SAW-WHET GOLF COURSE
1401 BRONTE ROAD
OAKVILLE, ONTARIO
L6M 4G3

ATTENTION: MR. GARI INGERTSA

RE: **GEOTECHNICAL INVESTIGATION**
FOR THE PROPOSED RESIDENTIAL SUBDIVISION
(SAW-WHET GOLF COURSE)
1401 BRONTE ROAD,
OAKVILLE, ONTARIO

REPORT NO.: 2012-23813

APRIL 17, 2012

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ORIGINAL : **(FILE SP-3256)** **SOIL PROBE LTD.**

TABLE OF CONTENT

ENCLOSURES

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DATE: April 17, 2012 **REPORT NO.: 2012-23813**
FILE NO.: SP-3256

1.0 INTRODUCTION

Mr. Gari Ingertsa of Saw-Whet Golf Course authorized Soil Probe Ltd. (SPL), through his approval of our Proposal No. 2011-1441, dated February 28, 2012, on March 13, 2012 to conduct a soil investigation for the proposed Residential Subdivision at 1401 Bronte Road, Oakville, Ontario

The purpose of this investigation was to determine the subsoil and groundwater conditions at the subject site and to provide the following but not limited to recommendations

1 .0 Engineered Fill Construction

2.0 Installation of Services (excavation, bedding, backfilling, etc.)

2.0 Road Pavements

3.0 House Foundations & Basement Construction

4.0 Excavations & Dewatering

5.0 Earth Pressures

6.0 Seismic Site Classification

2.0 PROJECT & SITE DESCRIPTION

The subject site comprises an irregularly shaped golf course located south-east corner of Bronte Road and Upper Middle Road West. It is bounded on the east by the Fourteen Mile Creek lands and on the south by the Halton Regional Police Service Compound (western part) and Deerfield Golf Course (Eastern part).

The golf play area is in the southern part of the site (where most of the boreholes were drilled) with the northern part covered by trees; however, the location of Borehole No. 2 is outside the play area. There is an east to south-easterly downslope across the site with the maximum difference in existing grade elevations at borehole locations of about 7.8 m.

There is a club house building in the central area with a curved driveway entrance from Bronte Road and with parking lot at its south; a metal garage is located north of this building as also another relatively smaller auxiliary building on the south; also a one-storied Maintenance Building (metal frame) is located in the S-W corner area (Near B.H. No. 4 location). There is a relatively shallow and narrow creek with meandering alignment and running across the northern part of the site.

3.0 FIELD WORK

3.1 ITEMS OF FIELD WORK

The field work was carried out on April 2 & 3, 2012 which comprised drilling of a total of twelve (12) boreholes to an approximate depth of 5.0 m. The borehole locations are presented on Enclosure No. 14.

3.2 METHOD OF FIELD WORK

The boreholes were advanced using a bombardier mounted, 115 mm diameter, and solid stem auger machine, equipped for soil sampling. Standard penetration tests (SPTs) were conducted according to ASTM Method D1586 at frequent intervals. Representative soil samples were recovered from the split spoon sampler used in these SPTs. The results of the SPT, in terms of the number of blows per 0.3 m of penetration after 1st 15 cm, designated as "N-value", have been used to estimate the consistency of the native cohesive soil layers and relative density of the native cohesionless soil layers.

One standpipe piezometer was installed in Borehole No. 4. The presence of water was checked inside every borehole on completion of drilling, and the depth to water level (below existing grade) measured wherever water was found.

Two bulk soil samples were collected from Borehole Nos. 3 & 8 and brought to our laboratory for grading analysis and standard Proctor compaction test; also the soil samples recovered from the SPT spoon sampler were properly sealed, labelled and brought to our laboratory for classification and testing.

A soils technologist under the direction of a Senior Engineer supervised the fieldwork. The locations of the boreholes were selected and laid out by SPL. The existing grade elevations at borehole locations were determined by the client's surveyors.

4.0 LABORATORY TESTS

The soil samples recovered from the SPT spoon were properly sealed, labelled and brought to our laboratory. They were visually examined to classify each sample. The natural moisture content of each sample was determined by drying in the oven, in the laboratory.

The natural moisture contents, the description and classification of each sample and the N-values (of SPTs) are presented in the borehole logs of Enclosure Nos. 1 thru 12, while the terms and symbols used to describe the soils on these logs are summarized on Enclosure No. 13.

The two bulk soil samples (from Borehole Nos. 3 and 8) were subjected to grading analysis (using a set of sieves) and standard Proctor compaction tests. The results of the grading analyses are presented on Enclosure Nos. 15 and 16, and the moisture-dry density relationship curves on Enclosure Nos. 17 & 18.

5.0 SUBSOIL CONDITIONS

Details of subsoil conditions are given on the borehole log of Enclosure Nos. 1 thru 12, and a brief summary is as follows.

In general the underlying soil comprised native, mostly undisturbed clayey silt/clayey silt till with a topsoil/fill cover and underlain at some locations by weathered limestone.

5.1 TOPSOIL

Immediately below the existing grade, a thin layer of topsoil was found at all the Borehole locations. Its thickness varied between 75 mm (B.H. No. 3) and 200 mm (B.H. Nos. 4 & 12).

5.2 FILL/POSSIBLE FILL

Below the topsoil, fill was encountered at all the boreholes. Also a layer of wet brown fine sand encountered below fill at B.H. No. 4 is suspected to be a fill, and it is designated here as 'Possible Fill". The fill consisted of material varying from brown to mixed brown-red clayey silt with some sand, occasional pockets of topsoil, brown clayey silt with trace of sand and gravel and pocket of topsoil, brown sand-silt-clay with trace of gravel, wet silty sand with trace of plant remains, reddish brown clayey silt with some roots, red clayey silt, occasionally with some pieces of stone. These layers extend mostly to about 1.0 m below existing grade except B.H. No. 4 where it was about 3.2 m and possibly related to the construction of the Maintenance Building.

These fill/possible fill are generally moist, but occasionally wet (B.H. No. 4) as indicated by their natural moisture contents in the range of about 14% (B.H. Nos. 2 & 4) 31% (B.H. No. 7) with some of the relatively higher values reflecting their organic/topsoil content rather than moisture condition.

The grading curves of the 2 bulk samples of fill +Native soil are is presented on Enclosure Nos. 15 & 16; their moisture-density curves, Enclosure Nos. 17 & 18, show that the maximum dry densities are 1852 kg/m^3 and 1900 kg/m^3, respectively and the optimum moisture contents 13.7 % and 12.9%.

5.3 NATURAL GROUND

The above layers were followed by undisturbed native ground consisting mostly of glacial till/clayey silt, except for localised occurrence of granular soils, as described below.

5.3.1 Clayey Silt Till

Clayey silt till with trace to some sand and gravel was encountered below fill at B.H. Nos. 1, 2, 3, 5, etc., below clayey silt (B.H. No. 4) and below silty sand (B.H. No. 12) (both to be discussed later), and extending generally to the ends of boreholes; however, at B.H. No. 8 this layer is underlain by a limestone and at B.H. No. 12 by sand-gravel layer (Both discussed later).

The natural moisture contents of the till samples (in the range of about 6% at B.H. No. 7 to 18% at B.H. No.12) indicated that these soils to be moist condition. Based on the N-Values (19 to over 100), these layers are very stiff to hard in consistency.

5.3.2 Clayey Silt

Clayey silt was encountered below fill at B.H. Nos. 4, 6, 9, 10 & 11 extending to the ends of the boreholes. It is mostly red in color, but occasionally lenses of hard grey silty clay or brown wet sand-gravel seam was encountered within this layer.

The natural moisture contents of these cohesive samples (in the range of about 6% at B.H. No. 10 to 22% at B.H. No. 6) indicated that these soils to be in moist to wet conditions. Based on the N-Values (7 to over 100), these layers are firm to hard in consistency.

5.3.3 Granular Soils

Localised layers of granular soil were encountered above and below glacial till at B.H. No. 12., these comprised brown wet silty very fine sand (upper layer) and brownish grey sand-gravel (lower layer).

The natural moisture contents of these 2 granular layers are about 21% and 9.6% respectively, indicating their wet conditions and their N-values 19 and over 100 indicating compact and very dense relative density.

5.3.4 Weathered Limestone

A very thin localised layer of weathered limestone was hit at the lower end of B.H. No. 8. The drilled thickness was only about 130 mm.

6.0 GROUND WATER CONDITIONS

The boreholes were advanced using dry augering, and ground seepage water was found at the depths of 1.8 m (B.H. No. 4), 4.1 m (B.H. No. 5), 3.2 m (B.H. Nos. 6 & 9), 2.8 m (B.H. No. 10) and 3.7 m (B.H. No. 12) below the existing grade.

Based on the above information and visual examination of the soil samples obtained, the ground seepage water encountered represents perched water in the overlying fill or wet pockets of silt/sand/gravel trapped in the impervious native clayey silt/till subsoils. The true water lies below the extremities of the boreholes.

7.0 DISCUSSIONS AND RECOMMENDATIONS

It is understood that the subject residential development will be fully serviced. The houses will be built after installation of services; however the alignments of internal roads/services are not available at this time. Also, due to the difference in existing grade elevations (Maximum about 7.8 m between borehole locations) and subject to the proposed design grades (which are not known at this point in time) some site re-grading comprising cutting in the relatively high ground areas and engineered filling in the lower areas will be required. Based on the information presented in preceding chapters, our preliminary comments and recommendations are given in general terms in the ensuing paragraphs.

