Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
PALGRAVE ESTATES II TO THE LAURELPARK SUBDIVISION
(Part of East Half of Lot 19, Concession 8,
Regional Municipality of Peel)
CALEDON, ONTARIO

Prepared for: Laurelpark Inc.
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1. INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by Laurelpark Inc. to conduct a geotechnical investigation for a vacant property (Palgrave Estates II to the Laurelpark Subdivision), located in the southwest quadrant of the intersection of Mt. Pleasant Road and Bruno Ridge Drive, in the Town of Caledon, proposed to be developed as an estate residential subdivision with internal service road and a Storm Drainage Block.

This report encompasses the results of the geotechnical investigation conducted for the property to assess its geotechnical suitability for the intended development. The field investigation consisted of advancing a total of twelve (12) exploratory boreholes across the site. The objective of the geotechnical investigation was to determine the prevailing subsurface soil and ground water conditions to provide geotechnical engineering recommendations for design of proposed house foundations, basement drainage, earthworks, earth pressure design parameters, pipe bedding, installation of underground utilities and pavement structure component design. In addition, geotechnical comments are also included on the pertinent construction aspects including excavation, backfill and ground water control.

In addition, the present August 2013 investigation involved advancing twelve (12) test pits across the site to confirm the depth of native soils, and ground water conditions.

2. SITE AND PROJECT DESCRIPTION

The site is located in the southwest quadrant of the intersection of Mt. Pleasant Road and Bruno Ridge Drive, in the Town of Caledon (Palgrave). The legal description of the property is Part of East Half of Lot 19, Concession 8, Regional Municipality of Peel, Caledon. The general location of the property is shown on Figure 1.

The property consists of a 25 acre (about 10 hectare) parcel of land which is currently vacant and undeveloped. The site topography is undulating and includes wood lot(s).

It is proposed to develop the site as a residential subdivision comprising a total of eight estate lots (three lots to be accessed from Diamondwood Drive and the remaining five lots from Mt. Pleasant Road) and a Storm Drainage Block. Proposed lots would be serviced by individual on-site sewage disposal facility, and the development would include a paved internal service road.

3. SECONDARY PLAN & OTHER DETAILED AREA POLICY CONSIDERATIONS

As noted above, the site is located in the southwest quadrant of the intersection of Mt. Pleasant Road and Bruno Ridge Drive, in the Town of Caledon (Palgrave) which is governed by the (*Town of Caledon Official Plan, Secondary Plans & Other Detailed Area Policies*) document. Chapter 7 of this document under Section 7.1.18.3 and 7.1.18.4 stipulates requirements for the subsurface investigations conducted in the areas governed by the above noted document.

It is noted in Section 7.1.18.3 that *a minimum of 100 metres of soil borings normally will be required for each half township lot. The borings will include a number of boreholes in order to describe adequately the soil properties and stratigraphic relationships of the site and the characteristics of the water table aquifer.* We note that each half of a township lot is 100 acres, therefore a minimum of 1 m of soil boring will have to be conducted per acre. The subject property consists of a 25 acre parcel, therefore a minimum of 25 m of soil boring is required for this site to satisfy the Township Official Plan requirements. The scope of our geotechnical investigation for the site consisted of advancing a total of twelve (12) boreholes across the site, each extending to a depth of about 6.5 m below existing surface. Therefore, a total of 78 m of drilling was conducted, which far exceeds the Township Official Plan requirements.

The official plan document in Section 7.1.18.3 states that *boreholes will be distributed as to sample representative upland and lowland soil types on the site*. Based on the topographic information for the site, the elevation relief across the proposed developable area is about 13 m (Elev. ± 284.5, upland and Elev. ± 272.0, lowland) and the borehole surface elevations vary across the site from Elev. ± 273.00 to Elev. ± 284.00 m. Therefore, the boreholes were distributed across the 'upland' and 'lowland' areas to sample representative soil types prevalent at the site in conformance to the requirements of Section 7.1.18.3 of the Official Plan.

We note that the borehole locations, depths and distributions were finalized based on our discussion, feedback and approval by the Town prior to our geotechnical investigation. The other requirements of the document as they pertain to the geotechnical investigation have been confirmed in the following sections of our report.

4. FIELD PROCEDURE

The field investigation for the site was conducted on May 15 and May 16, 2013 and consisted of advancing a total of twelve (12) exploratory boreholes each extending to a depth of about 6.5 m below existing ground surface, as follows:

- a total of twelve (12) boreholes (Boreholes 1 to 12) were advanced within the proposed lots and the service road, and

- twelve test pits (TP 1 to 12) were excavated across the site to measure ground water levels.

The test pits were advanced on August 15, 16 and 19, 2013. The locations, test pit logs, test pit details of each test pit and the photographs are appended.

The boreholes were staked in the field by a surveyor retained by the client who also measured ground surface elevations at the borehole locations. The borehole surface elevations are referenced to the Geodetic datum and provided for the purpose of relating borehole soil stratigraphy and should not be used or relied on for other purposes. The approximate locations of the boreholes are presented on Figure 2.

Various utility locate agencies were contacted by Terraprobe to clear borehole locations prior to the commencement of the field investigation.

The borings were drilled by a specialist drilling contractor using a track mounted drill rig power auger. The borings were advanced using continuous flight solid stem augers, and were sampled at 0.75 m interval (up to 3.0 m depth below grade) and at 1.5 m interval (below 3.0 m depth from the existing ground surface), with a conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D 1586). The field work (drilling, sampling and testing) was observed full time and recorded by a Terraprobe technician, who logged the boring and examined the samples as they were obtained.

The test pit locations were finalized and established by Terraprobe under the client's supervision. The locations of the test pits and boreholes (in combination) are provided on Figure 2.

Test pit excavations (TP1 to TP12) were excavated using a rubber tire backhoe by contractors retained by the client and Terraprobe. The objective of the test pit investigation was to obtain the subsurface soil and ground water information.

All samples were sealed into plastic jars and transported to our geotechnical laboratory for detailed inspection and testing. The borehole samples were examined (tactile) in detail by a geotechnical engineer, and classified according to visual and index properties. Geotechnical laboratory testing consisted of water content determination on all samples; and a sieve and hydrometer analysis on eleven (11) selected native soil samples (Borehole 1, Sample 5; Borehole 2, Sample 4; Borehole 4, Sample 5; Borehole 5, Sample 5; Borehole 6, Sample 7; Borehole 8, Sample 6; Borehole 9, Sample 3; Borehole 10, Sample 5; Borehole 11, Sample 4; Borehole 11, Sample 7 and Borehole 12, Sample 3). Atterberg Limits tests were also conducted on two (2) selected native soil samples (Borehole 1, Sample 5 and Borehole 4, Sample 5). The measured natural water contents of individual samples and the results of the sieve and hydrometer analyses as well as Atterberg Limits tests are plotted on the enclosed borehole logs at respective sampling depths. The results of sieve and hydrometer analyses and Atterberg Limits tests are also summarized in Section 5.3, and appended.

Ground water levels were observed in the open boreholes and test pits upon completion of the site investigation. Standpipe piezometers were installed in Boreholes 1, 5, 8, 9, 10, 11 and 12 to facilitate shallow ground water monitoring. The results of the ground water monitoring are summarized in Section 5.4 of this report.

5. SUBSURFACE CONDITIONS

The results of the individual boreholes are summarized below and recorded on the accompanying Borehole Logs. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions at the site.

It should be noted that the soil conditions are confirmed at the borehole locations only and may vary between and beyond the boreholes. The stratigraphic boundaries shown on the logs are based on a non-continuous sampling. These boundaries represent an inferred transition between various strata, rather than a precise plane of geologic change.

In summary, the subsurface soil conditions encountered in the boreholes and test pits advanced across the site were found to be generally consistent. The boreholes encountered a topsoil layer at the ground surface underlain by a layer of weathered/disturbed soil zone and/or earth fill materials, which was in turn underlain by undisturbed native soil deposit extending to the full depth of investigation (up to about 6.5 m depth below grade) at each borehole location.

5.1 Topsoil

A surficial topsoil layer was encountered at all borehole locations, varying in thickness from about 250 mm (Borehole 1) to 400 mm (Borehole 3). The topsoil was noted to be dark brown to black in colour and predominantly consisted of sandy silt matrix.

The data pertaining to the topsoil thickness provided here was estimated from borehole drilling and sample review, and is approximate. We note that the ground surface at the property appeared to have been ploughed/disturbed at locations, and therefore, the topsoil thickness at the borehole locations could not be estimated accurately. The topsoil thickness may vary between and beyond the boreholes. The topsoil data provided may not be sufficient for estimating topsoil quantities and/or associated costs. We recommend that a shallow test pit investigation should be carried out to measure accurate topsoil thicknesses across the site for topsoil quantity estimation.

5.2 Native Soils

Undisturbed native soil deposit was encountered in all boreholes beneath the topsoil layer, except Boreholes 6, 8 and 10 where a zone of earth fill/disturbed native soils was encountered beneath the topsoil layer which extended to a depth of about 1.5 m below grade. The upper zone of native soils extending to a depth of about 0.8 m below grade was noted to be weathered/disturbed. The composition of the earth fill/weathered/disturbed soils was generally similar to that of the underlying undisturbed native soils (clayey silt/silt), and included a trace amount of organics.

The Standard Penetration test results ('N' Values) obtained from earth fill/weathered/disturbed soil zone varied from about 4 to 8 blows per 300 mm of penetration indicating a firm to stiff consistency.

The measured moisture content of the earth fill/weathered/disturbed soil samples varied from 7 to 29 percent by weight indicating a moist to very moist condition. We note that some of the relatively high moisture contents are likely due to the presence of organics.

The undisturbed native soils (underlying the earth fill/weathered zone) predominately consisted of silt deposit with trace to some sand, trace to some clay and trace amounts of gravel. In Boreholes 5 and 12, the undisturbed native soils predominantly consisted of sandy silt to silt and sand deposit which extended to the full depth of investigation (up to about 6.6 m below grade). The silt deposit in Boreholes 1, 2 and 10 graded into clayey silt to silt and clay till deposit with trace amounts of sand and gravel at depths of 4.6 m, 4.6 m and 6.1 m depth below grade respectively, and extended to the full depth of investigation (up to about 6.6m below grade). The native soils were generally brown in colour and became grey at deeper depths. Intermittent seams/zones of sand/silty sand were also noted in some of the boreholes. Refer to enclosed borehole logs for detailed stratigraphy details.

The Standard Penetration Test results ('N' Values) obtained from the undisturbed native silt/sandy silt to silt and sand soils generally varied from 12 to 76 blows per 300 mm of penetration, indicating a compact to very dense (typically dense) relative density.

The measured moisture contents of these soil samples ranged from 2 to 22 percent by weight indicating a typically moist to very moist condition.

The Standard Penetration Test results ('N' Values) obtained from the undisturbed native clayey silt to silt and clay till soils generally varied from 13 to 58 blows per 300 mm of penetration, indicating a stiff to hard (typically hard) consistency.

The measured moisture contents of the till soil samples generally ranged from 16 to 18 percent by weight, indicating a typically moist condition.

It should be noted that the glacial till deposit may contain larger sized depositional elements (cobbles and boulders) that are not specifically identified in the boreholes. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples for the particles of this size.

The subsurface soil and ground water conditions encountered in the test pits are presented on the attached Log of Test Pit sheets. The stratigraphic boundaries indicated on the Log of Test Pit sheets were observed from the sides of the excavations, and typically represent a transition from one soil type to the other. These boundaries should not be interpreted to represent exact plane of geological change. The subsurface conditions will vary between and beyond the test pit locations.

5.3 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of water content determination on all samples, and a sieve and hydrometer analysis, and Atterberg Limits tests on selected native soil samples. The permeability values of the soil samples analyzed were estimated from the results of the grain size analysis.

A summary of the Sieve and Hydrometer (grain size) analysis results and estimated permeability of the samples analyzed is presented below:

Borehole No. Sample No.	Sampling Depth below Grade	Percentage				Description (MIT System)	Estimated Permeability on the order of
		Gravel	Sand	Silt	Clay		
Borehole 1 Sample 5	3.3 m	0	1	80	19	SILT, some clay, trace sand	10^{-6} cm/sec
Borehole 2 Sample 4	2.5 m	0	12	77	11	SILT, some sand, some clay	10^{-6} cm/sec
Borehole 4 Sample 5	3.3 m	3	9	69	19	SILT, some clay, trace sand, trace gravel	10^{-6} cm/sec

Borehole No. Sample No.	Sampling Depth below Grade	Percentage				Description (MIT System)	Estimated Permeability on the order of
		Gravel	Sand	Silt	Clay		
Borehole 5 Sample 5	3.3 m	1	67	29	3	SILTY SAND, trace clay, trace gravel	10^{-4} cm/sec
Borehole 6 Sample 7	6.3 m	0	11	79	10	SILT, some sand, some clay	10^{-6} cm/sec
Borehole 8 Sample 6	4.8 m	0	11	77	12	SILT, some clay, some sand	10^{-6} cm/sec
Borehole 9 Sample 3	1.8 m	0	8	77	15	SILT, some clay, trace sand	10^{-6} cm/sec
Borehole 10 Sample 5	3.3 m	0	7	86	7	SILT, trace clay, trace sand	10^{-5} cm/sec
Borehole 11 Sample 4	2.5 m	0	7	81	12	SILT, some clay, trace sand	10^{-6} cm/sec
Borehole 11 Sample 7	6.2 m	0	9	80	11	SILT, some clay, trace sand	10^{-6} cm/sec
Borehole 12 Sample 3	1.8 m	0	36	57	7	SILT AND SAND, trace clay	10^{-5} cm/sec

The results of Atterberg Limits tests were plotted on A-Line Graph (refer to enclosed figures, Atterberg Limits Test Results). The results of Atterberg Limits Tests are summarized below:

Borehole No. Sample No.	Sampling Depth below Grade	Liquid Limit (WL)	Plastic Limit (WP)	Plasticity Index (IP)	Natural Water Content (WN)	Plasticity/ Compressibility
Borehole 1 Sample 5	3.3 m	26	19	7	20	Slightly Plastic/slight or low compressibility
Borehole 4 Sample 5	3.3 m	24	16	8	17	Slightly Plastic

5.4 Ground Water

Observations pertaining to the depth of ground water level and borehole caving were made in the open boreholes immediately after the completion of drilling, and are noted on the enclosed borehole logs. Standpipe piezometer were installed in Boreholes 1, 5, 8, 9, 10, 11 and 12 and the ground water levels measurement was taken on May 24, 2013, approximately one week following the installation. A summary of these observations is provided below:

Borehole No.	Depth of Boring	Depth to Cave	Water level at the time of drilling	Water level in piezometer on May 24, 2013
1	6.6 m BG	open	dry	0.4 m BG
2	6.6 m BG	open	6.0 m BG	NP
3	6.6 m BG	open	dry	NP
4	6.6 m BG	open	dry	NP
5	6.6 m BG	open	dry	dry
6	6.6 m BG	open	1.2 m BG	NP
7	6.6 m BG	open	5.9 m BG	NP
8	6.6 m BG	open	5.5 m BG	0.6 m BG
9	6.6 m BG	open	dry	2.5 m BG
10	6.6 m BG	open	5.4 m BG	0.5 m BG
11	6.4 m BG	open	dry	1.2 m BG
12	6.6 m BG	open	dry	dry

BG = Below Grade
NP = No Piezometer

It should be noted that the ground water levels may fluctuate seasonally depending on the amount of precipitation and surface runoff.

The depth of unstabilized ground water and caving were measured in each of the test pits following the excavation. The test pits were left open for at least 3 days to measure stabilized ground water levels. These measurements were taken on August 19 and 23, 2013. A summary of these observations is provided as follows:

Test Pit No.	Depth of Excavation	Depth to Cave	Unstabilized Water Level Depth upon Completion (depth)	Water Level in Excavation on August 19/23, 2013 (depth)
1	2.4 m BG	open	2.3 m BG	1.9/1.7 m BG
2	2.4 m BG	open	2.3 m BG	2.2/2.0 m BG
3	2.0 m BG	open	0.8 m BG	0.8/0.6 m BG
4	2.4 m BG	open	2.3 m BG	1.8/1.7 m BG
5	2.0 m BG	open	2.0 m BG	NA/1.9 m BG
6	2.0 m BG	open	2.0 m BG	NA/1.5 m BG
7	2.0 m BG	open	2.0 m BG	NA/1.4 m BG
8	2.5 m BG	open	2.1 m BG	2.2/2.1 m BG
9	2.1 m BG	open	2.0 m BG	2.0/2.0 m BG
10	2.1 m BG	open	2.0 m BG	NA/1.9 m BG
11	2.0 m BG	open	2.0 m BG	NA/1.5 m BG
12	2.2 m BG	open	dry m BG	dry/dry

BG = Below Grade
NA = Not Applicable

Ground water levels may fluctuate seasonally depending on the amount of precipitation and surface runoff.

6. DISCUSSION AND RECOMMENDATIONS

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use of the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

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. If there are any changes to the site development features or there is any additional information available relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Terraprobe should be retained to review the implications of these changes with respect to the contents of this report.

6.1 House Foundations

The existing topsoil and weathered/disturbed soils and earth fill materials are not suitable for the support of the proposed house foundations. However, based on the borehole information, these soils were generally encountered within the upper zone (0.8 to 1.5 m below existing grades) of the soil stratigraphy. The underlying undisturbed native soils of stiff to hard consistency or compact to very dense relative density are considered suitable for the support of proposed house foundations. It is understood that the site grading may require construction of engineered fill to the raise ambient grades in some areas. Recommendations for conventional spread footing foundations supported on undisturbed native soils and engineered fill materials are provided in the following sub-sections.

6.1.1 Spread Foundations on Native Soils

The undisturbed native soils (silt/clayey silt till/sandy silt to silt and sand soils of compact to very dense relative density or stiff to hard consistency) encountered in the boreholes are considered suitable for the support of the proposed houses on conventional spread footing foundations. It is understood that the proposed residential dwellings would consist of a double storey structure with basement.

A nominal net allowable geotechnical reaction of 150 kPa (Serviceability Limit States, SLS), and a factored geotechnical resistance of 225 kPa at Ultimate Limit States, (ULS) may be used for the design of conventional spread footing foundations supported on the underlying competent undisturbed native soils of compact to very dense relative density/stiff to hard consistency. Higher bearing pressures are available and can be assessed in detail, on a location specific basis, if required.

The footings must bear at least 0.3 m into the competent undisturbed native strata. It should be noted that the relatively deep reworked/disturbed/earth fill materials (extending to a depth of about 1.5 m below grade) were noted at Boreholes 6, 8 and 10 which will require foundations in this area to be extended to relatively deeper depths in order to be supported on the underlying competent undisturbed native soils.

The minimum width of continuous strip footings supported on the undisturbed native soils must be 500 mm and the minimum size of isolated footings must be 800 mm x 800 mm regardless of loading considerations, in conjunction with the above recommended geotechnical resistance. The geotechnical resistance(s) as recommended allow for up to 25 mm of total settlement. This settlement will occur as load is applied and is linear elastic and non-recoverable. Differential settlement is a function of spacing, loading and foundation size.

6.1.2 Spread Foundations on Engineered Fill

It is understood that construction of engineered fill may be required to raise ambient grades in some areas. The engineered fill refers to earth fill designed and constructed with the full-time inspection and testing, so as to support the building foundations without excessive settlement. Construction of engineered fill should only be conducted under the full-time engineering guidance and supervision.

Prior to the placement of the engineered fill, it is recommended that the topsoil and/or weathered/disturbed native soils and earth fill materials be stripped from beneath and beyond the proposed foundation envelope (minimum of 2 m beyond), and that the subgrade be proof-rolled. Any soft or wet areas which deflect excessively during the proof roll, should be sub-excavated and replaced with suitably compacted clean earth fill in lifts of 150 mm thick or less.

The engineered fill should consist of clean earth, free from any organic or deleterious matter. The native soils can be utilized as engineered fill provided they are not too wet for efficient compaction and do not contain excessive organic inclusion.

The engineered fill materials should be placed in lifts of 150 mm or less, and compacted to a minimum of 98 percent Standard Proctor Maximum Dry Density (SPMDD). 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 foundation 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 1.2 m of earth cover or equivalent insulation to provide adequate frost protection.

The placement and inspection of the engineered fill must be conducted under the full time supervision of a qualified geotechnical engineer. Provided the engineered fill is placed and compacted as indicated above, a maximum net allowable geotechnical reaction of 150 kPa (Serviceability Limit States, SLS), and a factored geotechnical resistance of 225 kPa at Ultimate Limit States, (ULS) may be used for the design of conventional spread footing foundations supported on engineered fill.

In case of footings supported on engineered fill, the minimum width for the conventional spread strip footing should be at least 600 mm, and the minimum size of the individual column footing be 1000 mm x 1000 mm regardless of loading considerations.

It must be noted that engineered fill material inherently experiences some settlement (typically 1 to 1.5 percent of the total height) regardless of the degree of compaction. This settlement may take a few months to complete. If a time lag cannot be facilitated between the engineered fill construction and the house construction due to project schedule, consideration should be given to use Granular 'B' (OPSS 1010) material for engineered fill construction.

It should be noted that for houses placed on engineered fill, nominal reinforcing steel is recommended in the foundation walls. The reinforcing steel should consist of two (2) continuous 15 M bars at the top of the foundation wall and two (2) continuous 15 M bars at the bottom. Figure 3 provides details of the recommended reinforcing steel. A copy of "Engineered Fill Earthworks Specifications" is appended for reference.

high light

6.1.3 Placement of Footings and Floor Slab

The footing sizes for housing and small buildings are stipulated in the Ontario Building Code (2006), and should be referred and followed for the foundation design. All exterior foundations, or foundations in unheated areas should be provided with a minimum soil cover of 1.2 m or equivalent insulation, for frost protection. However, it is anticipated that the house basement foundations placed on the competent undisturbed native soils could be at greater depth(s) than the minimum depth required for the foundation subgrade frost protection consideration.

It is recommended that all excavated footing bases must be evaluated by a qualified geotechnical engineer to ensure that the founding soils exposed at the excavation base are consistent with the design bearing pressure intended by the geotechnical engineer.

Prior to pouring concrete for the footings, the footing areas should be cleaned of all deleterious materials such as topsoil, softened, disturbed or caved materials, as well as any standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided.

The native soils and engineered fill tend to weather and deteriorate rapidly on exposure to the atmosphere or surface water. Footing excavations which remain open for an extended period of time should be protected by a skim coat of lean concrete.

Concrete floor slabs should be placed on at least 150 mm of granular base (OPSS Granular "A" or 19 mm crusher run limestone, OPSS 1010, or 19 mm clear crushed stone, OPSS 1004) compacted to a minimum of 95 percent SPMDD or vibrated to a dense state in case of clearstone. Prior to the placement of the granular materials, the subgrade should be assessed and approved by a geotechnical engineer. Any loose, soft, wet and incompetent subgrade areas, as identified, must be subexcavated and backfilled with suitably compacted clean earth fill materials. The granular base should be placed either on the undisturbed native subgrade or clean earth fill compacted to at least 95 percent SPMDD.

6.2 Basement Drainage

Consideration should be given for the site grading design to ensure that basements are constructed at least 0.5 m above the ground water level. Where basement floor level is located within 0.5 m of the ground water level, a provision of subfloor drainage is required. In case a basement is designed below the ground water level, the basement must be waterproofed up to the proposed outside finished grade level and the structure should be designed to resist uplift force.

