows:

Table 5: Design Minimum factor of Safety

Type	Land Uses	Design Minimum Factor Of Safety
A	PASSIVE: no buildings near slope; farm field, bush, forest, timberland, woods, wasteland, badlands, tundra	1.1
B	LIGHT: no habitable structures near slope; recreational parks, golf courses, buried small utilities, tile beds, barns, garages, swimming pools, sheds, decks, satellite dishes, dog houses	1.20 to 1.30
C	ACTIVE: habitable or occupied structures near slopes; residential, commercial, and industrial buildings, retaining walls, storage/warehousing of non-hazardous substances	1.30 to 1.50
D	INFRASTRUCTURE and PUBLIC USE: public use structures and buildings (i.e., hospitals, schools, stadiums), cemeteries, bridges, high voltage power transmission lines, towers, storage/warehousing of hazardous materials, waste management areas	1.40 to 1.50

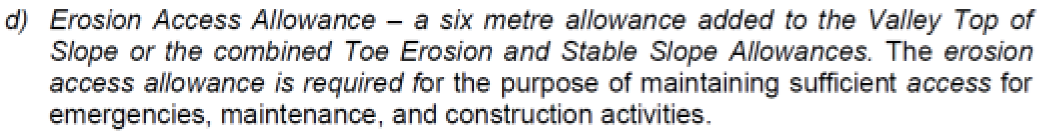
The Upper Thames Conservation Authority (UTRCA) policies are likely based on a minimum Factor of Safety of 1.5 for all development applications and 1.3 for infrequent short-term elevated ground water conditions.

The soil strength parameters utilized in this assessment were based on effective stress analysis for long-term slope stability. Graphical depictions of the slope stability analysis results are presented in Appendix E. Based on the results of the analyses; it is our opinion that a stable slope profile of 2 horizontal to 1 vertical for long-term conditions would be appropriate for the overburden soils at the site.

The position of the Long-Term Stable Top of Slope was established based on the applicable toe erosion setback and the stability setback (long-term stable inclination). Drawings 2A, 2B, 3A and 3B presents the cross-sections and relevant details of the cross-sections analyzed for determination of the Long-term Stable Top of Slope. Drawings 2 and 3 presents the location of the Long-term Stable Top of Slope on the site plan. For planning purposes, the long-term refers to a 100-year planning horizon.

5.4 Erosion Access Allowance

The UTRCA requires an additional 6 m setback from the long-term stable top of slope. The intent is to control top of bank land use that could potentially impact slope stability and to ensure that future development is not impacted by slope deformations. This setback also provides a means of access to the slope. Policies for this component of the setback have been established by UTRCA in the document '*Environmental Planning Policy Manual for the Upper Thames River Conservation Authority (June, 2006, Revised October 24, 2017).* The policies that pertain specifically to new development or redevelopment on the property are outlined under Policy #2.2.7.2.2 d), where it states the following:



> d) *Erosion Access Allowance – a six metre allowance added to the Valley Top of Slope or the combined Toe Erosion and Stable Slope Allowances.* The *erosion access allowance is required* for the purpose of maintaining sufficient *access* for emergencies, maintenance, and construction activities.

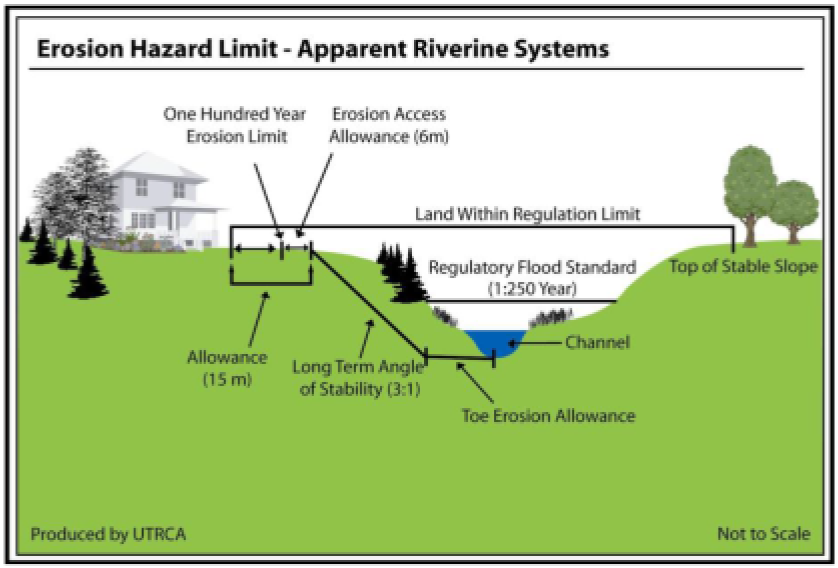


Figure 2-3

5.5 Review of Watermain Interconnection and Trail

Englobe is in receipt the Mill Court watermain & trail connection drawing, prepared by CJDL, dated February 5, 2025. In this design it is proposed to install a 250 mm diameter watermain and an asphalt paved multi-use trail. The drawing is presented in Appendix A.

A stability analyses was carried out for a selected slope section A-A' utilizing a commercially available slope stability program Rocscience - Slide 6.0. The following average soil properties were assumed for the soil strata in the slope stability analysis.

Table 6: Soil Properties for Slope Stability Analysis

Stratigraphic Unit	Unit Weight (kN/cu.m)	Effective Shear Resistance c' (kPa)	Effective Angle of Internal Friction φ' (degrees)
Sand, very loose	19	0	27
Sand, compact	20	0	32
Sand, dense	21	0	34

In addition to the above soil properties, traffic loading (10 kPa) was assumed for the purposes of this assessment. A piezometric surface was incorporated in the analyses to simulate elevated ground water conditions. The slope at Section A-A' was selected for this analysis since it was considered the most critical section in the study area. Graphical depictions of the slope stability analysis results are presented in Appendix E.

The minimum Factors of Safety calculated by the analysis are summarized in the following table for various conditions:

Table 7: Minimum Factors of Safety for Section A-A'

Slope Condition - Section A-A'	Minimum Factor of Safety
Existing Slope	2.071
Proposed Grade Modifications with Muli-Use Trail	1.926

Based on the results of the analyses, it is our opinion that the proposed trail can be safety constructed without adversely affecting the long-term stability of the valley slope. No risk to life or property damage is anticipated.

6 Discussion and Recommendations

The following discussion is based on our interpretation of the factual data obtained during this investigation and is intended for the use of the design engineer only. Comments made regarding the construction aspects are provided only in as much as they may impact on design considerations. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

This report is provided on the basis of these terms of reference and on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards and guidelines of practice. The pertinent sections of the Ontario Building Code may require additional considerations beyond the recommendations provided in this report and should be referred. If there are any changes to the site development features, or if there is any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Englobe should be retained to review the implications of these changes with respect to the contents of this report.

6.1 Site Preparation

At the time of the investigation the grading plan for the site had not yet been developed, however it can be expected that some cutting and/or filling will be required prior to construction. Any fill that will be required in areas to be developed for foundations or slabs-on-grade must be constructed as an engineered fill. It is expected that the site restoration and filling will be carried out in advance of construction. The design aspects of the engineered fill are discussed below.

All topsoil and existing earth fill must be stripped from areas designated to receive engineered fill. The exposed subgrade soil should then be proof rolled and any soft or wet areas which deflect excessively during the proof roll should be sub-excavated. The engineered fill should extend for a distance of at least 2 m beyond the perimeter of the building envelope as measured at the founding level, and should extend downwards from this point at a 1 to 1 (horizontal to vertical) slope, to the original ground. In addition, the engineered fill should extend to an elevation of at least 0.6 m above the proposed footing elevation. This is to ensure that the foundations are placed on the engineered fill both in plan and elevation. The engineered fill must be provided with a minimum of 1.2m of earth cover or equivalent insulation to provide adequate frost protection.

Engineered fill required to restore grade or to achieve the site grading plan must consist of clean earth materials, free of topsoil, rubble, wood, plant materials etc. and at a suitable placement water content to consistently achieve the compaction requirements outlined below.

Selective re-use of excavated soil consisting of the underlying native soils from the site for engineered fill may be feasible subject to the weather conditions at the time of construction. For this reason, we do not recommend undertaking pre-grading activities during spring or spring-like conditions.

Imported earth for use as engineered fill must meet the applicable MECP site condition standards for the site as established in a Phase Two Environmental Site Assessment (ESA), as well as the physical requirements outlined above. If a Phase Two ESA is not available, MECP Table 1 standards should be used as the acceptance criteria. Alternatively, consideration could be given to using OPSS 1010 Granular B Type I material from a commercial source. Source acceptance testing of materials imported for use as engineered fill must be carried out prior to the importation to the site.

Engineered fill must be placed and uniformly compacted in 200 mm thick lifts to at least 98 percent of standard Proctor maximum dry density. For optimal performance, the placement water content of the fill should be maintained within about 2 percent of the laboratory optimum water content for compaction. The limits of any engineered fill can best be determined by the geotechnical engineer during construction. Engineered fill will need to extend laterally a sufficient distance to develop adequate lateral resistance for foundations and pavements. The lateral distance required can be calculated by assuming a 10 horizontal to 7 vertical line extending down and away from the outer edge of the underside of any foundations, floor slabs and pavements constructed in engineered fill. Benches should be cut into the existing slopes at a maximum 600 mm height to allow placement of new fill in a horizontal manner.

All aspects of engineered fill construction including final excavation, material selection, placement and compaction must be verified by the geotechnical engineer. In-situ density testing is required during construction to confirm that each lift has been compacted to the specified degree and that the placement moisture content is within an acceptable range.

Engineered fill can be expected to experience post-construction settlement on the order of 1 percent of the depth of the engineered fill. The time period over which this settlement occurs depends on the composition of the engineered fill as follows (after initial placement):

a)	Sand or gravel soil;	several days
b)	Silt soil;	several weeks
c)	Clay or clayey soil;	several months

The placement of engineered fill might also result in post-construction settlement of the underlying natural soil. The timing of foundation construction must take into account the post-construction settlement of the engineered fill and the foundation soil.

6.2 Building Foundations

The following discussion is provided with the understanding that any and all buildings proposed for the site will be designed in conformance to the current Ontario Building Code (OBC) or other regulatory bodies within the jurisdiction. This section addresses the feasibility of constructing conventional spread and/or strip footings at the site.

6.2.1 Spread Footing Foundations

All topsoil and very loose to loose sand/silt deposits shall be removed from new foundation areas, and the following table provides the highest founding levels at the borehole locations where conventional spread footings founded on approved native silt subgrades will provide a maximum serviceability limit states (SLS) design pressure of 75 kPa. For ultimate limit states (ULS) design, a factored geotechnical resistance value equal to 112 kPa may be used, where the resistance factor is equal to 0.5. Depth to competent bearing surface is given in Table 6.

Table 8: Depth to Competent Bearing Surface

Borehole No.	Ground Surface Elevation (m)	Depth to Bearing Stratum (mbgl)	Elevation of Bearing Strata (m)
BH-01-19	257.74	0.8	256.94
BH-02-19	254.78	1.6	253.18
BH-03-19	262.27	3.8	258.47
BH-04-19	259.14	1.6	257.54
BH-05-19	260.10	1.8	258.30
BH-06-19	260.69	2.3	258.39
BH-07-19	261.34	0.8	260.54
BH-08-19	266.37	2.3	264.07
BH-09-19	261.01	0.6	260.41
BH-10-19	257.33	2.2	255.13
BH-11-19	257.58	1.6	255.98
BH-13-19	262.26	2.3	259.96
BH-14-19	265.63	3.0	262.63

In order to minimize the disturbance of soil subgrades it is recommended that foundation excavations be carried out using a smooth-blade bucket.

Any unsuitable soil may be removed to the same width as the footing and replaced with minimum strength 10 MPa concrete to provide contact between the footing and the approved native subgrade.

The total and differential settlements of footings not more than three (3) metres in width and subjected to the maximum serviceability limit states design pressure is estimated to not exceed 20 mm and 15 mm, respectively.

To provide sufficient protection against heave due to frost action, all exterior footings and footings in non-heated areas must incorporate a minimum depth of soil cover of 1.2 m between the footing subgrade and the finished ground surface.

6.2.2 Foundations on Engineered Fill

Provided the engineered fill is constructed and compacted as indicated in Section 6.1, foundations may be designed using a factored geotechnical resistance at Ultimate Limit States (ULS) of 225 kPa and a bearing reaction at Serviceability Limit States (SLS) of 150 kPa. The minimum footing width of 500 mm is recommended for strip footings and a minimum footing width of 900 mm should be considered for spread footings supported on engineered fill.

The engineered fill must extend a minimum depth of about 800 mm below the underside of footing elevation to achieve the factored geotechnical resistance of 225 kPa ULS and a bearing reaction of 150 kPa SLS, otherwise a reduce bearing values of 112 kPa ULS / 75 kPa SLS will govern the specified design specification.

It is recommended that nominal reinforcement at a minimum comprising two (2) continuous 15 M bars at the top and two (2) continuous 15 M bars at the bottom of the foundation walls be provided. In addition, two (2) continuous 15M bars must also be provided in the strip footings.

6.3 Site Classification for Seismic Site Response

Seismic hazard is defined in the 2012 Ontario Building Code (OBC 2012) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 s, 0.5 s, 1.0 s and 2.0 s and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g. shear wave velocity (vs), Standard Penetration Test (SPT) resistance, and undrained shear strength (su)) in the top 30 meters of the site stratigraphy below the foundation level, as set out in Table 4.1.8.4A of the Ontario Building Code (2012). There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g. sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain peak ground acceleration (PGA), peak ground velocity (PGV) site coefficients Fa and Fv, respectively, used to modify the UHS to account for the effects of site-specific soil conditions.

Based on the above noted information, it is recommended that the site designation for seismic analysis be ‘Site Class C’, as per Table 4.1.8.4.A of the Ontario Building Code (2012). The values of the site coefficient for design spectral acceleration at period T, F(T), and of similar coefficients F(PGA) and F(PGV) shall conform to Tables 4.1.8.4.B. to 4.1.8.4.I of the OBC 2012, as amended January 1, 2020, using linear interpolation for intermediate values of PGA.

6.4 Slab-on-Grade Construction

Depending on the final site grading levels selected, the subgrade for slab-on-grade construction could consist of native sand and/or engineered fill. The moduli of subgrade reaction appropriate for slab on grade design on the aforementioned soils are as follows:

- Engineered fill: 18,000 kPa/m
- Undisturbed sand or silt: 25,000 kPa/m

Concrete floor slabs should be placed on at least 150 mm of granular base (OPSS Granular A or 19 mm crusher run limestone) compacted to a minimum of 95 percent of standard Proctor maximum dry density. Prior to the placement of the granular materials, the subgrade should be assessed by a geotechnical engineer or its representative. Any incompetent subgrade areas as identified must be subexcavated and backfilled with suitable compacted clean earth fill materials. Similarly, any soft or wet areas should also be subexcavated and be backfilled with suitably compacted clean earth fill. The granular fill base should be placed either on the undisturbed native subgrade or clean earth fill compacted to at least 95 percent of standard Proctor maximum dry density.

Concrete slabs exposed to freezing temperatures should be provided with 50 mm thick rigid Styrofoam insulation below the slab to prevent differential settlements from frost heave and thaw settlement. All weather exposed concrete shall have 5 to 8% air entrainment or as otherwise specified in Tables 2 and 4 of CSA A23.1.

No underfloor drains are required provided the exterior grades are lower than the finished floor slab and positively sloped away from the building.

The water to cement ratio and slump of the concrete utilized in the floor slab should be strictly controlled to minimize shrinkage of the slab. Control joints should be sawed into the slab at maximum 4 m spacings within 12 hours of initial concrete placement in order to pre-locate shrinkage cracks. The saw-cut depths should be ¼ of the slab thickness. The slab should be wet cured for seven days to minimize problems with shrinkage and curling.

6.5 Basement Drainage

The basement wall must be provided with damp-proofing provisions in conformance to the Section 9.13.2 of the current Ontario Building Code. The basement wall backfill for a minimum lateral distance of 0.6 m out from the wall should consist of free-draining granular material (OPSS 1010 Granular 'B'), or provided with a suitable alternative drainage cellular media such as Miradrain 2000 (Mirafi) or Terradrain 200 (Terrafix). The flow to the building storm water sump from the subsurface drainage will be governed largely by the building perimeter drainage collection during rainfall and runoff events.

To assist in maintaining basements dry from seepage, it is recommended that exterior grades around the buildings be sloped away at a 2 percent gradient or more, for a distance of at least 1.2 m. As well, perimeter foundation drains should be provided, consisting of perforated pipe surrounded by a granular filter (minimum 150 mm thick). The granular filter should consist of OPSS HL 8 Coarse Aggregate.

The size of the sump pit should be adequate to accommodate the water seepage. Outlet provisions must conform to the plumbing code requirements.

6.6 Lateral Earth Pressures

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

Table 9: Coefficient of Lateral Earth Pressure

Stratum/Parameter	ϕ	γ	Ka	Ko	Kp
Compact Granular Fill Granular 'B' (OPSS 1010)	32	21.0	0.31	0.47	3.25
Silt, Sand or Similar Fill	30	19.0	0.33	0.50	3.00

Walls subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K [\gamma (h-hw) + \gamma' hw + q] + \gamma w hw$$

where,
P = the horizontal pressure at depth, h (m)
K = the earth pressure coefficient,
hw = the depth below the ground water level (m)
γ = the bulk unit weight of soil, (kN/m3)
γ' = the submerged unit weight of the exterior soil, (γ - 9.8 kN/m3)
q = the complete surcharge loading (kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, acting in conjunction with the earth pressure, this equation can be simplified to:

$$P = K[\gamma h + q]$$

The factored geotechnical resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction (R) depends on the normal load on the soil contact (N) and the frictional resistance of the soil (tan ϕ) expressed as: R = N tan ϕ. This is an unfactored resistance. The factored resistance at ULS is Rf = 0.8 N tan ϕ. The K value to be used for the design will depend on the rigidity of the wall.

6.7 Site Servicing

It is expected that site services will consist of storm and sanitary sewers and watermains, with relatively shallow inverts (less than 3 m). The invert elevation is expected to be within the undisturbed clayey silt till stratum. Excavations for underground services should be made as outlined in Section 7.1 of this report. The locations and depths of any building foundations which would potentially be affected by the proposed utilities should be identified prior to commencing the excavation.

6.7.1 Bedding

Considering the relatively shallow depth of the fill material at the Site, underground service lines will generally be installed on undisturbed clayey silt till or engineered fill. The native deposits in the area provide adequate support for buried services. However, suitability of the material must be verified during excavation and installation, by qualified geotechnical personnel experienced in such works.

The bedding materials should be adequately compacted to provide support and protection to the service pipes. Provided the base area for the sewer pipes and watermain are free of all soft and deleterious materials, the pipe bedding should comply with a Class B bedding configuration as per the requirements of OPSD 802.030 (rigid pipe) and/or OPSD 802.010 (flexible pipe). Where disturbance of the trench base has occurred, due to the presence of soft fine-grained soils, ground water seepage and the like, the disturbed soils should be sub-excavated and replaced with suitably compacted granular fill. If standing water is present in the base of the service and watermain trenches then High

Performance Bedding (HPB) and/or HL6 clear stone wrapped in geo-textile may be adopted as bedding material below the pipe to provide stabilization.

6.7.2 Backfill

Backfilling of trenches can be accomplished by reusing the excavated soils or similar fill material, provided the moisture content of the material is maintained within ±2 percent of optimum and the fill is free of topsoil, organics and any deleterious material. The fill placed in excavated trenches should be in loose lifts not exceeding 200 mm thick and compacted to not less than 95 percent of standard Proctor maximum dry density in non-settlement sensitive areas and 98 percent of standard Proctor maximum dry density in settlement sensitive areas. If narrow trenches are constructed in areas where the subgrade integrity is important, then use of compacted granular fill is recommended for backfill.