7.1 SITE RE-GRADING AND ENGINEERED FILLING

As noted above, site re-grading and engineered filling will be required at the subject site, and this re-grading, comprising cut and fill operations can be carried out using the methodology given below:

Engineered Fill Construction Methodology: The engineered fill construction to raise the grades (in the currently low ground areas of the south east) using on-site excavated relatively clean fill and native soils (glacial till, clayey silts) from the high ground on the west & north-west areas will require strict quality control, and as such will need full time supervision and inspection of earthworks during construction.

The methodology to satisfactorily construct engineered fill for supporting the underground services, foundations for the proposed new homes, driveway pavements and other related structures is as follows.

A) Method & Target

a) Prior to raising the grades with engineered fill:

i) All the highly organic rich fill, over the cut and fill areas of the site, should be completely removed and discarded or stockpiled for re-use in landscaping areas.

ii) Any tree within the proposed development boundary should also be cut and removed along with their major root systems;

iii) The existing structures on the site should be removed.

b) The exposed sub-grade should be inspected by an SPL's soils engineer before upfilling. If any unsuitable soils (including any spongy, wet or soft/loose spots) become apparent at this time should be sub-excavated to stable subgrade and replaced with compactable approved soil compatible with subgrade conditions. as directed by the geotechnical engineer.

c) Any relatively clean portions of existing fill/possible fill can remain in place provided they are approved by Soil Probe's field inspector, and compacted to at least 98% of standard Proctor Maximum Dry Density (SPMDD).

d) The approved fill soil should be placed in layers not exceeding 200 mm before compaction; Oversize particles (cobbles and boulders) larger than 120 mm should be discarded and each fill layer should be uniformly compacted to at least 98% of the material's SPMDD. Continuous compaction testing should be conducted on each layer of fill placed using nuclear gauge equipment to ensure the above-noted density.

e) The engineered fill should be extended at least 2 times its thickness, but not less than 2.0 m beyond the limit of the house structures to be supported. Once the envelope is set, the house structures cannot be moved towards engineered fill margins without consulting the soil engineer. Similarly, no excavation or any other operations affecting competency of the engineered fill should be undertaken without consultation with the soil consultant.

f) The engineered fill envelope should be clearly and accurately defined in the field and documented by qualified surveyors and recorded, and a copy given to the soils consultant. This should include its outer limits, and top and bottom elevations.

g) The engineered fill should not be constructed during winter months when persistent or intermittent freezing temperatures occur. This is to ensure that the fill is free of frozen soils, ice and snow.

h) If the proposed engineered fill areas are to be left for a period of time that includes winter months, a minimum of 1.2 m soil cover must be provided to prevent frost action and disturbance.

B) Material & Equipment

a) On-site excavated, clean inorganic earth (native and/or fill) may be reused as an engineered fill material, provided the moisture contents are strictly controlled to keep it within +/- 2% of its optimum value.

b) The moisture–density relationship curves of two (2) representative samples of the on-site materials, presented on Enclosure Nos. 15 & 16 may be used as ready general references when on-site material is used. For example, as shown on the borehole logs, most of the relatively clean fill and native soils at upper levels are at about the optimum moisture content; as such these soils may be re-used in engineered filling without any moisture adjustments; also it is expected that some mixing of on-site soils will occur during construction, and this may decrease the variability.

c) If imported inorganic mineral soils are used for engineered fill construction, they must meet the Ministry of the Environment and Energy's (MOEE) Decommissioning Landfill Guidelines, and their moisture contents should preferably be close to their respective optimum values.

d) For the mixture of on-site excavated clean fill and/or silt dominated till/silty clay soils or similar imported soils, a heavy sheepsfoot roller should be employed be achieve above-specified degree of field density. However, if the imported earth is relatively coarse textured granular soil, a smooth drum roller shall be required.

C) Related Recommendations during House Construction

a) The final footing sub-grade for houses on engineered fill should be inspected by the Geotechnical Engineer supervising the engineered fill prior to placement of concrete to ensure that foundations are placed within the structural fill envelope.

b) The footings resting on engineered fill, constructed as above, can generally be designed using an allowable soil pressure of up to 150 kPa (SLS) and 220 kPa (ULS).

c) It is good engineering practice to increase the rigidity of foundations of structures erected over engineered fill, and this is generally achieved by making the footings at least 0.5 m wide, and providing nominal reinforcing to such footings and foundation walls in consultation with the project structural engineer. This measure helps to bridge over eventual weak spots in the fill. SPL's recommendation in this regard will be provided after completion of engineered filling taking into consideration the age, quality and nature of the engineered fill mantle.

7.2 BEDDING AND INSTALLATION OF UNDERGROUND SERVICES

The borings have indicated that the undisturbed native subsoils (as well as engineered fill) are favorable for supporting the service pipes, manholes, catch basins and other related structures.

Based on the above said subsoil findings, an OPSS Class 'B' Type bedding (i.e.OPSD-802) shall perform satisfactorily. The class 'B' bedding material should consist of either 20 mm crusher-run limestone or OPSS Granular 'A' compacted to 100% of their SPMDD.

Alternatively, HL 8 stone bedding may be used in the drier areas. However, in the wetter subgrade areas, the HL 8 stone should be wrapped around with a filter cloth 270R Terrafix (or equivalent).

7.3 EXCAVATION AND DEWATERING

The excavations for laying of the underground services will pose little difficulty, if any; however. The excavation equipments should be capable of dealing with boulders that are frequently encountered in tills and also limestone if excavations extend into it (Ref. B.H. No. 8 location). All excavations should be carried out in accordance with the latest version of the Occupational Health and Safety Act (OHSA) and applicable regulations for construction projects.

The subsoils that will be encountered during service excavations are classified (as per OHSA) below in **Table 1**.

TABLE 1 - SOIL CLASSIFICATION AS PER OCCUPATIONAL HEALTH AND SAFETY ACT (OHSA)

SOIL DESCRIPTION	SOIL CLASS, ACCORDING TO OHSA
Existing fill/possible fill /silty sand/sand-gravel	3
Native Tills, Clayey Silt	2
Limestone	1

An excavation side slope of 1 (Vertical): 1 (Horizontal) is expected to be generally satisfactory for excavation within the upper soil layers; however, steeper slopes may be feasible within the very stiff to hard tills at lower levels.

No unusual ground water problems are anticipated during laying of the underground sewer pipes. Any seepage water encountered due to bleeding of wet pockets/seams in the native soils may be controlled by conventional means such as pumping from sumps.

7.4 SERVICE TRENCH BACKFILLING

The on-site excavated relatively clean inorganic earth can be reused as a compacted backfill, provided the moisture contents are strictly controlled; i.e. the moisture content of the backfill material should be within 2% of its optimum value.

Since the natural moisture contents of the native soils at upper levels at the subject site are close to the optimum moisture content values (Ref. B.H. Logs on Enclosure Nos. 1 to 12 and moisture-density relationship curves on Enclosure Nos. 17 & 18, a relatively high degree of field density will not be too difficult to achieve through mixing and reworking during backfilling and simultaneous compaction effort.

It is recommended that the compaction of the backfill earth should be carried out in thin uniform lifts (not exceeding 200 mm per lift in loose state) and compacted generally to 95% SPMDD using a heavy duty sheepsfoot roller. However, the top 600 mm of the final subgrade should be compacted to at least 98% SPMDD.

In confined areas such as beside and immediately above or between the two sewer pipes, around the manholes and catch basins, imported sand should be used for backfilling and compacted to the specified degree of compaction with portable, light equipment.

7.5 ROAD PAVEMENT DESIGN

On-site excavated backfill earth in the sewer trenches forming the final subgrade structure supporting the subdivision roads is anticipated to be predominantly frost susceptible mixture of clean fill and native glacial till and clayey silt. Therefore, based on the frost susceptibility characteristics and expected volume of vehicular traffic in a residential subdivision, the following minimum pavement designs shall perform satisfactorily.

RECOMMENDED ROAD PAVEMENT DESIGNS

PAVEMENT COMPONENT	PAVEMENT THICKNESS (mm)	
	LOCAL ROADS	COLLECTOR ROAD
Asphalt Wearing Course (OPSS 150) HL-3 Asphalt Base Course (OPSS150) HL8	40 50	50 75
20 mm Crusher-run Limestone (CRL) base 50 mm Crusher-run Limestone (CRL) subbase	150 200	125 375

The 20 mm diameter CRL shall meet the Ontario Provincial Standard Specification (OPSS) Granular "A" gradation specification. The 50 mm diameter CRL shall meet the OPSS Granular B "Type I" gradation specification. The stone bases should be compacted to at least 100% of their SPMDD.

The asphaltic concretes are to be hot-mixed, hot-laid in accordance with current OPSS specifications, Forms 310 and 150 (Ontario PGAC grades PG 58-28 equivalency), and compacted to a minimum of 97% of maximum Relative Density (mRD).

Non-ideal Conditions: The pavement design, presented above, is based on the assumption that construction will be undertaken under dry weather conditions and that the sub-grade is stable and not heaving under construction equipment traffic. However, if under non-ideal conditions, the final sub-grade is wet and/or unstable, then additional imported sub-base material may become necessary.

Prior to placing the granular bases, the final sub-grade should be proof-rolled to identify soft spots, if any, and rectified as required in consultation with a soils engineer from this office.

To ensure the longevity of the pavement, the roadbed should be well drained at all times. We recommend that full-length perforated sub-drain pipes of 150 mm diameter be installed along both sides of the road, below the roadbed level, to ensure effective drainage. The sub-drain pipes should be surrounded by 20 mm size clear stone drainage zone of minimum 150 mm thickness, wrapped around with filter cloth to minimize infiltration of fines in pipes which would reduce their effectiveness. Also, the subgrade surface should be crowned to promote flow of water towards the sub-drains and catch basins.