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 with filter cloth and surrounded by a granular filter (minimum 15 cm thick) and freely outletting. The granular filter should consist of OPSS HL 8 Coarse Aggregate (refer to Figure 4).

The basement wall must be provided with damp-proofing provisions in conformance to the section 9.13.2 of the Ontario Building Code (2006). 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. The perimeter drain installation and outlet provisions must conform to the plumbing code requirements.

In addition to the above recommended perimeter drainage, a provision of a sub-floor drainage system installed beneath the basement floor slab is also recommended where the basement floor level is located within 0.5 m of the ground water level. The sub-floor drainage system should consist of perforated pipes (minimum 100 mm diameter) located at a maximum spacing of 5.0 m centre to centre (Figure 4A). The perimeter foundation and sub-floor drains may be outlet to a municipal sewer (if allowed), or to another suitable discharge point including surface drainage under gravity flow, or may be connected to a sump located in the lowest level of the basement. The water must be pumped up to a sewer or other suitable discharge point. The perimeter and sub-floor drain installation and outlet considerations must conform to the Ontario Building Code and plumbing code requirements.

The size of the sump should be adequate to accommodate the water seepage. The sub-floor drainage system should be designed to prevent the possibility of back-flow. A duplex pumping arrangement (main pump with a provision of a backup pump) on emergency backup power is recommended. The pumps should have sufficient capacity to accommodate a maximum peak flow of water of about 5 to 8 gallons per minute. This flow is not anticipated to be a sustained flow, but could be achieved under certain peak flow conditions.

6.3 Storm Drainage Block - Bioretention Area

Based on the preliminary project design concept, a proposed bioretention area would be located in the southeast corner of the property. Boreholes 8 and 10 were advanced within the proximity of the proposed bioretention area. The boreholes were advanced to a depth of about 6.5 m below existing grade. The boreholes encountered a layer of topsoil at the ground surface underlain by a zone of fill/reworked/disturbed soils (extending up to a depth of about 1.5 m below grade) which was in turn underlain by undisturbed native silt with trace to some sand, trace to some clay and trace amounts of gravel, extending to the full depth of investigation.

Sieve and hydrometer (grain size) analyses on the selected native soil samples obtained from these boreholes (Borehole 8, Sample 6 and Borehole 10, and Sample 5) were carried out. The results of the grain size analyses indicated that the native soils consists of 77 to 86 percent silt, 7 to 12 percent clay and 7 to 11 percent sand particles by weight. The estimated permeability of the native silt, based on the soil samples analyzed, is on the order of 10^{-5} to 10^{-6} cm/sec. The measured ground water level in the boreholes was about 5.5 m depth below grade upon completion of drilling. The water level in the piezometers on May 24, 2013 was at about 0.5 m depth below grade. It is noted that the undisturbed native soils at the bioretention area location consist of low permeability silt deposit which should preclude significant amounts of free flow/seepage of the ground water. Therefore, it is possible that the ground water level measured in the piezometers is likely due to the perched water typically present within the fill/disturbed soil zone and/or in the relatively permeable sand seam(s) noted.

The design details of the proposed bioretention area were not available at the time of preparation of this report. Based on the preliminary information, it is understood that the proposed bioretention area will be about 1.5 to 1.8 m deep below existing grade. The borehole data suggests that the bioretention area base and side slopes should consist of undisturbed native silt of relatively low permeability (on the order of 10^{-6} cm/sec) which should preclude significant seepage or percolation into and from the bioretention area, and therefore, a liner may not be required. Consideration should be given to conduct a test pit investigation to better assess the subsurface soil and ground water conditions at the proposed bioretention area locations to provide final and updated geotechnical engineering recommendations for the bioretention design including the requirement of a liner.

The bioretention area slopes and base must be inspected by a geotechnical engineer to assess the exposed soil conditions, and to identify presence of any relatively permeable sand layers/pockets typically found within the native soil deposit, in order to provide recommendations for possible modification to the geotechnical design of the bioretention area. These modifications may include local subexcavation of the relatively permeable soil zone(s) and backfilling with low permeable clay/silty clay soils.

Based on the subsurface soils conditions encountered in the boreholes, the recommended preliminary stable slope inclination for the side slope is 4 horiz. to 1 vert. above water level and 5 horiz. to 1 vert. below any permanent pool elevations, if applicable. It must be noted that regulatory agencies may have specific requirements with respect to bioretention area design (including side slopes) in addition to the slope considerations noted above.

6.3.1 Earth Berm and Bioretention Area Slope Surface Treatment

The final bioretention area design grades may require an earth-berm. The earth fill material used for the berm construction should be of low permeability and free of organics/topsoil. It should consist of at least 15 percent clay and 35 percent silt size particles. Any cobbles or boulders greater than 100 mm in size as well as visible roots, stumps and topsoil should be excluded from the earth berm fill, as should any earth fill soils containing excessive amounts of sand or silt. The earth fill materials should be placed in lifts not exceeding 150 mm and be compacted to a minimum of 95 percent of the SPMDD. The materials shall be placed and compacted at a water content of between 2 percent dry and 3 percent wet of the optimum moisture content. In order to achieve required compaction of the berm fill at the final slope surface, consideration should be given to 'over-build' the berm (minimum 1.5 m beyond the design slope surface) and cut neatly to the final design slope configuration. The subgrade area beneath berm fill and bioretention area base should be stripped to remove all organics, topsoil and vegetation. The exposed subgrade should be proof-rolled and inspected by a qualified geotechnical engineer to confirm the founding soil conditions. Any loose, soft or otherwise deleterious materials must be removed to their full extent and replaced with approved compacted earth fill (as specified above) under the direction of a qualified geotechnical engineer. Similarly, pockets/areas of sand/silt soils in cut areas must be identified, subexcavated and replaced with compacted approved low permeability earth fill soils. The subgrade should be compacted to at least 95 percent SPMDD prior to the berm fill placement.

The final slope surface and all bare or exposed areas (where applicable) should be provided with suitable ground cover or erosion protection. The slope surface should be provided with a thin layer of topsoil (minimum 100 mm thick) and should be hydro-seeded with a grass mixture and mulch. If seeded, during the first 2 to 3 years, the surface cover of topsoil and seeding may require periodic maintenance until the vegetation becomes well established. It is recommended that erosion netting be staked on the outside slope (where applicable) for erosion protection (and inside slope which is above the water level).

It is understood that the inside slopes of the bioretention area will likely be vegetated. Periodic fluctuations in the water level will make inside slopes susceptible to minor sheet and rill erosion over extended periods of exposure if these slopes remain bare and without vegetation. Occasional maintenance and repair of the inside bare slopes (and removal of accumulated sediment in the base) will be required. A lining of the inside slopes would reduce the amount of maintenance. The lining may consist of rip-rap or local field stones.

It is recommended that any piping or trenching in the bioretention area should be provided with seepage cut-off collars (clay plugs, concrete plugs, or other barriers) to protect against water seepage through the pipe bedding and backfill.

In case the relatively permeable zones (sand lenses) are encountered in the slope and base, these zones should be subexcavated and replaced with approved low permeability soils. The backfill soil should consist of a natural soil material (such as clay or clayey silt). Primary considerations for the design of the clay backfill/liner will be low permeability, protection from frost damage, desiccation, and burrowing animals. The clay backfill should be a minimum of 1.0 m thick. The backfill soils must consist of low permeability materials (clayey silt or clay) in order to perform adequately and to provide a barrier to potential seepage. As noted before, the backfill material must include a minimum of 15 percent clay (finer than 0.002 mm) and 35 percent silt sized (finer than 0.08 mm, i.e., passing No. 200 sieve) particles. The backfill material must not include particles greater than 100 mm dimension, greater than 15 percent of the material larger than 4.8 mm size (No. 4 sieve), and greater than 5 percent organic content by weight, as well as visible roots, stumps and topsoil.

It is required to ensure that the berm soils and backfill/liner materials for the permeable zones (if encountered in the base and sides) are compacted to a homogenous mass, and does not remain as distinct "clods" or "clumps". The backfill should be constructed in thin lifts (not exceeding 150 mm thick) and heavily compacted to a minimum of 95 percent SPMDD. The soil should not contain any frozen material should the construction proceeds under winter conditions (ideally not recommended). Also, adequate protection against frost penetration must be provided as required (eg. straw bales, tarping, heating).

The delineation of the permeable soil zones, subexcavation and replacement must be conducted under the full time supervision of a qualified geotechnical engineer.

It is recognized that a broad range of soil materials may be suitable for the berm/backfill/liner material (i.e., will meet the specifications noted above). It is recommended that contractors bidding on the project provide the results of testing, to indicate the following:

- The location (source) of the clay material.
- Verification of the uniformity of the material.
- Demonstration that sufficient material is available for the project.
- Laboratory testing to demonstrate that the material meets the minimum specifications noted above.

The berm/liner construction must be conducted under the full time supervision of a qualified geotechnical engineer. Periodic on-site samples should be collected and tested to ensure that the material placed conforms to the project specification.

6.4 Excavations and Ground Water Control

The borehole data indicate that the topsoil, weathered/disturbed/earth fill and undisturbed native soils would be encountered in the excavations. Excavations must be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. These regulations designate four broad classifications of soils to stipulate appropriate measures for excavation safety.

TYPE 1 SOIL
a. is hard, very dense and only able to be penetrated with difficulty by a small sharp object;
b. has a low natural moisture content and a high degree of internal strength;
c. has no signs of water seepage; and
d. can be excavated only by mechanical equipment.

TYPE 2 SOIL
a. is very stiff, dense and can be penetrated with moderate difficulty by a small sharp object;
b. has a low to medium natural moisture content and a medium degree of internal strength; and
c. has a damp appearance after it is excavated.

TYPE 3 SOIL

a. is stiff to firm and compact to loose in consistency or is previously-excavated soil;
b. exhibits signs of surface cracking;
c. exhibits signs of water seepage;
d. if it is dry, may run easily into a well-defined conical pile; and
e. has a low degree of internal strength

TYPE 4 SOIL

a. is soft to very soft and very loose in consistency, very sensitive and upon disturbance is significantly reduced in natural strength;
b. runs easily or flows, unless it is completely supported before excavating procedures;
c. has almost no internal strength;
d. is wet or muddy; and
e. exerts substantial fluid pressure on its supporting system.

The weathered/disturbed soils or earth fill materials encountered in the boreholes are classified as Type 3 Soil above and Type 4 Soil below the prevailing ground water level, the undisturbed native glacial till soils comprising silt/clayey silt to silt and clay matrix would be classified a s Type 2 Soil and the cohesionless silt, sandy silt as well as silt and sand would be classified as Type 3 Soil above and Type 4 Soil below the prevailing ground water level, under these regulations.

Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates steepest slopes of excavation by soil type as follows:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in the Occupational Health and Safety Act and Regulations for Construction Projects, and include provisions for timbering, shoring and moveable trench boxes.

As noted before, undisturbed native soils may contain larger sized depositional elements (cobbles and boulders) that are not specifically identified in the boreholes. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples for particles of this size. Provision should be made in excavation contract to allocate risks associated with the time spent and equipment utilized to remove or penetrate such obstructions when encountered.

The measured ground water level in boreholes varied from about 1.2 (Borehole 6) to 6.0 m (Borehole 2) below grade upon completion of drilling, while Boreholes 1, 3, 4, 5, 9, 11 and 12 remained dry. The ground water level measured in the standpipe piezometers (installed in Boreholes 1, 5, 8, 9, 10, 11 and 12) varied from about 0.4 m (Borehole 1) to 2.5 m (Borehole 9) below grade on May 24, 2013, while the piezometers in Boreholes 5 and 12 remained dry. The measured ground water level in test pits varied from about 0.8 m (Test Pit 3) to 2.3 m (Test Pits 1 and 2) below grade upon completion of excavation, while Test Pit 12 remained dry. The highest ground water levels measured in the test pits varied from about 0.6 m (Test Pit 3) to 2.1 m (Test Pit 8) below grade on August 23, 2013, while the water level in Test Pit 12 remained dry. The ground water levels may fluctuate seasonally depending upon the precipitation and surface runoff.

The native silt (with trace to some sand, trace to some clay and trace amounts of gravel) and glacial till deposit encountered at the site are expected to have a relatively low permeability (on the order of 10^{-6} cm/sec) and should preclude significant ground water seepage into the excavation in the short-term. However, we note that intermittent sand seams are likely present within the native soil deposit. The weathered/disturbed soils and earth fill materials as well as sand seams and lenses likely present within the native deposit may include perched ground water. The perched ground water seepage should diminish slowly and can be controlled by continuous pumping from a conventional sump and pump arrangement at the base of the excavation.

However, it must be noted that excavations extending below the prevailing ground water level encountered at the site will result in ground water seepage/discharge. The excavations carried through and below the water bearing cohesionless soil (silt/sand), will experience loosening and sloughing of the base and sides, thus requiring wider excavation slopes. Therefore, for excavations extending to depths greater than 0.3 m below the water table, it will be necessary to lower the ground water level below the excavation base prior to and during the subsurface construction. Dewatering of more than 50,000 litres/day would require a permit from the Ministry of Environment.

It is recommended that once the design details of the development are finalized (including the invert levels of the underground utilities), consideration should be given to conduct trial excavations (test pits) to obtain further information pertaining to ground water seepage, and to provide further recommendations necessary for dewatering/ground water control at this site.

6.5 Earth Pressure Design Parameters

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

$$P = K\,[\gamma\,(h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

where: P = the horizontal pressure at depth, h (m)
K = the earth pressure coefficient,
h_w = the depth below the ground water level (m)
γ = the bulk unit weight of soil, (kN/m^3)
γ' = the submerged unit weight of the exterior soil, (γ - 9.8 kN/m^3)
q = the complete surcharge loading (kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, this equation can be simplified to:

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

This equation assumes that free-draining granular backfill is used and positive drainage is provided to ensure that there is no hydrostatic pressure acting in conjunction with the earth pressure.

Resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction ® depends on the normal load on the soil contact (**N**) and the frictional resistance of the soil (**tan** ϕ) expressed as $R = N \tan \phi$. This is an ultimate resistance value and does not contain a factor of safety.

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

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

Parameter	**Definition**	**Units**
ϕ	internal angle of friction	degrees
γ	bulk unit weight of soil	kN/ m^3
K_a	active earth pressure coefficient (Rankin)	dimensionless
K_o	at-rest earth pressure coefficient (Rankin)	dimensionless
K_p	passive earth pressure coefficient (Rankin)	dimensionless

Stratum/Parameter	ϕ	γ	K_a	K_o	K_p
Silt/Sandy Silt to Silt and Sand	32	21.0	0.30	0.47	3.25
Glacial Till	32	21.5	0.30	0.47	3.25
Weathered/Disturbed/Earth Fill Materials	30	19.0	0.35	0.50	3.00
Compact Granular Fill	32	21.0	0.30	0.47	3.25

The values of the earth pressure coefficients noted above are for the horizontal backfill grade behind the wall. The earth pressure coefficients for inclined grade will vary based on the inclination of the retained ground surface.

6.6 Backfill

The topsoil and weathered/disturbed soils as well as earth fill materials containing excessive amounts of organic inclusion should not be reused as backfill in settlement sensitive areas, such as beneath the floor slabs, trench backfill and pavement areas. However, these materials may be stockpiled and reused for landscaping purposes.

The existing weathered/disturbed native soils and earth fill materials may be considered suitable for backfill provided these soils are within 3 percent of the optimum moisture content. It should be noted that there may be some isolated wet zones within the subsurface soils which could be too wet to compact. Any soil material with 3 percent or higher in-situ moisture content than its optimum moisture content, could be put aside to dry or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content could be wasted and be replaced with imported material which can be readily compacted.

The weathered/disturbed native soils and earth fill materials will require selection and sorting to be reused as backfill. The selection and sorting must be conducted under the supervision of a geotechnical engineer. The site soils will be best compacted with a heavy sheepsfoot type roller.

In settlement sensitive areas, the backfill should consist of clean earth and should be placed in lifts of 150 mm thickness or less, and heavily compacted to a minimum of 95 percent SPMDD at a water content close to optimum (within 3 percent). The upper 1.2 m of the pavement subgrade must be compacted to a minimum of 98 percent SPMDD.

It should be noted that the soils encountered on the site are generally not free draining, and will be difficult to handle and compact should they become wetter as a result of inclement weather or seepage. Hence, it can be expected that the earthworks will be difficult and may incur additional costs if carried out during the wet periods (i.e. spring and fall) of the year.

6.7 Pipe Bedding

The engineered fill and undisturbed native materials will be suitable for support of buried services on conventional well graded granular base material. The utility subgrade may require stabilization as deemed necessary based on the subgrade assessment. Where disturbance of the trench base has occurred, such as due to groundwater seepage, or construction traffic, the disturbed soils should be subexcavated and replaced with suitably compacted granular fill.

Granular bedding material should consist of a well graded, free draining soil, such as OPSS Granular "A" or 19 mm Crusher Run Limestone or its equivalent as per the pertinent Town/Region specifications. The bedding material should be placed in 150 mm lifts and compacted to a minimum of 95 percent SPMDD or vibrated/tamped to a dense state in case of a clear stone material.

A clear stone type bedding may be considered, however, such bedding should only be used in conjunction with a suitable geotextile filter (Terrafix 270R or equivalent) where sand/silt subgrade is encountered. Otherwise, without proper filtering, there may be entry of fines from the native soils into the bedding. This loss of ground could result in loss of support to the pipes and possible future settlements. Where subgrade consists of clayey soils, a geotextile filter is not required.

If the invert of the trench is below the water table and local drawdown of the groundwater level cannot be tolerated for environmental reasons then clay plugs should be installed within the granular bedding and the granular zones of backfill material to help prevent migration of the ground water along the relatively free draining bedding material and/or backfill material due to the "French Drain" effect.

Clay plugs should be placed in the trenches at 50 m intervals (or less) along the full length of the trench, where the invert of the trench is below the water table. The plug should be at least 1.0 m thick measured along the pipe, and should completely replace the granular bedding and relatively pervious (sand, granular) backfill. The clay plugs must be compacted to a minimum of 95 percent SPMDD. The clay plug material should have a coefficient of permeability less than 10^{-6} cm/s and must include a minimum of 15 percent clay (finer than 0.002 mm) and 30 percent silt sized (finer than 0.08 mm, i.e., passing No. 200 sieve) particles. The backfill material must not include particles greater than 100 mm dimension, greater than 15 percent of the material larger than 4.8 mm size (No. 4 sieve), and greater than 5 percent organic content by weight, as well as visible roots or topsoil.

Alternatively, concrete cut-off collars can be installed around the pipe barrel to achieve the same effect. Collars should not be placed closer than 1.0 m to a pipe joint and precautions should be taken to ensure that a minimum of 95 percent compaction is achieved around the collars. Watertight connections are required between the collar and the pipe wall. The trench backfilling operations should be carried out with materials that are similar to the materials that have been excavated. In particular, the sand zones must not be truncated by backfilling of the trench using lower permeability materials.

6.8 Pavement Design

Based on the existing and proposed site grades, it is understood that both cut and fill may be required for grading design, therefore, the pavement subgrade may consist of undisturbed native soil or compacted earth fill. The pavement subgrade should be proof-rolled with a heavy rubber tire vehicle (such as a grader) and any loose, soft, wet or unstable areas should be sub-excavated, and backfilled with clean earth fill material placed in 150 mm thick lifts and compacted to a minimum of 98 percent SPMDD. Local subexcavation in some areas may be required due to loose/soft, wet and incompetent subgrade conditions or excessive topsoil/organic presence as identified during the proof-roll.

The existing weathered/disturbed soils or earth fill materials encountered on the site may be utilized for subgrade preparation provided they do not contain excessive amounts of organics and deleterious materials, as well as their in-situ moisture content is within 3 percent of the optimum moisture content. The selection and sorting of these soils for reuse, should be conducted under the supervision of a geotechnical engineer. Pavement subgrade upfill material should be compacted to a minimum of 95 percent SPMDD, while the upper zone (within 1.2m of the design subgrade) should be compacted to a minimum of 98 percent SPMDD.

The following flexible pavement designs are recommended for the proposed residential development.

Material	Compaction Requirement	Minimum Component Thickness
		Local Residential Road
Surface Course Asphaltic Concrete: HL3 (OPSS 1150 and pertinent Town specifications)	as per OPSS 310	40 mm
Base Course Asphaltic Concrete: HL8 (OPSS 1150 and pertinent Town specifications)	as per OPSS 310	65 mm
Base Course: Granular 'A' (OPSS 1010 and pertinent Town specifications)	100 % Standard Proctor Maximum Dry Density	150 mm
Subbase Course: Granular 'B' (OPSS 1010 and pertinent Town specifications)	98 % Standard Proctor Maximum Dry Density	300 mm

The minimum pavement component thicknesses for the road would depend on the width of the road right-of-way. Therefore, Town specifications should be referred for the minimum pavement component thicknesses once the road right-of-way widths are finalized.

The granular materials should be placed in lifts 150 mm thick or less and be compacted to a minimum of 100 percent and 98 percent SPMDD for granular base and granular sub-base, respectively. 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 and 1150 and pertinent Town specifications. It is recommended that Town and other pertinent specifications should be referred for use of higher grade of asphalt cement for asphaltic concrete where applicable.

Control of surface water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum grade of two percent) to provide effective drainage towards subgrade drains. Grading adjacent to the pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement. Continuous pavement subdrains should be provided along both sides of the roads and drained into respective catchbasins to facilitate drainage of the subgrade and granular materials. The subdrain invert should be maintained at least 0.3 m below subgrade level (refer to Figure 5).

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures must be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as possible when fill is placed, and the natural subgrade is not disturbed or weakened after it is exposed.

The above pavement design thicknesses are considered adequate for the design traffic. However, if the pavement construction occurs in wet, winter or inclement weather, it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular sub-base, base or both. Further, traffic areas for construction equipment may experience unstable subgrade conditions. These areas may be stabilized utilizing additional thickness of the granular materials.

It should be noted that in addition to strict adherence to the above recommended pavement design, a close control on the pavement construction process will also be required in order to obtain the desired pavement life. Therefore, it is recommended that regular inspection and testing should be conducted during the construction to confirm material quality, thickness, and to ensure adequate compaction.

6.9 Tile Field Design Considerations

The details of the proposed septic bed locations were not available at the time of preparation of this report. The results of the subsurface investigation indicate the future septic bed locations would be predominantly underlain by relatively low permeability silt deposit.

Based on the current available soil conditions, the tile field will likely have to be constructed as either a partial or fully-raised sand bed. However, we understand that a location specific test pit investigation will later be carried out to obtain subsurface condition information at individual septic field areas once the detail design of the development is completed. According to the Ontario Building Code, the base of the pipe trenches in the septic bed must be at least 900 mm above the silt layer to ensure the bed operates properly. Typical trenches are 600 - 900 mm in depth. Alternatively, a shallow buried trench system could be used, provided that an additional (tertiary) a treatment unit is included. The final design of the septic system must be completed by a qualified designer once the building plans and site grading plans are complete.

It should be noted that if the daily sewage flow for the building is greater than 10,000 liters, then MOE approval will be required for the septic system instead of the local municipality. MOE approval can take several months to obtain, and additional hydrogeologic investigation will likely be required.

For site design purposes, the following setbacks will need to be conformed when siting the septic system:

- Septic tank not closer than:
    - 1.5 m to any structure

  - 3 m to the property line
  - 15 m to surface water body

- Tile field not closer than:
  - 5 m to any structure
  - 3 m to the property line
  - 15 m to surface water body

The above setbacks for the tile field must be increased by 2 m for each 1 m that the bed is elevated above the surrounding ground.