6.8 Pavement Design

6.8.1 Subgrade Preparation

Earth fills or disturbed soil strata, consisting predominantly of clayey silt, were encountered immediately beneath the ground cover in most of the boreholes and test pits. The disturbed/weathered native soil materials were occasionally observed to contain organics, and rootlets. These soil conditions may be suitable to support pavements for the potential roadway and parking areas provided the exposed subgrade is proofrolled, recompacted, and inspected as per Sections 6.1 and 6.7.

If new fill is required to raise the grade, selected on-site fill could be used, provided it is free of any topsoil and other deleterious material. The fill should be placed in large areas where it can be uniformly compacted by a heavy sheep-foot type roller in maximum 300 mm thick lifts with each lift uniformly compacted to at least 95 percent of standard Proctor maximum dry density. The upper 1 m of backfill beneath areas to be developed as pavements should be compacted to 98 percent of standard Proctor maximum dry density.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of sub-base fills, restricted construction lanes, and half-loads during paving may be required, especially if construction is carried out during wet weather conditions.

Control of surface water is a significant factor in achieving good pavement life. Grading of adjacent pavement areas must be designed so that water is not allowed to pond adjacent to the outside edges of the pavement or curb. The existing earth fill and native soils are highly susceptible to frost heave, and pavements constructed on these materials must be designed accordingly. The subgrade must be free of depressions and sloped (preferably at a minimum grade of two percent) to provide effective drainage toward subgrade drains.

Continuous pavement subdrains should be provided along both sides of the driveway/access routes and drained into catch-basins to facilitate drainage of the subgrade and the granular materials. The subdrain invert should be maintained at least 0.3 metres below subgrade level. Subdrains should also be provided at all catch-basins within the parking areas.

6.8.2 Asphaltic Concrete Pavement Design

Preparation of pavement subgrades should be carried out as outlined for slab-on-grade construction. The approved subgrade may be raised to design subgrade level with approved compactable on-site soil, providing it is placed in maximum 300 mm thick lifts and each lift is compacted to at least 95% of the material's MSPDD. As an alternative to subexcavation, a woven geotextile separator, such as

Terratrack 24-15, Amoco 2002, Mirafi 500XL or equivalent, may be placed over spongy areas at design subgrade level prior to placing the Granular 'B' sub-base layer.

Under dry subgrade and weather conditions during construction, the following pavement designs are recommended for a local street, collector street and driveways.

Table 10: Pavement Design

Pavement Classification	HI 8 Surface Asphalt	HI 3 Base Asphalt	Granular 'A' Base	Granular 'B' Sub-Base
Local Street	40 mm	50 mm	150 mm	300 mm
Collector Street	80 mm	50 mm	150 mm	450 mm
Driveways	35 mm	40 mm	150 mm	300 mm
Multi-Use Trail (Mill Street)	n/a	75 mm	250 mm	n/a

The granular materials should be placed in lifts 200 mm thick or less, and compacted to a minimum of 98 percent SPMDD for granular base and granular sub-base. Asphalt materials should be rolled and compacted as per OPSS 310. The granular and asphalt pavement materials and their placement should conform to OPSS Forms 310, 501, 1010, 1101 and 1150 and pertinent municipal specifications. Municipal and other applicable specifications should be referred for use of higher grades of asphalt cement (PGAC 64-28) for asphaltic concrete where applicable.

It is recommended that the placement of the wearing surface be delayed for at least one year after construction of the binder course to minimize the effects of post construction settlement of subgrade fill. Prior to placing the wearing surface, the binder course should be evaluated and remedial work carried out as required in preparation for final construction.

7 Construction Recommendations

7.1 Excavations

7.1.1 Topsoil

Topsoil was encountered at the ground surface at all borehole locations and varied in thickness between about 230 to 500 mm. The variability is likely due to tilling operation as part of the site agricultural activities.

Topsoil within the limits of the project shall be salvaged prior to beginning excavating, fill or hauling, operations by excavating topsoil and stockpiling the material at designated locations on drawings or as designated by the owner in a manner that will facilitate measurement, minimize sediment damage, and not obstruct natural drainage. All stockpiles (topsoil and/or earth fill) shall be protected from sediment transport by surface roughening and perimeter silt fencing.

7.1.2 Overburden Soil

All trench excavations and excavations for foundations must comply with Ontario Regulation 213/91 (Construction Projects) under the Occupational Health and Safety Act. The loose to compact sand contacted in the boreholes would be classified as Type 3 soils (O.Reg. 213/91, s. 226(4)). Temporary cut slopes within Type 3 soils should be at a slope of 1:1 (H: V) or flatter from the base of excavation as per O.Reg. 213/91, s. 234(2) (free of groundwater effects).

In absence of groundwater seepage, the intact native stiff to very stiff clayey silt contacted in the boreholes may be classified as Type 2 soils (O.Reg. 213, s. 226(3)) and temporary side slopes may be cut near vertical in the bottom 1.2 m and must be trimmed back not steeper than 1 horizontal to 1 vertical above this level as per O.Reg. 213/91 s. 234(2). If wet deposits are contacted, excavation side slopes may be expected to slough to flatter slopes, potentially as flat as 3:1 (H: V) or flatter. If an excavation contains more than one type of soil, the soil shall be classified as the type with the highest number as per section 227.3 of O.Reg. 213/91.

7.1.3 Groundwater

Groundwater seepage should be expected from the shallow silty sand/sandy silt layers. It is expected that the seepage may be handled using conventional sump pumping and trenching techniques. Where groundwater seepage and/or sloughing occurs, the excavation side slopes will need to be flattened or adequately braced to ensure stability. Every excavation that a worker may be required to enter shall be kept reasonably free of water (O.Reg. 213/91, s. 230). Care should be taken to direct surface runoff away from open excavations.

Minor to moderate groundwater inflow is expected where the excavations extend up to 0.5 m below the stabilized groundwater table. It is believed that this groundwater inflow can be controlled using a gravity dewatering system with perimeter interceptor ditches and (high capacity) pumps. Moderate to significant groundwater inflow should be expected for excavations extending more than 0.5 m below the stabilized groundwater table and a positive dewatering system installed by a dewatering specialist will most likely be required to lower the groundwater level in order to maintain a safe and adequately dry excavations.

An Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW) is required by the Ministry of Environment and Climate Change in the event that the daily taking of groundwater exceeds 50,000 L or 400,000 L per day, respectively.

It is recommended that several test pits be dug during the tendering stage of the project in order that prospective contractors may familiarize themselves with the soil and groundwater conditions to be contacted at the site.

7.2 Depth of Frost Penetration

The design frost penetration depth for the general area is 1.2 m. Therefore, a permanent soil cover of 1.2m or its thermal equivalent insulation is required for frost protection of foundations. All exterior footings, footings beneath unheated areas and foundations exposed to freezing temperatures should have at least such earth cover or equivalent synthetic insulation for frost protection. During winter construction exposed surfaces to support foundations must be protected against freezing by means of loose straw and tarpaulins, heating, etc.

For buried utility lines, variations from the above noted depth of frost penetration might be considered, depending on various factors such as the type of backfilling materials or the temperature and moisture exposure of the area (prevailing winds, drifting snow, etc.). However, these variations do not generally represent a concern unless special equipment and/or buried utilities have specific requirements regarding the subsurface temperature and moisture regime (i.e., water lines or sensitive electrical utilities etc.). In such special situations further tests and analysis should be conducted on a case-by-case basis.

The depth of frost penetration is also defined as the zone of active weathering where sizeable variations in the moisture content accompany the yearly temperature fluctuations. Therefore, the foundation grades should be established at or below this depth. For light poles and other light structures that are to be installed on a single footing, if some frost heave (25 mm to 50 mm) cannot be tolerated, the foundation elements should also be provided with the above noted minimum depth of soil cover or equivalent exterior-grade insulation.

7.3 Site Work

The soil at this site is fine-grained and will become weakened when subjected to traffic when wet. If there is site work carried out during periods of wet weather, then it can be expected that the subgrade will be disturbed unless an adequate granular working surface is provided to protect the integrity of the subgrade soils from construction traffic. Subgrade preparation works cannot be adequately accomplished during wet weather and the project must be scheduled accordingly. The disturbance caused by the traffic can result in the removal of disturbed soil and use of fill material for site restoration or underfloor fill that is not intrinsic to the project requirements. Attempting to build slabs and pavements at this site during wet weather could significantly increase earthworks and pavement costs.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during paving and other work are required, especially if construction is carried out during unfavourable weather.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the founding subgrade and concrete must be provided. The soil at this site is highly susceptible to frost damage. Consideration must be given to frost effects, such as heave or softening, on exposed soil surfaces in the context of this particular project development.

7.4 Construction Inspection and Testing

During construction of the new building, testing should be carried out for quality assurance. Soils testing for the project would include engineering site visits to confirm bearing capacity for footings for the new buildings. Compaction testing shall be carried out on structural fill beneath the building, foundation wall backfills, sub-slab granular fill, and service pipe bedding and trench backfill.

During the placement of concrete at the construction site, testing should be performed to determine the slump and air content of the concrete, and concrete cylinders should be cast for compressive strength testing in accordance with the requirements of CSA A23.1 and A23.2. Field sampling and testing of concrete shall be according to OPSS 904. Preparation of the test cylinders, curing, and testing should be carried out by Englobe.

Englobe maintains CCIL certified concrete laboratories in Kitchener and London and can provide concrete sampling and testing services for the project as required. Englobe staff also provide quality testing services for building envelope, structural steel, reinforcing steel, and roofing.

8 Statement of Limitations

The geotechnical recommendations provided 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. Since all details of the design may not be known at the time of report preparation, we recommend that we be retained during the final design stage to verify that the geotechnical recommendations have been correctly interpreted in the design. Also, if any further clarification and/or elaboration are needed concerning the geotechnical aspects of the project, Englobe should be contacted. We recommend that we be retained during construction to confirm that the subsurface conditions do not deviate materially from those encountered in the test holes and to ensure that our recommendations are properly understood. Quality assurance testing and inspection services during construction are a necessary part of the evaluation of the subsurface conditions.

The geotechnical recommendations provided in this report are intended for the use of the Client or its agent and may not be used by a Third Party without the expressed written consent of Englobe and the Client. They are not intended as specifications or instructions to contractors. Any use which a contractor makes of this report, or decisions made based on it, are the responsibility of the contractor. The contractor must also accept the responsibility for means and methods of construction, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect their work. Englobe accepts no responsibility and denies any liability whatsoever for any damages arising from improper or unauthorized use of the report or parts thereof.

It should be noted that the soil boundaries indicated on the borehole logs are inferred from noncontinuous sampling and observations during drilling and should not be interpreted as exact planes of geological change. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design. Also, the subsoil and groundwater conditions have been determined at the borehole locations only.

It is further noted that, depending on the time of year the field work was completed, water levels should be expected to vary, perhaps significantly from those observed at the time of this investigation.

It is important to note that the geotechnical assessment involves a limited sampling of the site gathered at specific test hole locations and the conclusions in this report are based on this information gathered and in accordance with normally accepted practices. The subsurface geotechnical, hydrogeological, environmental, and geologic conditions between and beyond the test holes will differ from those encountered at the test holes. Also, such conditions are not uniform and can vary over time. Should subsurface conditions be encountered which differ materially from those indicated at the test holes, we request that we be notified to assess the additional information and determine whether changes should be made as a result of the conditions. Englobe will not be responsible to any party for damages incurred because of failing to notify Englobe that differing site or subsurface conditions are present upon becoming aware of such conditions.

The professional services provided for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise stated specifically in the report. The recommendations and opinions given in this report are based on our professional judgment and are for the guidance of the Client or its Agent in the design of the specific project. No other warranties or guarantees, expressed or implied, are made. The Englobe recommendations are contingent upon provision of a consistently competent, stable subgrade, which is properly drained and free of soft spots and objectionable materials such as organics.

Appendix A
Drawings

ENGLOBE

Y:\SHARED\CA\KITCHENER\DATA\PROJECTS\160\2022 (BRANTFORD-KITCHENER-LONDON)\02208613.000 - SUBDIVISION, CHRISTIE STREET, DORCHESTER\Z4_CAD\02208613.000 FIG 1.DWG

0 50 100 150 200 250 m

SCALE 1:6000

NOTES:

1-REFERENCES: © Google Earth 2023.

2-Drawing scale may be distorted due to file conversion and/or copying. Measurements taken from the drawing must be verified in the field.

Project

Proposed Residential Subdivision

83 Christie Street, Dorchester, ON

Title

Site Location Plan

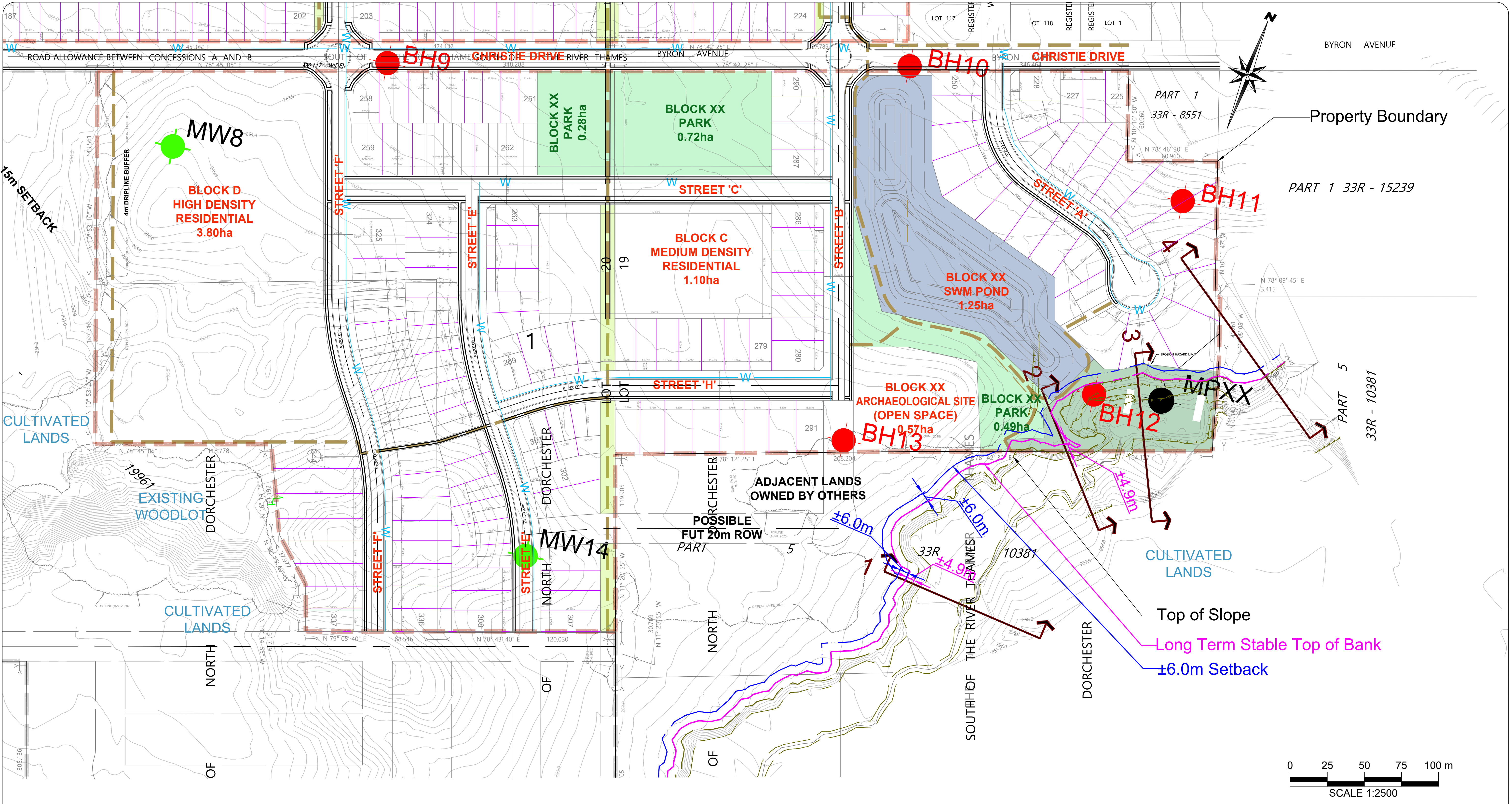
ENGLOBE

440, Hardy Road, Unit 3
Brantford (Ontario) N3T 5L8
Telephone : 519.720.0078
Fax : 519.720.0976

Prepared	A.Teka	Discipline	GEOTECHNICAL	Project manager	R.Helwing
Drawn	A.Teka	Scale	1:6000	Sequence no.	01 of 02
Checked	R.Helwing	Date	2024-01-31		

M. dept.	Project	Disc.	Dwg no.	Rev.
04	02208613.000	GE	001	00

Y:\SHARED\CA\KITCHENER\DATA\PROJECTS\1601\2022 (BRANTFORD-KITCHENER-LONDON)\02208613.000 - SUBDIVISION, CHRISTIE STREET, DORCHESTER\24_CAD\02208613.000 FIGURES 2024-03-22 KC.DWG



LEGEND :

● MONITORING WELL LOCATION (Englobe 2019)

● BOREHOLE LOCATION (Englobe 2019)

● MINI PIEZOMETER P(Englobe 2019)

SECTION LOCATION

REFERENCE
Concept Plan of Subdivision
South of the River Thames
Geographic Township of North Dorchester
Municipality of Thames Centre
County of Middlesex
Job No.: 18010, Date: May 04, 2023
By: CJDL Consulting Engineers

Project

Proposed Residential Subdivision
South Side

83 Christie Street, Dorchester, ON

Title

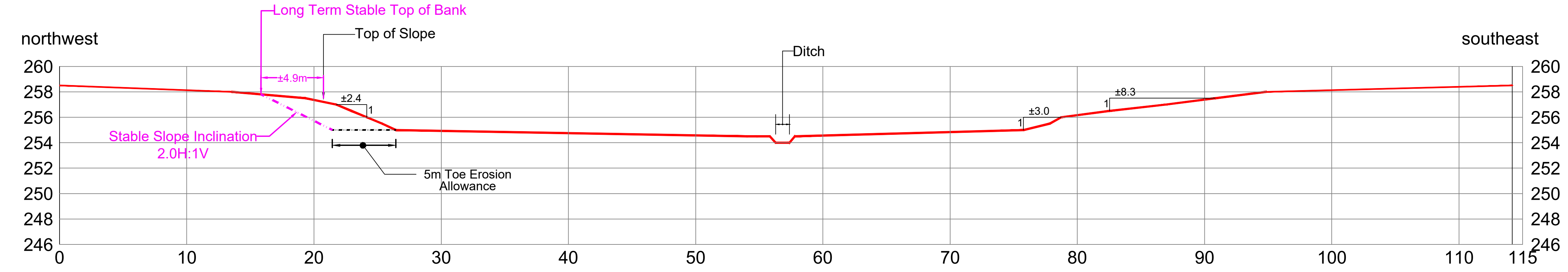
BOREHOLE AND SECTION LOCATION PLAN

ENGLOBE

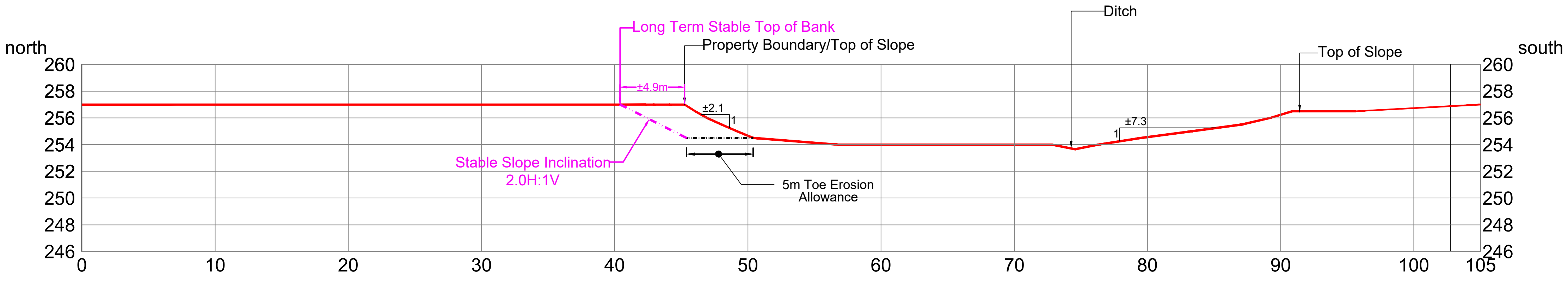
Prepared	C. Kamal	Discipline	GEOTECHNICAL	Project manager	R.Helwig
Drawn	C. Kamal	Scale	As Shown	Sequence no.	--
Checked	R.Helwig	Date	March 2024		