7.6 CONSTRUCTION OF HOUSES

7.6.1 Foundations

The borings have revealed that the undisturbed native subsoil is capable of supporting the proposed houses through conventional strip and/or strip footing foundations. The footings should be founded at a minimum depth of 1.25 m (B.H. No. 1), 1.55 m (B.H. No. 2), 1.05 m (B.H. Nos. 3, 8 thru 12), 4.1 m (B.H. No. 4) and 0.76 m (B.H. Nos. 5 & 6) all below existing grade. An allowable soil bearing pressure of 150 kPa at SLS and 220 kPa at ULS is recommended.

Similarly, footings embedded in engineered fill placed and compacted according to the 'Methodology of Engineering Filling' given above may also be designed for an allowable soil bearing pressures of 150 kPa (SLS) and 220 kPa (ULS). The footings and foundation walls of houses on engineered fill should be nominally reinforced in consultation with the project structural engineer.

All exterior footings should have a minimum soil cover of 1.2 m for frost protection.

Prior to pouring concrete, the subsoil at the footing founding levels should be inspected by a soils engineer.

7.6. 2 Basement Construction

The installation of perimeter weepers enclosed in filter socks around exterior footings and damp-proofing of exterior basement walls would be required as per the Ontario Building Code requirement. The weeping tiles should be connected to a positive frost free outlet from which the water is removed.

Basement floor slabs can rest on engineered fill and/or undisturbed natural ground. For bedding and to serve as a moisture barrier under the basement floor slabs, a minimum of 100 mm thick layer of crushed stone should be placed.

7.6.3 Garages, Driveways and Landscaping

In view of the predominance of frost-susceptible silt-dominated soils at this site, one must realize that heaving of the pavement will occur during the cold weather. As such the following recommendations shall apply.

- The driveways at the entrances to the garages must be backfilled with non-frost-susceptible granular material, with a frost taper at a slope of 1 (vertical): 2 (horizontal).
- The garage floor slab must be insulated with 50-mm Styrofoam or equivalent.
- Interlocking stone pavement must be constructed on a free-draining granular base at least 1.0 m thick, with proper drainage which will prevent water from ponding in the granular base.
- Post foundations for wooden decks, lampposts, etc., must either be backfilled with non-frost-susceptible granular, or if backfilled with silt-dominated on-site soils, these must be shielded with a folded polyethylene membrane.

7.6.4 Excavation and Dewatering for House Construction

The same guidelines as given earlier in Sub-section 7.3 “Excavation for Service Installation” will apply for excavation for house foundation/basement construction, etc.

7.7 EARTH PRESSURES

The following equation should be used to estimate the intensity of the lateral earth pressure acting against any earth retaining structure, such as the manhole/basement walls.

$$P = K(\gamma h + q)$$

Where K = Appropriate coefficient of earth pressure;
γ = Unit weight of compacted backfill, adjacent to the walls;
h = Depth (below adjacent highest grade) at which P is calculated;
q = intensity of any surcharge distributed uniformly over the backfill surface.

The coefficient of the earth pressure at rest (K_o) should be used in the calculation of the earth pressure on the manhole/basement walls, which are expected to be rather rigid and not to deflect.

7.8 GEOTECHNICAL PARAMETERS

For the on-site soils, the following geotechnical parameters may be assumed:

i) Wet unit weight (γ) kN/m^3 = 19.0

ii) Co-efficients of Earth Pressure:

at Rest (K_o)	=	0.5
Active (K_a)	=	0.3
Passive (K_p)	=	3.0

iii) Co-efficient of permeability:

a) In-situ tills/clayey silt: < 10^{-6} cm/sec;

iv) Allowable soil bearing pressure for the design of thrust block structure:

a) in the native soil @ 1.5 m below existing grade or lower: 100-150 kPa

b) in engineered fill @ 1.5 m below finished grade or lower: 75 kPa.

v) Bulking factor: <10%

7.9 EARTHQUAKE CONSIDERATIONS

In accordance with the Ontario Building Code 2006 (O. Reg. 350/06, as amended) (OBC), the proposed houses including their foundation elements should be designed to resist earthquake loads.

Based on the OBC, the subject site should be classed as "Site Class D" for designing against earthquake forces.

7.10 SITE PREPARATION (EXISTING STRUCTURS/DRIVEWAY/ORGANIC-RICH FILL/TREE REMOVAL)

It is recommended that prior to starting any earthworks for re-grading and subsequent construction of sewers, roads, new homes etc., and the following site preparations should be carried out:

i) All organically rich fill should be completely stripped and discarded and/or stockpiled for re-use in the landscaping areas. Notwithstanding, any relatively clean existing fills/possible fill may be stockpiled and re-used where deemed necessary.

ii) The existing buildings within the development area (e.g. the club house, the garage, the maintenance building) should be demolished and the resulting debris removed off-site; the building foundations should also be dug out and removed.

iii) The asphalt of the existing driveway entrance (to club house) and parking lot should be demolished and removed off-site, leaving the underlying granulars.

iv) Any tree within the proposed development boundary should also be cut and removed along with its major root systems.

8.0 STATEMENT OF LIMITATIONS

The comments and recommendations presented in this report are based on the geotechnical data gathered from the boreholes at the locations indicated on the Plot Plan of Enclosure No. 14, and are intended as a guide for the design engineers of the project. Soil and groundwater conditions between and beyond the borehole locations may differ from those encountered at the time of our soil investigation and may become apparent during construction. Our responsibility is limited to an accurate interpretation of the soil and groundwater conditions prevailing at the locations investigated.

Additional Borehole investigations should be carried out once the internal road alignments are selected.

Respectfully Submitted,
SOIL PROBE LTD.

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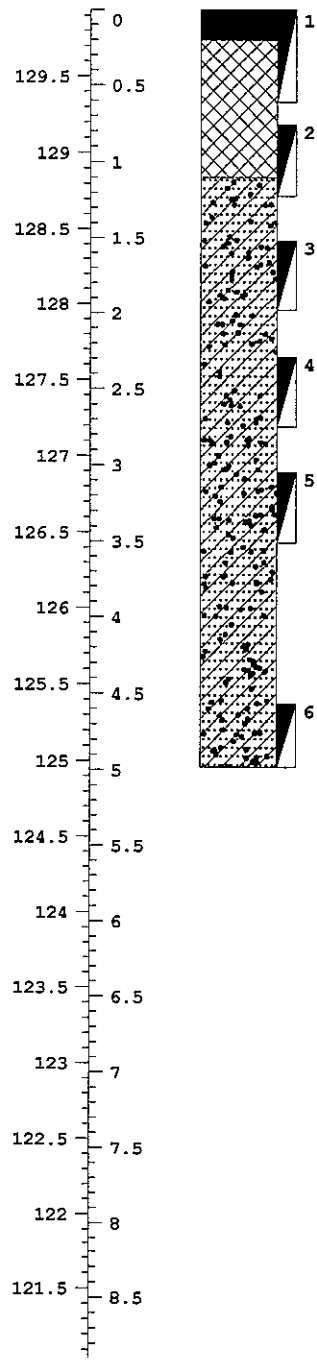
Encl.

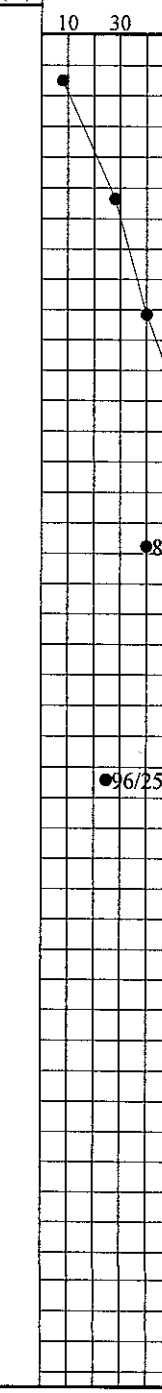
BOREHOLE LOG
BOERHOLE NO.: 1

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 129.94
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 2, 2012
WATER LEVEL DEPTH (m):
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)
		TOPSOIL - about 200 mm thick			
		FILL - brown to mixed brown-red clayey silt with some sand, occasional pockets of topsoil (upper 300 mm or so) , moist	22.6	8	
		CLAY SILT TILL - with some sand, trace of gravel, grayish brown, moist, hand.	13.3	28	
			12.3	40	
			12.8	56	
			8.9	86	
		- colour changes to brownish grey below about 4.0 m			
		End of Borehole @ 4.98 m Borehole dry on completion	7.5	96/ 25*	
		96/25* = 96 blows for 25 cm of sampler penetration after 1st 15 cm			



Enclosure No. 1

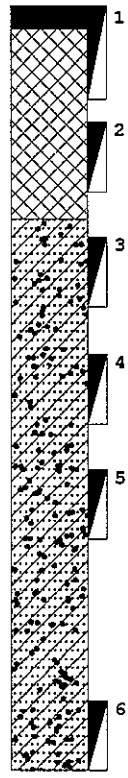
SOIL PROBE LTD.