7.0 LIMITATIONS AND USE OF REPORT

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. A comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions.

The discussion and recommendations are based on the factual data obtained from the investigation and are intended for use by the owner and its retained designers in the design phase of the project. Since the project is still in the design stage, all aspects of the project relative to the subsurface conditions cannot be anticipated. Terraprobe should review the design drawings and specifications prior to the construction. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructibility issues and quality control may not be relevant to the revised project. Terraprobe should be retained to review the implications of changes with respect to the contents of this report.

The investigation at this site was conceived and executed to provide information for project design. It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could have an effect on construction costs, techniques, equipment, and scheduling. Contractors bidding on or undertaking work on this project should therefore, in this light, be directed to decide on their own investigations, as well as their own interpretations of the factual investigation results. They should be cognizant of the risks implicit in subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was prepared for the express use of Laurelpark Inc. and its retained design consultants. It is not for use by others. This report is copyright of Terraprobe Inc. and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe Inc. and Laurelpark Inc., who are the authorized users.

It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statues, will make use of, and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

We trust the foregoing information is sufficient for your present requirements. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Yours truly,

Terraprobe Inc.

LICENSED PROFESSIONAL ENGINEER
May 29, 2017
H.U. AHMED
PROVINCE OF ONTARIO

Helal Ahmed, P. Eng., Conslt. Engineer
Senior Engineer

B. Singh, M.A.Sc., P. Eng.
Principal

APPENDIX

TERRAPROBE INC.

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silty	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

∇	Unstabilized water level
▼	1st water level measurement
▼	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

BOREHOLE LOGS

TERRAPROBE INC.

Terraprobe

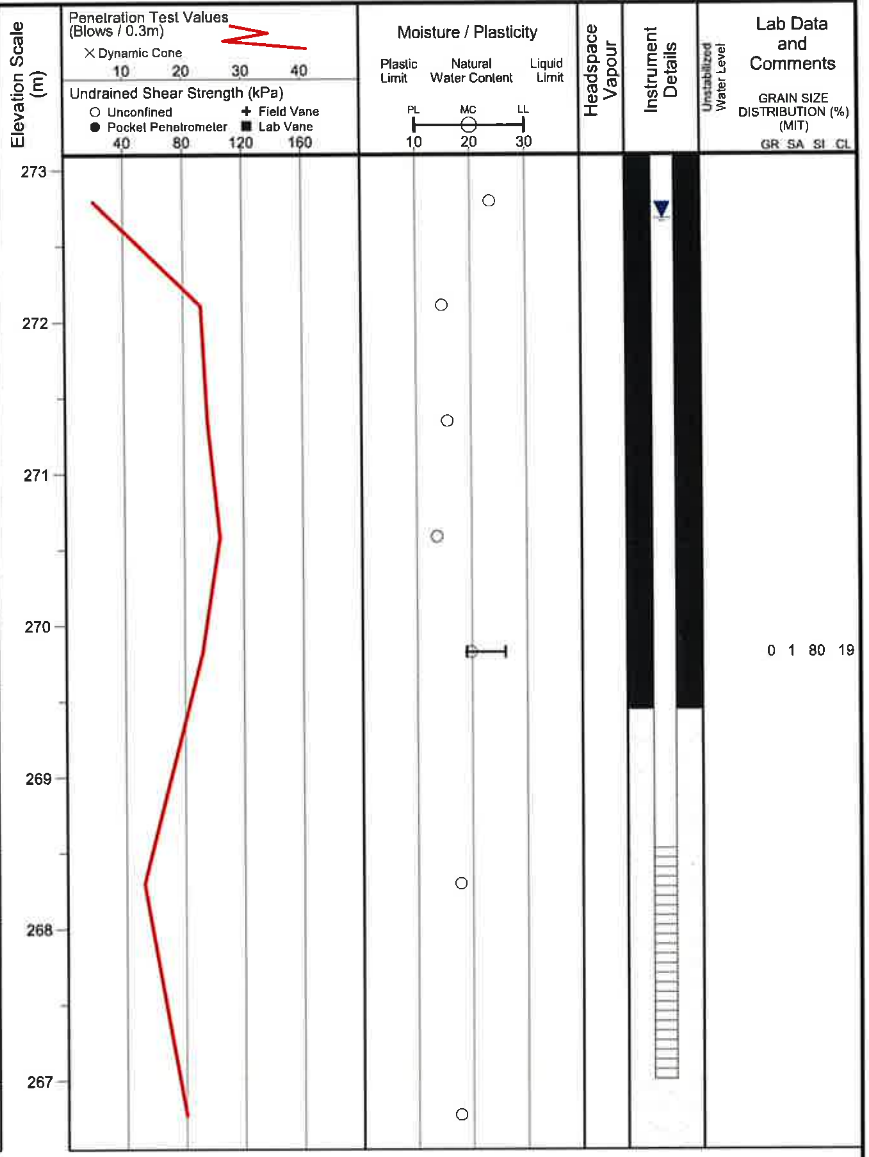
BOREHOLE LOG 1

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 16, 2013
Sheet No. : 1 of 1

Position : E: 598025, N: 4865443 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Elev Depth (m)	Description (SOIL PROFILE)	Number (SAMPLES)	Type	SPT 'N' Value	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
273.1	**GROUND SURFACE**				
	250mm **TOPSOIL**				
272.8 0.3	Trace organics (WEATHERED/DISTURBED)	1	SS	5	
272.3 0.8	**SILT**, trace to some sand, trace to some clay, trace gravel, compact, brown, moist	2	SS	23	
		3	SS	24	
		4	SS	26	
		5	SS	23	0 1 80 19
268.5 4.6	**CLAYEY SILT to SILT AND CLAY**, trace sand, trace gravel, stiff to very stiff, grey, moist (GLACIAL TILL)	6	SS	13	
		7	SS	20	
266.5 6.6					



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 24, 2013	0.4	272.7

library: library - terraprobe gint.glb report: terraprobe soil log file: 11-13-3052 bh logs.gpj

Terraprobe

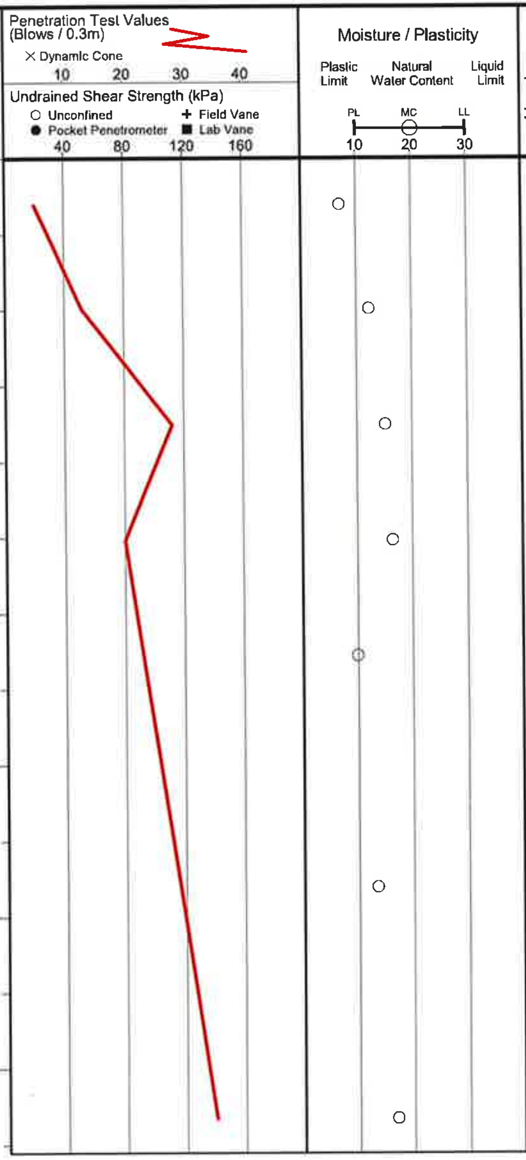
BOREHOLE LOG 2

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 16, 2013
Sheet No. : 1 of 1

Position : E: 598111, N: 4865495 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Elev Depth (m)	Description	Number	Type	SPT 'N' Value	Unstabilized Water Level	GR	SA	SI	CL
280.0	**GROUND SURFACE**								
	300mm **TOPSOIL**								
279.7 0.3	Trace organics (WEATHERED/DISTURBED)	1	SS	5					
279.2 0.8	**SILT**, trace to some sand, trace to some clay, trace gravel, (possible intermittent sand seams), compact, brown, moist	2	SS	13					
		3	SS	28					
		4	SS	20		0	12	77	11
	...silty sand	5	SS	23					
		6	SS	29	∇				
273.9 6.1	**CLAYEY SILT**, trace sand, trace gravel, hard, brown, moist (GLACIAL TILL)	7	SS	35					
273.4 6.6	**END OF BOREHOLE**								



Headspace Vapour

Instrument Details

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)

Unstabilized water level measured at 6.0m below ground surface; borehole was open upon completion of drilling.

Terraprobe

BOREHOLE LOG 3

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

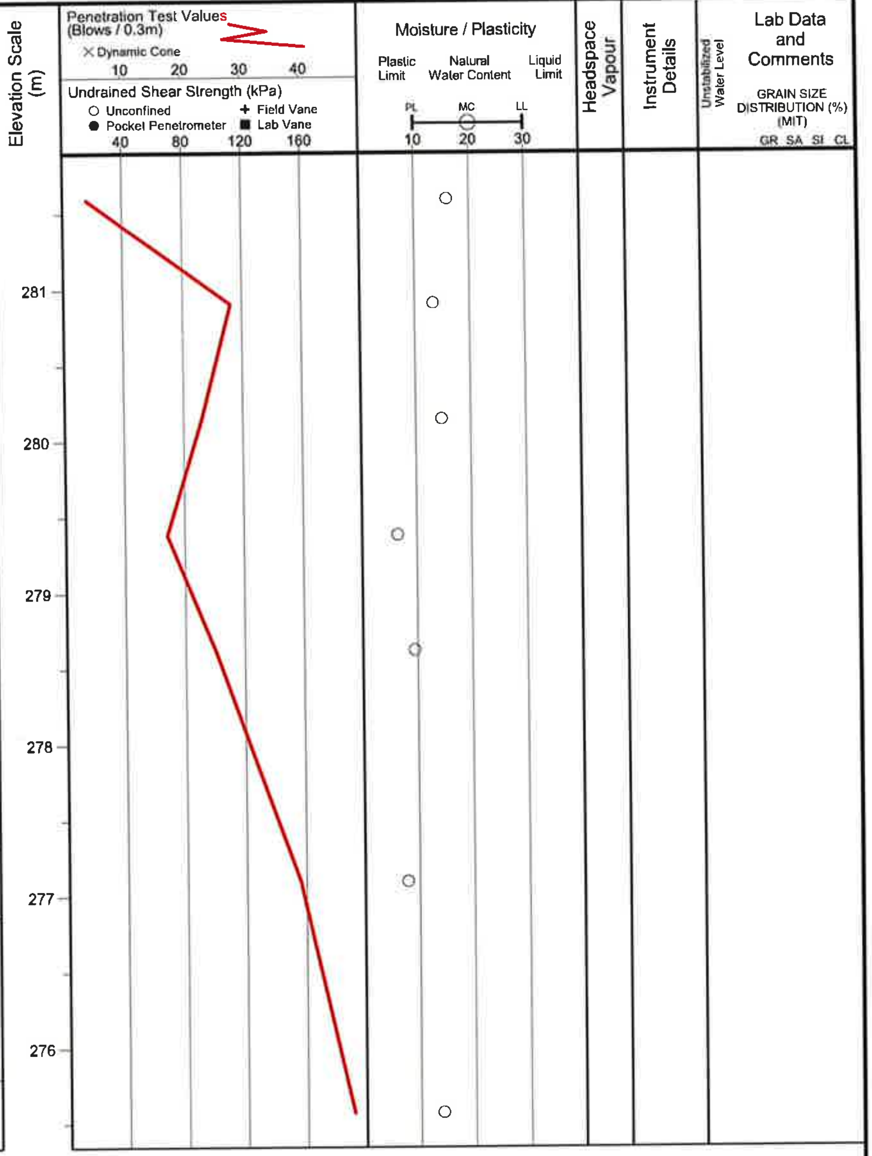
Project No.: 11-13-3052
Date started : May 16, 2013
Sheet No. : 1 of 1

Position : E: 295137, N: 4865588 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	SOIL PROFILE Elev Depth (m)	Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value
	281.9	**GROUND SURFACE**				
0		400mm **TOPSOIL**		1	SS	4
	281.5 0.4	Trace organics (WEATHERED/DISTURBED)				
1	281.1 0.8	**SILT**, trace to some sand, trace to some clay, trace gravel, compact to dense, brown, moist		2	SS	28
2				3	SS	23
		...silty sand below		4	SS	17
3				5	SS	25
4						
5				6	SS	39
6		...some clay		7	SS	48
	275.3 6.6					

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



Terraprobe

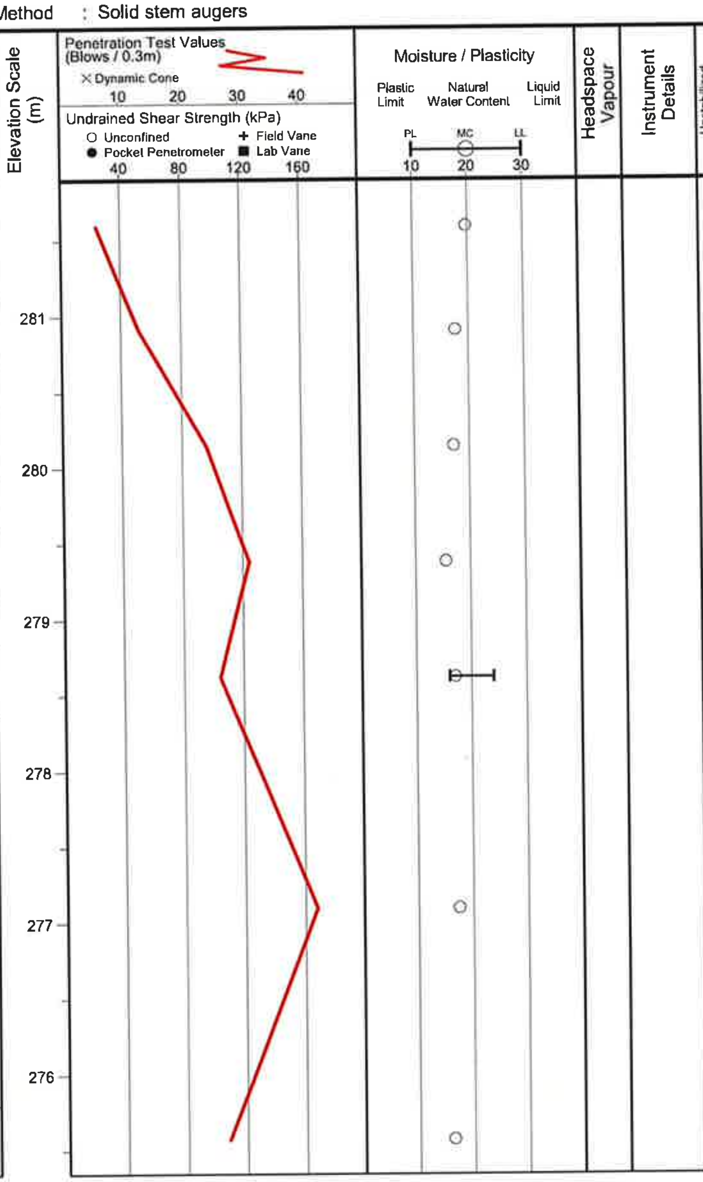
BOREHOLE LOG 4

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 16, 2013
Sheet No. : 1 of 1

Position : E: 598223, N: 4865593 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			Lab Data and Comments
Elev Depth (m)	Description	Number	Type	SPT 'N' Value	GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
281.9	**GROUND SURFACE**				
	300mm **TOPSOIL**	1	SS	6	
281.6 0.3	Trace organics (WEATHERED/DISTURBED)				
281.1 0.8	**SILT**, some clay to clayey silt, trace sand, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)	2	SS	13	
		3	SS	24	
		4	SS	31	
		5	SS	26	3 9 69 19
		6	SS	42	
	...grey below	7	SS	27	
275.3 6.6	**END OF BOREHOLE**				



Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 5

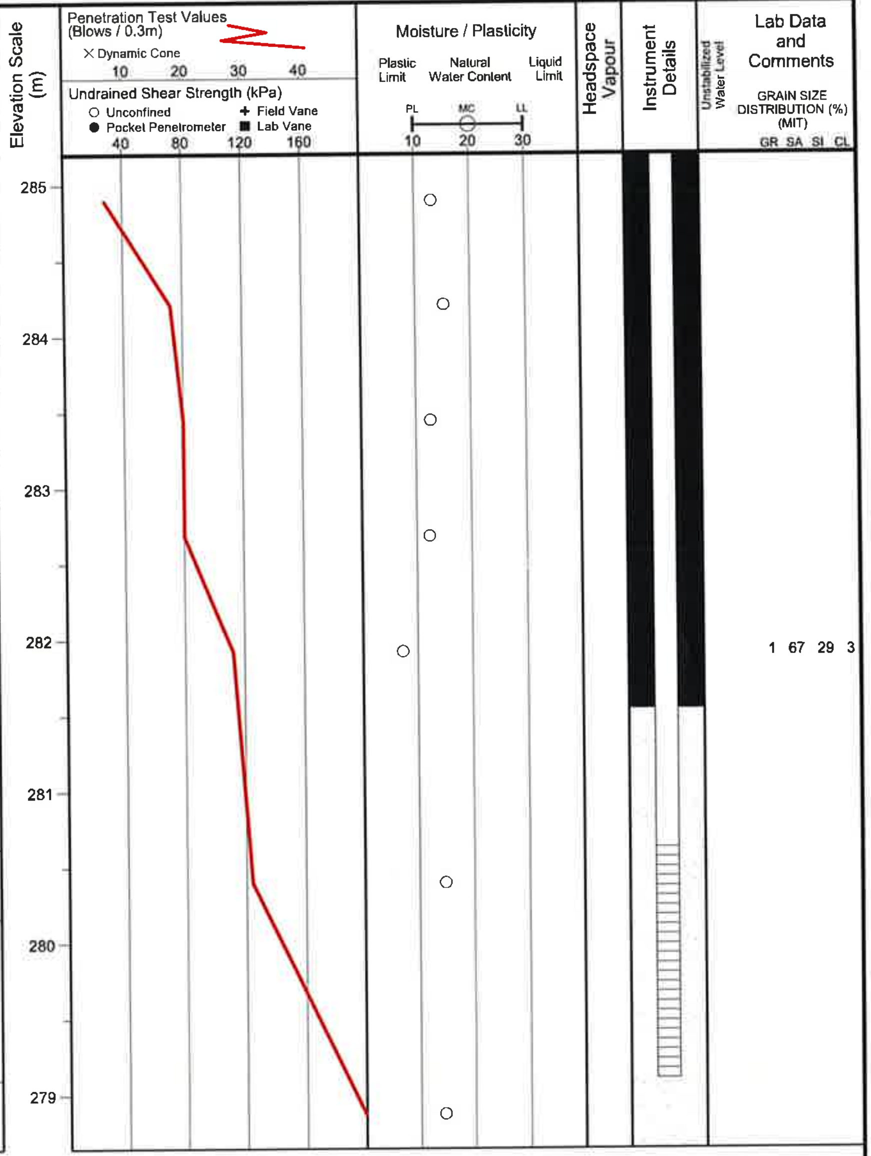
Terraprobe

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 16, 2013
Sheet No. : 1 of 1

Position : E: 598309, N: 4865735 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value
0	285.2	**GROUND SURFACE**			
	284.9 0.3	300mm **TOPSOIL**	1	SS	7
	284.4 0.8	Trace organics (WEATHERED/DISTURBED)			
1		**SANDY SILT to SILT AND SAND**, trace clay, trace gravel, compact to dense, brown, moist	2	SS	18
2			3	SS	20
			4	SS	20
3		...silty sand	5	SS	28
4					
5			6	SS	31
6		...very dense	7	SS	76
	278.6 6.6				



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 24, 2013	dry	n/a

Terraprobe

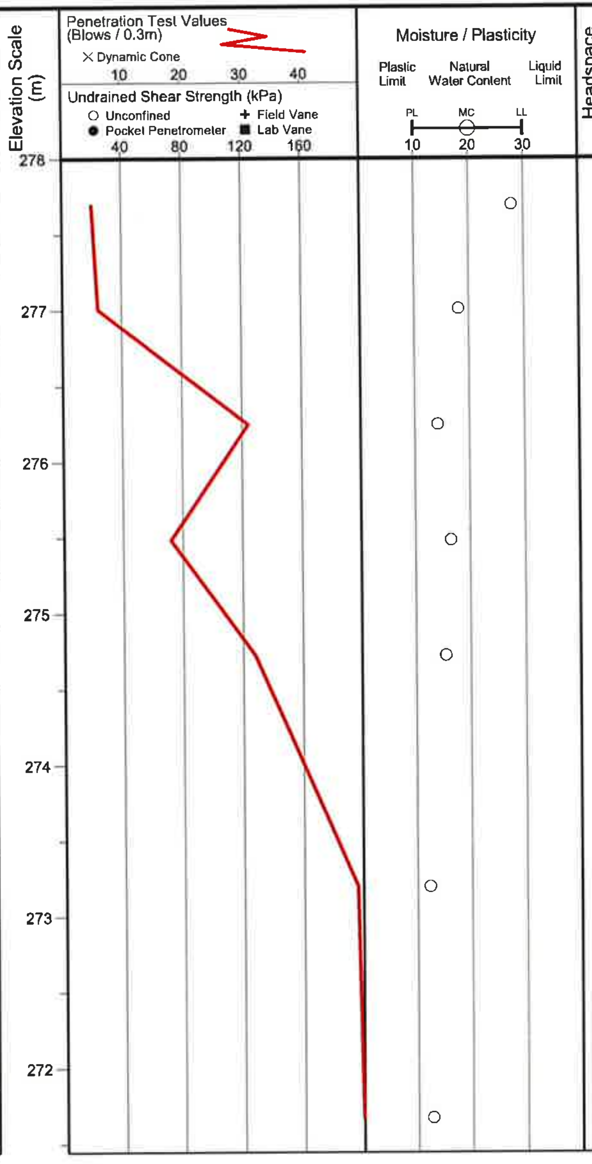
BOREHOLE LOG 6

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 15, 2013
Sheet No. : 1 of 1

Position : E: 598386, N: 4865796 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
	278.0	**GROUND SURFACE**					
0		300mm **TOPSOIL**					
	277.7 0.3	**FILL**, clayey silt, trace to some sand, trace gravel, trace organics, topsoil, firm, brown / grey, moist ...(REWORKED/DISTURBED)	1	SS	5		
1			2	SS	6	∇	
	276.5 1.5	**SILT**, trace to some sand, trace to some clay, trace gravel, (possible intermittent sand seams), compact to dense, brown, moist	3	SS	31		spoon wet
2			4	SS	18		
3		...grey below	5	SS	32		
4							
5			6	SS	49		
6		...very dense	7	SS	70		0 11 79 10
	271.4 6.6						



END OF BOREHOLE

Unstabilized water level measured at 1.2m below ground surface; borehole was open upon completion of drilling.

library: library - terraprobe gint.glb report: terraprobe soil log file: 11-13-3052 bh logs.gpj

Terraprobe

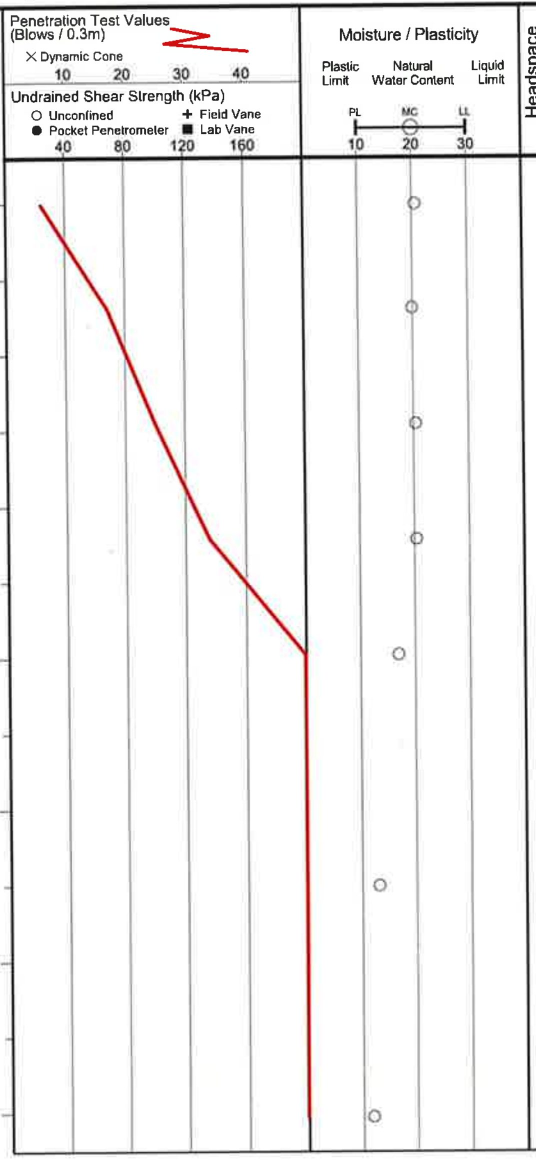
BOREHOLE LOG 7

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 15, 2013
Sheet No. : 1 of 1

Position : E: 598421, N: 4865843 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Number	Type	SPT 'N' Value	Elevation Scale (m)	Lab Data and Comments
0	280.3	**GROUND SURFACE**					
	279.9 0.4	350mm **TOPSOIL**	1	SS	6	280	
	279.5 0.8	Trace organics (WEATHERED/DISTURBED)					
1		**SILT**, trace to some sand, trace to some clay, trace gravel, (possible intermittent sand seams), compact to very dense, brown, moist	2	SS	17	279	
2			3	SS	25	278	
			4	SS	34		
3			5	SS	55	277	spoon wet
4						276	
5		...grey below	6	SS	67	275	
6							▽
	273.7 6.6		7	SS	68	274	



Headspace Vapour | Instrument Details | Unstabilized Water Level | GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 5.9m below ground surface; borehole was open upon completion of drilling.