Resp.	Project	Phase	Disc.	Type	Drawing no.	Rev.
01	02208613.000	0100	GE	D	2	00

CROSS SECTION 1-1'



CROSS SECTION 2-2'



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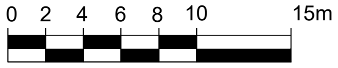


Project

Proposed Residential Subdivision
South Side

83 Christie Street, Dorchester, ON

Title

DETAILED CROSS SECTIONS
SECTION 1-1' AND SECTION 2-2'

ENGLOBE

Prepared **C. Kamal**
Drawn **C. Kamal**
Checked **R.Helwig**

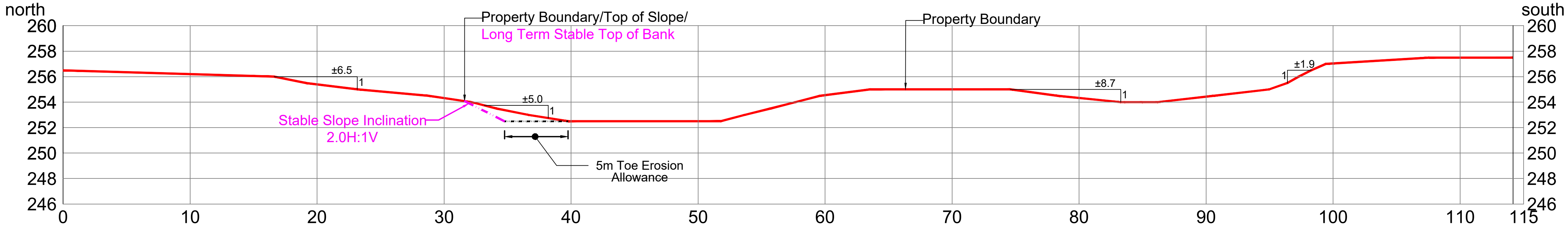
Discipline **GEOTECHNICAL**
Scale **As Shown**
Date **March 2024**

Project manager **R.Helwig**
Sequence no. **--**

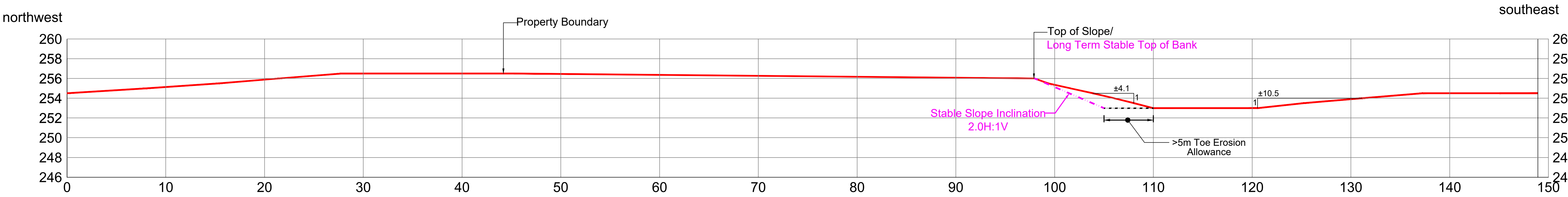
Resp.	Project	Phase	Disc.	Type	Drawing no.	Rev.
01	02208613.000	0100	GE	D	2A	00

Y:\SHARED\CA\KITCHENER\DATA\PROJECTS\160\2022 (BRANTFORD-KITCHENER-LONDON)\02208613.000 - SUBDIVISION, CHRISTIE STREET, DORCHESTER\24_CAD\02208613.000 FIGURES 2024-03-22 KC.DWG

CROSS SECTION 3-3'



CROSS SECTION 4-4'



1:400

0 2 4 6 8 10 15m

Project

Proposed Residential Subdivision
South Side

83 Christie Street, Dorchester, ON

Title

DETAILED CROSS SECTIONS
SECTION 3-3' AND SECTION 4-4'

ENGLOBE

Prepared	**C. Kamal**	Discipline	**GEOTECHNICAL**	Project manager	**R.Helwig**
Drawn	**C. Kamal**	Scale	**As Shown**	Sequence no.	**--**
Checked	**R.Helwig**	Date	**March 2024**		

Resp.	Project	Phase	Disc.	Type	Drawing no.	Rev.
01	02208613.000	0100	GE	D	2B	00

Y:\SHARED\CA\KITCHENER\DATA\PROJECTS\160\2022 (BRANTFORD-KITCHENER-LONDON)\02208613.000 - SUBDIVISION, CHRISTIE STREET, DORCHESTER\Z4_CAD\02208613.000 FIGURES 2024-03-22 KC.DWG

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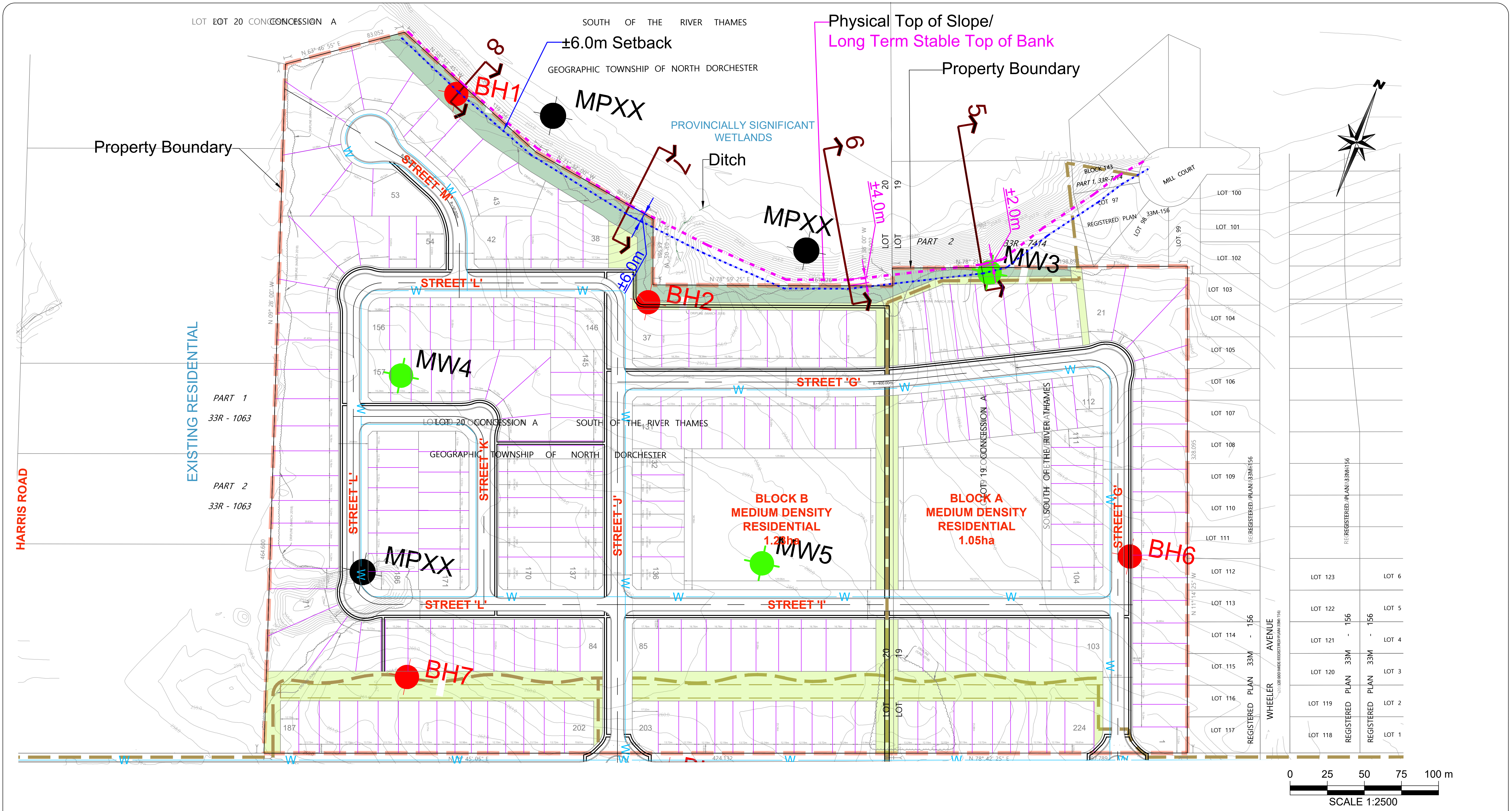


LEGEND :

● MONITORING WELL LOCATION (Englobe 2019)

● BOREHOLE LOCATION (Englobe 2019)

● MINI PIEZOMETER P(Englobe 2019)

SECTION LOCATION

REFERENCE
Concept Plan of Subdivision
South of the River Thames
Geographic Township of North Dorchester
Municipality of Thames Centre
County of Middlesex
Job No.: 18010, Date: May 04, 2023
By: CJDL Consulting Engineers

Project

Proposed Residential Subdivision
North Side

83 Christie Street, Dorchester, ON

Title

BOREHOLE AND SECTION LOCATION PLAN

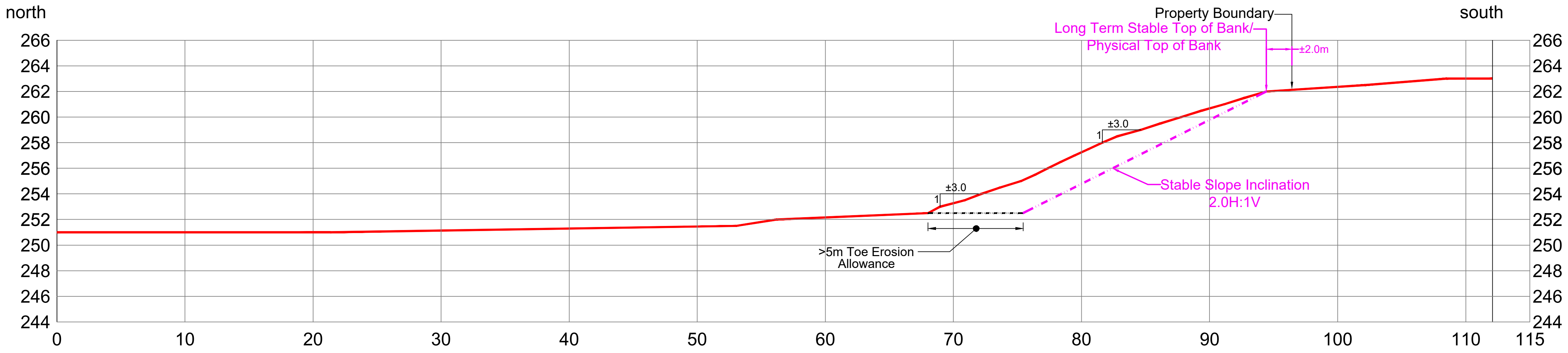
ENGLOBE

Prepared	C. Kamal	Discipline	GEOTECHNICAL	Project manager	R.Helwig
Drawn	C. Kamal	Scale	As Shown	Sequence no.	--
Checked	R.Helwig	Date	March 2024		

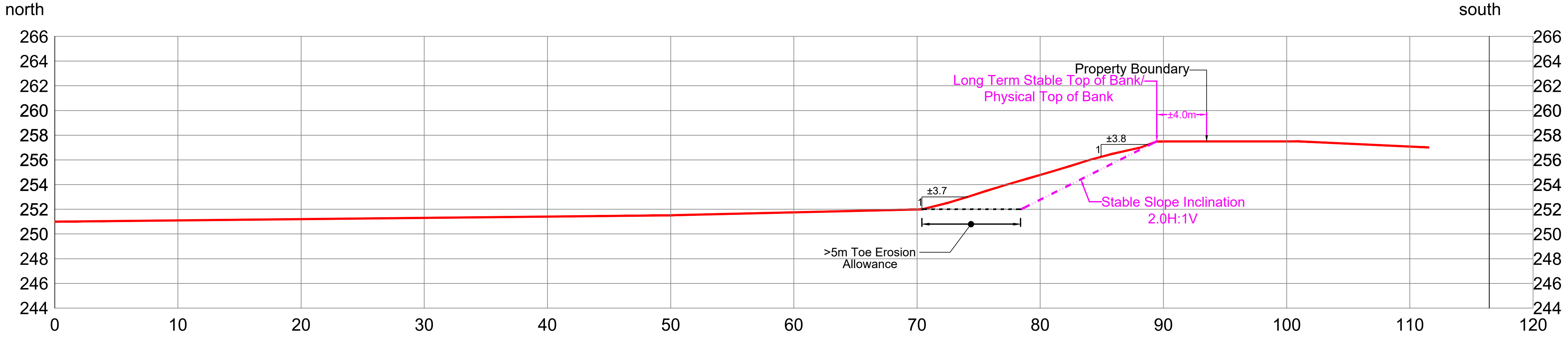
Resp.	Project	Phase	Disc.	Type	Drawing no.	Rev.
01	02208613.000	0100	GE	D	3	00

Y:\SHARED\CA\KITCHENER\DATA\PROJECTS\160\2022 (BRANTFORD-KITCHENER-LONDON)\02208613.000 - SUBDIVISION, CHRISTIE STREET, DORCHESTER\24_CAD\02208613.000 FIGURES 2024-03-22 KC.DWG

CROSS SECTION 5-5'



CROSS SECTION 6-6'



1:400

0 2 4 6 8 10 15m

Project

Proposed Residential Subdivision
North Side

83 Christie Street, Dorchester, ON

Title

DETAILED CROSS SECTIONS
SECTION 5-5' AND SECTION 6-6'

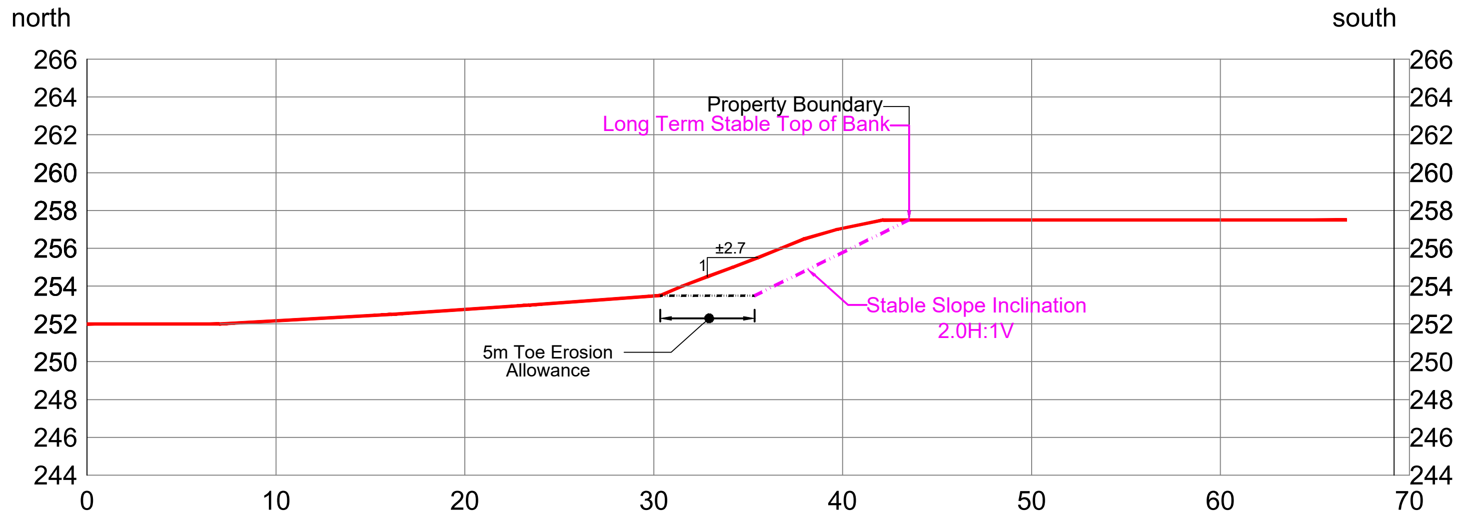
ENGLOBE

Prepared	C. Kamal	Discipline	GEOTECHNICAL	Project manager	R.Helwig
Drawn	C. Kamal	Scale	As Shown	Sequence no.	--
Checked	R.Helwig	Date	March 2024		

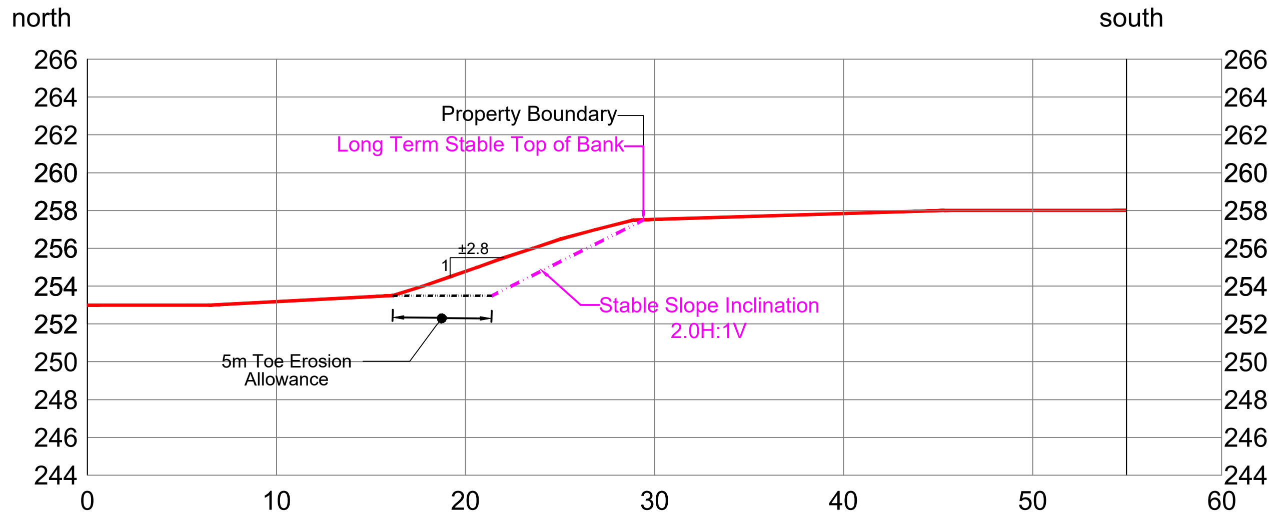
Resp.	Project	Phase	Disc.	Type	Drawing no.	Rev.
01	02208613.000	0100	GE	D	3A	00

Y:\SHARED\CA\KITCHENER\DATA\PROJECTS\160\2022 (BRANTFORD-KITCHENER-LONDON)\02208613.000 - SUBDIVISION, CHRISTIE STREET, DORCHESTER\24_CAD\02208613.000 FIGURES 2024-03-22 KC.DWG

CROSS SECTION 7-7'



CROSS SECTION 8-8'



0 2 4 6 8 10 15m

1:400

Project

Proposed Residential Subdivision
North Side

83 Christie Street, Dorchester, ON

Title

DETAILED CROSS SECTIONS
SECTION 7-7', SECTION 8-8' AND SECTION 9-9'

ENGLOBE

Prepared	C. Kamal	Discipline	GEOTECHNICAL	Project manager	R.Helwig
Drawn	C. Kamal	Scale	As Shown	Sequence no.	--
Checked	R.Helwig	Date	March 2024		