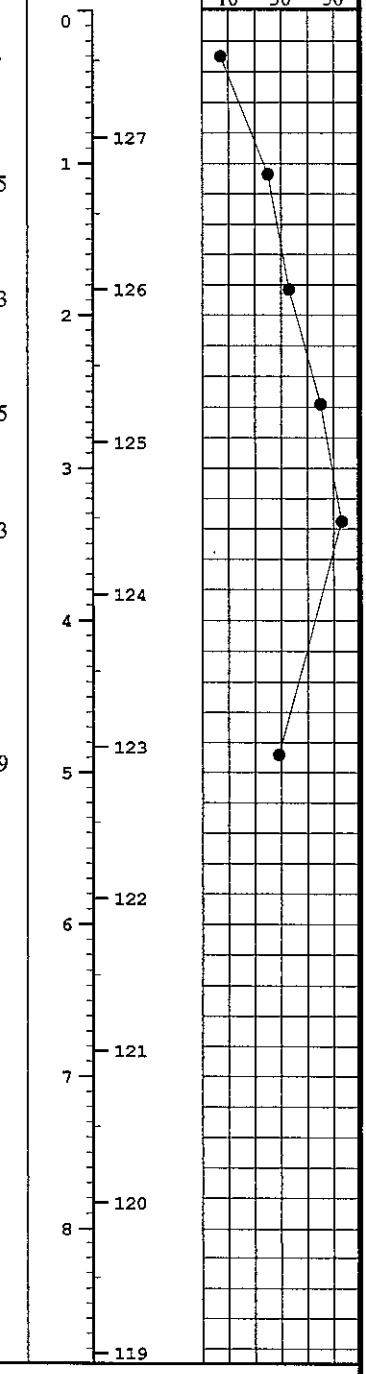
BOREHOLE LOG
BOERHOLE NO.: 2

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 127.83
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 2, 2012
WATER LEVEL DEPTH (m):
M.C. = Natural Moisture Content

ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)	CURVE N (Blows/0.3m)
127.5 / 0	1	TOPSOIL - about 150 mm thick (Non-play area with surficial grass)	22.5	7		
127 / 0.5	2	FILL - brown clayey silt with traces of sand & gravel, pockets of topsoil, moist	13.9	25		
126.5 / 1	3	CLAYEY SILT TILL - trace of sand & gravel, grayish brown, moist, hand	13.4	33		
126 / 1.5		- colour changes to brownish gray below about 2.1 m				
125.5 / 2	4		11.8	45		
125 / 2.5	5		11.0	53		
124.5 / 3						
124 / 3.5	6	- colour changes to gray below about 4.7 m	11.5	29		
123.5 / 4		End of Borehole @ 5.03 m Borehole dry on completion				
123 / 4.5						
122.5 / 5						
122 / 5.5						
121.5 / 6						
121 / 6.5						
120.5 / 7						
120 / 7.5						
119.5 / 8						
119 / 8.5						





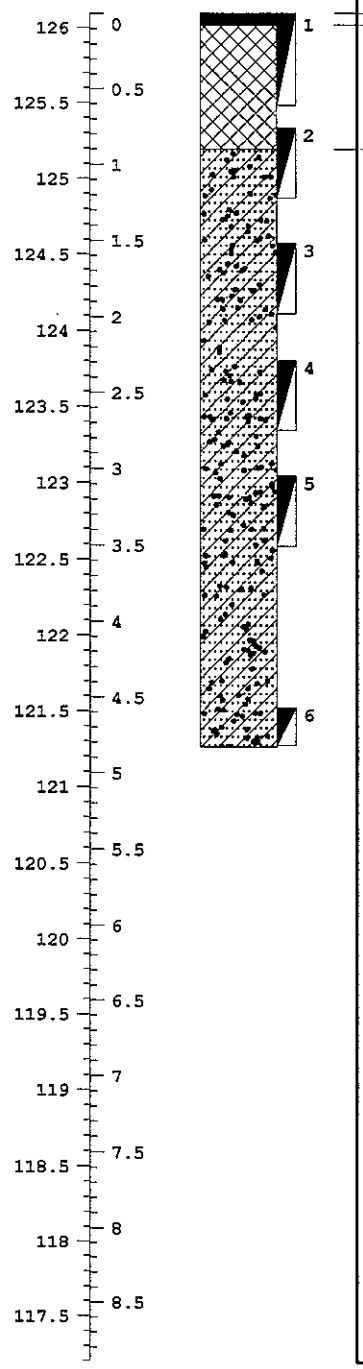
Enclosure No. 2

SOIL PROBE LTD.

BOREHOLE LOG
BOERHOLE NO.: 3

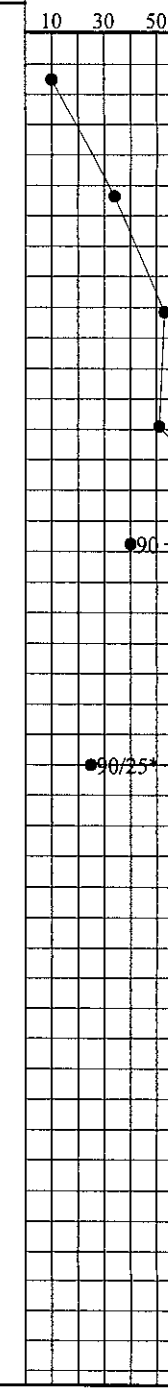
PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 126.09
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 2, 2012
WATER LEVEL DEPTH (m):
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)
126 / 0	1	TOPSOIL - about 75 mm thick (thick surficial grass present)			
125.5 / 0.5		FILL - brown clayey silt with some sand and fine gravel, moist	20.7	10	
125 / 1	2	CLAYEY SILT TILL - traces of sand & gravel, grayish brown to brown, moist, hard	13.1	34	
124.5 / 1.5	3	- includes some medium gravel below about 1.8 m	10.3	53	
124 / 2					
123.5 / 2.5	4		6.8	51	
123 / 3	5		7.2	90	
122.5 / 3.5					
122 / 4					
121.5 / 4.5	6				
121 / 5		End of Borehole @ 4.83 m Borehole dry on completion	7.6	90/ 25*	
120.5 / 5.5					
120 / 6					
119.5 / 6.5					
119 / 7					
118.5 / 7.5					
118 / 8					
117.5 / 8.5					

CURVE N (Blows/0.3m)



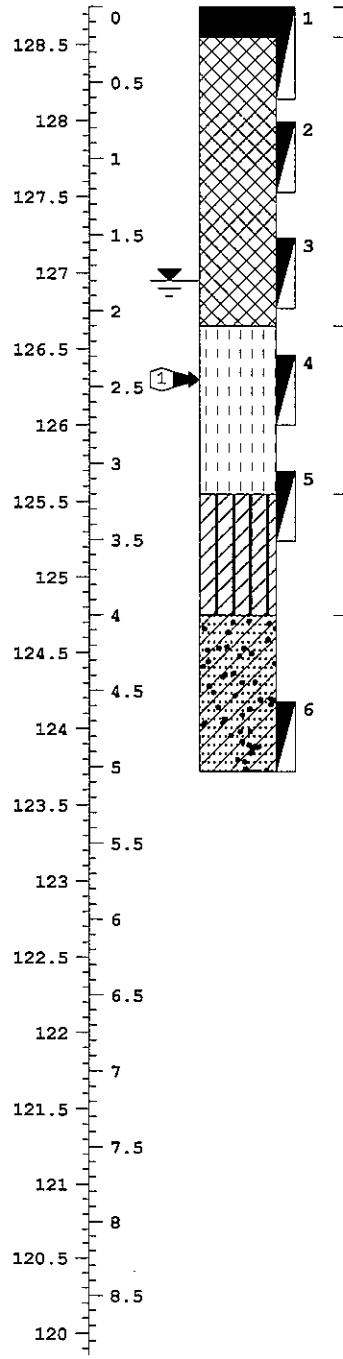
Enclosure No. 3

SOIL PROBE LTD.

BOREHOLE LOG
BOERHOLE NO.: 4

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 128.75
CAVED AT DEPTH (m): 2.45
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 3, 2012
WATER LEVEL DEPTH (m): 1.8
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)
128.5 / 0	TOPSOIL - about 200 mm thick			
0.5	FILL - brown, sand-silt-clay with trace fine gravel, moist	15.2	6	
128 / 1		14.2	9	
127.5 / 1.5	- layer of brown wet silty sand with trace of plant remains below about 1.4 m			
127 / 2		19.9	10	
126.5 / 2.5	POSSIBLE FILL - brown fine sand, wet			
126 / 3		24.8	7	
125.5 / 3.5	CLAYEY SILT - grey, wet, firm	20.2	7	
125 / 4				
124.5 / 4.5	CLAYEY SILT TILL - traces of sand and gravel, gray, moist, hand.			
124 / 5		12.3	42	
123.5	End of Borehole @ 5.03 m			
5.5	Water level @ 1.8 m in piezometer on installation and			
123 / 6				
122.5 / 6.5				
122 / 7				
121.5 / 7.5				
121 / 8				
120.5 / 8.5				
120				

CURVE N (Blows/0.3m): 10, 30, 50

Standpipe piezometer installed in borehole

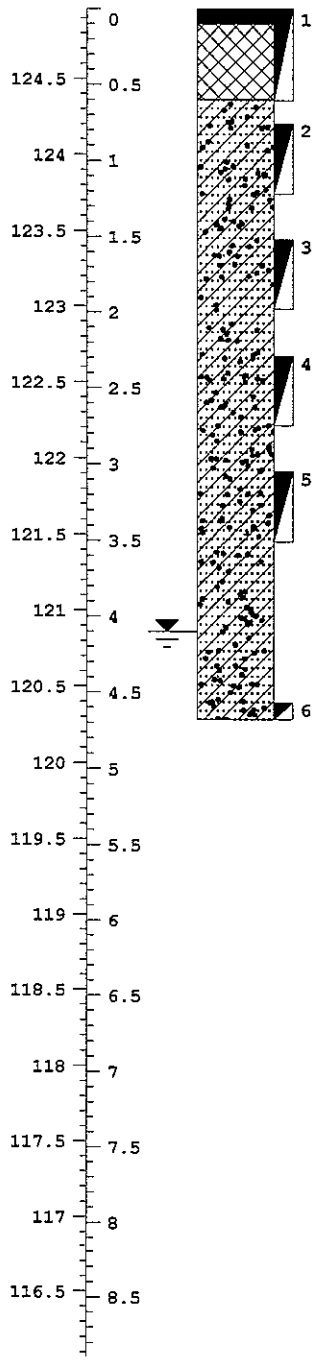
Enclosure No. 4

SOIL PROBE LTD.