Terraprobe

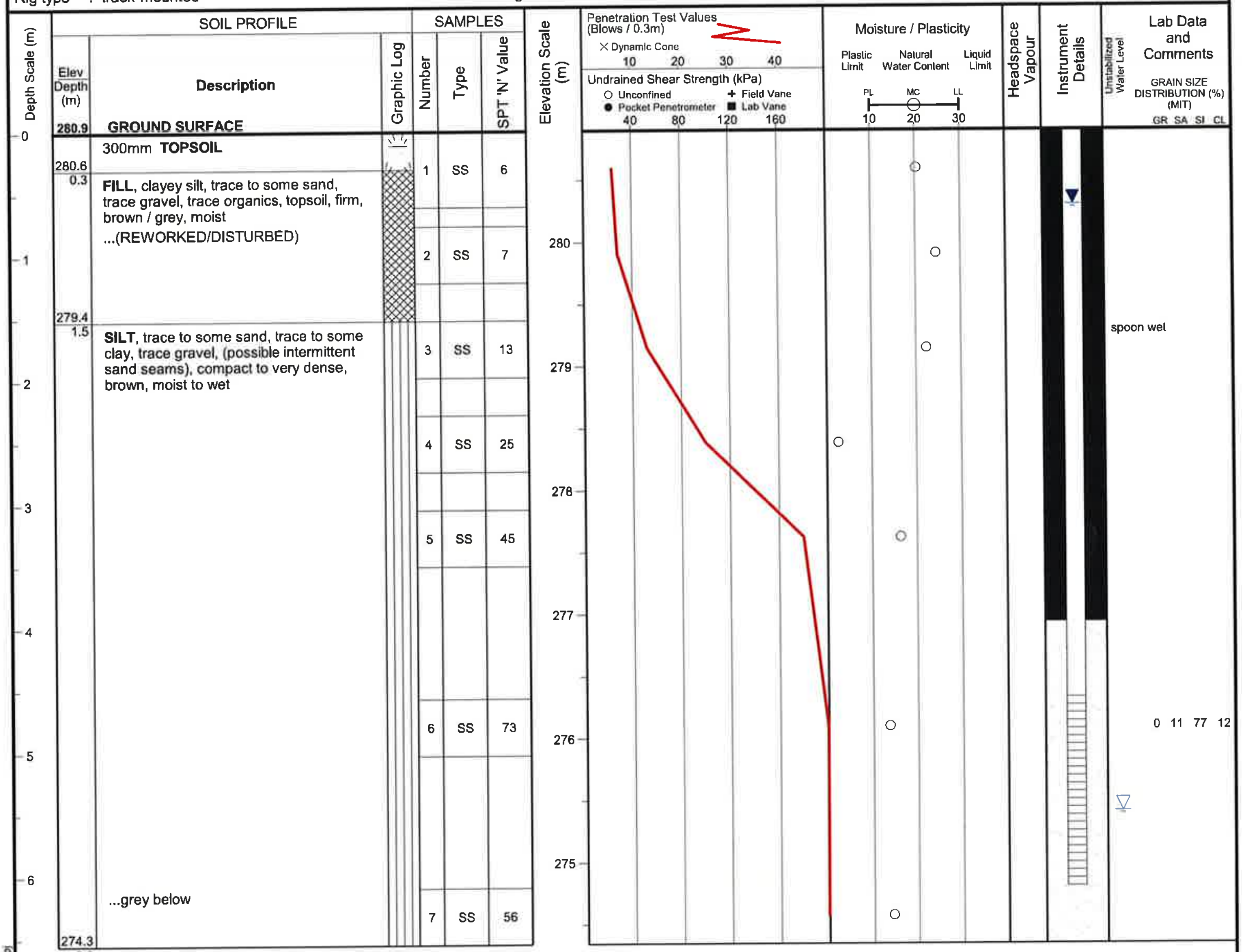
BOREHOLE LOG 8

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 15, 2013
Sheet No. : 1 of 1

Position : E: 598465, N: 4865898 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Elev Depth (m)	Description (SOIL PROFILE)	Number	Type	SPT 'N' Value
280.9	**GROUND SURFACE**			
	300mm **TOPSOIL**	1	SS	6
280.6 0.3	**FILL**, clayey silt, trace to some sand, trace gravel, trace organics, topsoil, firm, brown / grey, moist ...(REWORKED/DISTURBED)	2	SS	7
279.4 1.5	**SILT**, trace to some sand, trace to some clay, trace gravel, (possible intermittent sand seams), compact to very dense, brown, moist to wet	3	SS	13
		4	SS	25
		5	SS	45
		6	SS	73
	...grey below	7	SS	56
274.3 6.6	**END OF BOREHOLE**			



Unstabilized water level measured at 5.5m below ground surface; borehole was open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 24, 2013	0.6	280.3

Terraprobe

BOREHOLE LOG 9

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 16, 2013
Sheet No. : 1 of 1

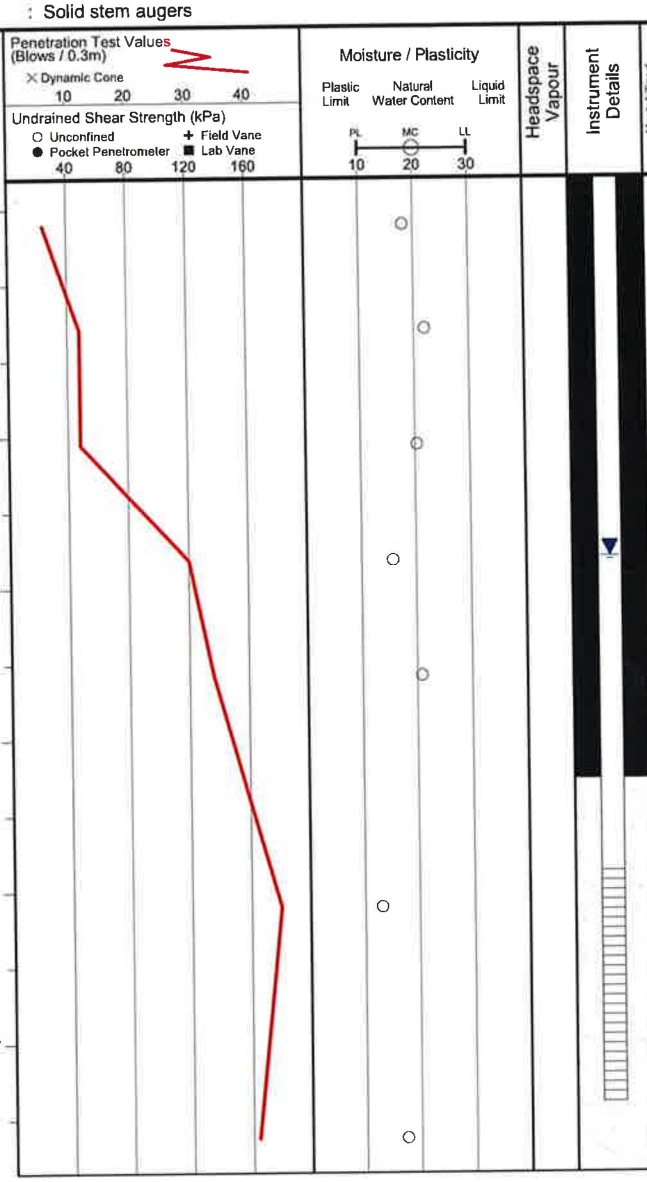
Position : E: 598343, N: 4865854 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

SOIL PROFILE

Elev Depth (m)	Description
282.7	**GROUND SURFACE**
282.4 0.3	300mm **TOPSOIL**
281.9 0.8	Trace organics (WEATHERED/DISTURBED)
276.1 6.6	**SILT**, trace to some sand, trace to some clay, trace gravel, compact to dense, brown, moist

SAMPLES

Number	Type	SPT 'N' Value
1	SS	6
2	SS	12
3	SS	12
4	SS	30
5	SS	34
6	SS	45
7	SS	41



Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR	SA	SI	CL
0	8	77	15

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 24, 2013	2.5	280.2

library: library - terraprobe gint.glb report: terraprobe soil log file: 11-13-3052 bh logs.gpj

Terraprobe

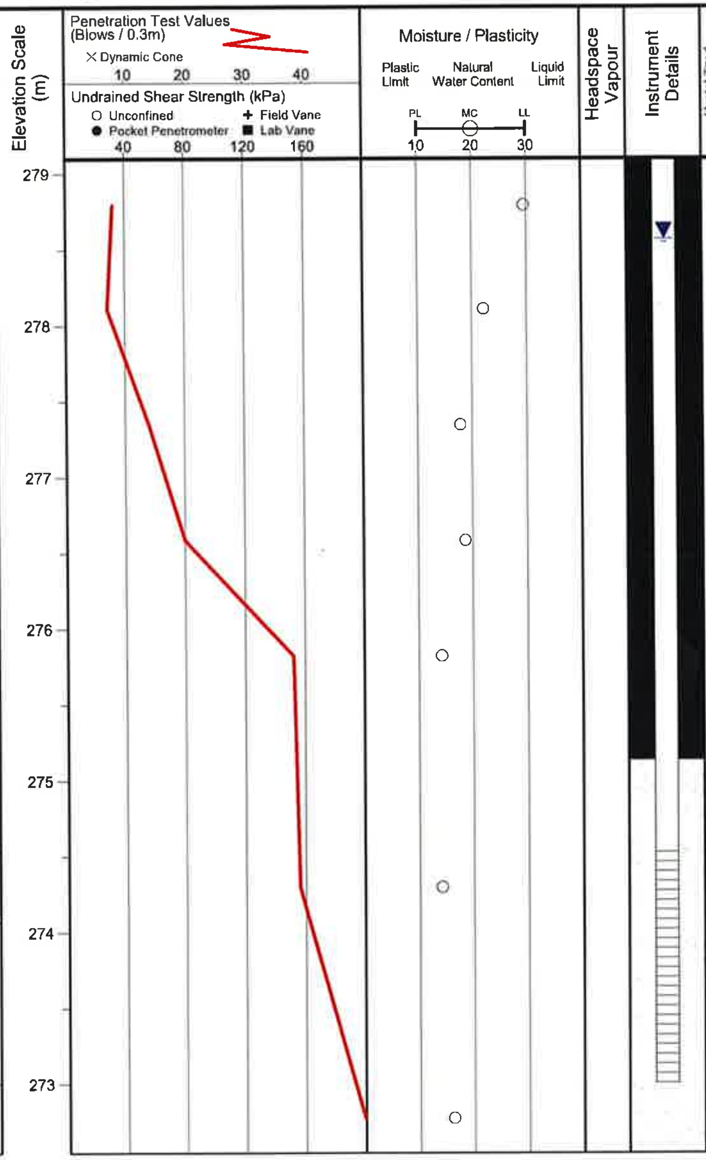
BOREHOLE LOG 10

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 15, 2013
Sheet No. : 1 of 1

Position : E: 598480, N: 4865808 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Elev (m)	Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Lab Data and Comments	GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
279.1	0	**GROUND SURFACE**					
		350mm **TOPSOIL**	1	SS	8		
278.7	0.4	**FILL**, silt, some sand, trace to some clay, trace organics, topsoil presence, loose, brown / grey, moist ...(REWORKED/DISTURBED)	2	SS	7		
277.6	1.5	**SILT**, trace to some sand, trace to some clay, trace gravel, (possible intermittent sand seams), compact to dense, brown, moist	3	SS	14		
			4	SS	20	spoon wet	
			5	SS	38		0 7 86 7
		...grey below	6	SS	39		
273.0	6.1	**CLAYEY SILT**, trace sand, trace gravel, hard, grey, moist (GLACIAL TILL)	7	SS	58		
272.5	6.6						



END OF BOREHOLE

Unstabilized water level measured at 5.4m below ground surface; borehole was open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 24, 2013	0.5	278.6

Terraprobe

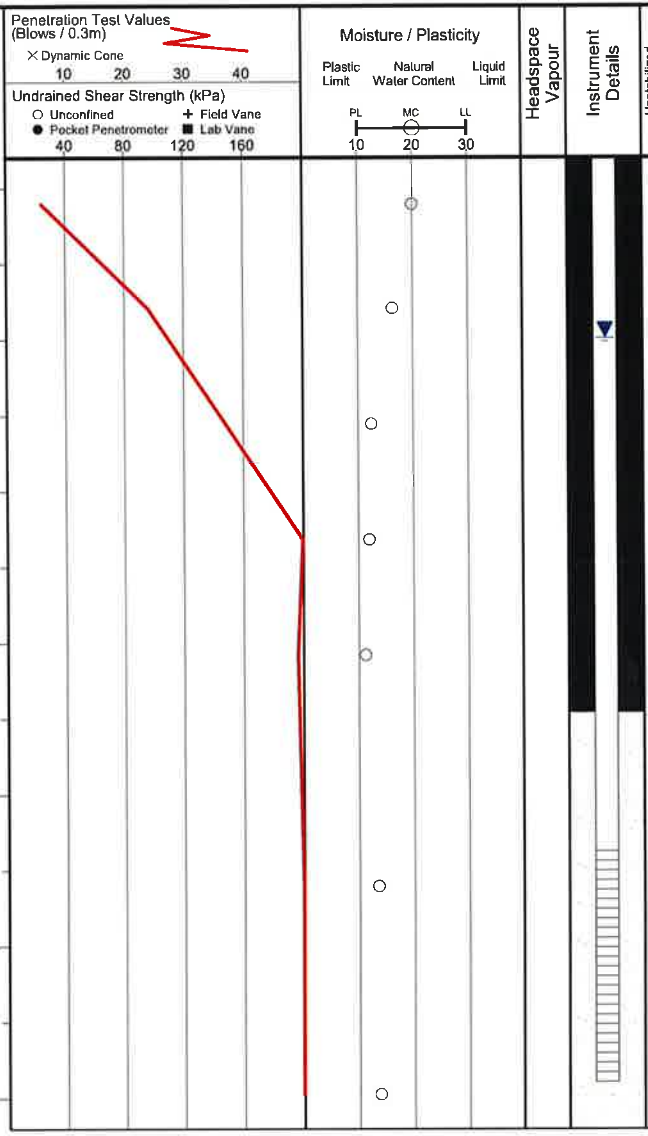
BOREHOLE LOG 11

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 16, 2013
Sheet No. : 1 of 1

Position : E: 598392, N: 4865760 (UTM 17T)
Rig type : track-mounted
Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	280.2	**GROUND SURFACE**					
		300mm **TOPSOIL**				280	
	279.9 0.3	Trace organics (WEATHERED/DISTURBED)	1	SS	6		
	279.4 0.8	**SILT**, trace to some sand, trace to some clay, trace gravel, (possible intermittent sand seams), compact to very dense, brown, moist					
1			2	SS	24	279	
			3	SS	37		
2						278	
			4	SS	62		0 7 81 12
3		...grey below	5	SS	49	277	
4						276	
			6	SS	62		
5						275	
6			7	SS	62	274	0 9 80 11
	273.8 6.4						



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 24, 2013	1.2	279.0

Terraprobe

BOREHOLE LOG 12

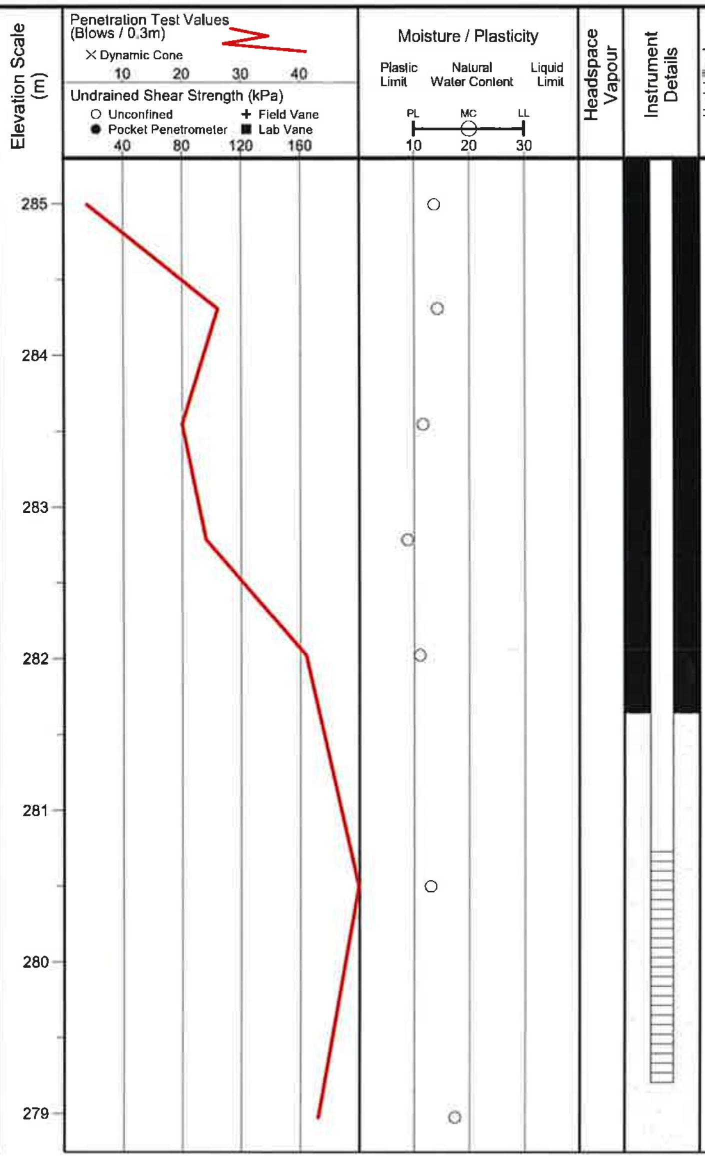
Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No.: 11-13-3052
Date started : May 16, 2013
Sheet No. : 1 of 1

Position : E: 598168, N: 4865581 (UTM 17T)
Rig type : track-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
285.3	GROUND SURFACE				
	350mm **TOPSOIL**	1	SS	4	
284.9 0.4	Trace organics (WEATHERED/DISTURBED)				
284.5 0.8	**SANDY SILT to SILT AND SAND**, trace clay, trace gravel, compact to very dense, brown, moist	2	SS	26	
		3	SS	20	0 36 57 7
		4	SS	24	
		5	SS	41	
		6	SS	67	
		7	SS	43	
278.7 6.6	**END OF BOREHOLE**				



Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
May 24, 2013	dry	n/a

TEST PIT
LOGS

TERRAPROBE INC.

Terraprobe

TEST PIT LOG 1

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 15, 2013
Sheet No. : 1 of 1

Position : E: 598036, N: 4865443 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit PL 10 — Natural Water Content MC 20 — Liquid Limit LL 30

Headspace Vapour

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Depth Scale (m)	Elev Depth (m)	Description (SOIL PROFILE)	Number (SAMPLES)	Type (SAMPLES)	Unstabilized Water Level
0.0		**GROUND SURFACE**			
		300mm **TOPSOIL**			
	0.3	Trace organics (WEATHERED/DISTURBED)	1	GS	
0.5	0.5	**SILT**, trace to some sand, trace to some clay, trace gravel, compact, brown / grey, moist			
1.0					
1.5			2	GS	
2.0					
		...wet below			▽
			3	GS	
	2.4	**END OF TEST PIT**			

Unstabilized water level measured at 2.3m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/19/2013	1.9	
8/23/2013	1.7	

library: library - terraprobe gint.glb report: terraprobe test pit log file: 11-13-3052 test pit logs.gpj

Terraprobe

TEST PIT LOG 2

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 15, 2013
Sheet No. : 1 of 1

Position : E: 598040, N: 4865462 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Undrained Shear Strength (kPa): ○ Unconfined; ● Pocket Penetrometer; + Field Vane; ■ Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) 10; Natural Water Content (MC) 20; Liquid Limit (LL) 30

Headspace Vapour

Unstabilized Water Level

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	Unstabilized Water Level	Lab Data and Comments
0.0		**GROUND SURFACE** 250mm **TOPSOIL**				
	0.3	Trace organics (WEATHERED/DISTURBED)	1	GS		
0.5	0.5	**SILT**, trace to some sand, trace to some clay, trace gravel, compact, brown / grey, moist				
1.0			2	GS		
	1.2	**SANDY SILT**, trace clay, compact, brown / grey, moist				
1.5			3	GS		
	1.7	**SILTY SAND**, trace clay, dense, brown / grey, wet				...at 1.7m, water seepage
2.0						
			4	GS	▽	
	2.4	**END OF TEST PIT**				

Unstabilized water level measured at 2.3m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/19/2013	2.2	
8/23/2013	2.0	

Terraprobe

TEST PIT LOG 3

Client : Laurelpark Inc.