Resp.	Project	Phase	Disc.	Type	Drawing no.	Rev.
01	02208613.000	0100	GE	D	3B	00

TYPICAL CROSS-SECTION 'A-A'
MULTI-USE TRAIL BLOCK
LOOKING NORTHEAST
SCALE: H 1:100 V 1:100

LEGEND

SAN	SANITARY SEWER
ST	STORM SEWER
W	WATERMAIN
W/S	WATER SERVICE
G	NATURAL GAS LINE
U/H	UNDERGROUND POWER LINE
O/H	OVERHEAD POWER LINE
FO	UNDERGROUND FIBRE OPTIC LINE
T	UNDERGROUND BELL LINE
C	UNDERGROUND CABLE LINE
	DITCH/SWALE
	TOE OF SLOPE, TOP OF BANK
	FENCE
	EDGE OF GRAVEL
	CURB, DROPPED CURB
	EDGE OF PAVEMENT
MH	MAINTENANCE HOLE
CO	CLEAN OUT
CB	CATCH BASIN
	WATER VALVE
CS	WATER SERVICE CURB STOP
HYD	HYDRANT
HP	GUY WIRE, UTILITY POLE
LS	LIGHT STANDARD
TL	TRAFFIC SIGNAL
	SIGN
GV	GAS VALVE
	UTILITY PEDESTAL
	TRANSFORMER
RIB IB SIB	SURVEY BARS
	CONIFEROUS, DECIDUOUS TREE
	SHRUB
	EDGE OF BUSH/DRIP LINE
BH	GEOTECHNICAL BORE HOLE

2024 EDITION

CONSULTANT:
CJDL
Consulting Engineers

Cyril J. Demeyere Limited
P.O. Box 460, 261 Broadway
Tillsonburg, Ontario. N4G 4H8
Tel: 519-688-1000
866-302-9886
Fax: 519-842-3235
cjdl@cjdleng.com

MUNICIPALITY OF
Thames Centre

STAMP:
PROFESSIONAL ENGINEER
LICENSED
D.J. LYLE
100217477
PROVINCE OF ONTARIO
PRELIMINARY
05 FEB 2025

REVISION

#	DESCRIPTION	DD/MM/YYYY	BY

MILL COURT WATERMAIN & TRAIL CONNECTION

CONTRACT #: 18010
SCALE: 1:250
PROJECT NAME: ACORN VALLEY SUBDIVISION
RP 11M-XXX
DOUG TARRY LIMITED
DRAWING #: 1

Appendix B
Slope Stability Rating Charts

TABLE I - SLOPE STABILITY RATING CHART - VALLEY SLOPE

Site Location:	83 Christie Drive, Dorchester, Ontario	File No. 02208613.000
Property Owner:	Cyril J. Demeyere Limited (CJDL)	
Inspection Date:	August 18, 2023	
Inspected By:	Behnoush Honarvar	

			Selected Slope Section(s)							
1.	SLOPE INCLINATION									
	Degrees	Horizontal / Vertical	**1-1’**	**2-2’**	**3-3’**	**4-4’**	**5-5’**	**6-6’**	**7-7’**	**8-8’**
a)	18 or less	3:1 or flatter	0	0	0*	0*	0	0*	0	0
b)	18 - 26	2:1 to more than 3:1	6*	6*	6	6	6*	6	6*	6*
c)	> 26	Steeper than 2:1	16	16	16	16	16	16	16	16
2.	SOIL STRATIGRAPHY									
a)	Shale Limestone, Granite (Bedrock)		0	0	0	0	0	0	0	0
b)	Sand, Gravel		6*	6*	6*	6*	6*	6*	6*	6*
c)	Glacial Till		9	9	9	9	9	9	9	9
d)	Clay, Silt		12	12	12	12	12	12	12	12
e)	Fill		16	16	16	16	16	16	16	16
f)	Leda clay		24	24	24	24	24	24	24	24
3.	SEEPAGE FROM SLOPE FACE									
a)	None or Near bottom only		0*	0*	0*	0*	0*	0*	0*	0*
b)	Near mid-slope only		6	6	6	6	6	6	6	6
c)	Near crest only or, From several levels		12	12	12	12	12	12	12	12
4.	SLOPE HEIGHT									
a)	2 m or less		0	0	0	0	0	0	0	0
b)	2.1 to 5 m		2*	2*	2*	2*	2	2	2*	2*
c)	5.1 to 10m		8	8	8	8	8*	8*	8	8
5.	VEGETATION COVER ON SLOPE FACE									
a)	Well vegetated; heavy shrubs or forested with mature trees		0*	0*	0*	0*	0*	0*	0*	0*
b)	Light vegetation; mostly grass, weeds, occasional trees		4	4	4	4	4	4	4	4
c)	No vegetation, bare		8	8	8	8	8	8	8	8
6.	TABLE LAND DRAINAGE									
a)	Table land flat, no apparent drainage over slope		0*	0*	0*	0*	0*	0*	0*	0*
b)	Minor drainage over slope, no active erosion		2	2	2	2	2	2	2	2
c)	Drainage over slope, active erosion, gullies		4	4	4	4	4	4	4	4
7.	PROXIMITY OF WATERCOURSE AT SLOPE TOE									
a)	15 metres or more from slope toe		0	0	0	0	0	0	0	0
b)	Less than 15 metres from slope toe		6*	6*	6*	6*	6*	6*	6*	6*
8.	PREVIOUS LANDSLIDE ACTIVITY									
a)	No		0*	0*	0*	0*	0*	0*	0*	0*
b)	Yes		6	6	6	6	6	6	6	6
	SLOPE STABILITY RATING VALUE **INVESTIGATION RATING SUMMARY**	**TOTAL**	**20**	**20**	**14**	**14**	**26**	**24**	**20**	**20**

SLOPE INSTABILITY		RATING	INVESTIGATION REQUIREMENTS
1.	Low potential	< 24	Site inspection only, confirmation, report letter
2.	Slight potential	25-35	Site inspection and surveying, preliminary study, detailed report
3.	Moderate potential	> 35	Site inspection, boreholes, surveying, detailed report

Appendix C
Borehole Logs

ENGLOBE

List of Abbreviations

The abbreviations commonly employed on the borehole logs, on the figures, and in the text of the report, are as follows:

Sample Types		Soil Test and Properties	
AS	Auger Sample	SPT	Standard Penetration Test
CS	Core Sample	UC	Unconfined Compression
RC	Rock Core	FV	Field Vane Test
SS	Split Spoon	ϕ	Angle of internal friction
TW	Thinwall, Open	γ	Unit weight
WS	Wash Sample	W_p	Plastic Limit
BS	Bulk Sample	w	Water content
GS	Grab Sample	W_L	Liquid Limit
WC	Water Content Sample	I_L	Liquidity Index
TP	Thinwall, Piston	I_p	Plastic Index
		PP	Pocket Penetrometer

Penetration Resistances	
Dynamic Penetration Resistance	The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) diameter 60˚ cone a distance 300 mm (12 in.) The cone is attached to 'A' size drill rods and casing is not used.
Standard Penetration Resistance, N (ASTM D1586)	The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) required to drive a standard split spoon sampler 300 mm (12 in.)
WH	Sampler advanced by weight of hammer
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure

Soil Description		
Cohesionless Soils Compactness Condition	**SPT N-Value** (blows per 0.3 m)	**Relative Density (D_r** (%)
Very Loose	0 to 4	0 to 20
Loose	4 to 10	20 to 40
Compact	10 to 30	40 to 60
Dense	30 to 50	60 to 80
Very Dense	Over 50	80 to 100
Cohesive Soils	**Undrained Shear Strength (C_u**	
Consistency	**kPa**	**psf**
Very Soft	Less than 12	Less than 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000
DTPL	Drier than plastic limit	Low Plasticity, W_L<30
APL	About plastic limit	Medium Plasticity, 30< W_L<50
WTPL	Wetter than plastic limit	High Plasticity, W_L>50

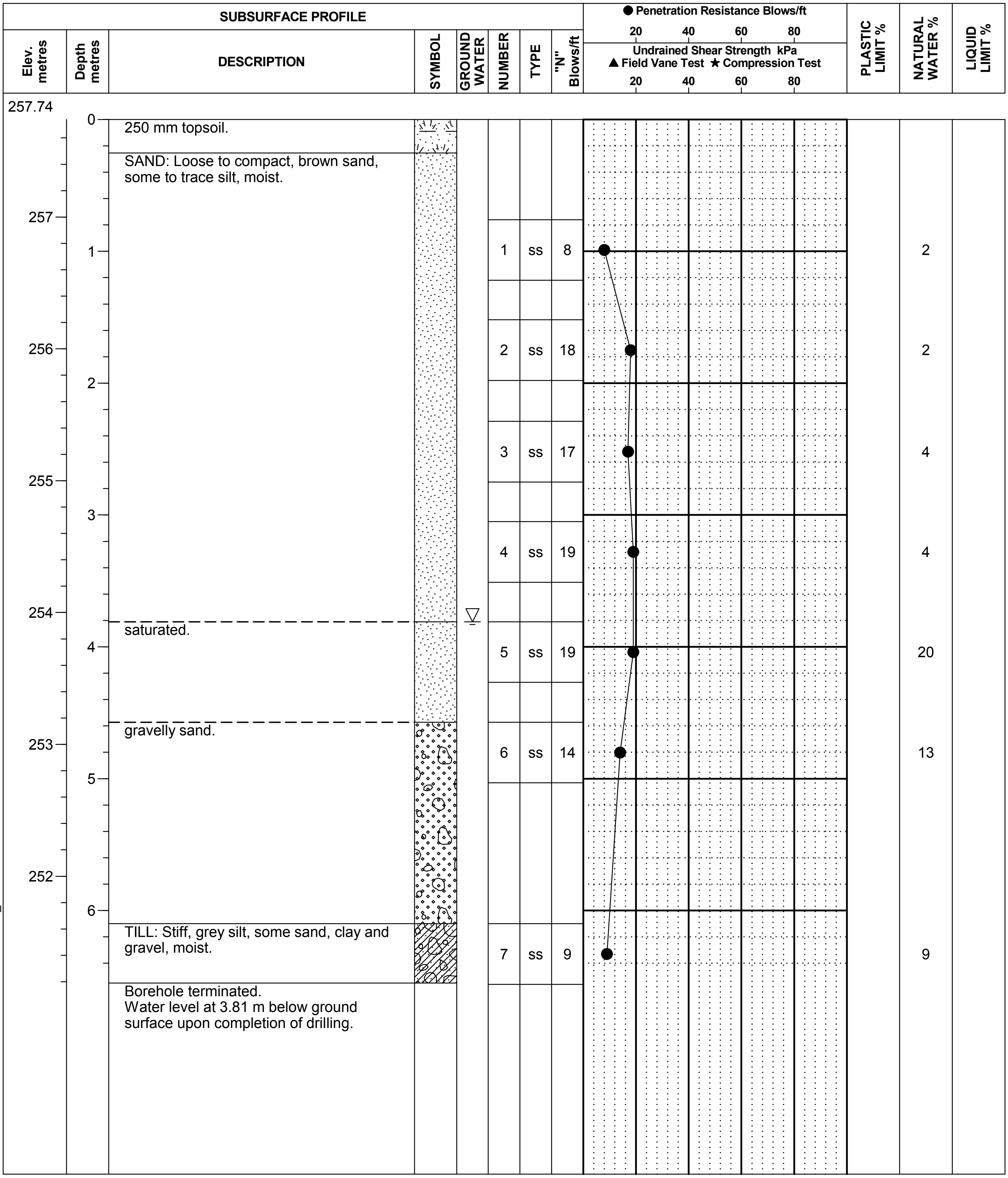
Englobe
CONSULTING SOILS AND MATERIALS ENGINEERS
417 Exeter Road, London, Ontario, N6E 2Z3
Phone: 519-685-6400 Fax: 519-685-0943

LOG OF BOREHOLE NO.

01-19

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

Encl. No. 01 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Jul 16, 2019



Elev. metres	DESCRIPTION	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
257.74	250 mm topsoil.						
	SAND: Loose to compact, brown sand, some to trace silt, moist.	1	ss	8		2	
		2	ss	18		2	
		3	ss	17		4	
		4	ss	19		4	
	saturated.	5	ss	19		20	
	gravelly sand.	6	ss	14		13	
	TILL: Stiff, grey silt, some sand, clay and gravel, moist.	7	ss	9		9	
	Borehole terminated. Water level at 3.81 m below ground surface upon completion of drilling.						

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CONSULTING SOILS AND MATERIALS ENGINEERS

417 Exeter Road, London, Ontario, N6E 2Z3 **Phone: 519-685-6400 Fax: 519-685-0943**

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

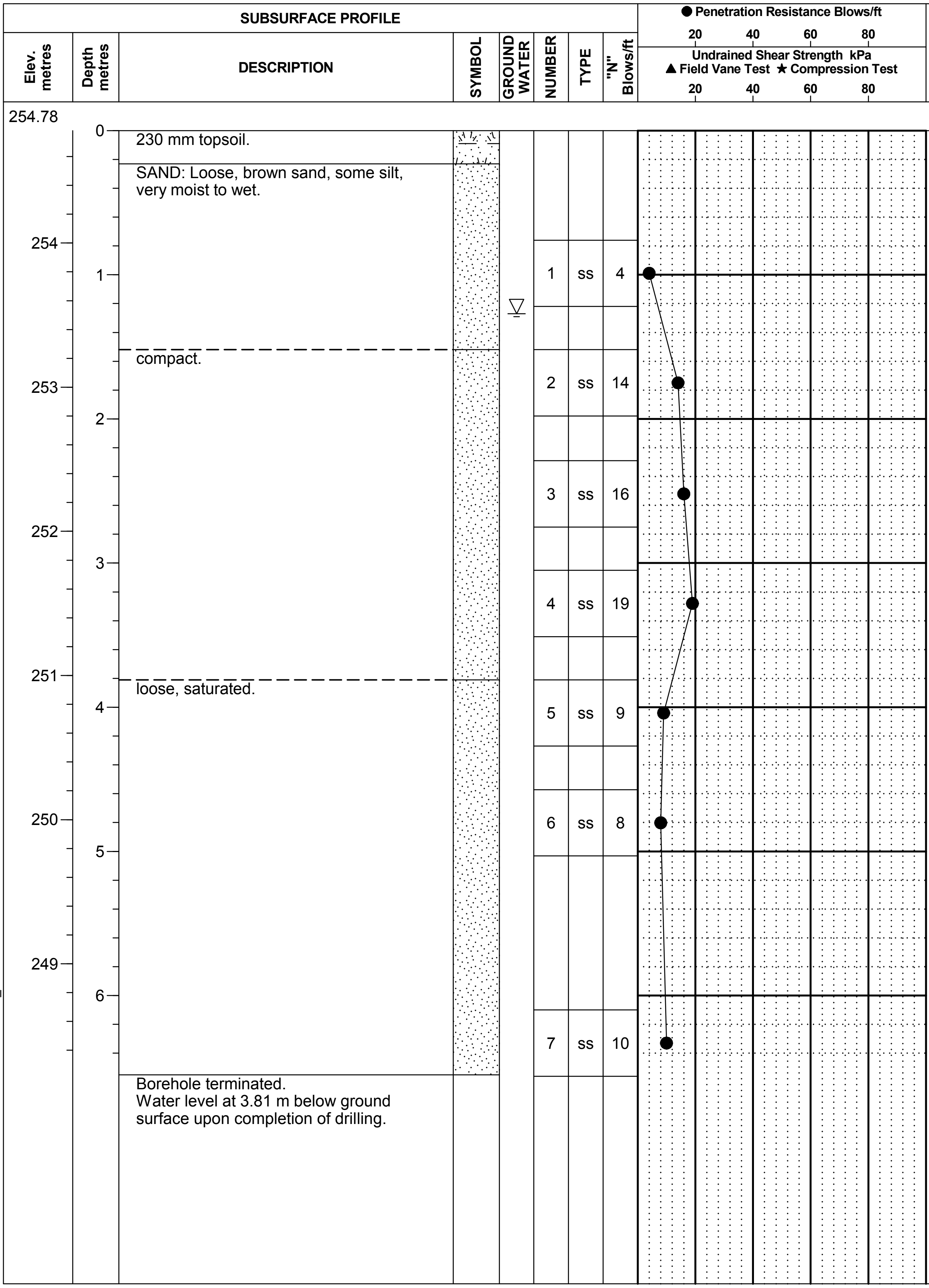
LOG OF BOREHOLE NO.

02-19

Encl. No. 02 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Jul 16, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
254.78	0	230 mm topsoil.							
		SAND: Loose, brown sand, some silt, very moist to wet.							
	1			1	ss	4		18	
			∇						
		compact.							
				2	ss	14		18	
				3	ss	16		14	
				4	ss	19		18	
		loose, saturated.							
				5	ss	9		19	
				6	ss	8		20	
				7	ss	10		18	
		Borehole terminated. Water level at 3.81 m below ground surface upon completion of drilling.							



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CONSULTING SOILS AND MATERIALS ENGINEERS

417 Exeter Road, London, Ontario, N6E 2Z3 **Phone: 519-685-6400 Fax: 519-685-0943**

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

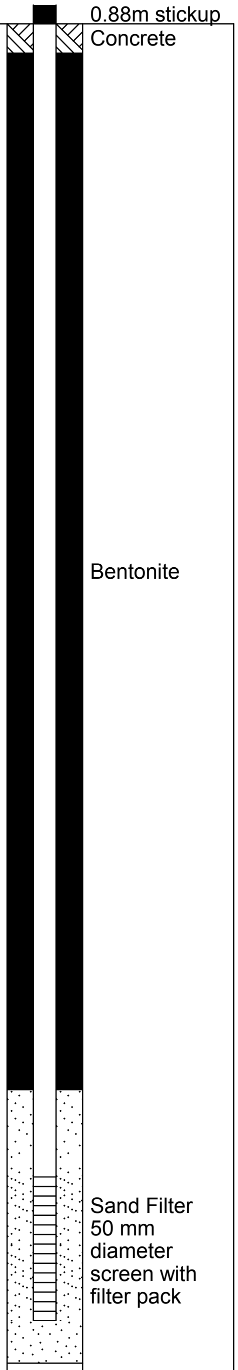
LOG OF BOREHOLE NO.
03-19

Encl. No. 03 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Jul 16, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %
262.27	0	300 mm topsoil.							
		SAND: Very loose, brown sand, some silt, moist.							
261	1			1	ss	4		6	
				2	ss	2		4	
260	2			3	ss	2		3	
259	3			4	ss	3		3	
258	4	compact, trace gravel.		5	ss	10		3	
257	5			6	ss	11		3	
256	6			7	ss	17		3	
254	8			8	ss	21		4	
253	9			9	ss	21		5	
252	10		▼						
251	11	saturated.		10	ss	16		21	
250	12	dense.		11	ss	36		19	
	14			12	ss	40			
		Borehole terminated. Water level at 10.52 m below ground surface upon completion of drilling.							

WELL CONSTRUCTION



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Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.

04-19

Encl. No. 04 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Jul 18, 2019

SUBSURFACE PROFILE

259.14 — 0.85m stickup

DESCRIPTION	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
250 mm topsoil.								concrete
SAND: Very loose to compact, brown sand, some silt, moist.		1	ss	3				
		2	ss	10				
very moist.								Bentonite
TILL: Stiff to very stiff, clayey silt, seams of sandy silt, saturated.	▼	3	ss	11		17		
		4	ss	17		17		
SAND: Compact, brown sand trace silt and gravel, saturated.		5	ss	10				
grey, loose silty sand.		6	ss	9		15		Sand Filter 50 mm diameter screen with filter pack
compact.		7	ss	27		17		
some gravel. Borehole terminated. Monitoring Well Installed.								

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REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.

05-19

Encl. No. 05 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Jul 18, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
260.10	0	230 mm topsoil.									0.80m stickup Concrete
260		SAND: Loose, brown sand, some silt, moist.									
259	1				1	ss	6		16		
		saturated.			2	ss	9		14		
		SILT: Stiff, brown clayey silt, trace sand, very moist.									Bentonite
258	2	seams of sandy silt.			3	ss	14		17		
257	3	very stiff, grey.			4	ss	19				
				▼							
256	4				5	ss	16		10		
		SAND: Compact, brown sand, some silt, trace gravel, saturated.									
255	5				6	ss	11				50 mm diameter screen with filter pack Sand Filter
254	6				7	ss	22		16		
253	7										Bentonite
		grey sand.			8	ss	11		15		
	8	Borehole terminated. Monitoring Well installed.									