BOREHOLE LOG
BOERHOLE NO.: 5

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 124.96
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 3, 2012
WATER LEVEL DEPTH (m): 4.1
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)	CURVE N (Blows/0.3m)
		TOPSOIL - about 100 mm thick (root mat) (Surficial grass present)				
		FILL - brown clayey silt with trace gravel, moist	22.5	10		
		CLAYEY SILT TILL - traces of sand and gravel, reddish brown, moist, hard	12.6	33		
		- includes some coarse gravel below about 1.8 m	8.9	76		
		- colour changes to reddish grey below about 2.4 m	9.2	50/ 10*		
			7.5	50/ 13+		
		End of borehole @ 4.68 m Water level @ 4.1 m on drilling completion	8.1	50/ 11+		

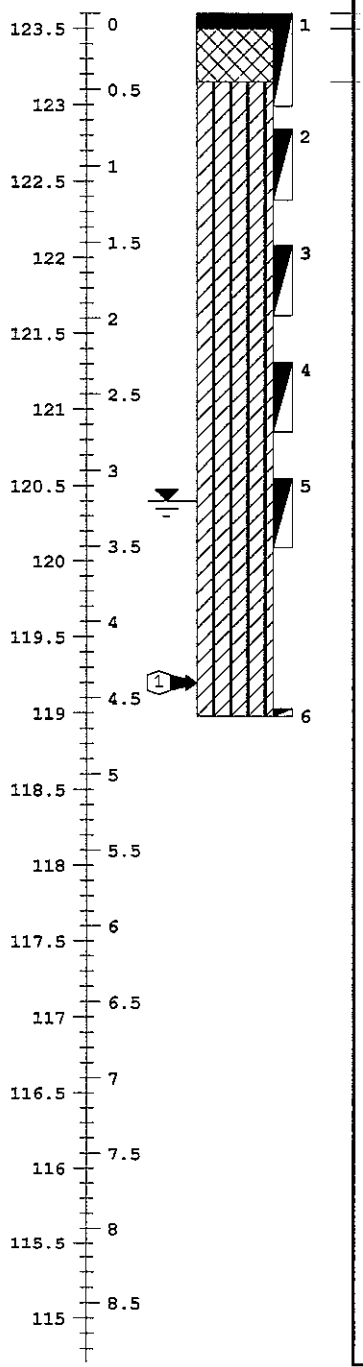
Enclosure No. 5

SOIL PROBE LTD.

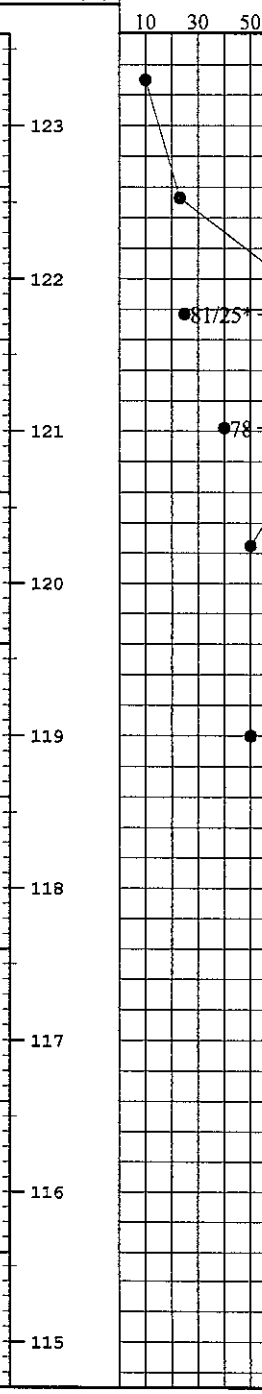
BOREHOLE LOG
BOERHOLE NO.: 6

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 123.6
CAVED AT DEPTH (m): 4.4
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 3, 2012
WATER LEVEL DEPTH (m): 3.2
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	STANDARD PENETRATION TEST DEPTH/ ELEVATION (m)
		TOPSOIL - about 100 mm thick (Thick surficial grass present)			
		FILL - reddish brown, clayey silt with some roots, moist	21.2	10	
		CLAYEY SILT - red (with occasional grey lense), moist, stiff	12.1	23	
		- becomes hard below about 1.4 m	9.0	81/ 25*	
		- thin lense of hard grey silty clay at about 2.7 m	7.3	78	
			8.6	50/ 10+	
		- becomes wet below about 4.0 m			
		End of Borehole @ 4.62 m Water Level @ 3.2 m on completion drilling	22.2	50/5+	



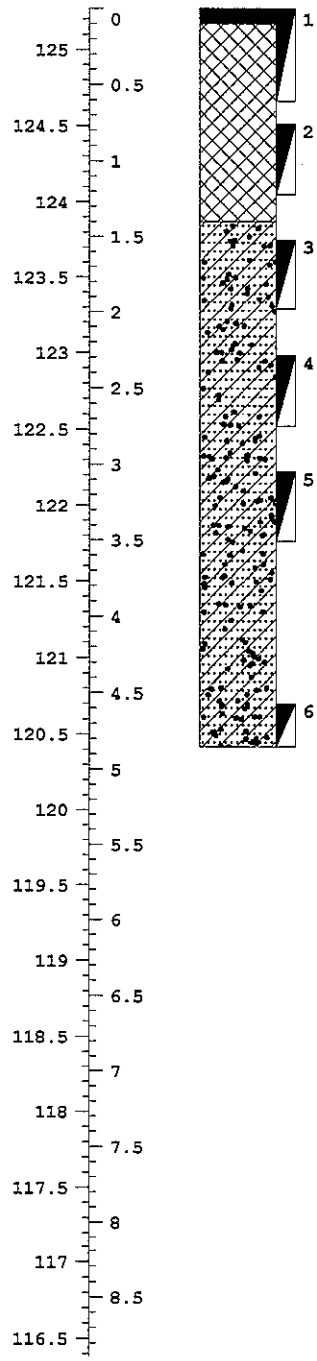
Enclosure No. 6

SOIL PROBE LTD.

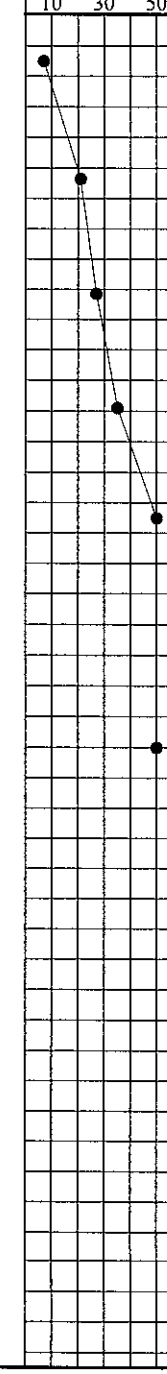
BOREHOLE LOG
BOERHOLE NO.: 7

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 125.27
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 2, 2012
WATER LEVEL DEPTH (m):
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)
125 / 0	TOPSOIL - about 100 mm thick (root mat)			
125 / 0	FILL - brown clayey silt with some pockets of topsoil, moist	30.6	7	
124.5 / 1		28.5	21	
124 / 1.5	CLAYEY SILT TILL - trace fine gravel, reddish brown with some grey spots, moist, very stiff			
123.5 / 2	- includes some medium gravels below about 1.8 m	13.1	27	
123 / 2.5	- becomes hard below about 2.1 m	11.7	35	
122.5 / 3		10.1	50/ 13*	
122 / 3.5				
121.5 / 4				
121 / 4.5				
120.5 / 5	- sand-gravel seam at about 4.7 m	6.5	50/ 13*	
120 / 5.5	End of Borehole @ 4.85 m			
119.5 / 6	Borehole dry on completion			
119 / 6.5	50/13* = 50 blows for 13 cm of sampler penetration after 1st 15 cm			
118.5 / 7				
118 / 7.5				
117.5 / 8				
117 / 8.5				
116.5				



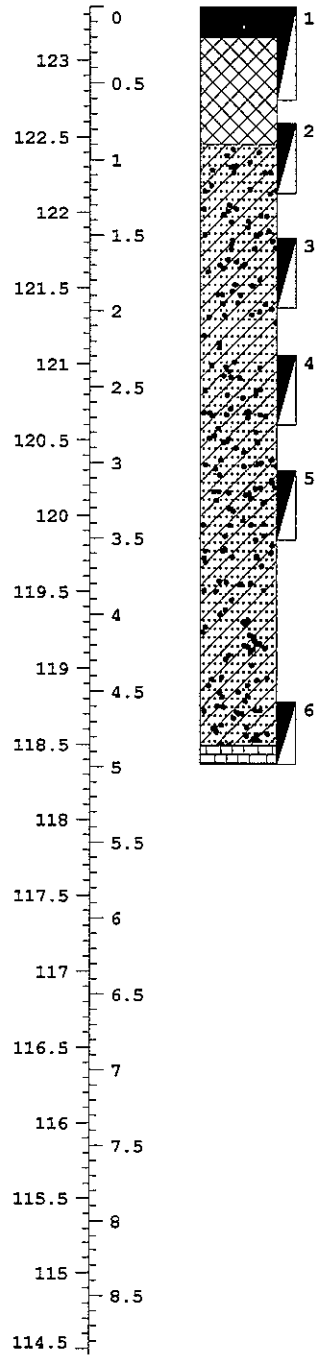
Enclosure No. 7

SOIL PROBE LTD.