Project : Palgrave Estates II

Location : Caledon, Ontario

Project No. : 11-13-3052

Date excavated : August 15, 2013

Sheet No. : 1 of 1

Position : E: 598073, N: 4865443 (UTM 17T)

Elevation Datum : N/A

Rig type : BACKHOE

Undrained Shear Strength (kPa): ○ Unconfined; ● Pocket Penetrometer; + Field Vane; ■ Lab Vane — 40, 80, 120, 160

Moisture / Plasticity: Plastic Limit PL 10; Natural Water Content MC 20; Liquid Limit LL 30

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	SAMPLES Type	Elevation Scale (m)	Headspace Vapour	Unstabilized Water Level	Lab Data and Comments
0.0		**GROUND SURFACE**							
		300mm **TOPSOIL**							
	0.3	Trace organics (WEATHERED/DISTURBED)		1	GS				
0.5	0.5	**SILTY SAND**, trace clay, trace organics, very loose, dark brown, moist / wet		2	GS			∇	...at 0.8m, water seepage
1.0	0.9	**SAND**, trace silt, trace clay, trace organics, very loose, brown, wet		3	GS				
1.5	1.5	**CLAYEY SILT**, some sand, stiff, grey, moist wet		4	GS				
	2.0	**END OF TEST PIT**							

Unstabilized water level measured at 0.8m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/19/2013	0.8	
8/23/2013	0.6	

Terraprobe

TEST PIT LOG 4

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 15, 2013
Sheet No. : 1 of 1

Position : E: 598076, N: 4865460 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Depth Scale (m)	SOIL PROFILE Elev Depth (m)	 Description	 Graphic Log	SAMPLES Number	 Type	Elevation Scale (m)	Undrained Shear Strength (kPa) ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane 40 80 120 160	Moisture / Plasticity Plastic Limit PL 10, Natural Water Content MC 20, Liquid Limit LL 30	Headspace Vapour	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0.0		GROUND SURFACE									
		250mm **TOPSOIL**									
	0.3	Trace organics (WEATHERED/DISTURBED)		1	GS						
0.5	0.5	**SILT**, trace to some sand, trace to some clay, trace gravel, compact, brown / grey, moist									
1.0											
1.5				2	GS						
	1.7	**SILTY SAND**, trace clay, compact, brown, wet									...at 1.8m, water seepage
2.0				3	GS					▽	
	2.4	**END OF TEST PIT**									

Unstabilized water level measured at 2.3m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/19/2013	1.8	
8/23/2013	1.7	

library: library - terraprobe gint.glb report: terraprobe test pit log file: 11-13-3052 test pit logs.gpj

Terraprobe

TEST PIT LOG 5

Client : Laurelpark Inc.

Project : Palgrave Estates II

Location : Caledon, Ontario

Project No. : 11-13-3052

Date excavated : August 19, 2013

Sheet No. : 1 of 1

Position : E: 598376, N: 4865832 (UTM 17T)

Elevation Datum : N/A

Rig type : BACKHOE

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	SAMPLES Type	Elevation Scale (m)	Lab Data and Comments
0.0		**GROUND SURFACE**					
		350mm **TOPSOIL**					
	0.4	Trace organics (WEATHERED/DISTURBED)					
0.5				1	GS		
	0.6	**SANDY SILT to SAND**, trace to some clay, trace gravel, (intermittent sand seams), compact to dense, brown / grey, moist					
1.0							
1.5				2	GS		
	1.8	**SILT**, some sand to sandy, trace clay (intermittent sand seams), compact, wet					...at 1.8m, water seepage
				3	GS		▽
	2.0	**END OF TEST PIT**					

Undrained Shear Strength (kPa)
○ Unconfined
● Pocket Penetrometer
+ Field Vane
■ Lab Vane
40 80 120 160

Moisture / Plasticity
Plastic Limit PL 10 — Natural Water Content MC 20 — Liquid Limit LL 30

Headspace Vapour

Unstabilized Water Level

GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Unstabilized water level measured at 2.0m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/23/2013	1.9	

Terraprobe

TEST PIT LOG 6

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 19, 2013
Sheet No. : 1 of 1

Position : E: 598387, N: 4865862 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Undrained Shear Strength (kPa)
○ Unconfined
● Pocket Penetrometer
+ Field Vane
■ Lab Vane
40 80 120 160

Moisture / Plasticity
Plastic Limit PL 10 · Natural Water Content MC 20 · Liquid Limit LL 30

Headspace Vapour

Unstabilized Water Level

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Depth Scale (m)	Elev Depth (m)	Description	Sample Number	Sample Type	Lab Data and Comments
0.0		GROUND SURFACE 350mm **TOPSOIL**			
	0.4	Trace organics (WEATHERED/DISTURBED)	1	GS	
0.5					
	0.7	**SAND**, trace to some silt, trace clay, compact to dense, brown, moist	2	GS	
1.0					
					...at 1.3m, water seepage
	1.4	**SILT**, some sand to sandy, trace clay, very dense, brown, wet	3	GS	
1.5					
	2.0	**END OF TEST PIT**			

Unstabilized water level measured at 2.0m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/23/2013	1.5	

Terraprobe

TEST PIT LOG 7

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 19, 2013
Sheet No. : 1 of 1

Position : E: 598393, N: 4865838 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Undrained Shear Strength (kPa)
○ Unconfined
● Pocket Penetrometer
+ Field Vane
■ Lab Vane
40 80 120 160

Moisture / Plasticity
Plastic Limit PL — Natural Water Content MC — Liquid Limit LL
10 20 30

Headspace Vapour

Unstabilized Water Level

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	SAMPLES Type	Unstabilized Water Level	Lab Data and Comments
0.0		**GROUND SURFACE**				
		300mm **TOPSOIL**				
0.5	0.5	Trace organics (WEATHERED/DISTURBED)	1	GS		
	0.7	**SANDY SILT**, trace clay, trace gravel, compact to dense, brown / grey, moist				
1.0			2	GS		
	1.4	**SANDY SILT to SAND**, trace clay, compact, brown / grey, wet				...at 1.4m, water seepage
1.5			3	GS		
	1.9 2.0	**SILT**, trace to some sand, trace to some clay, dense, brown / grey, wet	4	GS	∇	

END OF TEST PIT

Unstabilized water level measured at 2.0m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/23/2013	1.4	

TEST PIT LOG 8

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 16, 2013
Sheet No. : 1 of 1

Position : E: 598436, N: 4865818 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Undrained Shear Strength (kPa)
○ Unconfined
● Pocket Penetrometer
+ Field Vane
■ Lab Vane
40 80 120 160

Moisture / Plasticity
Plastic Limit / Natural Water Content / Liquid Limit
PL MC LL
10 20 30

Headspace Vapour

Unstabilized Water Level

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Depth Scale (m)	Elev Depth (m)	Description	Number	Type	Unstabilized Water Level	Lab Data and Comments
0.0		**GROUND SURFACE**				
		250mm **TOPSOIL**				
	0.3	Trace organics (WEATHERED/DISTURBED)				
0.5			1	GS		
	0.6	**SILT**, trace to some sand, trace to some clay, (intermittent sand seams), compact to dense, brown / grey, moist				
1.0						
1.5			2	GS		
	1.7	**SILT**, trace to some sand, trace to some clay, (intermittent sand seams), compact to dense, brown / grey, wet				...at 1.7m, water seepage
2.0					∇	
			3	GS		
2.5	2.5	**END OF TEST PIT**				

Unstabilized water level measured at 2.1m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/19/2013	2.2	
8/23/2013	2.1	

Terraprobe

TEST PIT LOG 9

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 16, 2013
Sheet No. : 1 of 1

Position : E: 598456, N: 4865792 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Undrained Shear Strength (kPa)
○ Unconfined
● Pocket Penetrometer
+ Field Vane
■ Lab Vane
40 80 120 160

Moisture / Plasticity
Plastic Limit PL 10 — Natural Water Content MC 20 — Liquid Limit LL 30

Headspace Vapour

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	SAMPLES Type	Elevation Scale (m)	Unstabilized Water Level
0.0		**GROUND SURFACE**				
		200mm **TOPSOIL**				
	0.2	Trace organics (WEATHERED/DISTURBED)				
0.5			1	GS		
	0.6	**SILT**, trace to some sand, trace clay, (intermittent sand seams), compact to dense, brown, moist				
1.0						
1.5						
			2	GS		▽
2.0		...wet				
	2.1	**END OF TEST PIT**				

Unstabilized water level measured at 2.0m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/19/2013	2.0	
8/23/2013	2.0	

Terraprobe

TEST PIT LOG 10

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 19, 2013
Sheet No. : 1 of 1

Position : E: 598432, N: 4865786 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Depth Scale (m)	SOIL PROFILE Elev Depth (m)	 Description	 Graphic Log	SAMPLES Number	 Type	Elevation Scale (m)	Undrained Shear Strength (kPa) ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane 40 80 120 160	Moisture / Plasticity Plastic Limit PL, Natural Water Content MC, Liquid Limit LL 10 20 30	Headspace Vapour	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0.0		**GROUND SURFACE**									
		300mm **TOPSOIL**									
	0.3	Trace organics (WEATHERED/DISTURBED)		1	GS						
0.5	0.5	**CLAYEY SILT**, trace to some sand, very stiff, brown / grey, moist									
1.0											
1.5				2	GS						
	1.8	**SILT**, trace to some sand, trace to some clay, compact to dense, brown / grey, moist to wet									...at 1.8m, water seepage
2.0				3	GS					▽	
	2.1	**END OF TEST PIT**									

Unstabilized water level measured at 2.0m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/23/2013	1.9	

library: library - terraprobe gint.glb report: terraprobe test pit log file: 11-13-3052 test pit logs.gpj

Terraprobe

TEST PIT LOG 11

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 19, 2013
Sheet No. : 1 of 1

Position : E: 598415, N: 4865777 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	SAMPLES Type	Elevation Scale (m)	Undrained Shear Strength (kPa) ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane 40 80 120 160	Moisture / Plasticity Plastic Limit PL, Natural Water Content MC, Liquid Limit LL 10 20 30	Headspace Vapour	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0.0		**GROUND SURFACE**									
		300mm **TOPSOIL**									
0.5	0.3	Trace organics (WEATHERED/DISTURBED)		1	GS						
1.0	0.6	**CLAYEY SILT**, trace to some sand, trace gravel, stiff, brown / grey, moist									
		...wet		2	GS						...at 1.4m, water seepage
				3	GS						
1.5	1.5	**SILT**, trace to some sand, trace to some clay, compact to dense, brown / grey, moist									
		...wet		4	GS					▽	
	2.0	**END OF TEST PIT**									

Unstabilized water level measured at 2.0m below grade; test pit was open upon completion of excavation.

SEEPAGE MEASUREMENTS

Time	Water Depth (m)	Elevation (m)
8/23/2013	1.5	

Terraprobe

TEST PIT LOG 12

Client : Laurelpark Inc.
Project : Palgrave Estates II
Location : Caledon, Ontario

Project No. : 11-13-3052
Date excavated : August 16, 2013
Sheet No. : 1 of 1

Position : E: 598405, N: 4865760 (UTM 17T)
Elevation Datum : N/A
Rig type : BACKHOE

Undrained Shear Strength (kPa)
○ Unconfined
● Pocket Penetrometer
+ Field Vane
■ Lab Vane
40 80 120 160

Moisture / Plasticity
Plastic Limit PL 10 — Natural Water Content MC 20 — Liquid Limit LL 30

Headspace Vapour

Unstabilized Water Level

Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	SAMPLES Type
0.0		**GROUND SURFACE**		
		250mm **TOPSOIL**		
	0.3	Trace organics (WEATHERED/DISTURBED)		
0.5			1	GS
	0.7	**SANDY SILT**, (intermittent sand seams), compact to dense, brown, moist		
1.0				
		...intermittent sand seams		
1.5			2	GS
	1.6	**SILT**, trace to some sand, trace to some gravel, compact to dense, brown / grey, moist		
2.0			3	GS
	2.2	**END OF TEST PIT**		

Test pit was dry and open upon completion of excavation.

TEST PIT PHOTOGRAPHS

TERRAPROBE INC.

Palgrave Estates II, Residential Development, Caledon

Photo 1 Test Pit: 1. Overall view of test pit upon completion.

Photo 2 Test Pit: 1. A view of the test pit on August 23, 2013, approximately one week following the excavation.

NOTE: For details please see Test Pit Log 1.

Photo 3 Test Pit: 2. Overall view of test pit upon completion.

Photo 4 Test Pit: 2. A view of the test pit on August 23, 2013, approximately one week following the excavation.
NOTE: For details please see Test Pit Log 2.

Palgrave Estates II, Residential Development, Caledon

Photo 5 Test Pit: 3. Overall view of test pit upon completion.

Photo 6 Test Pit: 3. A view of the test pit on August 23, 2013, approximately one week following the excavation.
NOTE: For details please see Test Pit Log 3.

Photo 7 Test Pit: 4. Overall view of test pit upon completion.

Photo 8 Test Pit: 4. A view of the test pit on August 23, 2013, approximately one week following the excavation.
NOTE: For details please see Test Pit Log 4.

Photo 9 Test Pit: 5. Overall view of test pit upon completion.

Photo 10 Test Pit: 5. A view of the test pit on August 23, 2013, approximately four days following the excavation.
NOTE: For details please see Test Pit Log 5.

Palgrave Estates II, Residential Development, Caledon

Photo 11 Test Pit: 6. Overall view of test pit upon completion.

Photo 12 Test Pit: 6. A view of the test pit on August 23, 2013, approximately four days following the excavation.
NOTE: For details please see Test Pit Log 6.

Photo 13 Test Pit: 7. Overall view of test pit upon completion.

Photo 14 Test Pit: 7. A view of the test pit on August 23, 2013, approximately four days following the excavation.
NOTE: For details please see Test Pit Log 7.

Photo 15 Test Pit: 8. Overall view of test pit upon completion.

Photo 16 Test Pit: 8. A view of the test pit on August 23, 2013, approximately one week following the excavation.
NOTE: For details please see Test Pit Log 8.

Photo 17 Test Pit: 9. Overall view of test pit upon completion.

Photo 18 Test Pit: 9. A view of the test pit on August 23, 2013, approximately one week following the excavation.
NOTE: For details please see Test Pit Log 9.

Photo 19 Test Pit: 10. Overall view of test pit upon completion.

Photo 20 Test Pit: 10. A view of the test pit on August 23, 2013, approximately four days following the excavation.
NOTE: For details please see Test Pit Log 10.

Photo 21 Test Pit: 11. Overall view of test pit upon completion.

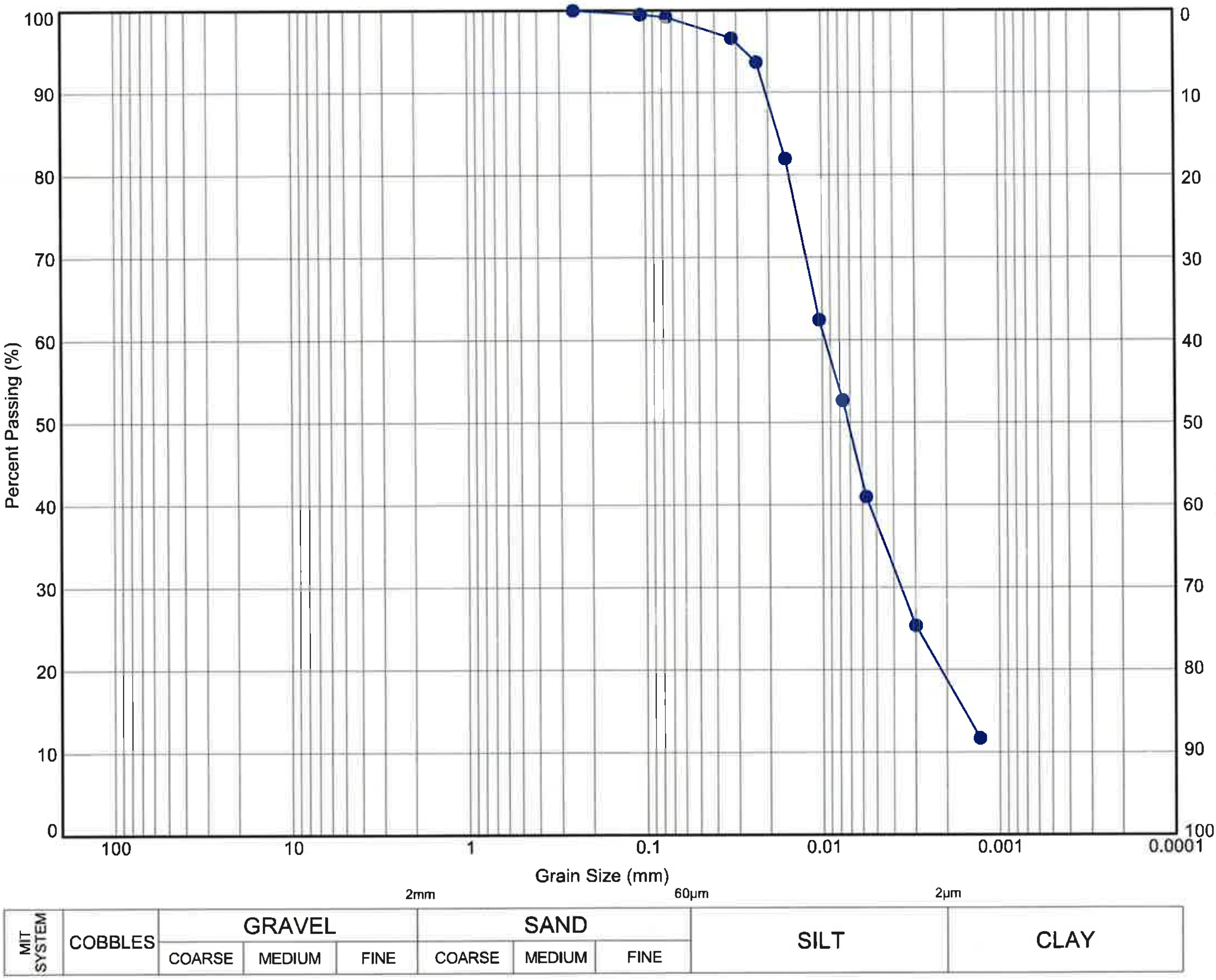
Photo 22 Test Pit: 11. A view of the test pit on August 23, 2013, approximately four days following the excavation.
NOTE: For details please see Test Pit Log 11.

Photo 23 Test Pit: 12. Overall view of test pit upon completion.

Photo 24 Test Pit: 12. A view of the test pit on August 23, 2013, approximately one week following the excavation.
NOTE: For details please see Test Pit Log 12.

SIEVE AND HYDROMETER ANALYSIS

TERRAPROBE INC.



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	1	SS5	3.3	269.8	0	1	80	19	

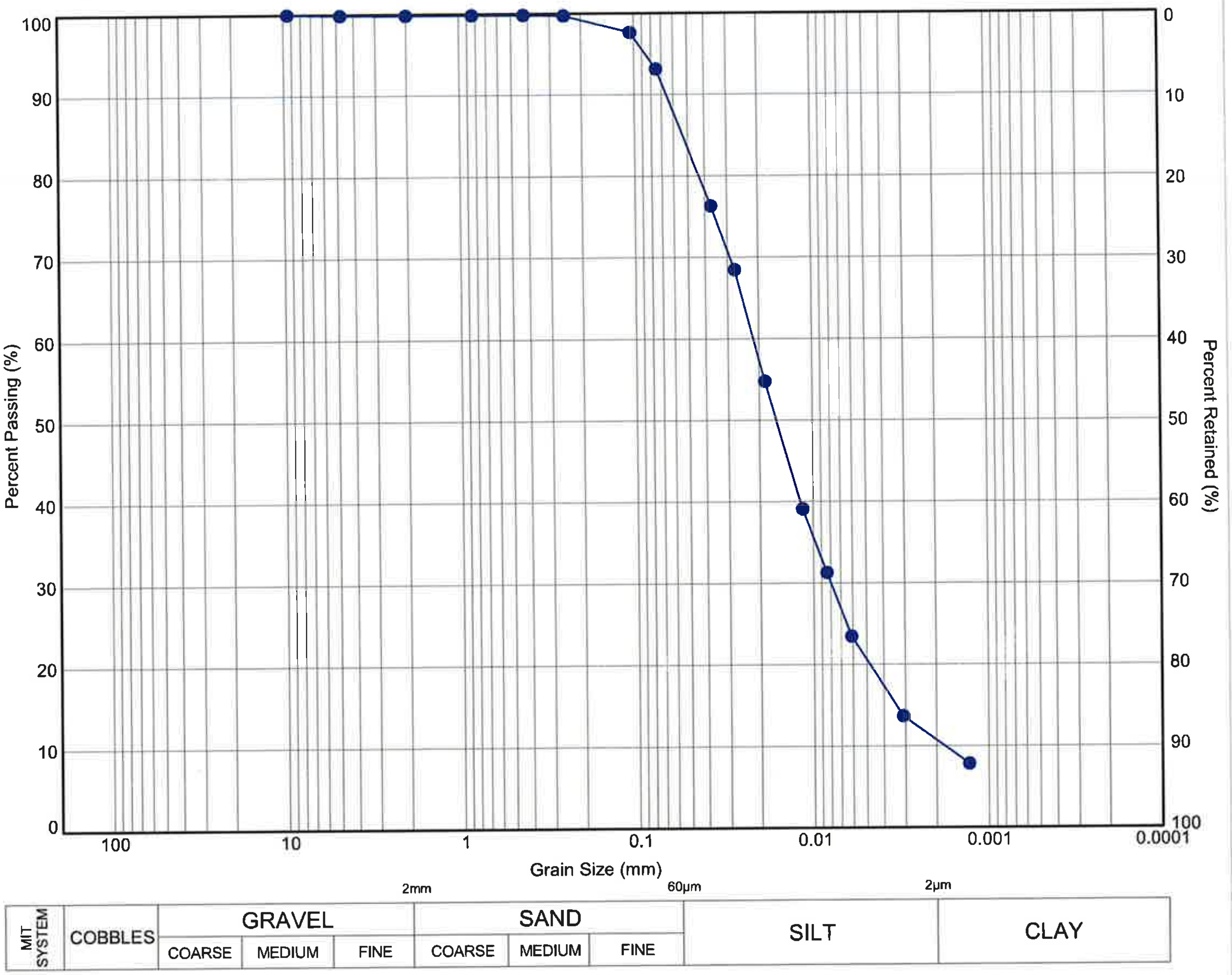
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, SOME CLAY, TRACE SAND

File No.: **11-13-3052**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**2**	SS4	2.5	277.5	0	12	77	11	