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

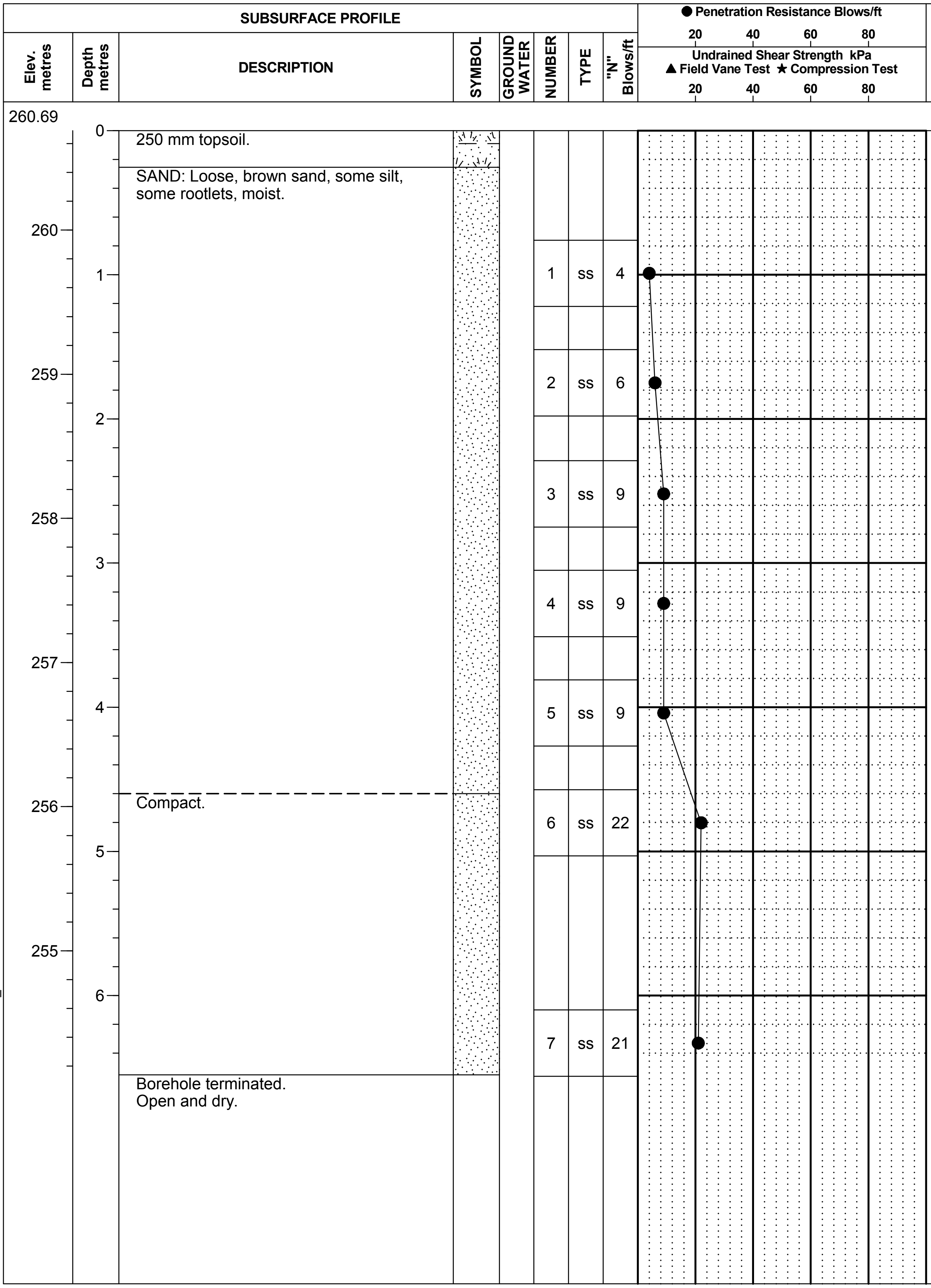
LOG OF BOREHOLE NO.

06-19

Encl. No. 06 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Jul 16, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
260.69	0	250 mm topsoil.								
		SAND: Loose, brown sand, some silt, some rootlets, moist.								
					1	ss	4		8	
					2	ss	6		7	
					3	ss	9		1	
					4	ss	9		4	
					5	ss	9		4	
		Compact.								
					6	ss	22		5	
					7	ss	21		6	
		Borehole terminated. Open and dry.								



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417 Exeter Road, London, Ontario, N6E 2Z3 **Phone: 519-685-6400 Fax: 519-685-0943**

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

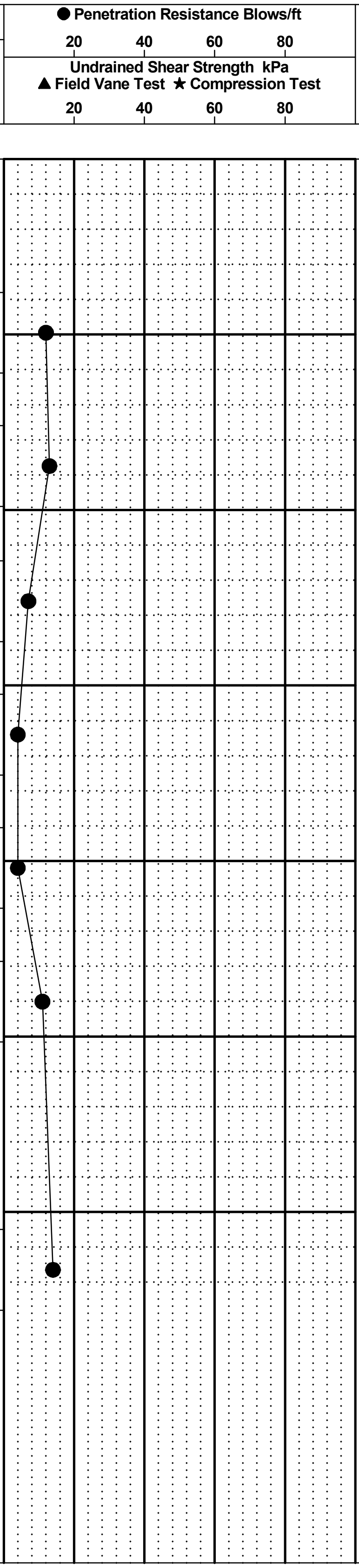
LOG OF BOREHOLE NO.

07-19

Encl. No. 07 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Jul 16, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
261.34	0	250 mm topsoil.							
		SAND: Compact, brown sand, some silty sand seams, moist.							
	1			1	ss	12		11	
		some to trace silt.							
				2	ss	13		2	
		loose, very moist.							
				3	ss	7		1	
				4	ss	4		3	
	4			5	ss	4		17	
			▽						
		compact, saturtated.							
				6	ss	11		21	
				7	ss	14		20	
		Borehole terminated. Water level at 4.3 m below ground surface upon completion of drilling.							



Englobe

CONSULTING SOILS AND MATERIALS ENGINEERS

417 Exeter Road, London, Ontario, N6E 2Z3
Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
08-19

Encl. No. 08 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Jul 18, 2019

SUBSURFACE PROFILE								LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft				
266.37	0	230 mm topsoil.									0.90m stickup Concrete
		SAND: Loose to very loose, brown sand, some silt, moist.									
					1	ss	5				
					2	ss	3				
		Compact, very moist.			3	ss	13		9		
					4	ss	20		1		
					5	ss	24		1		Bentonite
					6	ss	29		1		
				▼	7	ss	19		17		
		saturated.			8	ss	20		14		50 mm diameter screen with filter pack Sand Filter
					9	ss	23		17		
		Borehole terminated. Montoring Well Installed.									

Englobe

CONSULTING SOILS AND MATERIALS ENGINEERS

417 Exeter Road, London, Ontario, N6E 2Z3 **Phone: 519-685-6400 Fax: 519-685-0943**

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

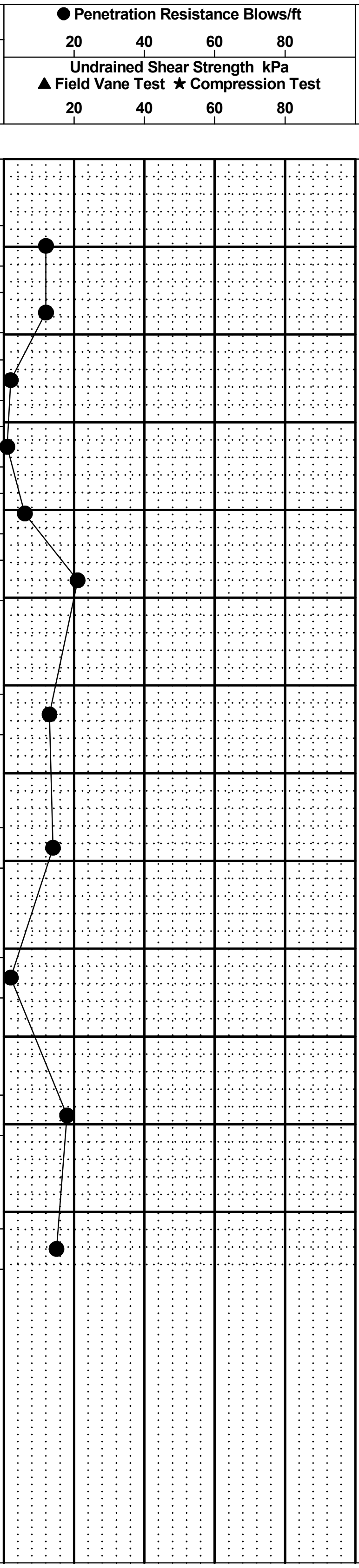
LOG OF BOREHOLE NO.

09-19

Encl. No. 09 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Aug 1, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
261.01	0	500 mm topsoil.								
		SILT: Compact, brown silt, some gravel, trace sand, moist.			1	ss	12			
					2	ss	12		7	
		SAND: Very loose, brown sand, some silt, trace rootlets, moist.			3	ss	2			
					4	ss	1		5	
					5	ss	6			
		compact, saturated.		∇	6	ss	21		17	
					7	ss	13		19	
					8	ss	14		18	
		very loose.			9	ss	2			
		compact.			10	ss	18			
					11	ss	15			
		Borehole terminated. Water level at 4.57 m below ground surface upon completion of drilling.								



Englobe

CONSULTING SOILS AND MATERIALS ENGINEERS

417 Exeter Road, London, Ontario, N6E 2Z3

Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.

10-19

Encl. No. 10 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Aug 1, 2019

Elev. metres	Depth metres	DESCRIPTION	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %	WELL CONSTRUCTION
257.33	0	500 mm topsoil.								0.9m stickup. Concrete
		SAND: Very loose, brown sand, trace silt and gravel, trace rootlets, moist.		1	ss	2		7		
				2	ss	7		19		
		Dense.	▼	3	ss	39		18		Bentonite
		compact, brown sand and gravel, trace silt, saturated.		4	ss	12		11		
		gravelly sand.		5	ss	18		5		
				6	ss	34		9		50 mm diameter screen with filter pack
		dense		7	ss	42		14		
		SILT: Compact, brown silt and sand, trace gravel, moist.		8	ss	25		15		
		clayey silt.		9	ss	24		9		
		Borehole terminated. Water level at 4.88 m below ground surface upon completion of drilling. Monitoring Well Installed.								

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CONSULTING SOILS AND MATERIALS ENGINEERS

417 Exeter Road, London, Ontario, N6E 2Z3 **Phone: 519-685-6400 Fax: 519-685-0943**

LOG OF BOREHOLE NO.

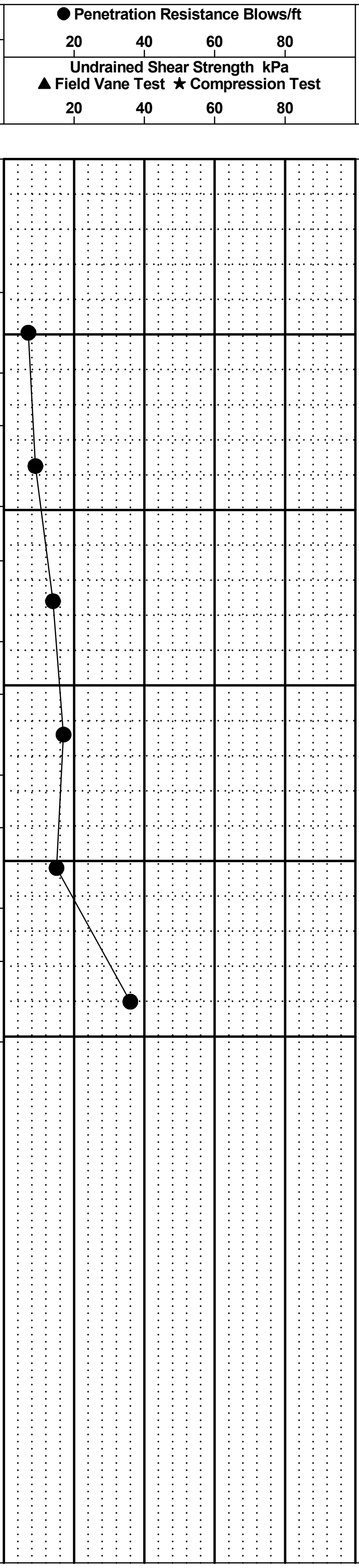
11-19

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

Encl. No. 11 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Aug 1, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
257.58	0	500 mm topsoil.								
257		SAND: Loose, brown sand, some silt, moist.								
	1				1	ss	7		2	
256					2	ss	9		3	
	2	compact.								
255					3	ss	14		3	
	3				4	ss	17		2	
254	4				5	ss	15			
253		Dense, saturated.			6	ss	36		16	
	5	Borehole terminated. Open and dry.								



REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

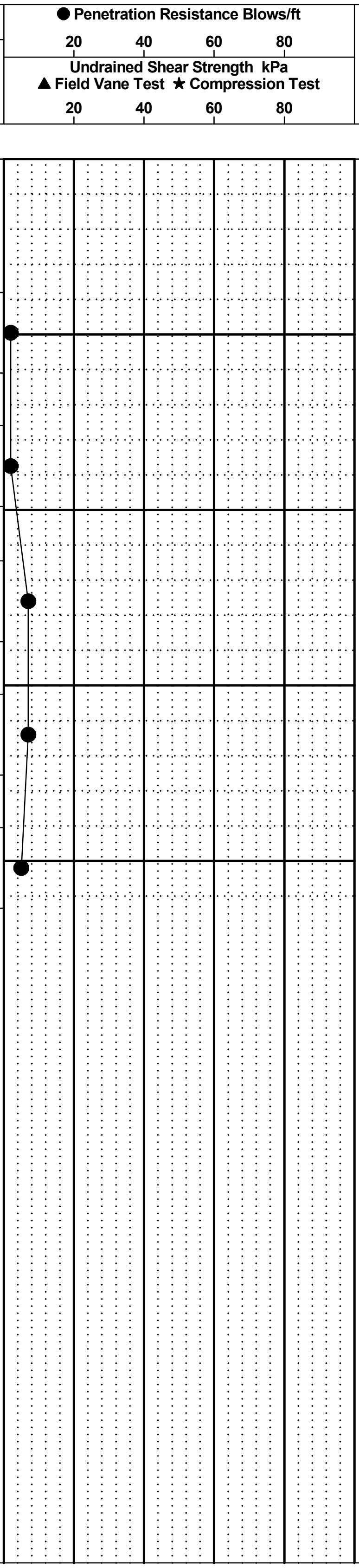
LOG OF BOREHOLE NO.

12-19

Encl. No. 12 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Aug 1, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
255.19	0	Peat: Very loose, dark brown/black, silt, some sand and clay, very moist.								
255										
254	1				1	ss	2		88	
					2	ss	2		31	
253	2	CLAY: Soft to firm, brown silty clay, some sand seams, very moist to wet.		∇						
					3	ss	7			
252	3				4	ss	7			
251	4				5	ss	5			
		Borehole terminated. Water level at 2.29 m below ground surface upon completion of drilling.								



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CONSULTING SOILS AND MATERIALS ENGINEERS

417 Exeter Road, London, Ontario, N6E 2Z3 **Phone: 519-685-6400 Fax: 519-685-0943**

REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.

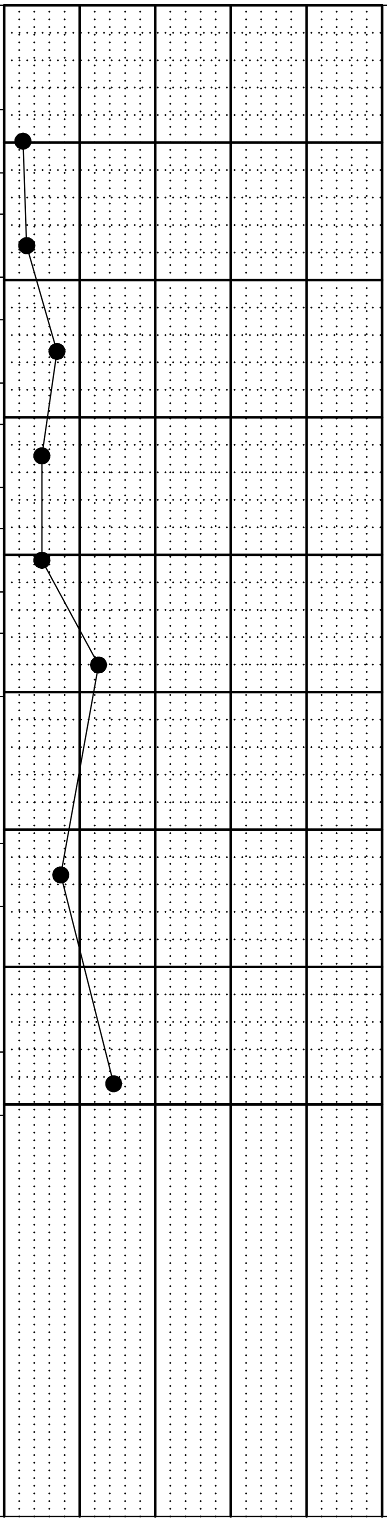
13-19

Encl. No. 13 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Aug 2, 2019

SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
262.26	0	500 mm topsoil.								
		SAND: Loose, brown sand, some silt, trace gravel, some rootlets on the upper layers, moist.			1	ss	5		12	
					2	ss	6			
		compact, layers of clayey silt, very moist.			3	ss	14		3	
					4	ss	10		17	
		SILT: Firm, brown clayey silt, some sand, wet.			5	ss	10		22	
		Compact, brown sandy silt, trace gravel, moist to wet.			6	ss	25			
				∇						
					7	ss	15			
		clayey silt, trace gravel, saturated.			8	ss	29			
		Borehole terminated. Water level at 5.79 m below ground surface upon completion of drilling.								

● Penetration Resistance Blows/ft
20 40 60 80
Undrained Shear Strength kPa
▲ Field Vane Test ★ Compression Test
20 40 60 80



REF. NO.: P-0019257-100
CLIENT: Cyril J. Demeyere Ltd.
PROJECT: Proposed Residential Subdivision
LOCATION: 83 Christie Drive, Dorchester, Ontario
DATUM ELEVATION: Geodetic

LOG OF BOREHOLE NO.
14-19

Encl. No. 14 (Sheet 1 of 1)
DRILLING DATA: London Soil Test
METHOD: Hollow Stem Auger
DIAMETER: 200mm
DATE: Aug 13, 2019

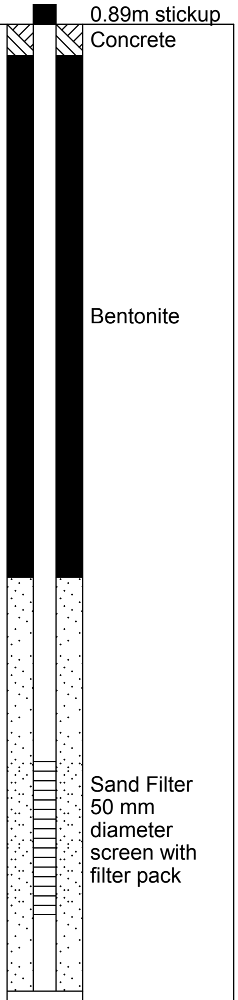
SUBSURFACE PROFILE

Elev. metres	Depth metres	DESCRIPTION	NUMBER	TYPE	"N" Blows/ft	LEL %	NATURAL WATER %	GAS %
265.63	0	300 mm topsoil.						
		SAND: Very loose, mottled brown sand, some silt, trace gravel, moist.						
			1	ss	1			
		compact.	2	ss	16			
		dense, silty sand.	3	ss	34			
		compact, saturated.	4	ss	18		20	
			5	ss	18			
			6	ss	25		22	
		Borehole terminated. Monitoring Well Installed.						