BOREHOLE LOG
BOERHOLE NO.: 8

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 123.35
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 3, 2012
WATER LEVEL DEPTH (m):
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)	CURVE N (Blows/0.3m)
123 / 0	1	TOPSOIL - about 150 mm thick				
122.5 / 0.5		FILL - brown clayey silt with some fine gravel, moist	14.4	9		
122 / 1	2	CLAYEY SILT TILL - trace to some sand, reddish brown, moist, very stiff	13.3	22		
121.5 / 1.5	3	- becomes hard & includes occasional layer of gray silt below about 1.8 m	13.3	36		
121 / 2	4	- colour changed to red below about 2.3 m	12.2	44		
120.5 / 2.5						
120 / 3	5		10.2	58		
119.5 / 3.5						
119 / 4						
118.5 / 4.5	6					
118 / 5		LIMESTONE- highly weathered, gray	9.3	73/ 25*		73/25*
117.5 / 5.5		End of Borehole @ 4.98 m Borehole dry on completion				
117 / 6		73/25* = 73 blows for 25 cm of sampler penetration after 1st 15 cm				
116.5 / 6.5						
116 / 7						
115.5 / 7.5						
115 / 8						
114.5 / 8.5						

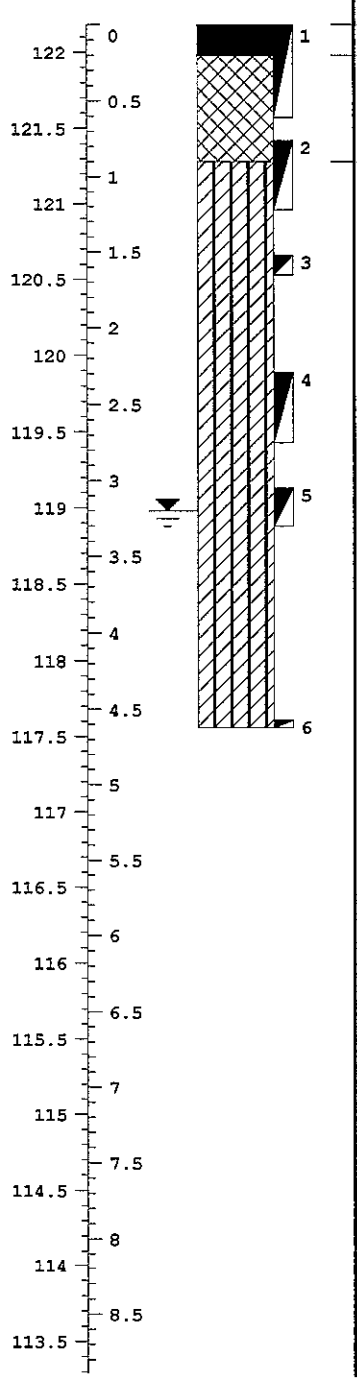
Enclosure No. 8

SOIL PROBE LTD.

BOREHOLE LOG
BOERHOLE NO.: 9

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 122.18
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 3, 2012
WATER LEVEL DEPTH (m): 3.2
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)	CURVE N (Blows/0.3m)
		TOPSOIL - about 200 mm thick (Green grassy Play area)	22.9	6		
		FILL - brown clayey silt, moist				
		CLAYEY SILT - red, moist, hard	20	43		
		- lense of grey hard silty clay at about 1.65 m	10.1	50/5+		
			9.8	49		
			8.8	50/ 10*		
		- becomes wet below about 4.0 m				
		End of Borehole @ 4.62 m	12.0	50/5+		
		Water Level @ 3.2 m on completion of drilling				
		50/13+ = 50 blows for 13 cm of sampler penetration 50/10* = 50 blows for 10 cm of sampler penetration after 1st 15 cm				

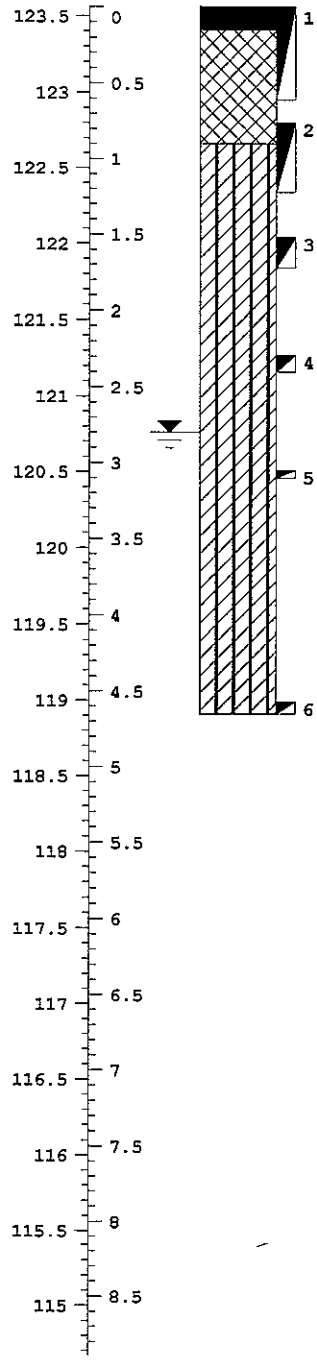
Enclosure No. 9

SOIL PROBE LTD.

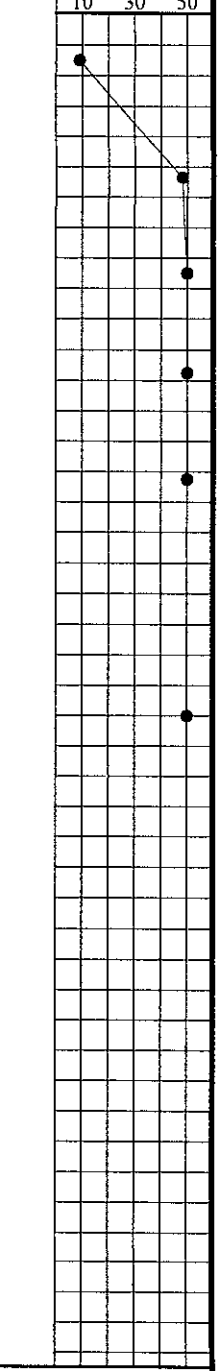
BOREHOLE LOG
BOERHOLE NO.: 10

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 123.56
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 3, 2012
WATER LEVEL DEPTH (m): 2.8
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)
		TOPSOIL - about 150 mm thick (root mat) (Green grassy play area)			
		FILL - red clayey silt, moist	19.1	9	
		CLAYEY SILT - red (some hard grey spots), moist to damp, hand	8.1	48	
			5.9	50/5*	
			7.1	50/ 11+	
		- wet layer at about 2.9 m	17.6	50/5+	
		- lense of moderately weathered limestone at about 3.3 m			
		- wet red clayey silt layer at about 4.0 m			
		End of Borehole @ 4.65 m	8.6	50/8+	
		50/5* = 50 blows for 5 cm of sampler penetration after 1st 15 cm			
		50/11+ = 50 blows for 11 cm of sampler penetration			
		Water @ 2.74 m on completion of drilling			



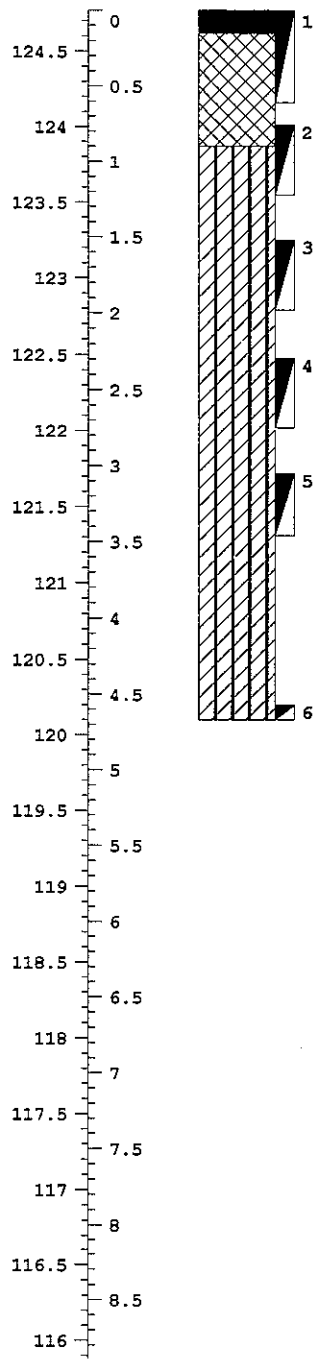
Enclosure No. 10

SOIL PROBE LTD.