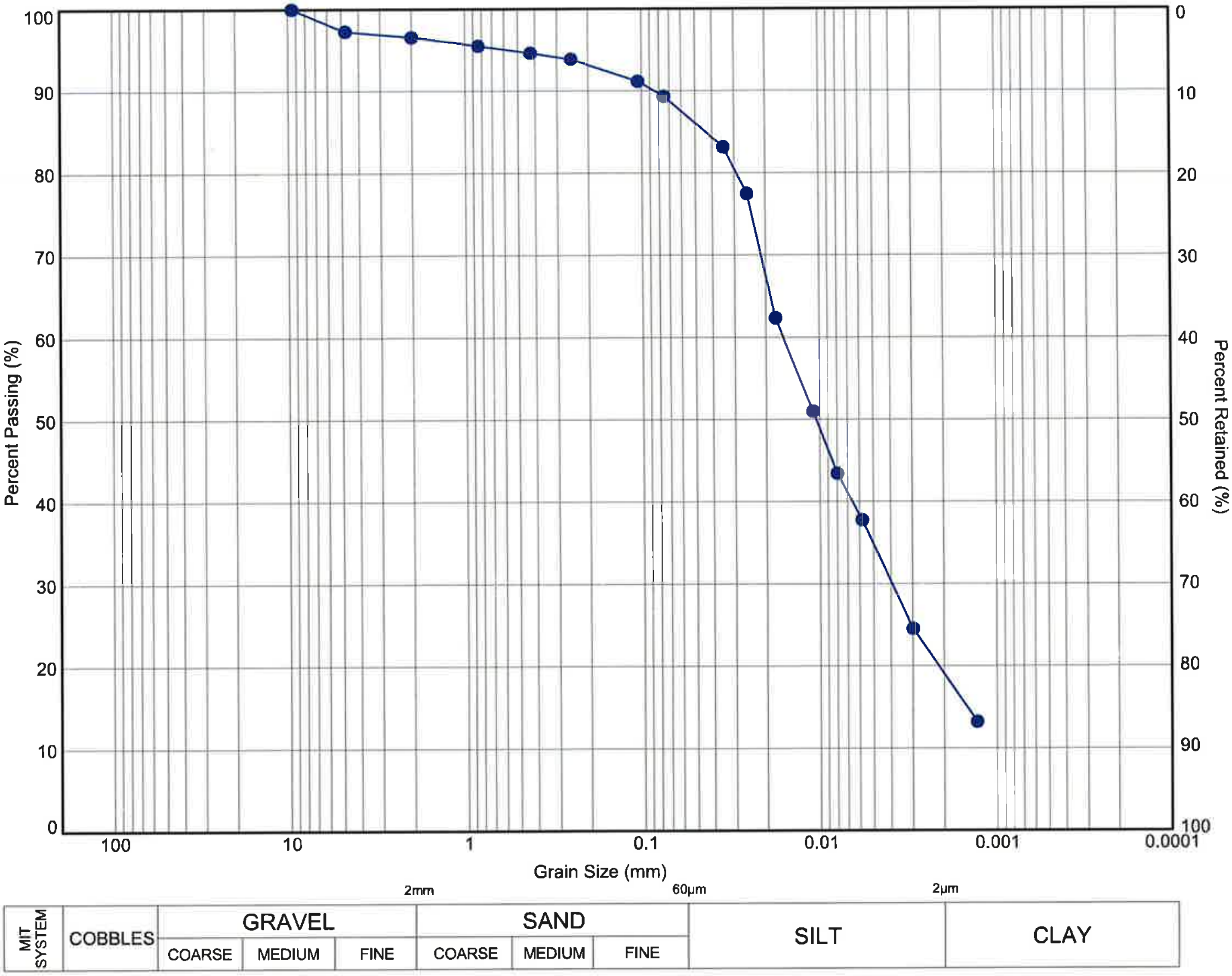
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, SOME SAND, SOME CLAY

File No.: **11-13-3052**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**4**	SS5	3.3	278.6	3	9	69	19	

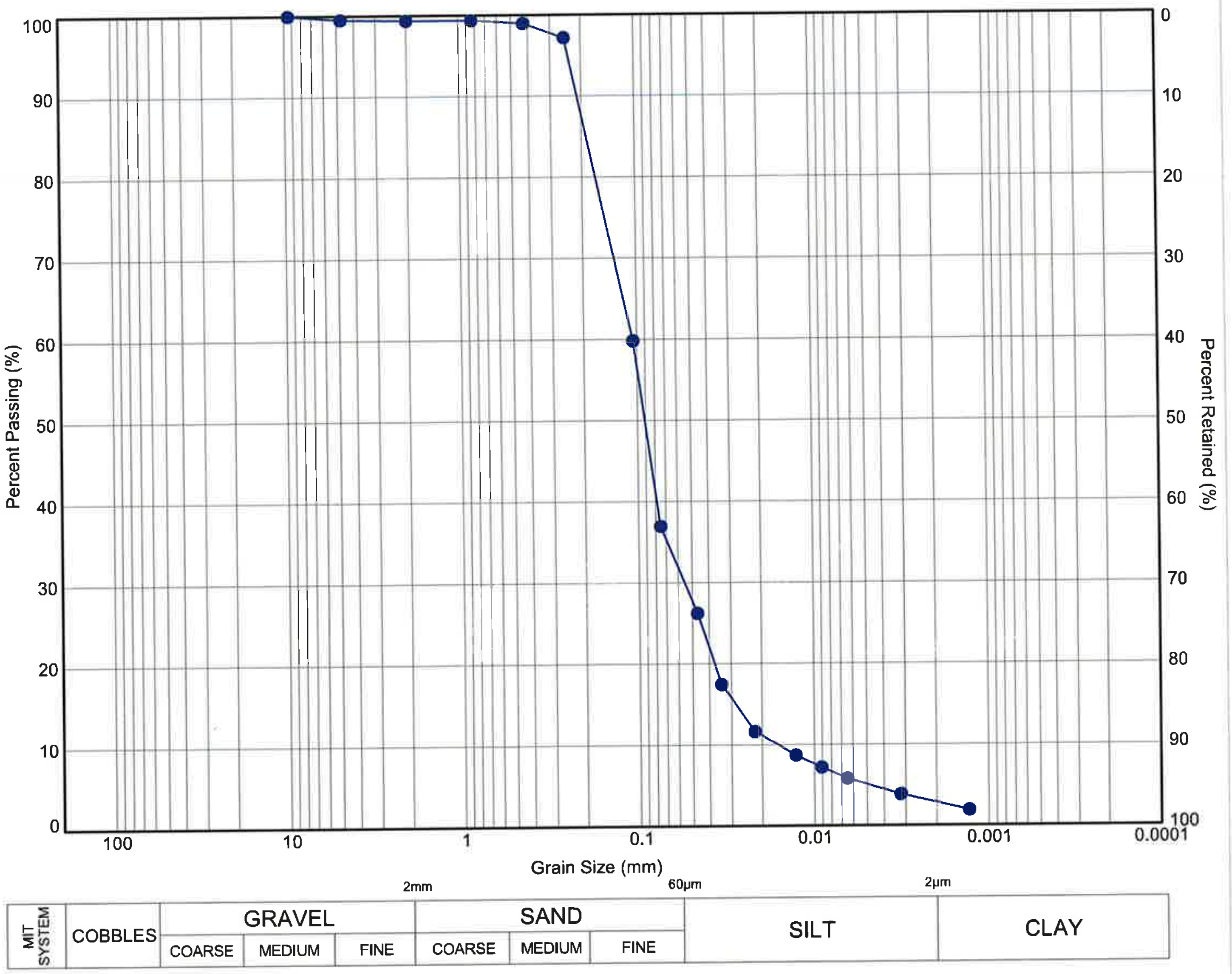
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, SOME CLAY, TRACE SAND, TRACE GRAVEL

File No.: **11-13-3052**



				MIT SYSTEM				
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
● **5**	SS5	3.3	281.9	1	67	29	3	

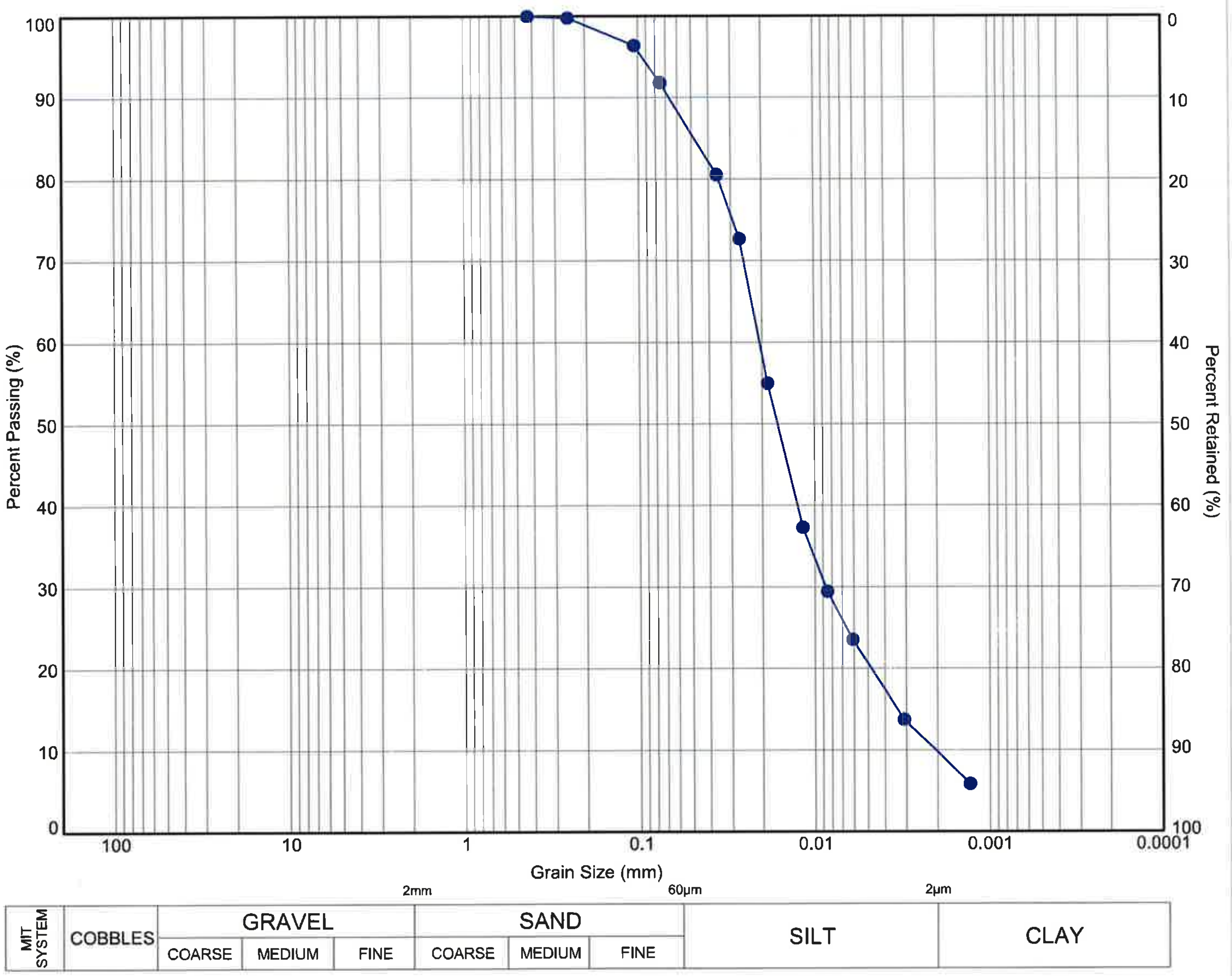
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILTY SAND, TRACE CLAY, TRACE GRAVEL

File No.: **11-13-3052**



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**6**	SS7	6.3	271.7	0	11	79	10	

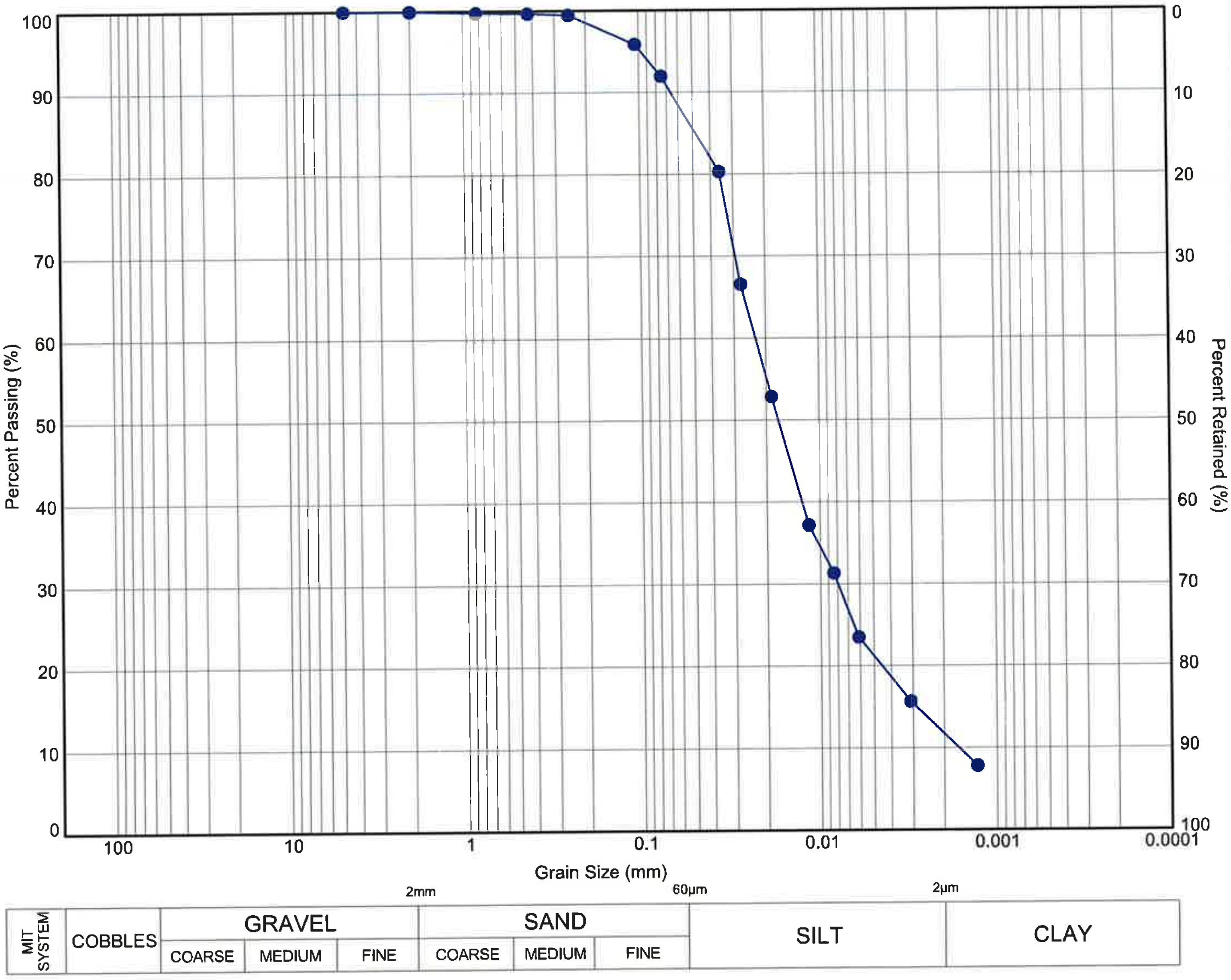
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, SOME SAND, SOME CLAY

File No.: **11-13-3052**



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**8**	SS6	4.8	276.1	0	11	77	12	

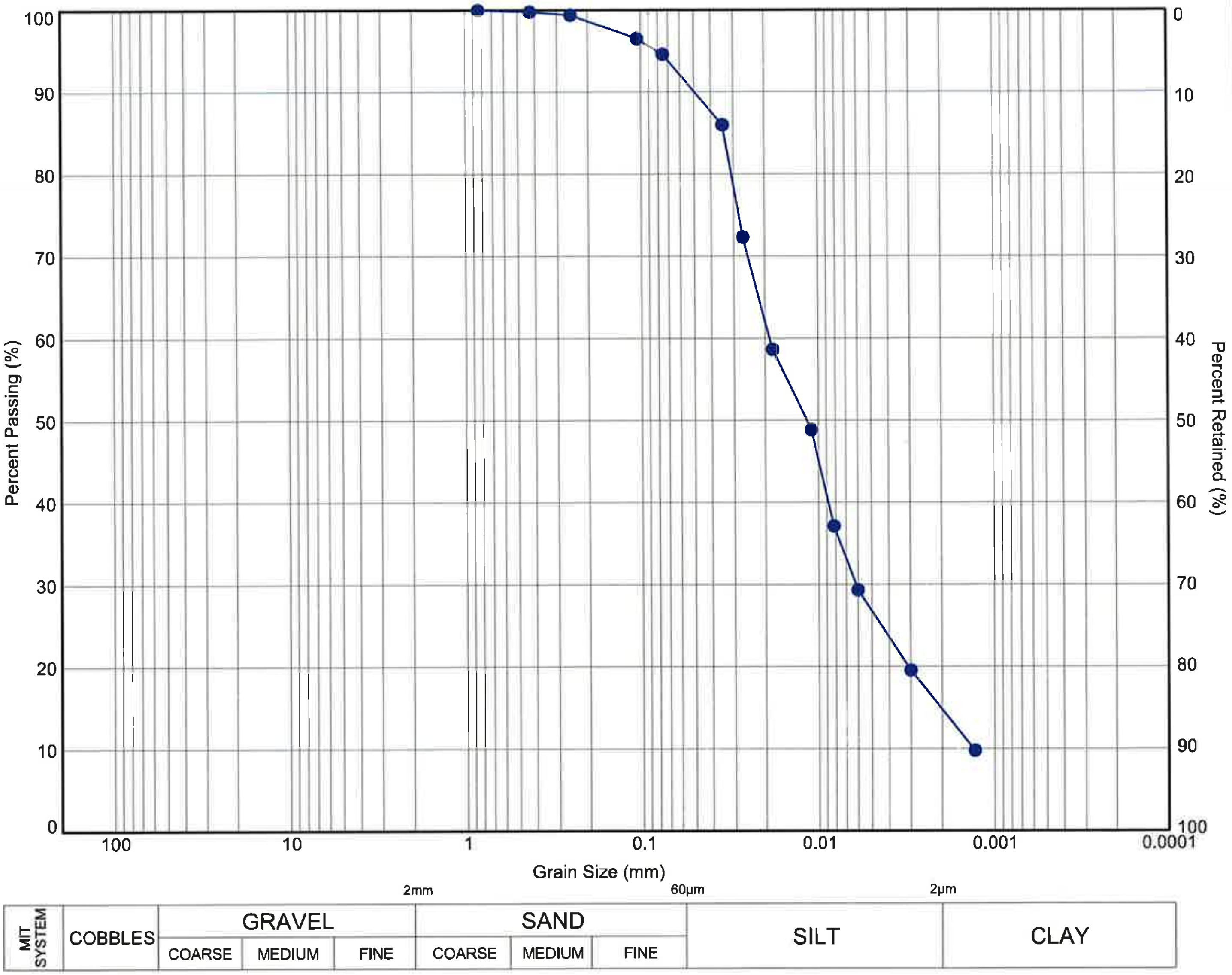
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, SOME CLAY, SOME SAND

File No.: **11-13-3052**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**9**	SS3	1.8	280.9	0	8	77	15	

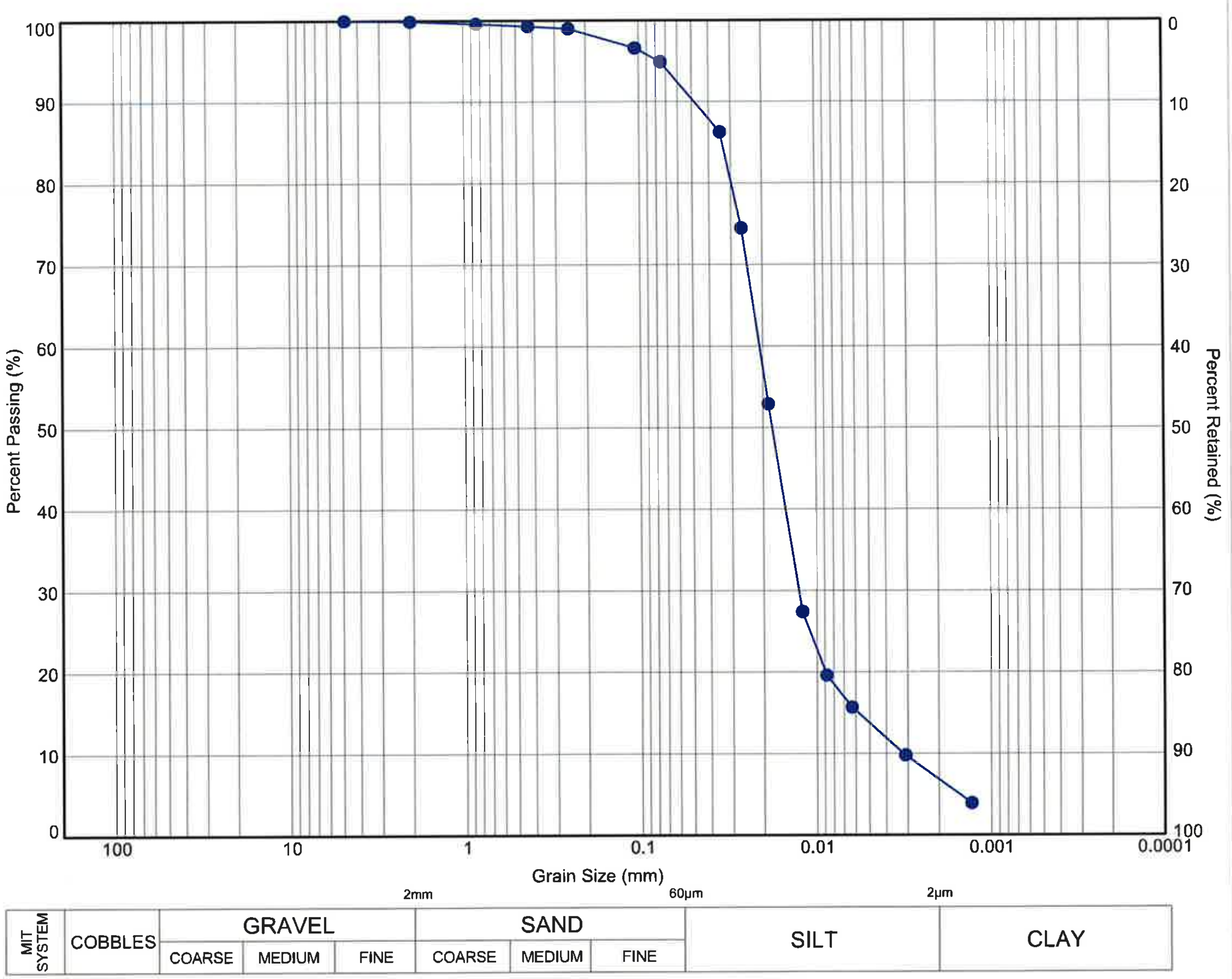
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, SOME CLAY, TRACE SAND

File No.: **11-13-3052**



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**10**	SS5	3.3	275.8	0	7	86	7	