Elev. scale: 265, 264, 263, 262, 261, 260, 259, 258, 257
Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

GROUND WATER: ▼

WELL CONSTRUCTION



Appendix D
Geotechnical Laboratory Analyses

ENGLOBE

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Englobe

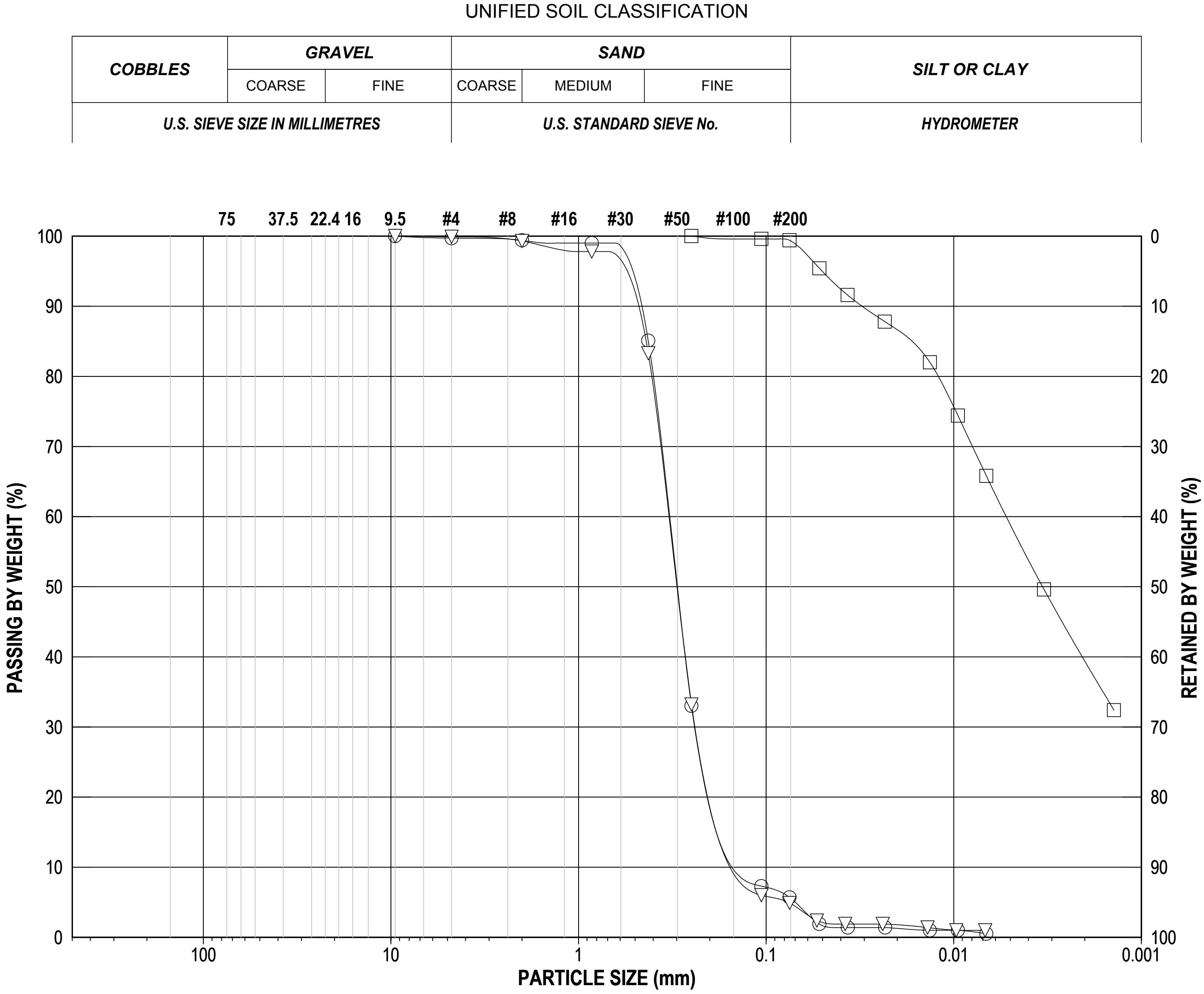
PARTICLE SIZE ANALYSIS

Project: **Proposed Residential Subdivision**

Figure No : **1**

Location: **83 Christie Street, Dorchester, Ontario**

File No : **P-0019257-0-01-100**



Symbol	Borehole n°	Sample n°	Depth (m)	Description
—○—	BH-03-19	SA-3	2.29 - 2.74	SAND, trace Silt
—□—	BH-05-19	SA-4	3.05 - 3.51	SILT and CLAY
—▽—	BH-06-19	SA-3	2.29 - 2.74	SAND, trace Silt

EQ-09-Ge-74A R.1 02.03.2011

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PARTICLE SIZE ANALYSIS

Project: **Proposed Residential Subdivision**

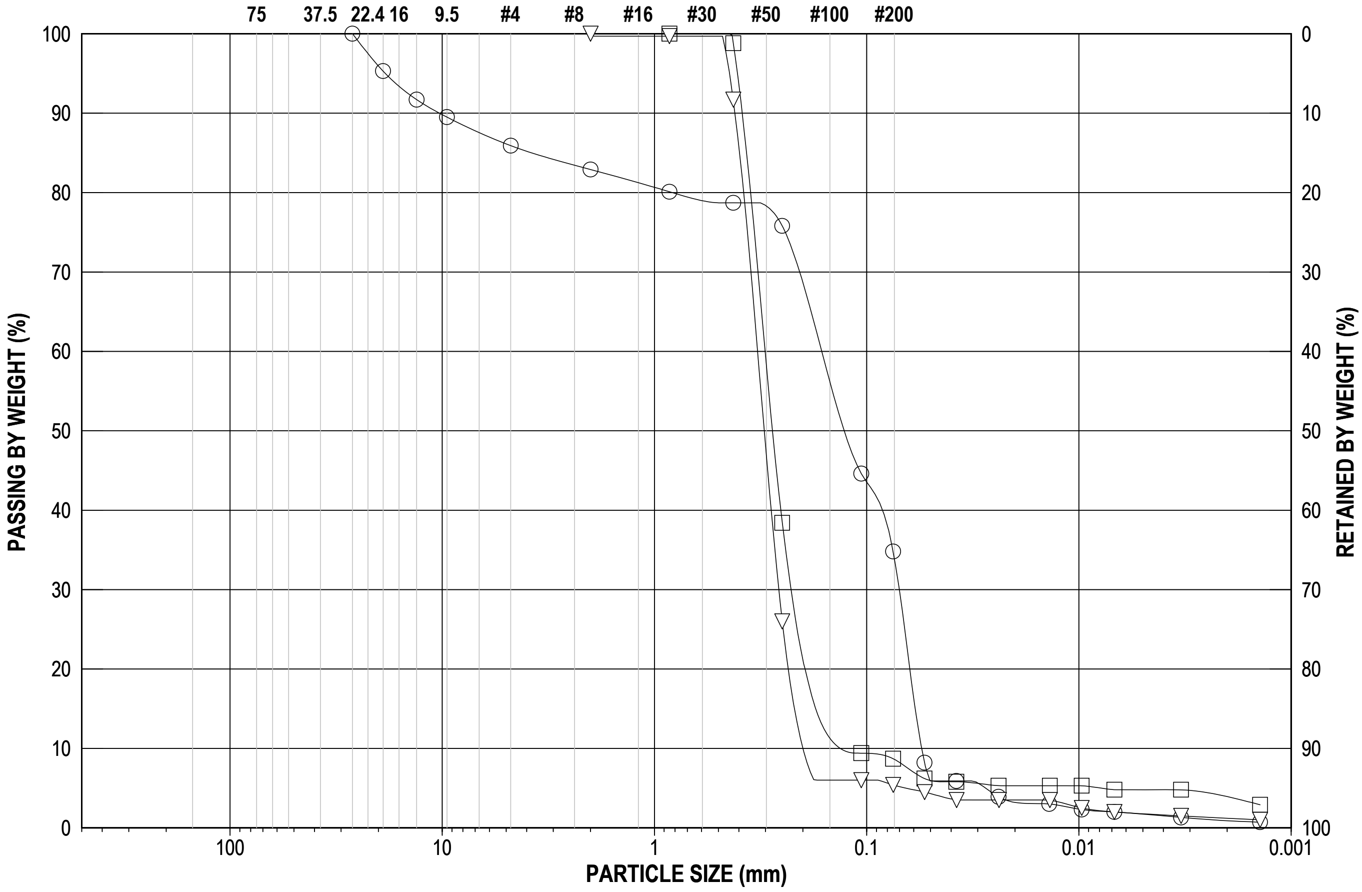
Figure No : **2**

Location: **83 Christie Street, Dorchester, Ontario**

File No : **P-0019257-0-01-100**

UNIFIED SOIL CLASSIFICATION

COBBLES	*GRAVEL*		*SAND*			*SILT OR CLAY*
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN MILLIMETRES			*U.S. STANDARD SIEVE No.*			*HYDROMETER*



Symbol	Borehole n°	Sample n°	Depth (m)	Description
─○─	BH-08-19	SA-3	2.29 - 2.74	Silty SAND, some Gravel, trace Clay
─□─	BH-09-19	SA-2	1.52 - 1.98	SAND, trace Silt and Clay
─▽─	BH-09-19	SA-5	3.81 - 4.27	SAND, trace Silt and Clay

EQ-09-Ge-74A R.1 02.03.2011

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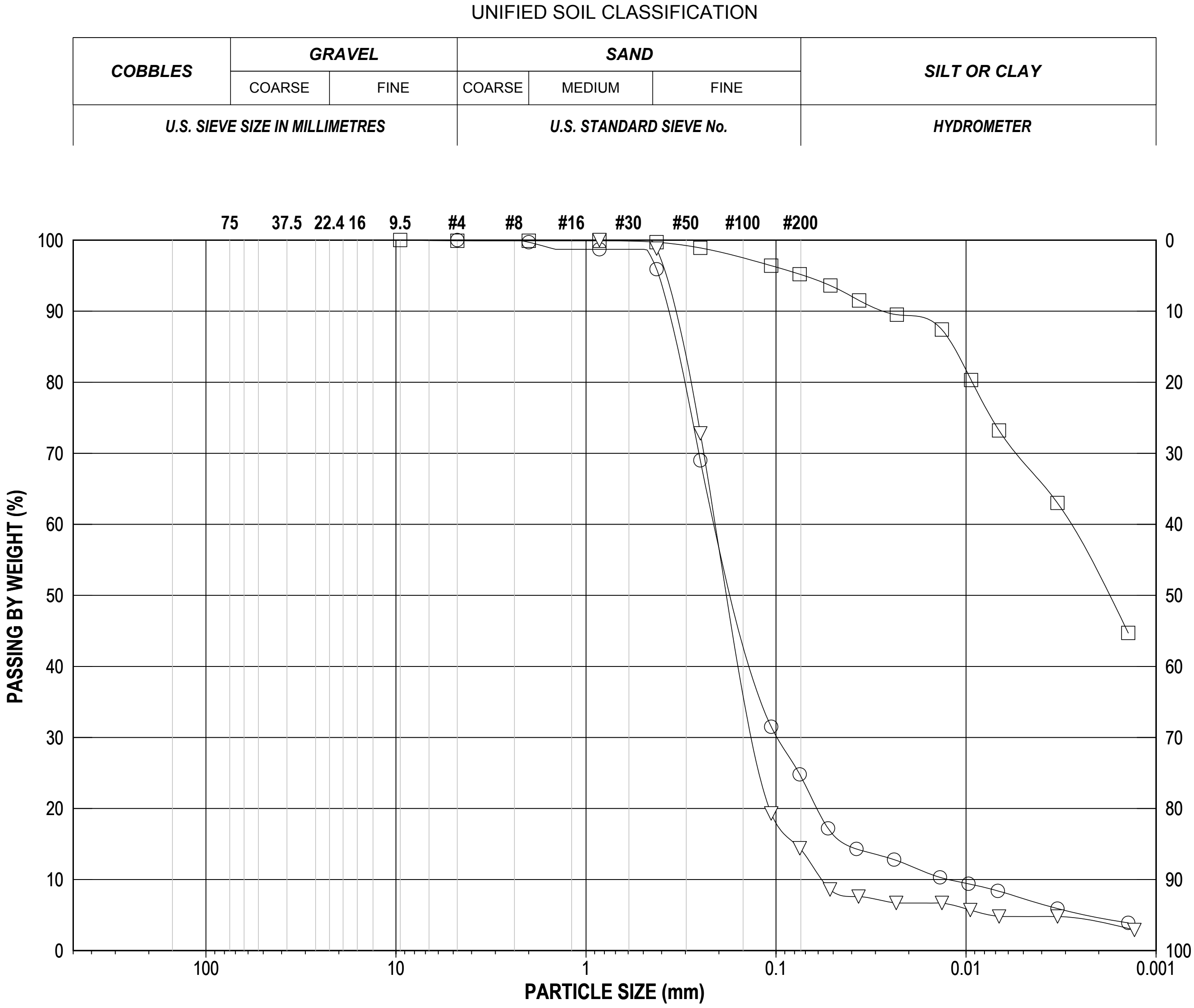
PARTICLE SIZE ANALYSIS

Project: **Proposed Residential Subdivision**

Location: **83 Christie Street, Dorchester, Ontario**

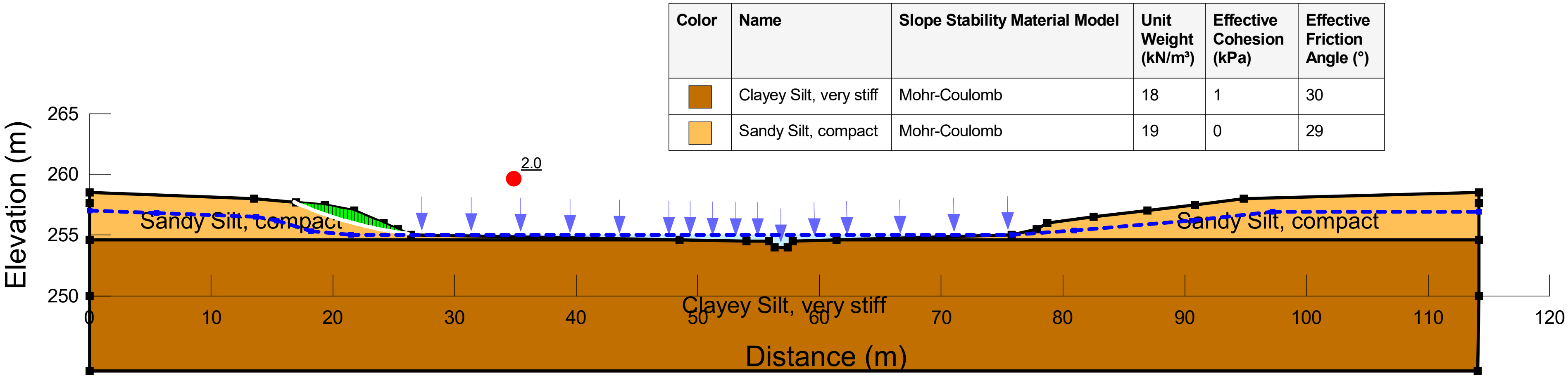
Figure No : **3**

File No : **P-0019257-0-01-100**



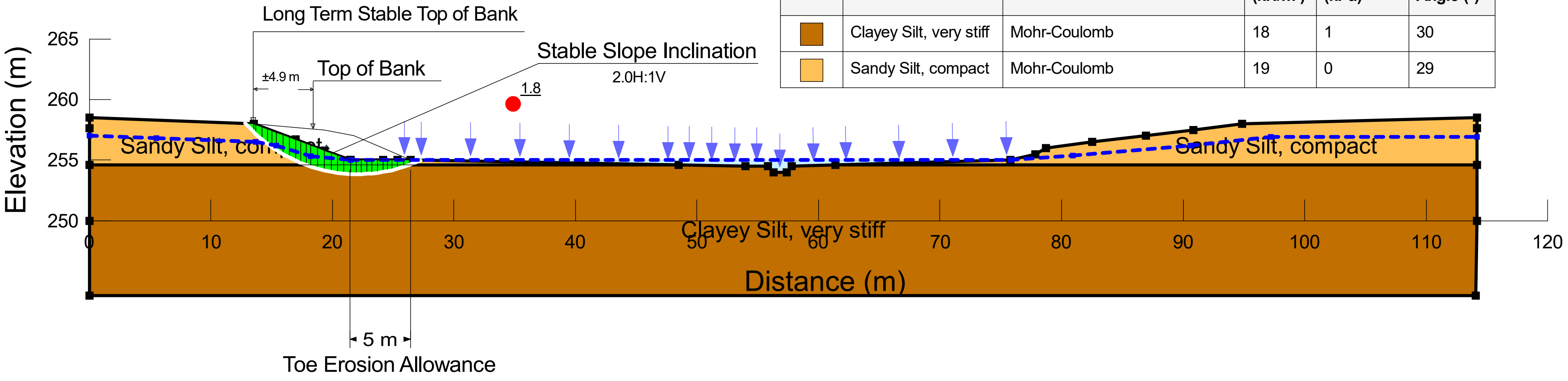
Symbol	Borehole n°	Sample n°	Depth (m)	Description
○	BH-12-19	SA-2	1.52 - 1.98	SAND and SILT, trace Clay
□	BH-12-19	SA-3	2.29 - 2.74	SILT and CLAY, trace Sand
▽	BH-13-19	SA-2	1.52 - 1.98	SAND, some SILT, trace Clay

Appendix E
Slope Stability Analyses



Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟫	Clayey Silt, very stiff	Mohr-Coulomb	18	1	30
🟧	Sandy Silt, compact	Mohr-Coulomb	19	0	29

Section 1- Northwest	
18010_Acorn Valley Subdivision.gsz	
04/18/2024	1:514



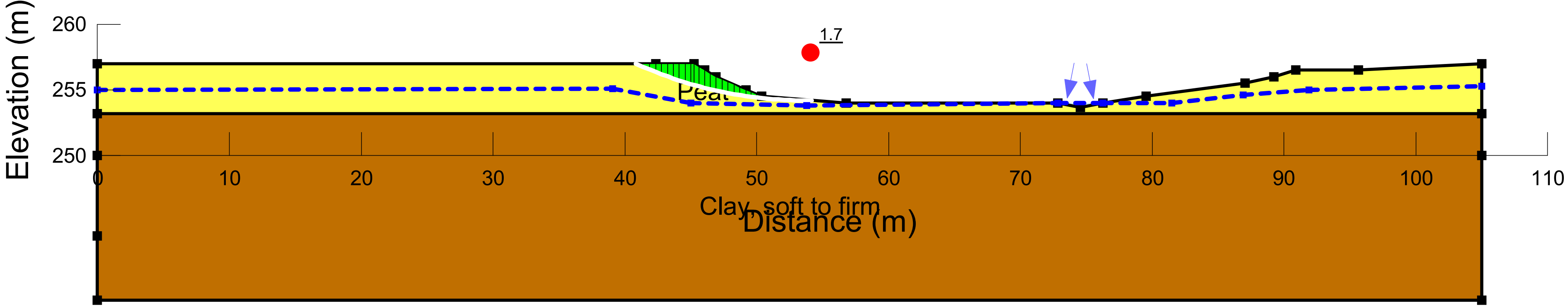
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟫	Clayey Silt, very stiff	Mohr-Coulomb	18	1	30
🟧	Sandy Silt, compact	Mohr-Coulomb	19	0	29