BOREHOLE LOG
BOERHOLE NO.: 11

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 124.77
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 3, 2012
WATER LEVEL DEPTH (m):
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	DEPTH/ ELEVATION (m)	CURVE N (Blows/0.3m)
		TOPSOIL - about 150 mm thick (root mat) (Green grassy play area)				
		FILL - red clayey silt with some stone pieces, moist.	15.2	34		
		CLAYEY SILT - red with some grey spots to layers, wet, moist damp, hard	15.4	31		
			9.9	57		
			9.8	58		
		- grey moderately weathered limstone lense at about 3.3 m	8.9	97/ 25*		
		End of Borehole @ 4.67 m 97/25* = 97 blows for 25 cm of sampler penetration after 1st 15 cm 50/10+ = 50 blows for 10 cm of sampler penetration Borehole dry on completion	6.8	50/ 10+		

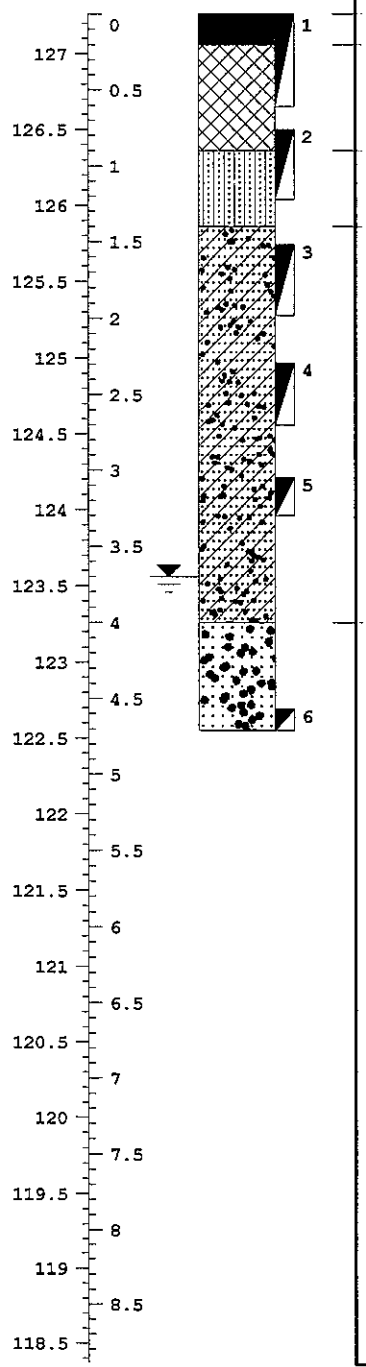
Enclosure No. 11

SOIL PROBE LTD.

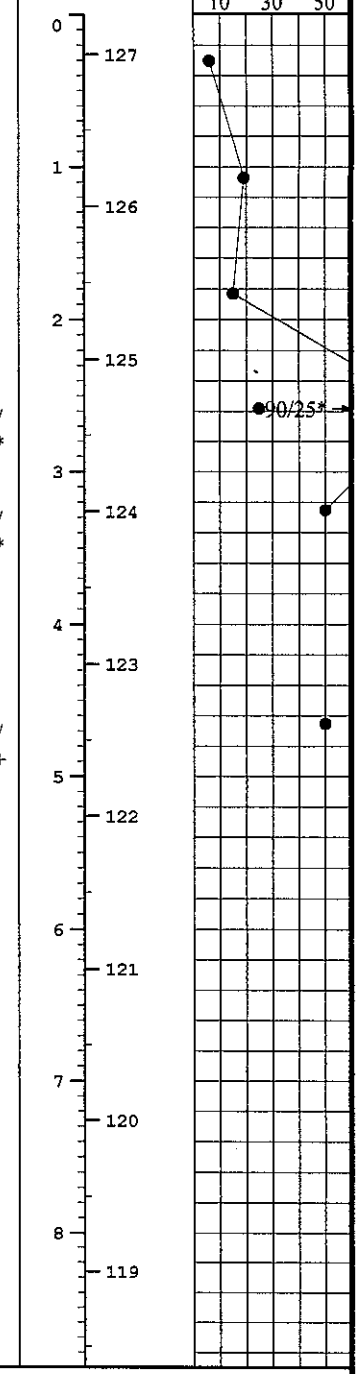
BOREHOLE LOG
BOERHOLE NO.: 12

PROJECT: Proposed Residential Subdivision
LOCATION: 1401 Bronte Road, Oakville, Ontario
ELEVATION (m) 127.26
CAVED AT DEPTH (m):
N=Blow Count in Standard Penetration Test (Blows/0.3m)

PROJECT NO.: SP-3256
DATE: April 2, 2012
WATER LEVEL DEPTH (m): 3.7
M.C. = Natural Moisture Content



ELEVATION/ DEPTH (m)	SOIL SYMBOLS	DESCRIPTION	M.C. %	STANDARD PENETRATION TEST N	STANDARD PENETRATION TEST DEPTH/ ELEVATION (m)
		TOPSOIL - about 200 mm thick (root mat) (Thick green grasse play area)			
		FILL - brown sand-silt-clay, moist	16.7	6	
		SILTY VERY FINE SAND - brown, wet, compact	20.8	19	
		CLAYEY SILT TILL - trace of sand, brown, moist, stiff	18.0	15	
		- wet seam at about 2.1 m			
		- includes some coarse gravel, becomes hard and color changes to brownish grey below about 2.5 m	12.9	90/ 25*	
			8.9	50/ 10*	
		SAND-GRAVEL - brownish grey, wet to very moist, very dense			
		End of Borehole @ 4.71 m Water Level @ 3.7 m on completion drilling 90/25* = 90 blows for 25 cm of sampler penetration after 1st 15 cm 50/14+ = 50 blows for 14 cm of sampler penetration	9.6	50/ 14+	



Enclosure No. 12

SOIL PROBE LTD.

KEY TO SYMBOLS

Enclosure No.: 13
File No.: SP- 3256
Report No.: 2012-23813

Symbol Description

Strata symbols


Topsoil


Sand-gravel


Fill


Cave-in Level


Clayey Silt Till


Water Level


Possible Fill


Clayey Silt


Limestone


Silty sand

Notes:

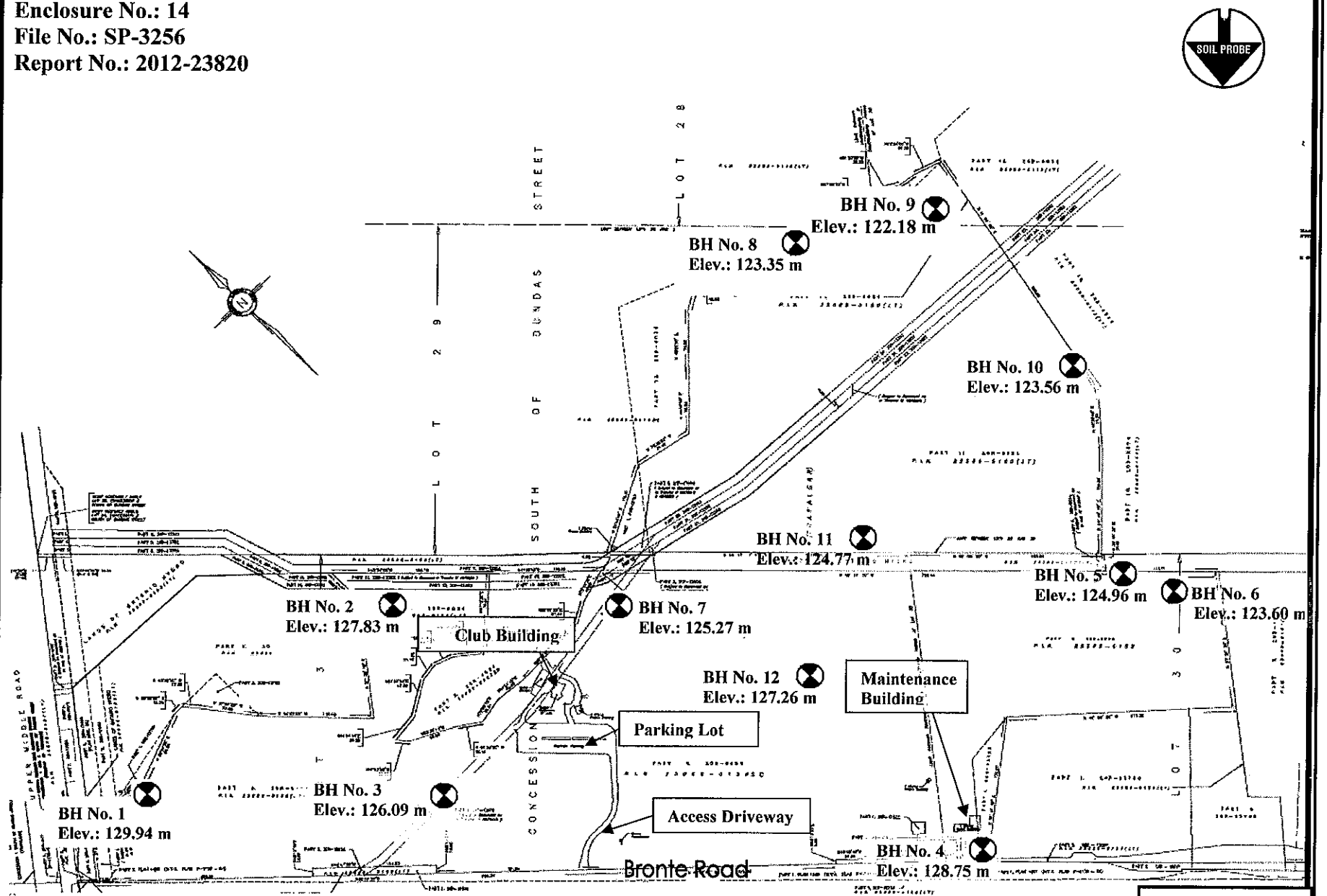
TERMS DESCRIBING RELATIVE DENSITY, BASED ON STANDARD PENETRATION TEST N-VALUE FOR COARSE GRAINED SOILS (major portion retained on No.200 sieve).