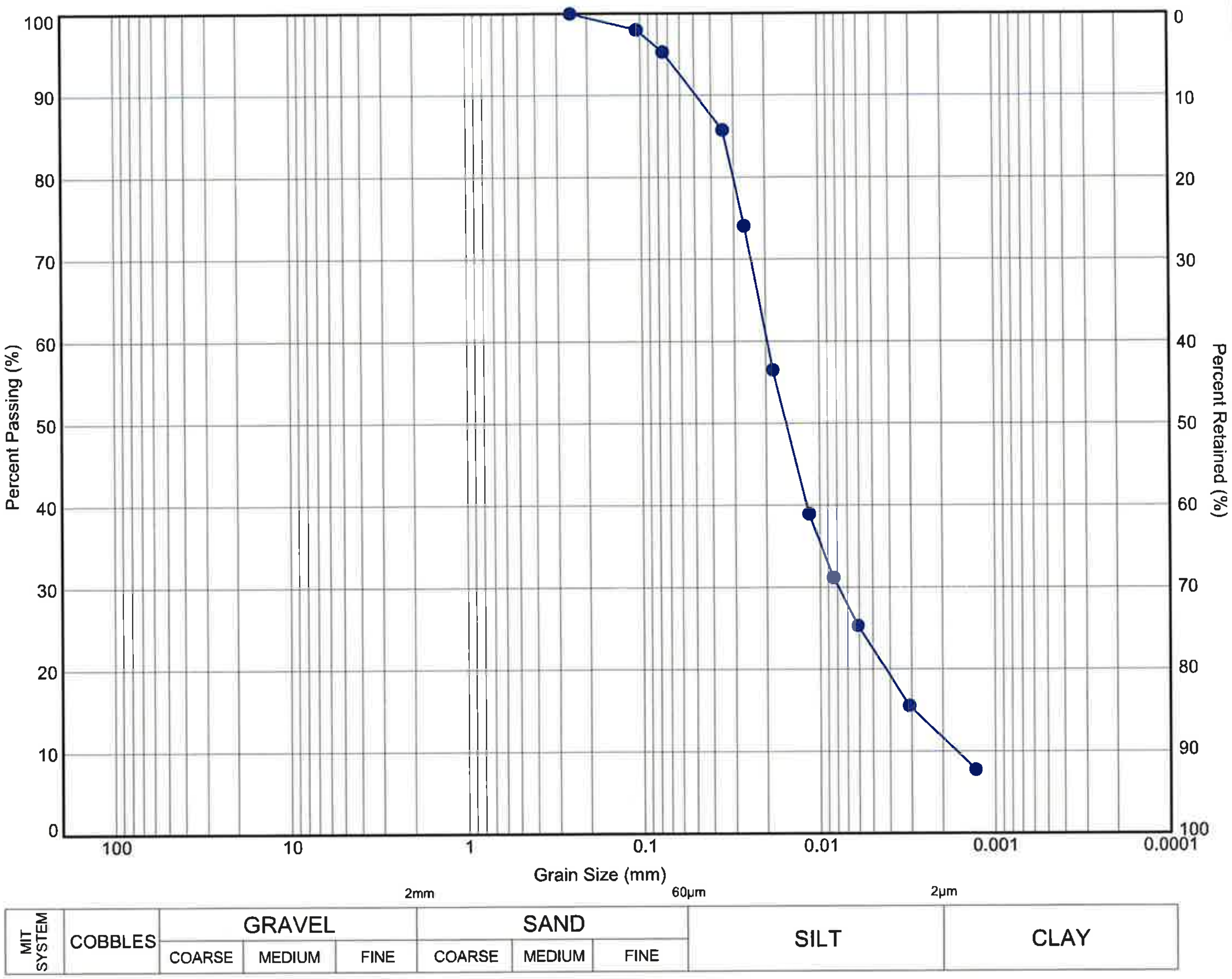
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, TRACE CLAY, TRACE SAND

File No.: **11-13-3052**



	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
					MIT SYSTEM				
●	**11**	SS4	2.5	277.7	0	7	81	12	

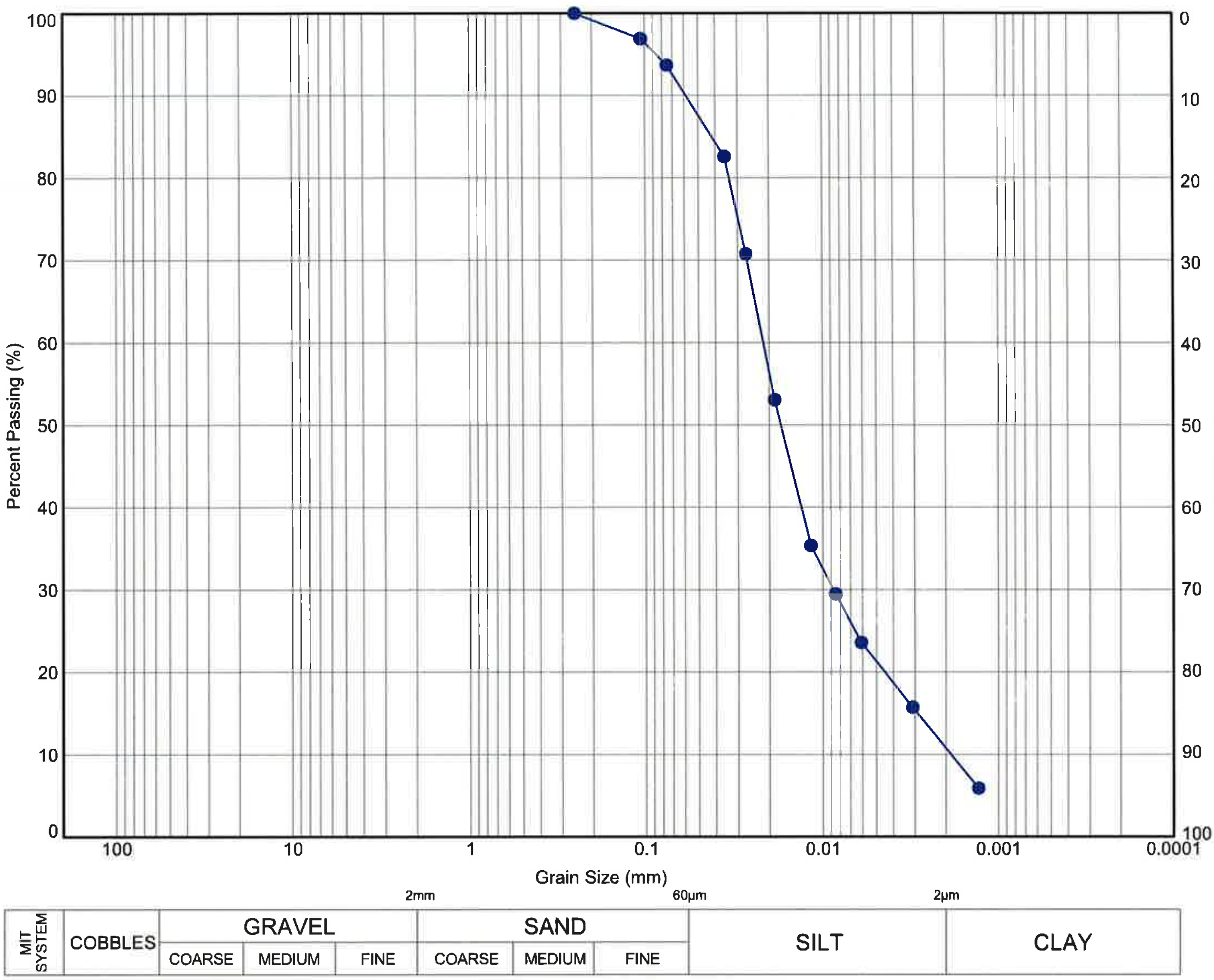
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, SOME CLAY, TRACE SAND

File No.: **11-13-3052**



					MIT SYSTEM				
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**11**	SS7	6.2	274.0	0	9	80	11	

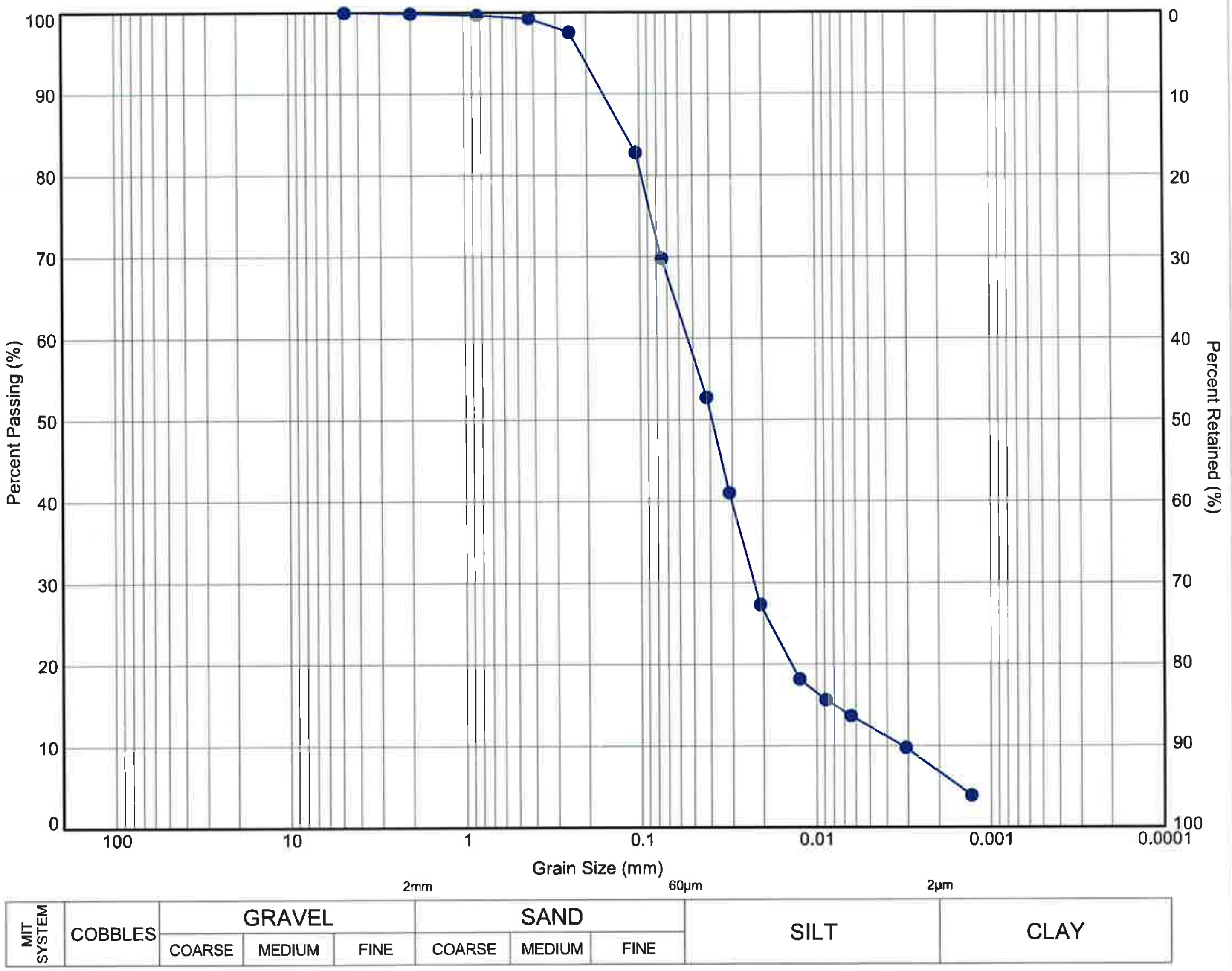
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILT, SOME CLAY, TRACE SAND

File No.: **11-13-3052**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**12**	SS3	1.8	283.5	0	36	57	7	

Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

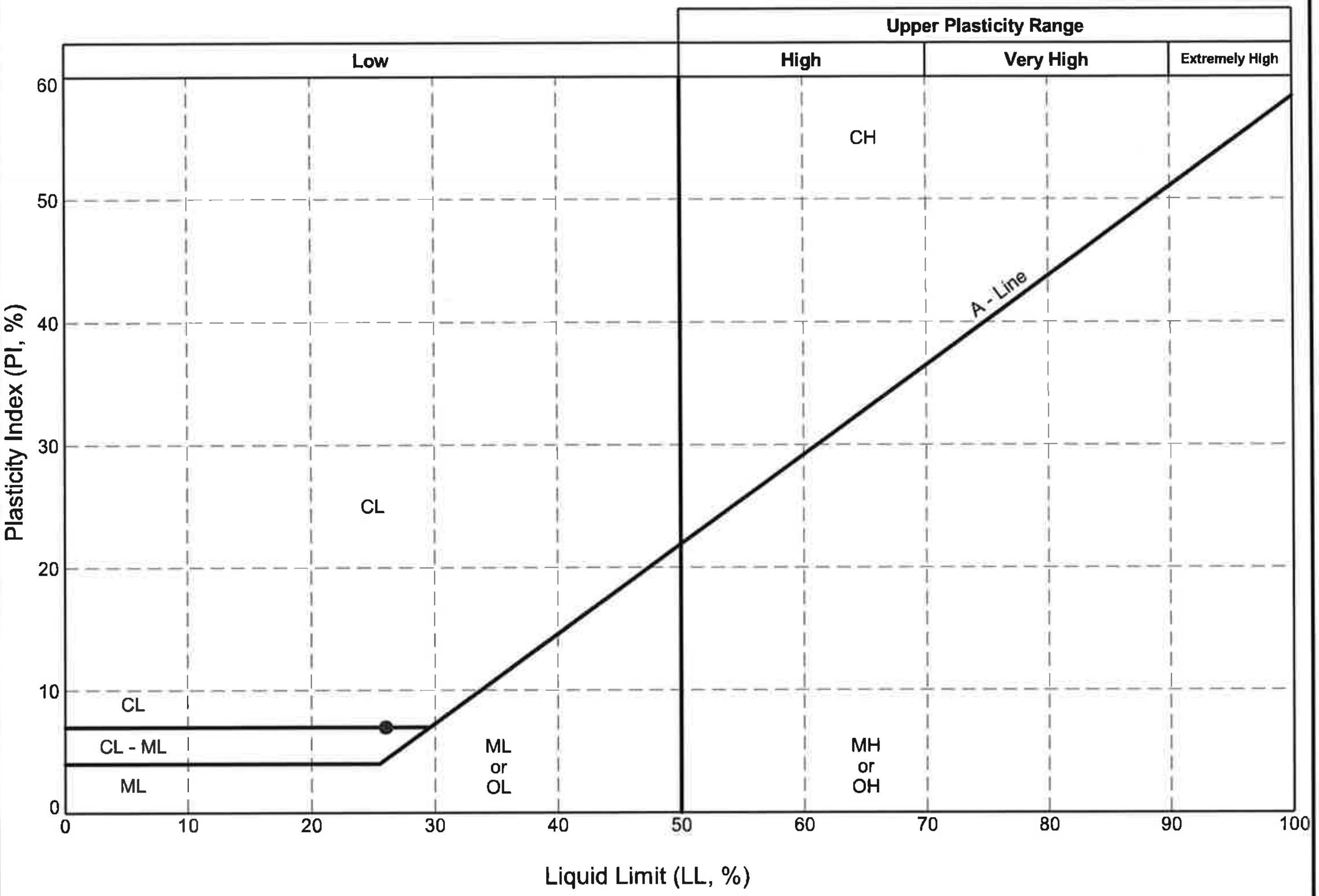
Title:

GRAIN SIZE DISTRIBUTION
SILT AND SAND, TRACE CLAY

File No.: **11-13-3052**

ATTERBERG LIMITS TEST RESULTS

TERRAPROBE INC.



Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)	Description
● 1	SS5	3.3	269.8	26	19	7	SLIGHTLY PLASTIC, SLIGHT OR LOW COMPRESSIBILITY

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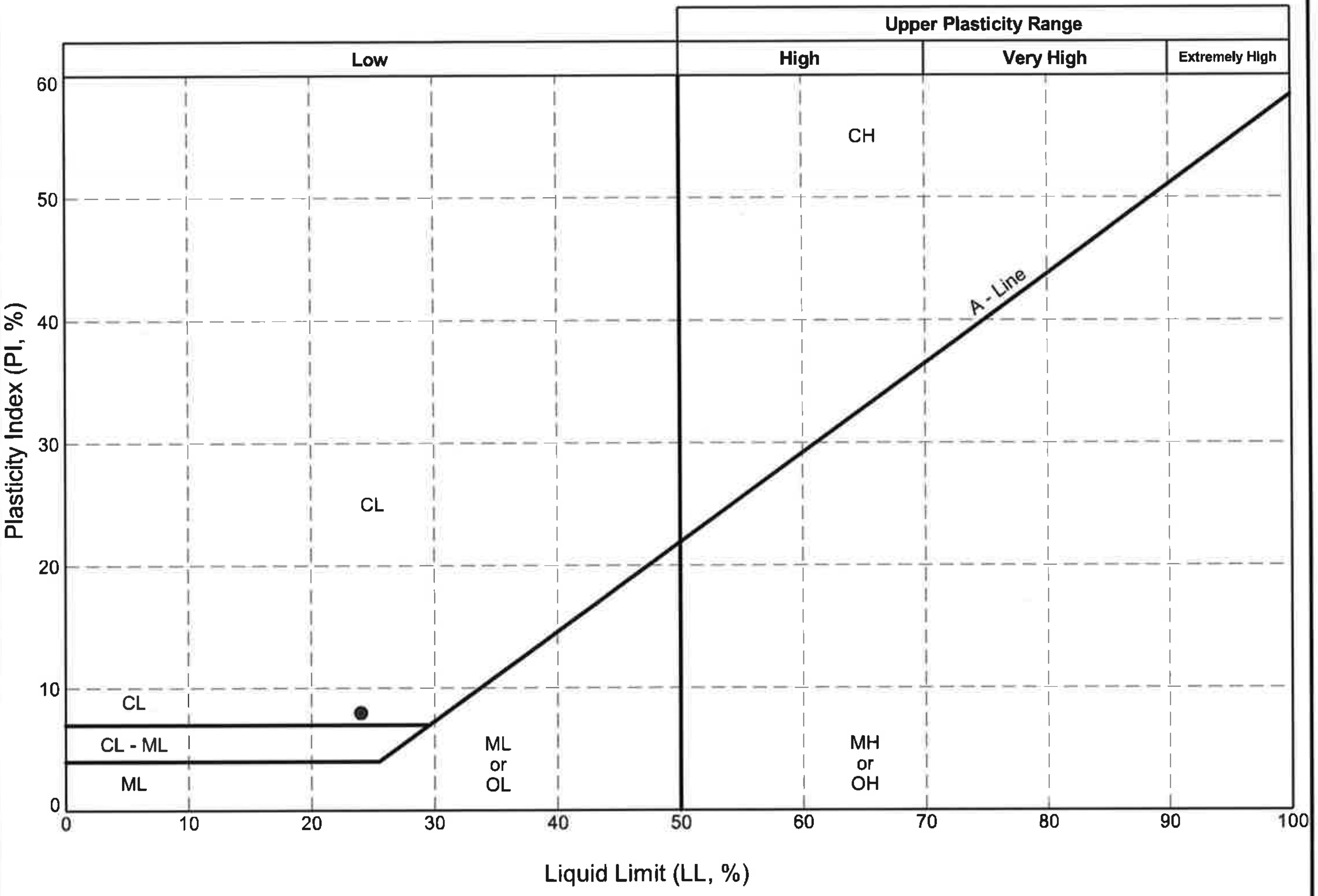
Title:

ATTERBERG LIMITS CHART

File No.:

11-13-3052



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)	Description
●	4	SS5	3.3	278.6	24	16	8	SLIGHTLY PLASTIC

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Title:

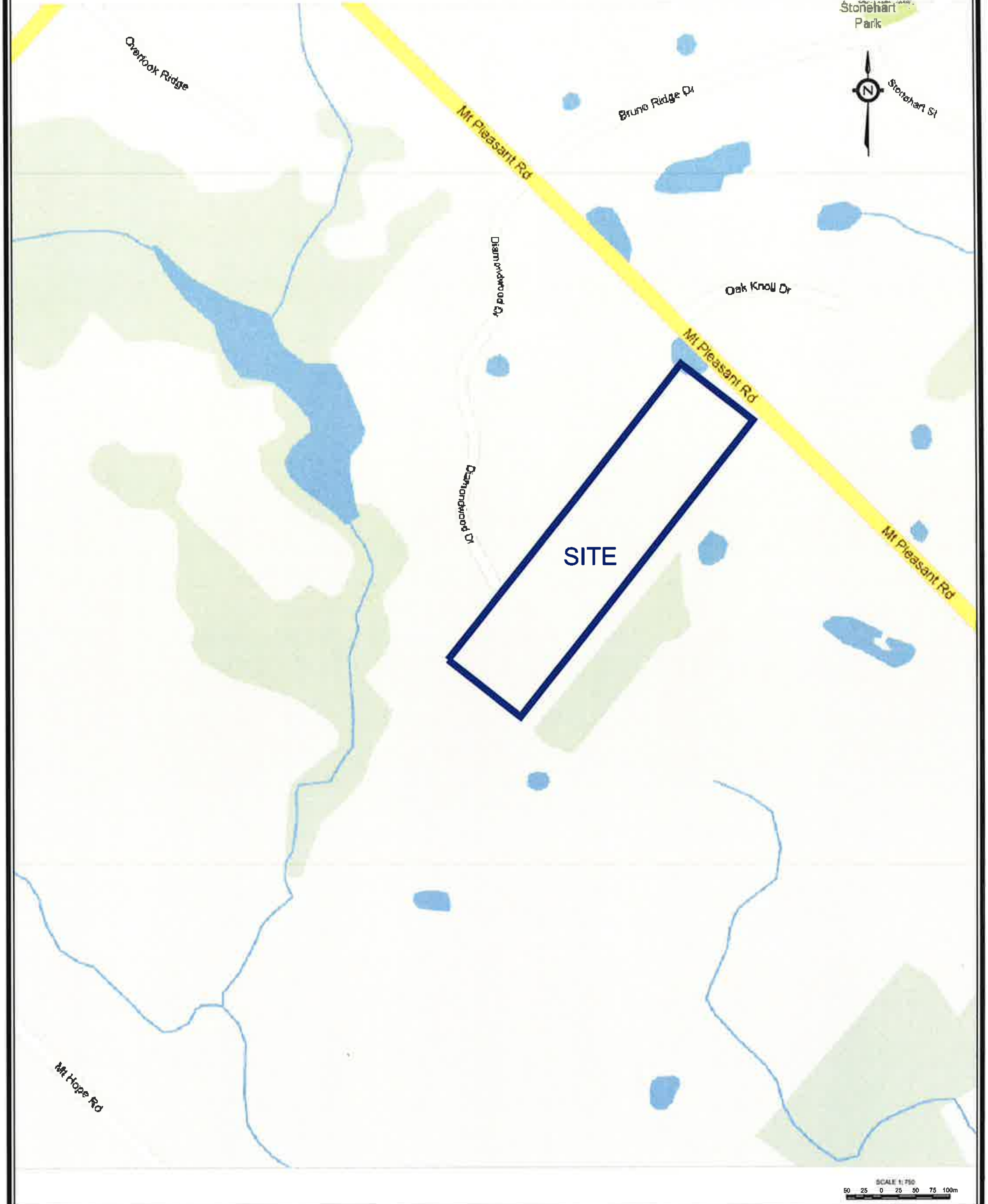
ATTERBERG LIMITS CHART

File No.:

11-13-3052

FIGURES

TERRAPROBE INC.



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Title:

SITE LOCATION PLAN

File No.