Section 1- Northwest -Stable Slope analysis

18010_Acorn Valley Subdivision.gsz

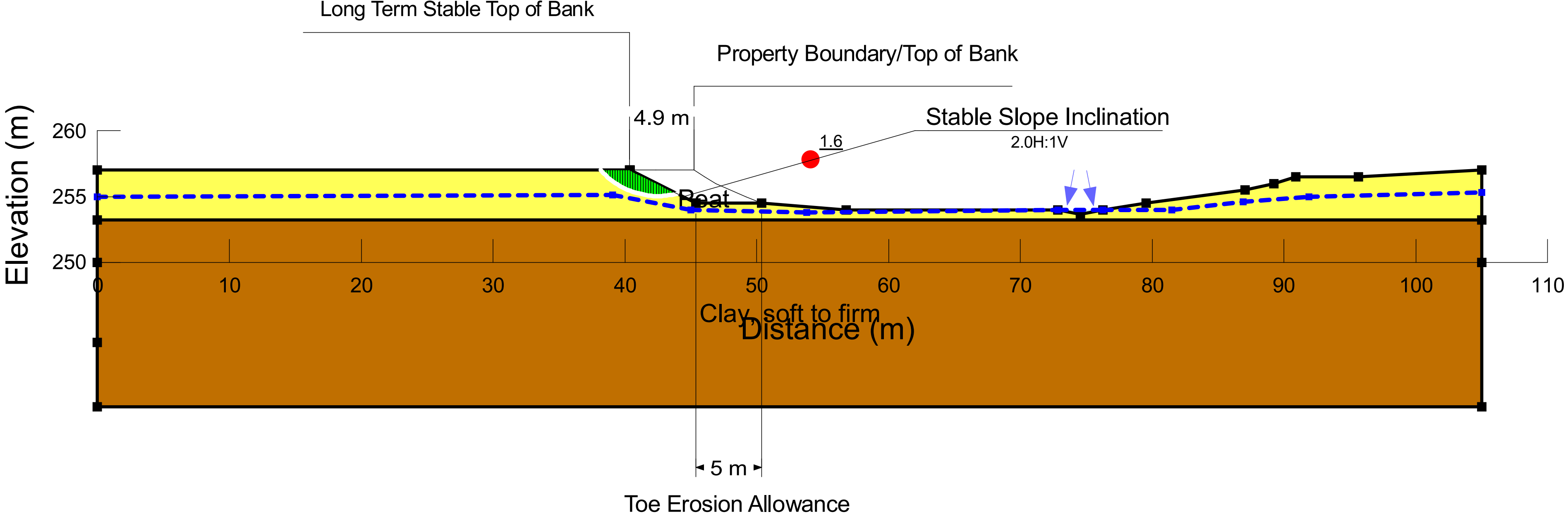
04/18/2024 1:514

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟫	Clay, soft to firm	Mohr-Coulomb	17	1	23
🟨	Peat	Mohr-Coulomb	17	0	24



Section 2- Northwest	
18010_Acorn Valley Subdivision.gsz	
04/18/2024	1:475

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟫	Clay, soft to firm	Mohr-Coulomb	17	1	23
🟨	Peat	Mohr-Coulomb	17	0	24

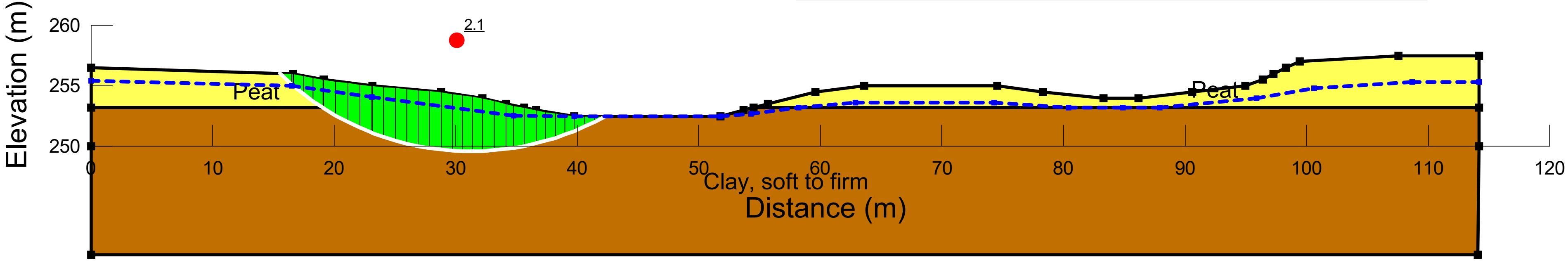


Section 2- Northwest-Stable Slope analysis

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:475

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟫	Clay, soft to firm	Mohr-Coulomb	17	1	23
🟨	Peat	Mohr-Coulomb	17	0	24

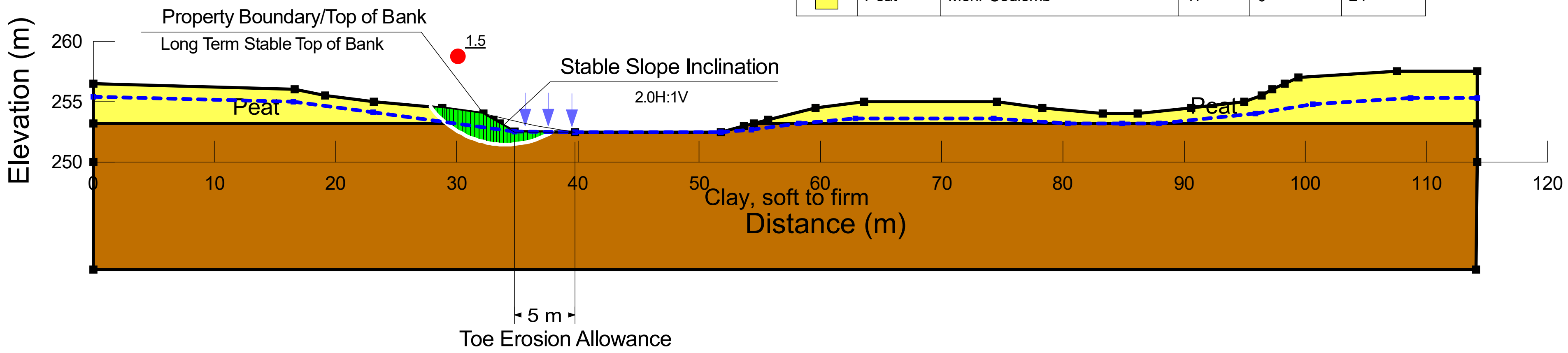


Section 3- Northwest

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:514

Color	Name	Slope Stability Material Model	Unit Weight (kN/m^3)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟫	Clay, soft to firm	Mohr-Coulomb	17	1	23
🟨	Peat	Mohr-Coulomb	17	0	24

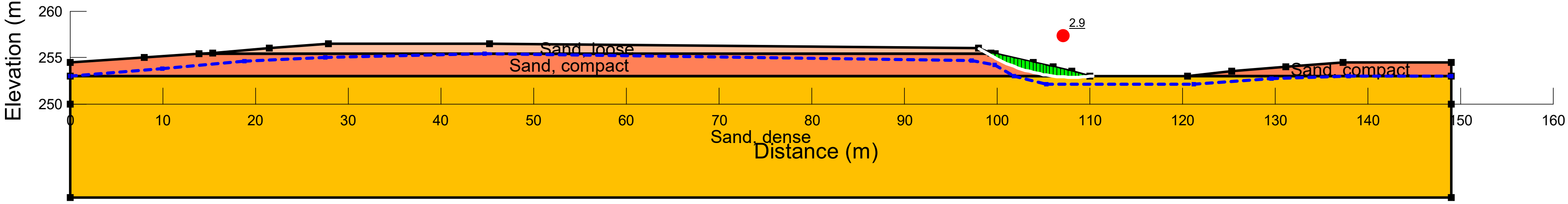


Section 3- Northwest -Stable Slope analysis

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:514

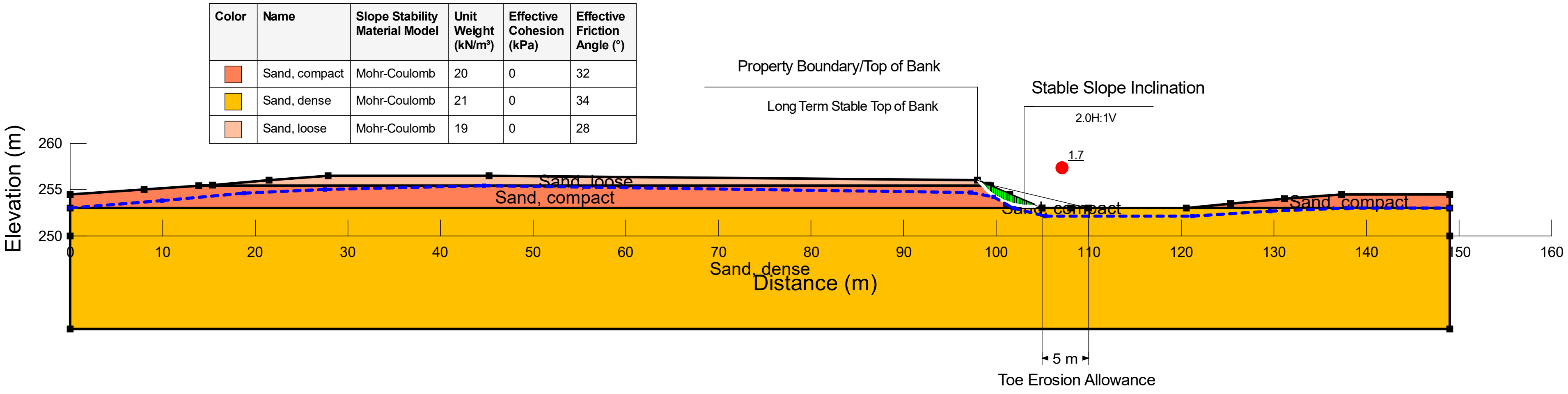
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟥	Sand, compact	Mohr-Coulomb	20	0	32
🟨	Sand, dense	Mohr-Coulomb	21	0	34
🟧	Sand, loose	Mohr-Coulomb	19	0	28



Section 4- Northwest

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:671

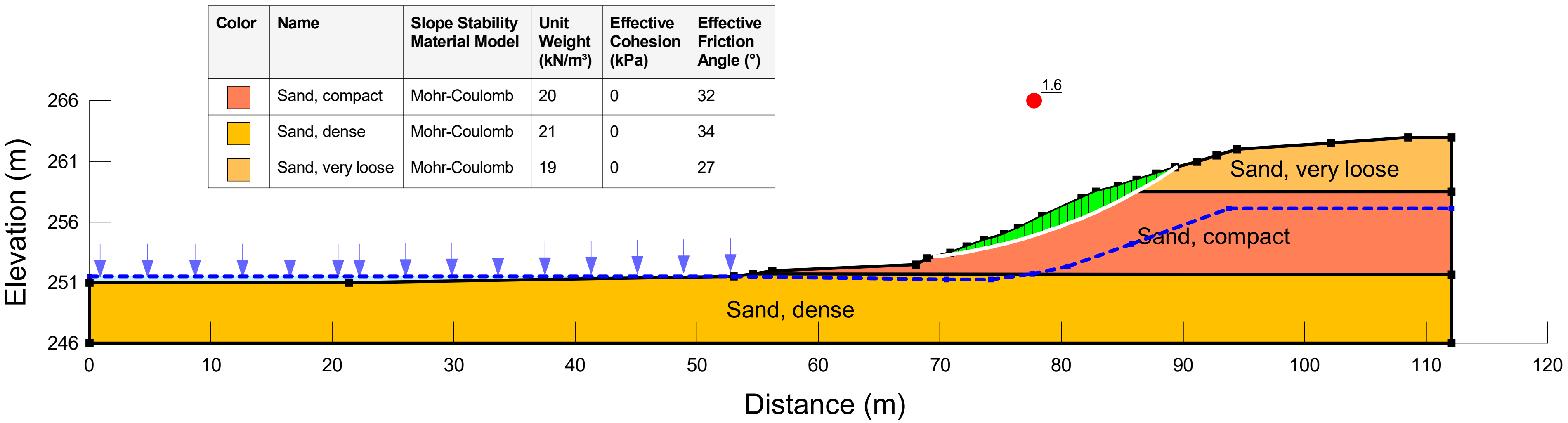


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟧	Sand, compact	Mohr-Coulomb	20	0	32
🟨	Sand, dense	Mohr-Coulomb	21	0	34
⬜	Sand, loose	Mohr-Coulomb	19	0	28

Section 4- Northwest -Stable Slope analysis

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:671

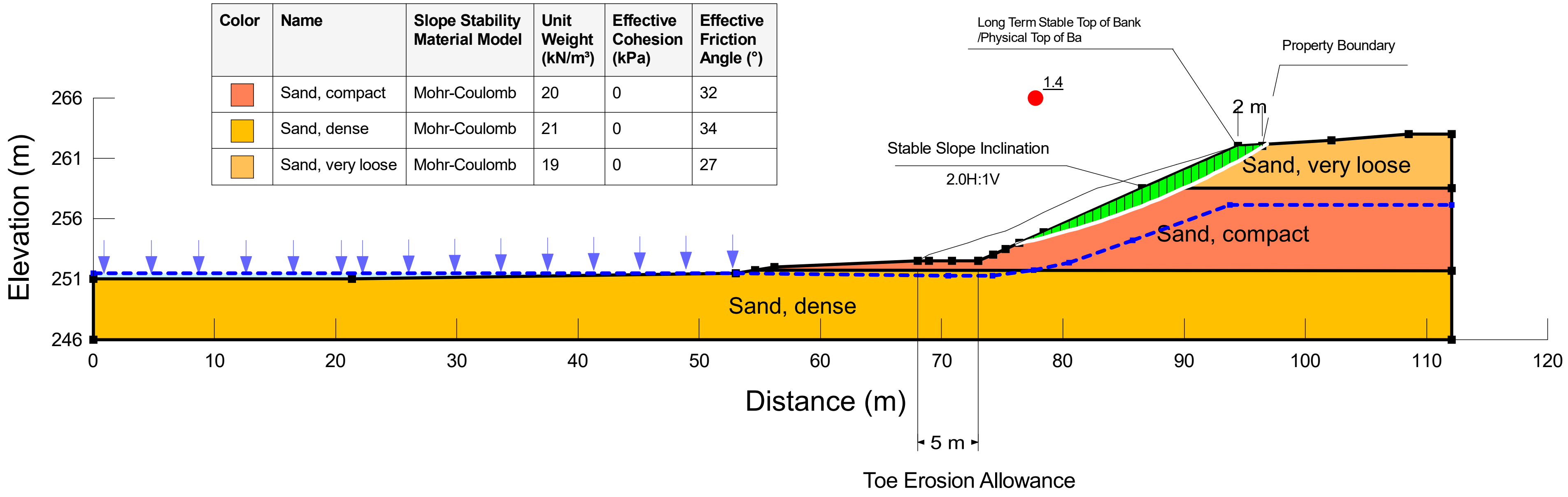


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟥	Sand, compact	Mohr-Coulomb	20	0	32
🟨	Sand, dense	Mohr-Coulomb	21	0	34
🟧	Sand, very loose	Mohr-Coulomb	19	0	27

Section 5- South

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:514

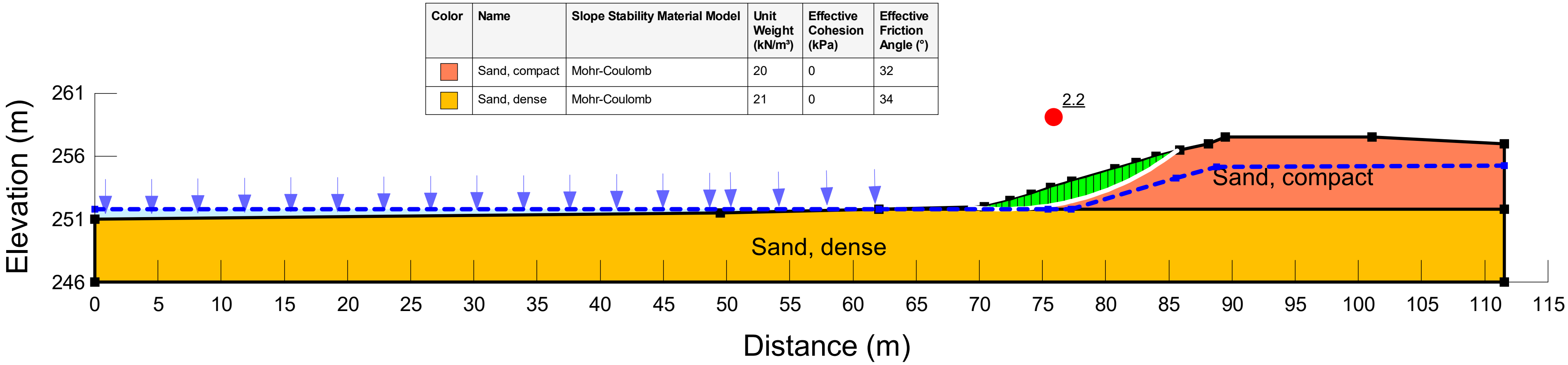


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟥	Sand, compact	Mohr-Coulomb	20	0	32
🟨	Sand, dense	Mohr-Coulomb	21	0	34
🟧	Sand, very loose	Mohr-Coulomb	19	0	27

Section 5- South -Stable Slope analysis

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:514

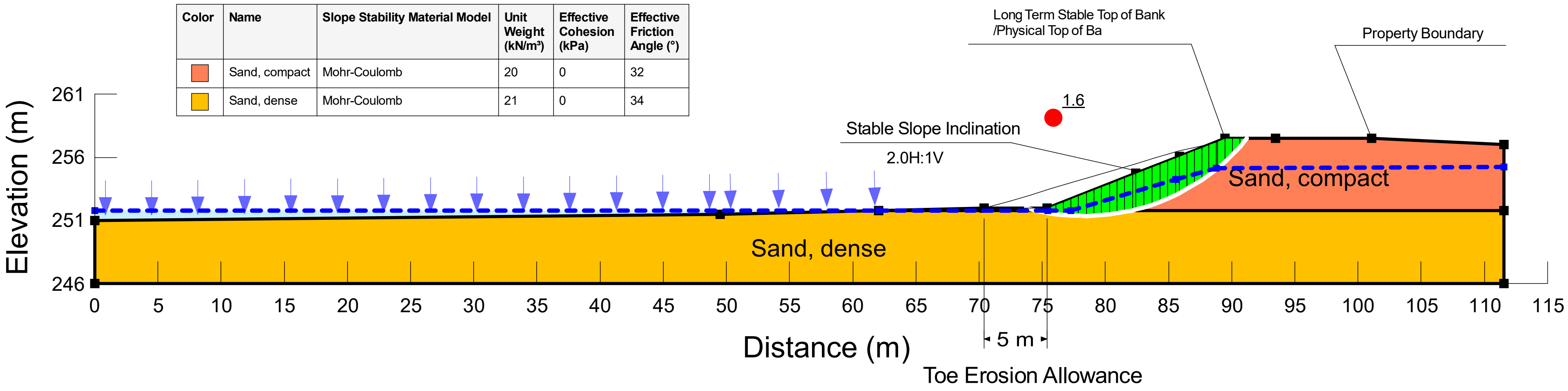


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟧	Sand, compact	Mohr-Coulomb	20	0	32
🟨	Sand, dense	Mohr-Coulomb	21	0	34

Section 6- South

18010_Acorn Valley Subdivision.gsz

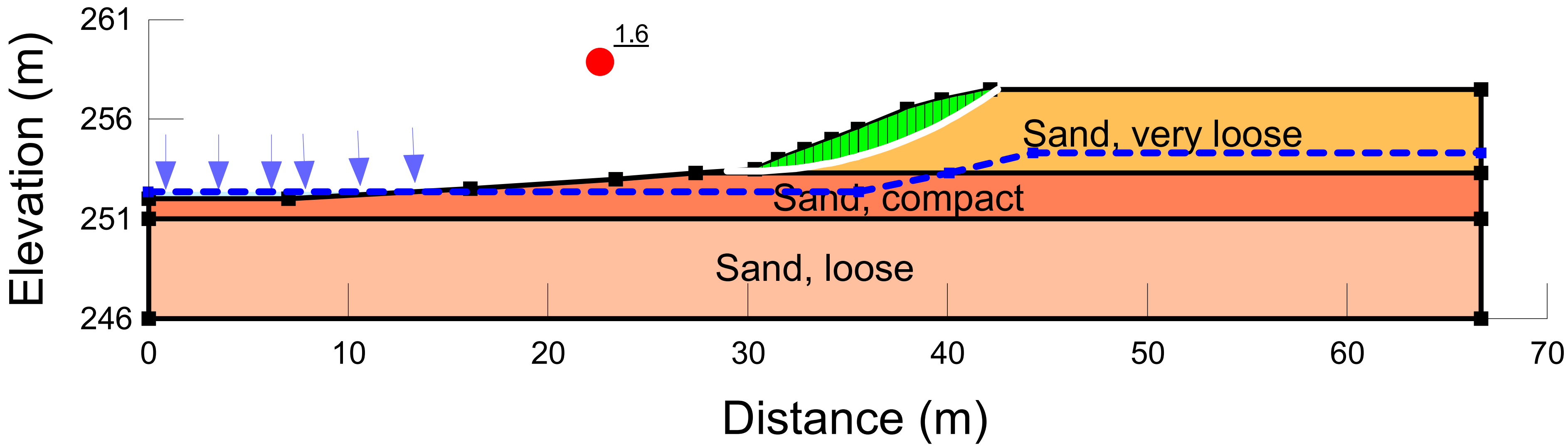
04/18/2024 1:494



Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟧	Sand, compact	Mohr-Coulomb	20	0	32
🟨	Sand, dense	Mohr-Coulomb	21	0	34

Section 6- South -Stable Slope analysis	
18010_Acorn Valley Subdivision.gsz	
04/18/2024	1:494

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟥	Sand, compact	Mohr-Coulomb	20	0	32
🟧	Sand, loose	Mohr-Coulomb	19	0	28
🟨	Sand, very loose	Mohr-Coulomb	19	0	27

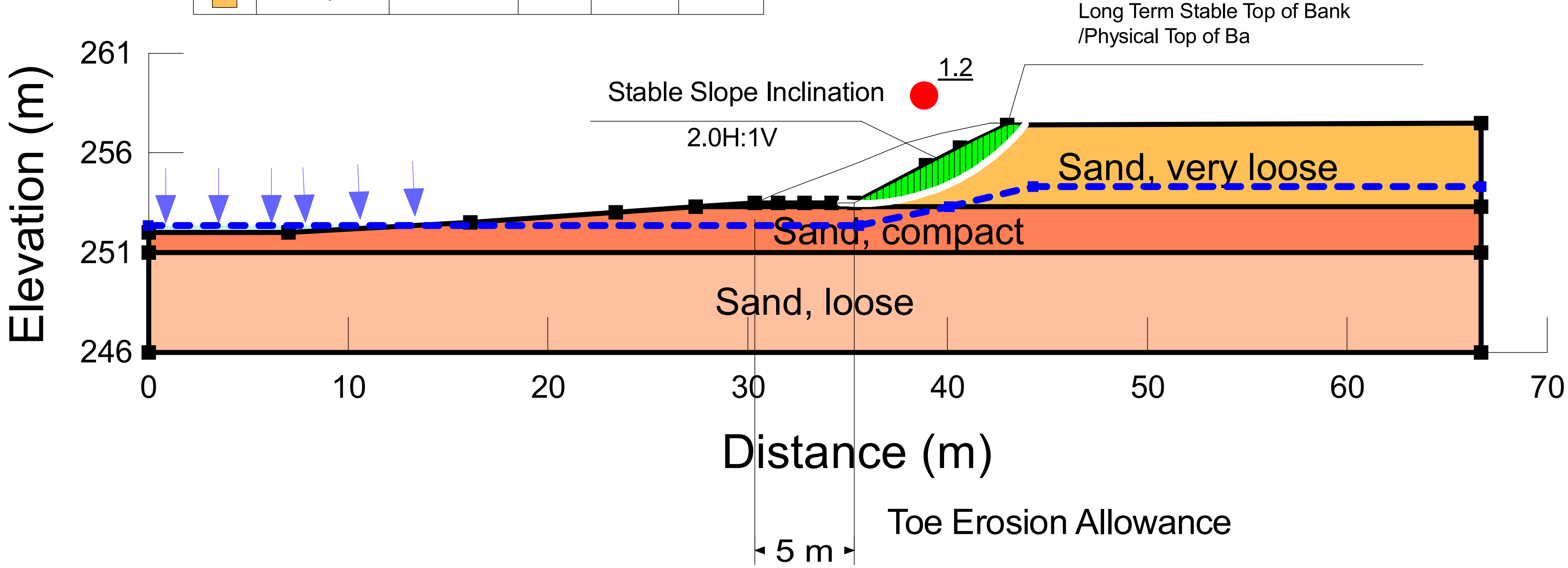


Section 7- South

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:315

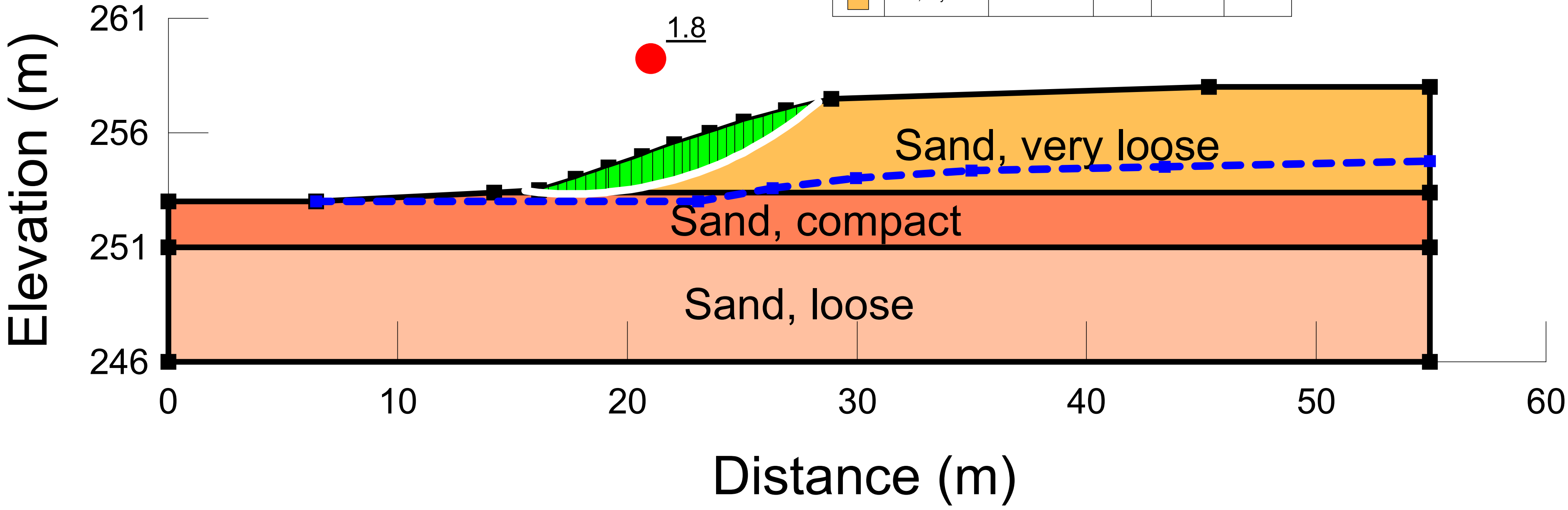
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟥	Sand, compact	Mohr-Coulomb	20	0	32
🟧	Sand, loose	Mohr-Coulomb	19	0	28
🟨	Sand, very loose	Mohr-Coulomb	19	0	27



Section 7- South -Stable Slope analysis

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:315

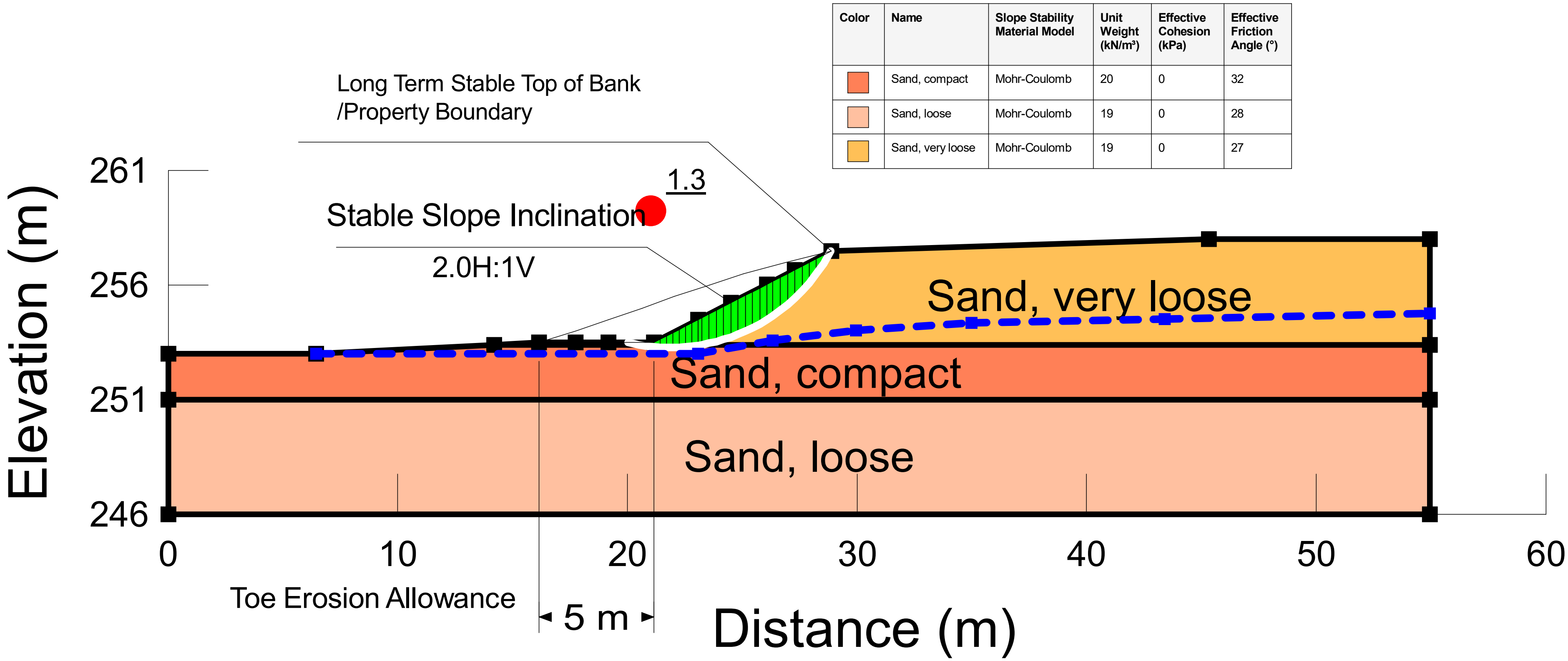


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
■	Sand, compact	Mohr-Coulomb	20	0	32
■	Sand, loose	Mohr-Coulomb	19	0	28
■	Sand, very loose	Mohr-Coulomb	19	0	27

Section 8- South

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:275

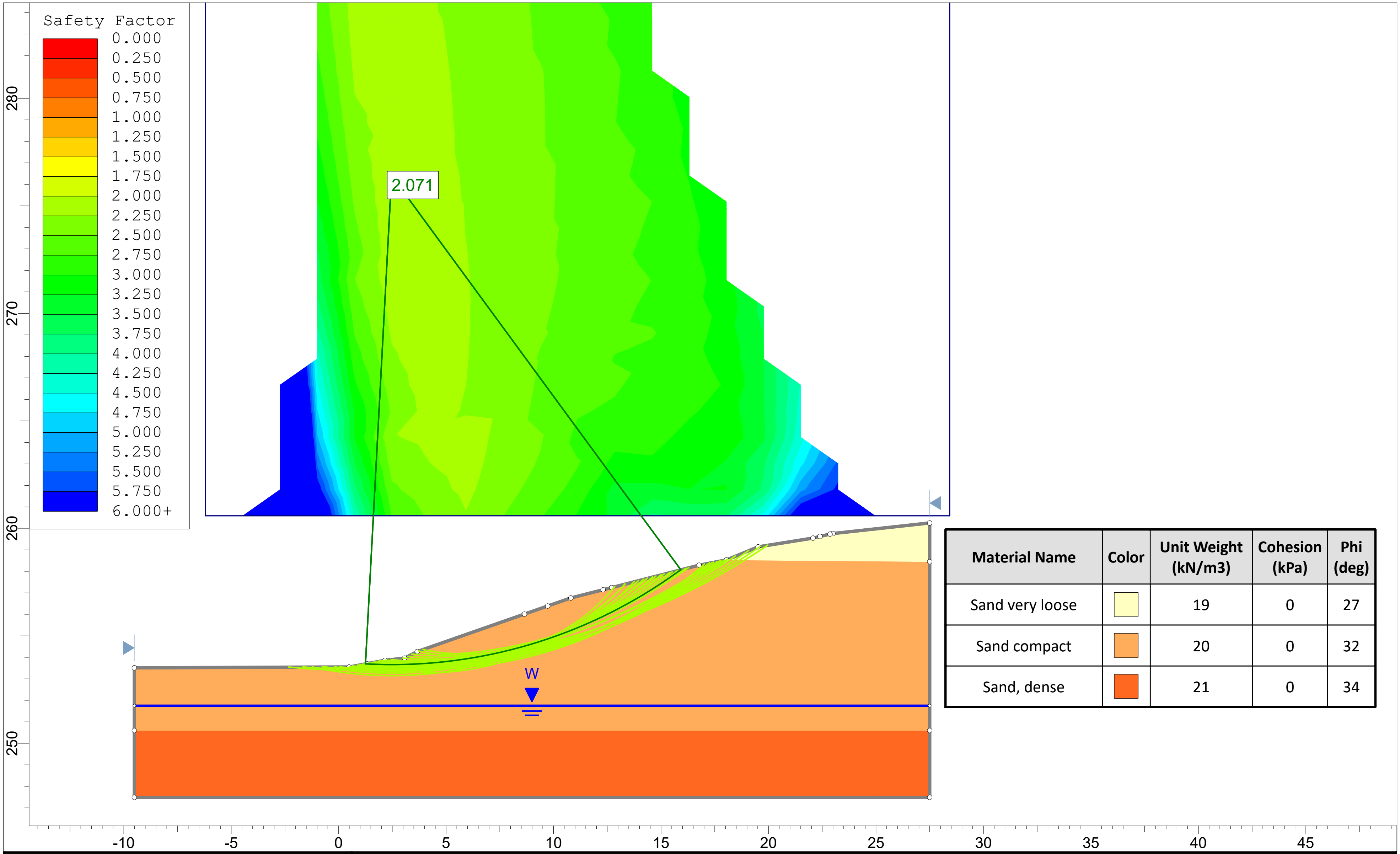


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
🟥	Sand, compact	Mohr-Coulomb	20	0	32
🟧	Sand, loose	Mohr-Coulomb	19	0	28
🟨	Sand, very loose	Mohr-Coulomb	19	0	27

Section 8- South -Stable Slope analysis

18010_Acorn Valley Subdivision.gsz

04/18/2024 1:275



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Sand very loose	🟨	19	0	27
Sand compact	🟧	20	0	32
Sand, dense	🟧	21	0	34

SLIDEINTERPRET 6.035

Project 02208613.000 - Subdivision, Christie Street, Dorchester

Analysis Description Global Stability Analyses - Existing Slope Section A-A

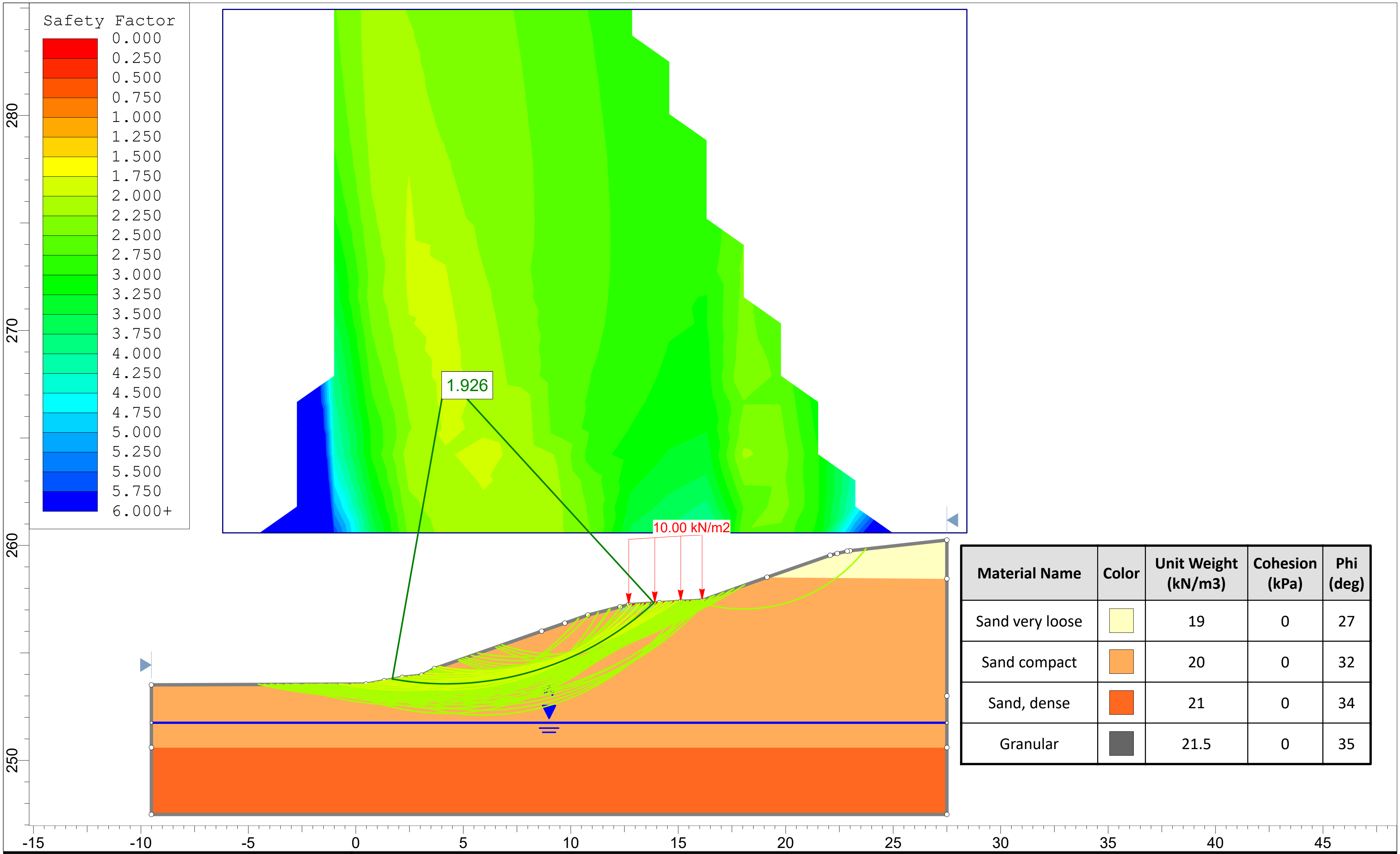
Drawn By P.Cannon

Scale 1:250

Company

Date

File Name 02208613.000 Section AA.slim



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
Sand very loose	🟨	19	0	27
Sand compact	🟧	20	0	32
Sand, dense	🟧	21	0	34
Granular	⬛	21.5	0	35

SLIDEINTERPRET 6.035

Project
02208613.000 - Subdivision, Christie Street, Dorchester

Analysis Description
Global Stability Analyses - Modified Slope Section A-A

Drawn By P.Cannon

Scale 1:250

Company

Date

File Name 02208613.000 Modified Section AA with trail.slim

ENGLOBE