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FIGURE :

1

LEGEND

⌖ Borehole Location

REFERENCE

Google Earth 2013

SCALE 50 25 0 25 50 75 100m

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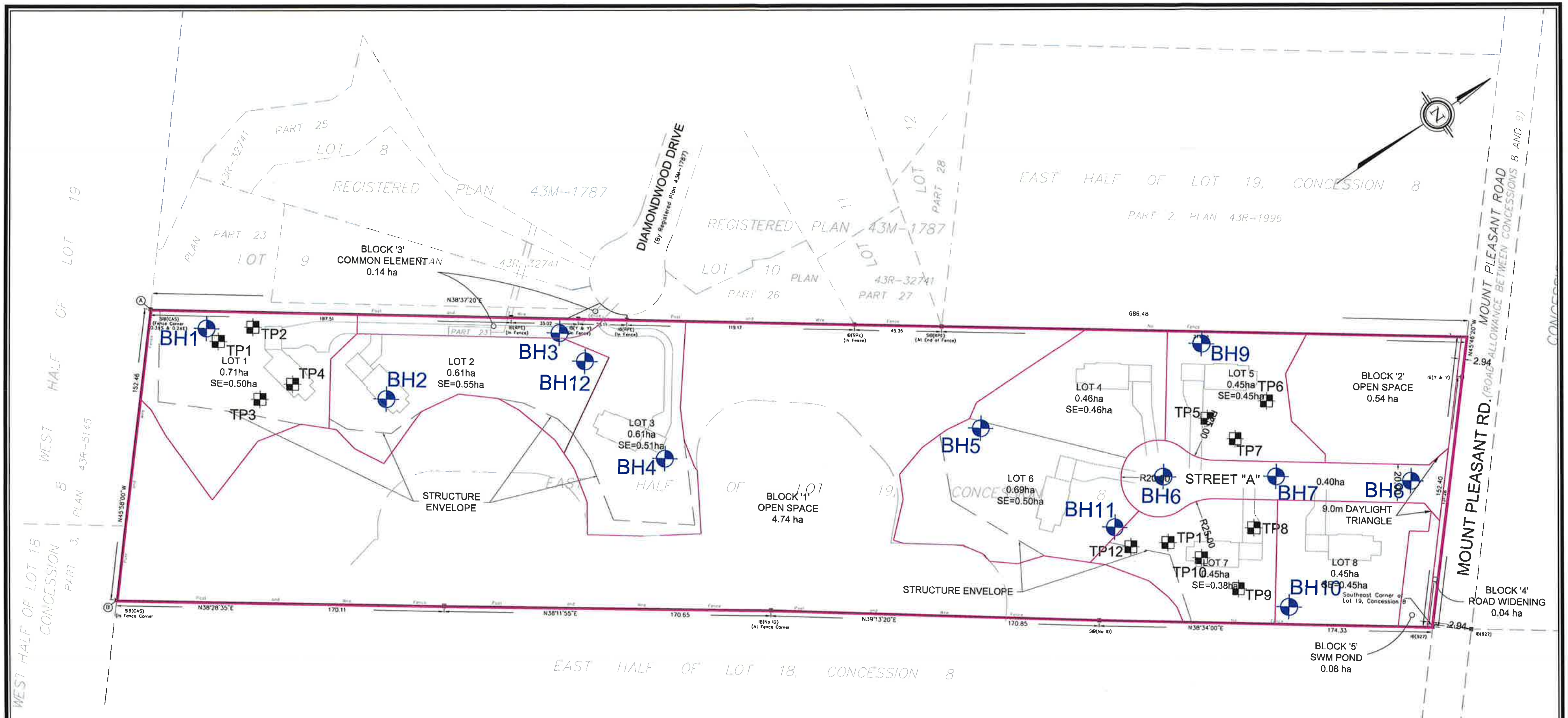
Title: **AERIAL PHOTO**

File No. 11-13-3052

FIGURE : 1A



REFERENCE

Drawing provided in digital format by Laurelpark Inc., drawing file x39680_Laurelpark_DP_20170509.dwg, 124821 SKETCH To Vienna, july 17, 2012.dwg. received June 21, 2017 by email.

LEGEND

▨ Test Pit Locations

⌖ Borehole Locations

— Property Boundary

30m 0 60m

SCALE 1: 2,000

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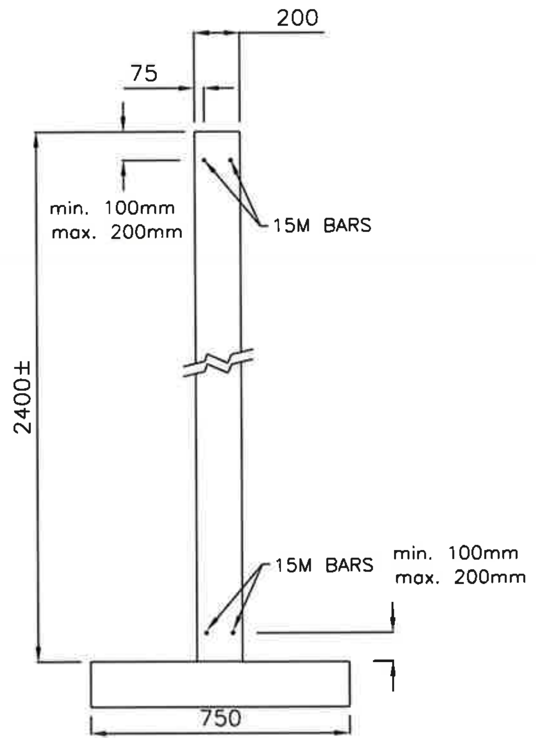
Title:
BOREHOLE AND TEST PIT LOCATION PLAN

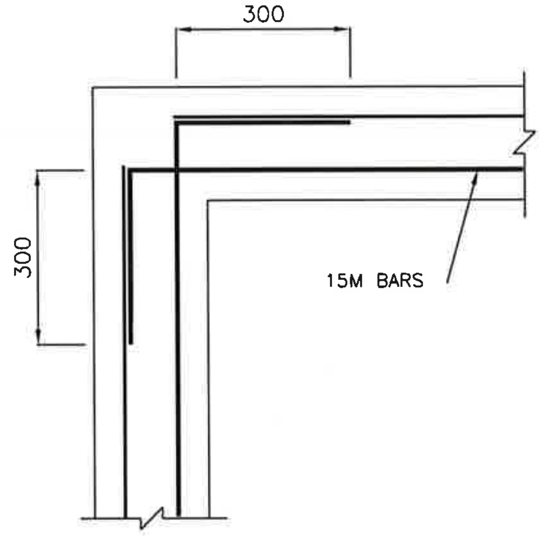
File No. 11-13-3052

FIGURE : 2



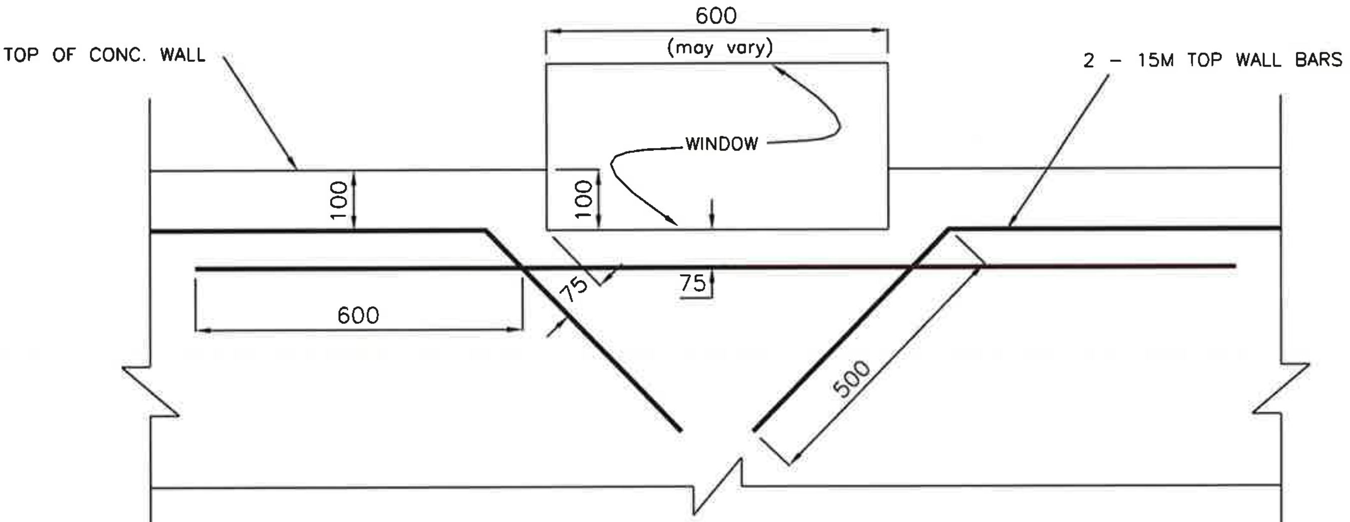
TYPICAL REINFORCED WALL

NOT TO SCALE



TYPICAL SPLICING AT CORNERS

NOT TO SCALE



TYPICAL WINDOW REINFORCING

NOT TO SCALE

NOTES:
1. Reinforcing steel C.S.A. G30.18–09 Grade 400
2. Concrete min. 28 day strength 20MPa (3000psi)
3. Base of all footing excavations to be inspected and approved prior to placing formwork.
4. All dimensions are in mm.

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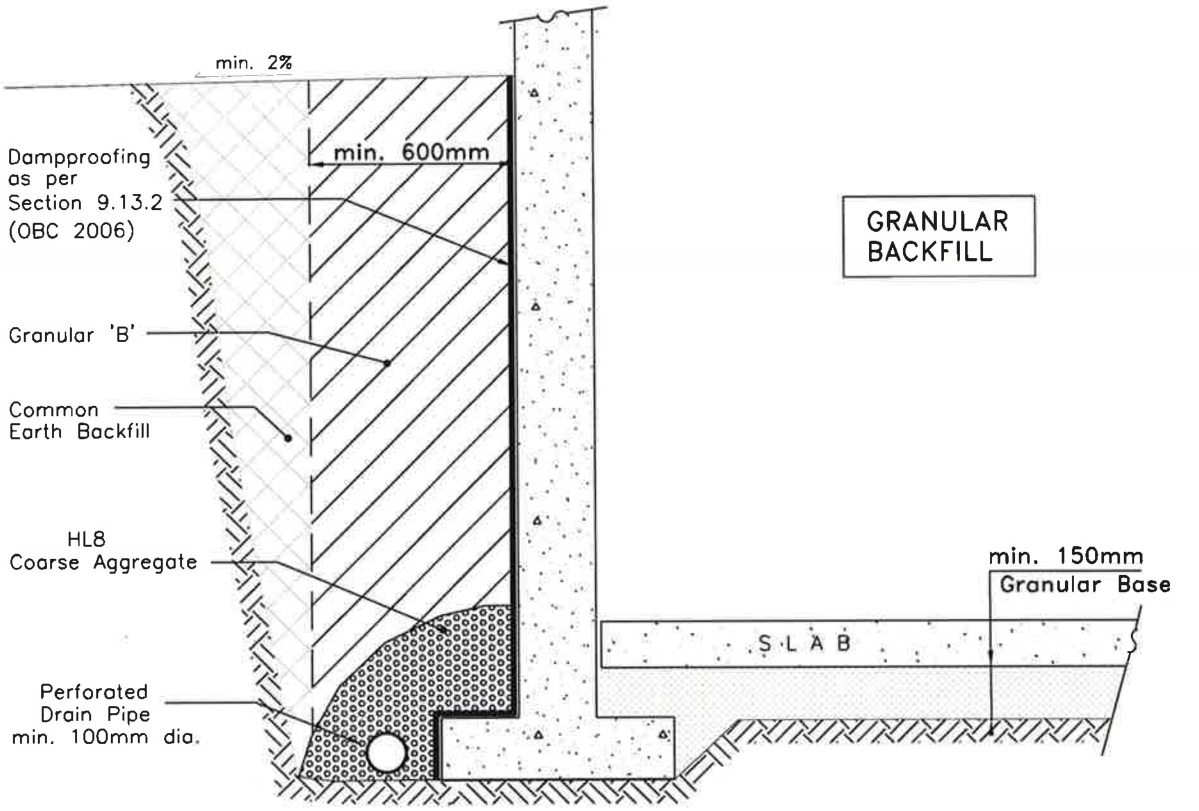
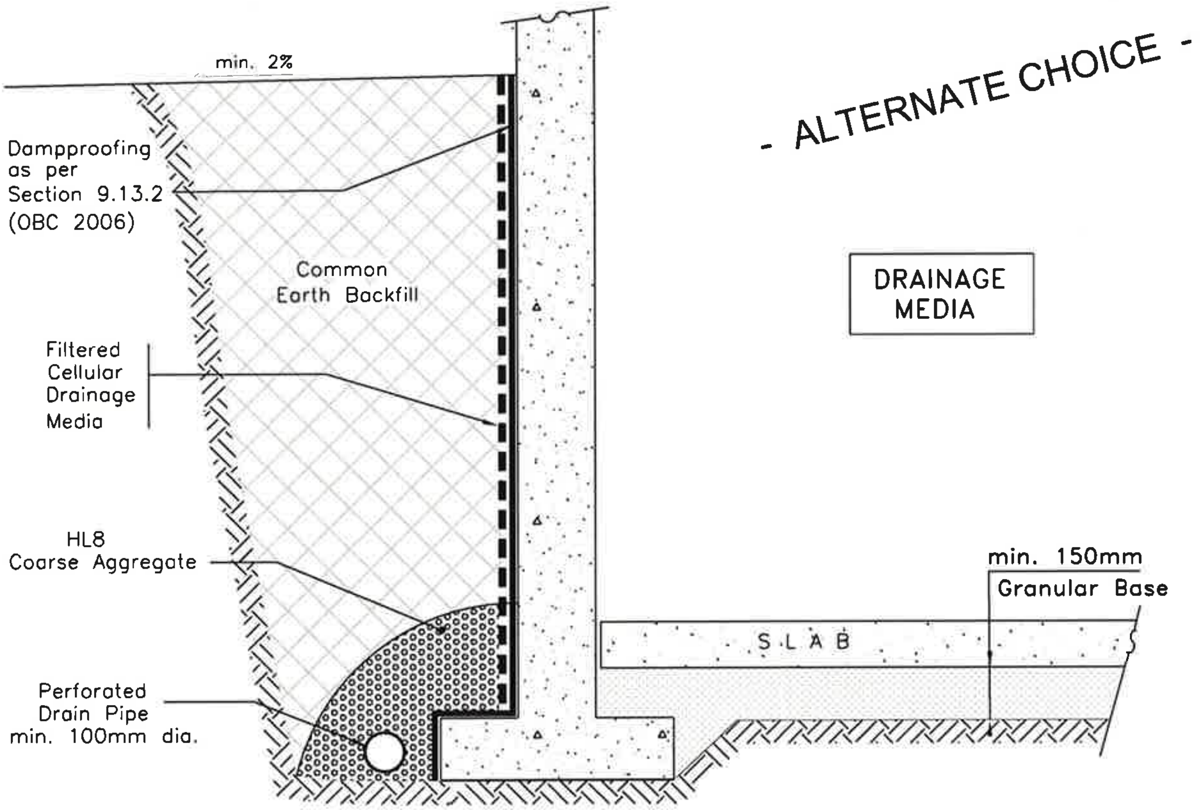
TYPICAL REINFORCED WALL DETAILS FOR HOUSES ON ENGINEERED FILL

11-13-3052

FIGURE: 3

\\PDC\server1-Project Files\11-Geo\2013\11-13-3052\A. Dwgs, Logs\AutoCAD\11-13-3052 fig 3.dwg, Kamal





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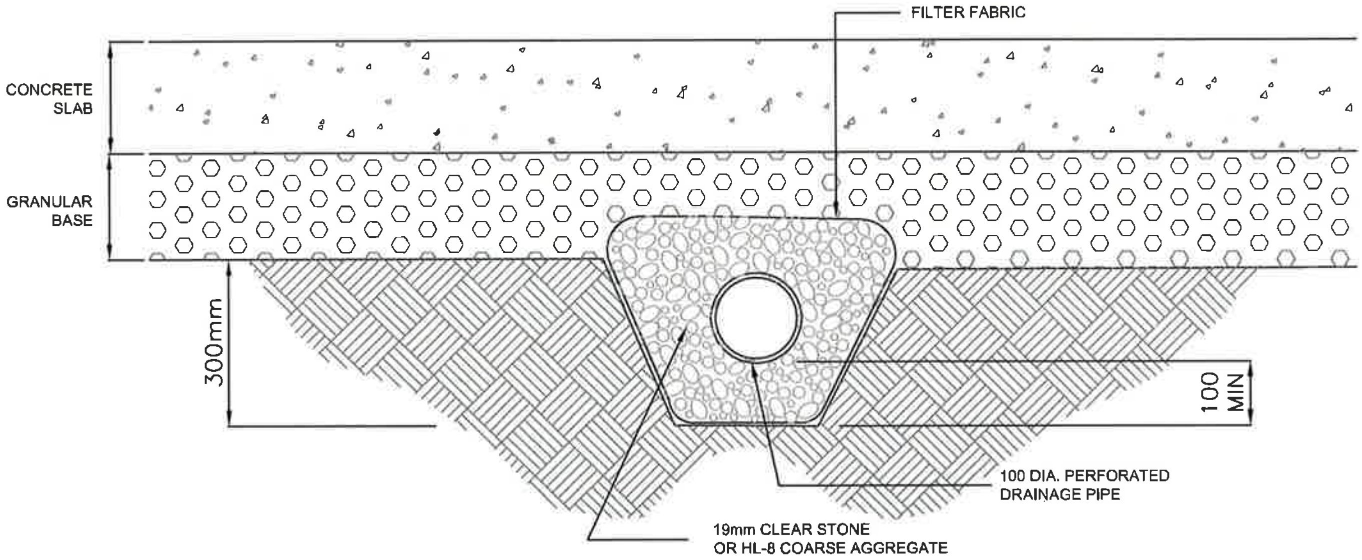
Title: BASEMENT DRAINAGE DETAIL

File No.: 11-13-3052

FIGURE: 4

\\PDC\Server\1-Project Files\11-Geo\2013\11-13-3052\A Dwgs, Logs\AutoCAD\11-13-3052 fig 4.dwg, Kamal



SUBDRAINAGE TRENCH DETAIL

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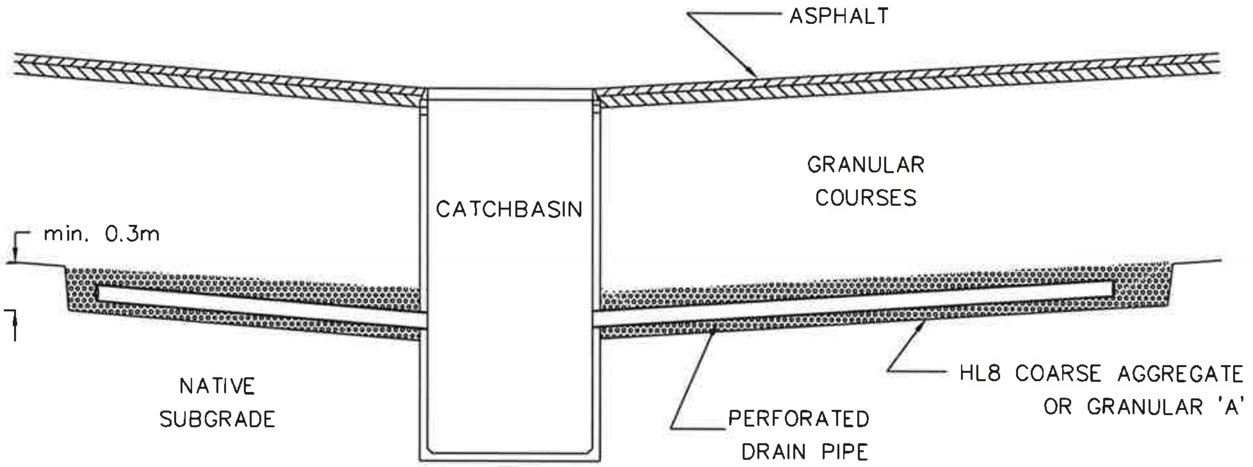
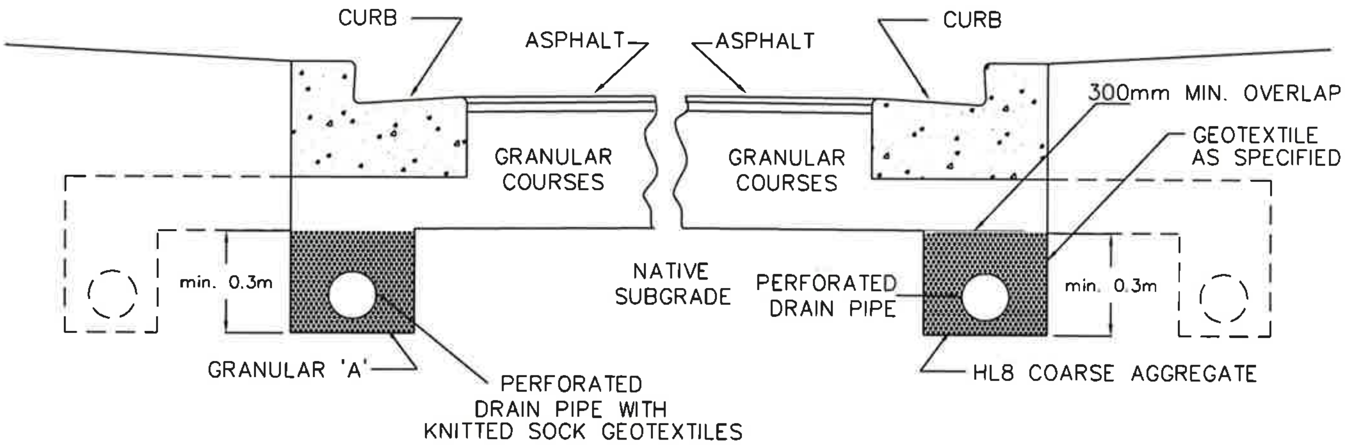
Title: **BASEMENT FLOOR SUBDRAINS**

FIGURE : 4A

File No. 11-13-3052



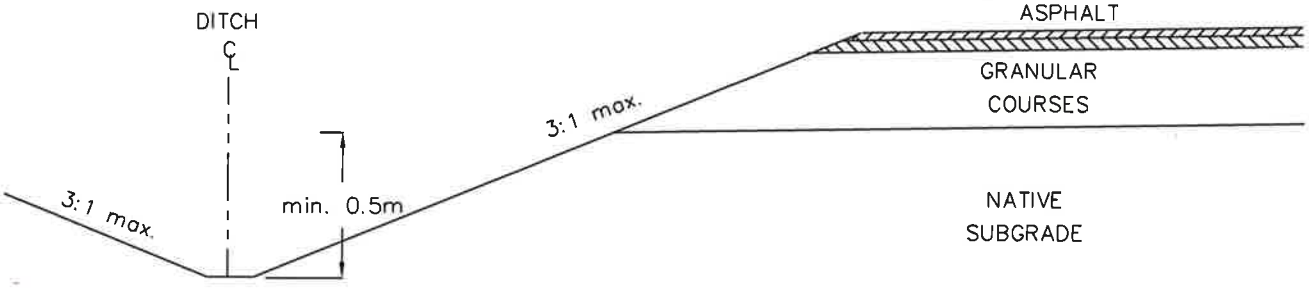
Longitudinal Sudrain Connection to Catchbasin



Unwrapped Trench

Wrapped Trench

Urban Cross Sections



Rural Cross Section

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Title: PAVEMENT DRAINAGE ALTERNATIVES

File No. 11-13-3052

FIGURE : 5

\\PDC\Server\1-Project Files\11-Geo\2013\11-13-3052\A. Dwgs. Logs\AutoCAD\11-13-3052 fig 5.dwg, Kamal