DESCRIPTIVE TERM	"N"-VALUE (blows/0.3m)	RELATIVE DENSITY (%)
Very Loose	< 4	< 15
Loose	4 to 10	15 to 35
Compact or Medium	10 to 30	35 to 65
Dense	30 to 50	65 to 85
Very Dense	> 50	> 85

TERMS DESCRIBING CONSISTENCY, BASED ON STANDARD PENETRATION TEST N-VALUE, FOR FINE GRAINED SOILS (major portion passing No. 200 sieve)

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH(kPa)	"N"-VALUE (blows/0.3m)
Very Soft	< 25	< 2
Soft	25 to 50	2 to 4
Firm	50 to 100	4 to 8
Stiff	100 to 200	8 to 15
Very Stiff	200 to 400	15 to 30
Hard	> 400	> 30

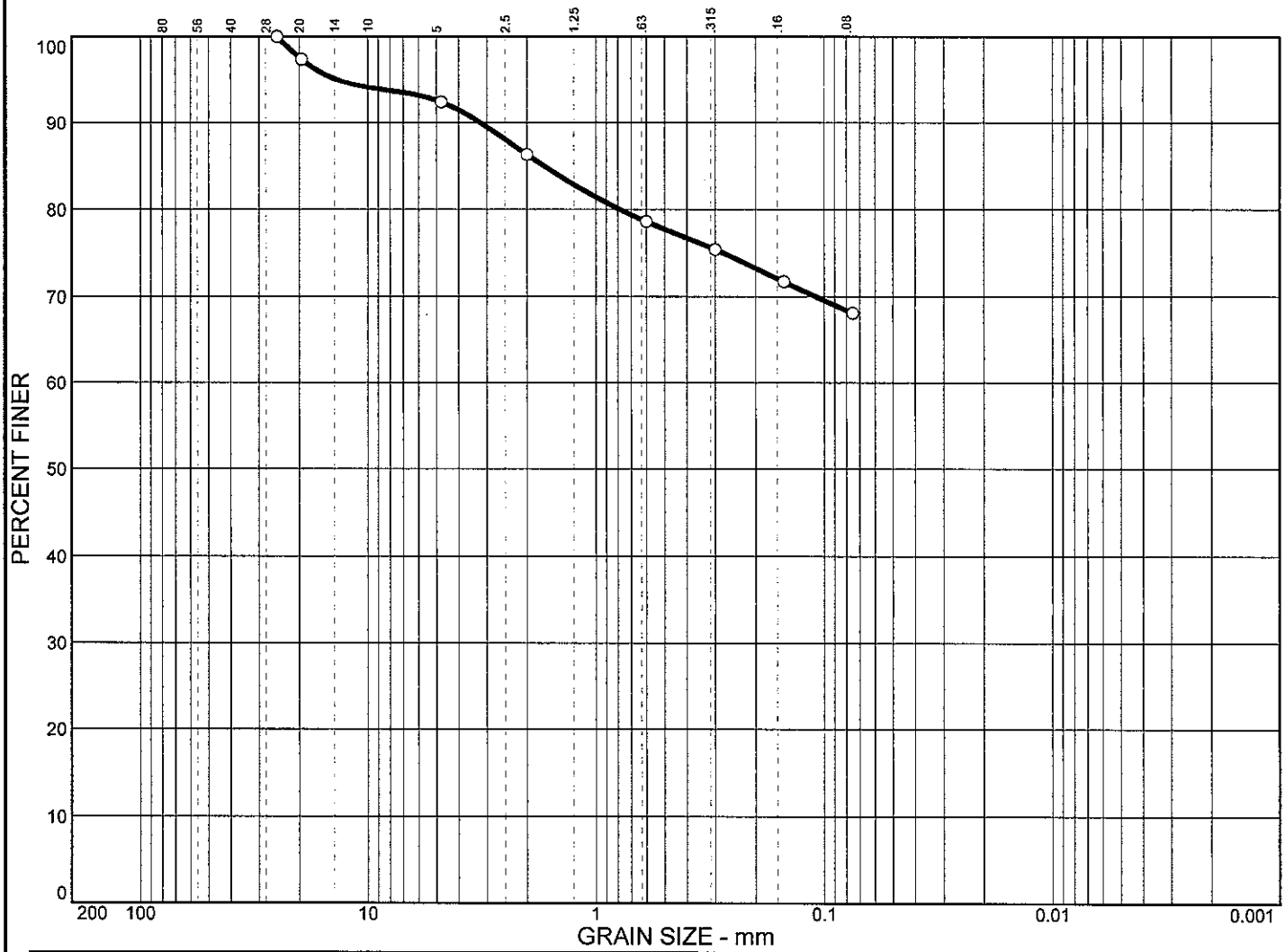
Enclosure No.: 14
File No.: SP-3256
Report No.: 2012-23820



PLOT PLAN SHOWING BOREHOLE LOCATONS FOR THE PROPOSED RESIDENTIAL SUBDIVISION (SAW-WHET GOLF COURSE) AT 1401 BRONTE ROAD, TOWN OF OAKVILLE, ONTARIO

LEGEND
⊗ Borehole

GRAIN SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	7.6	24.3	68.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.69							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Bulk Sample (Fill+Native Till)		

Project No. SP-3256 **Client:** Saw-Whet Golf Course

Project: Proposed Residential Subdivision (Saw-Whet Golf Course) 1401 Bronte Road, Oakville, Ontario

○ **Location:** Borehole # 3 Depth 0.6-2.8 m

Remarks:

○ Sampled by: Harshit

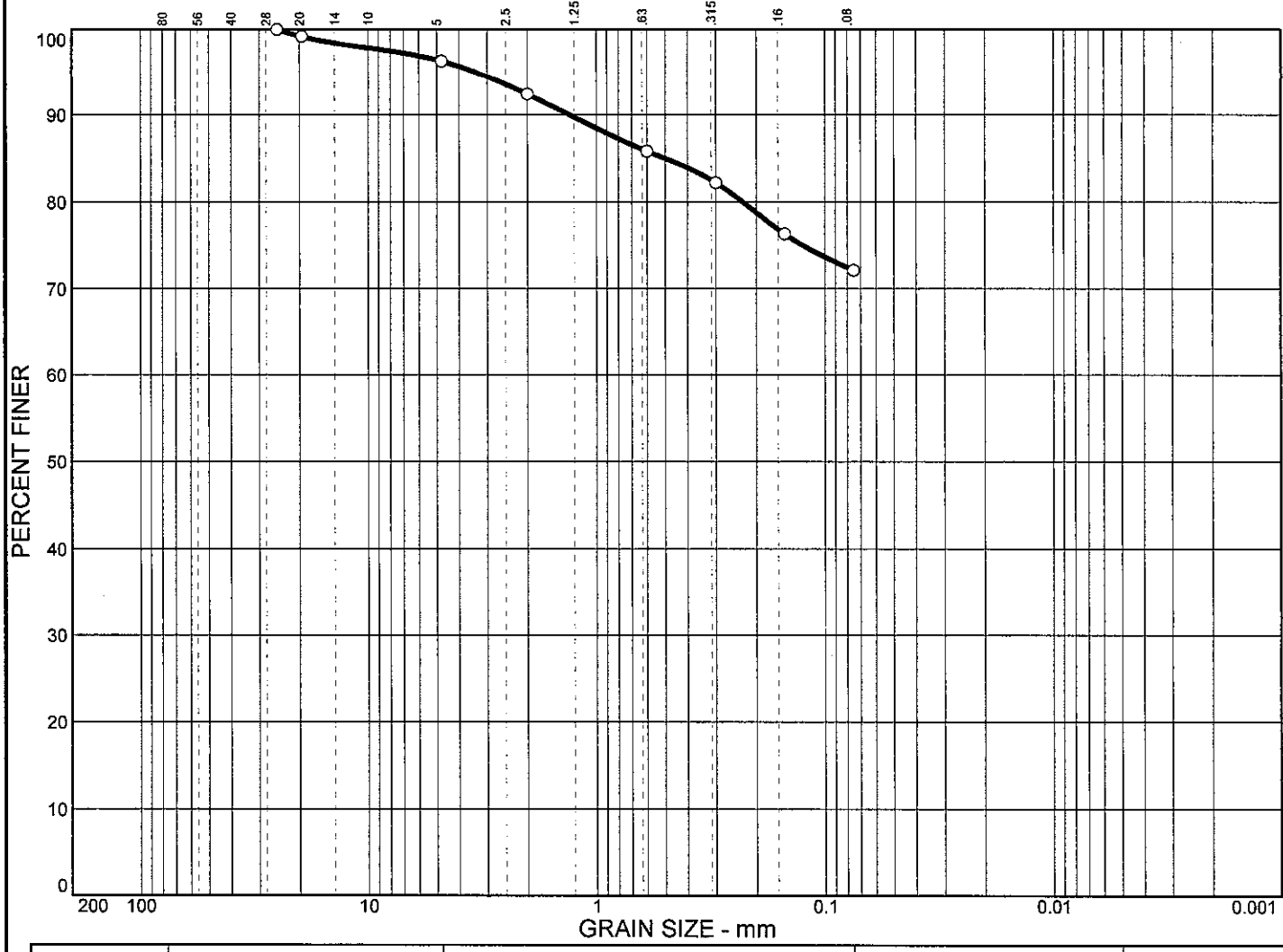
Reported on April 02, 2012

GRAIN SIZE DISTRIBUTION TEST REPORT

SOIL PROBE LTD.

Figure 15

GRAIN SIZE DISTRIBUTION TEST REPORT



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	3.7	24.2	72.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.503							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Bulk Sample (Fill+Native Till)		

Project No. SP-3256 **Client:** Saw-Whet Golf Course

Project: Proposed Residential Subdivision (Saw-Whet Golf Course) 1401 Bronte Road, Oakville, Ontario

○ **Location:** Borehole # 8 Depth 0.76-2.8 m

Remarks:

○ Sampled by: Harshit

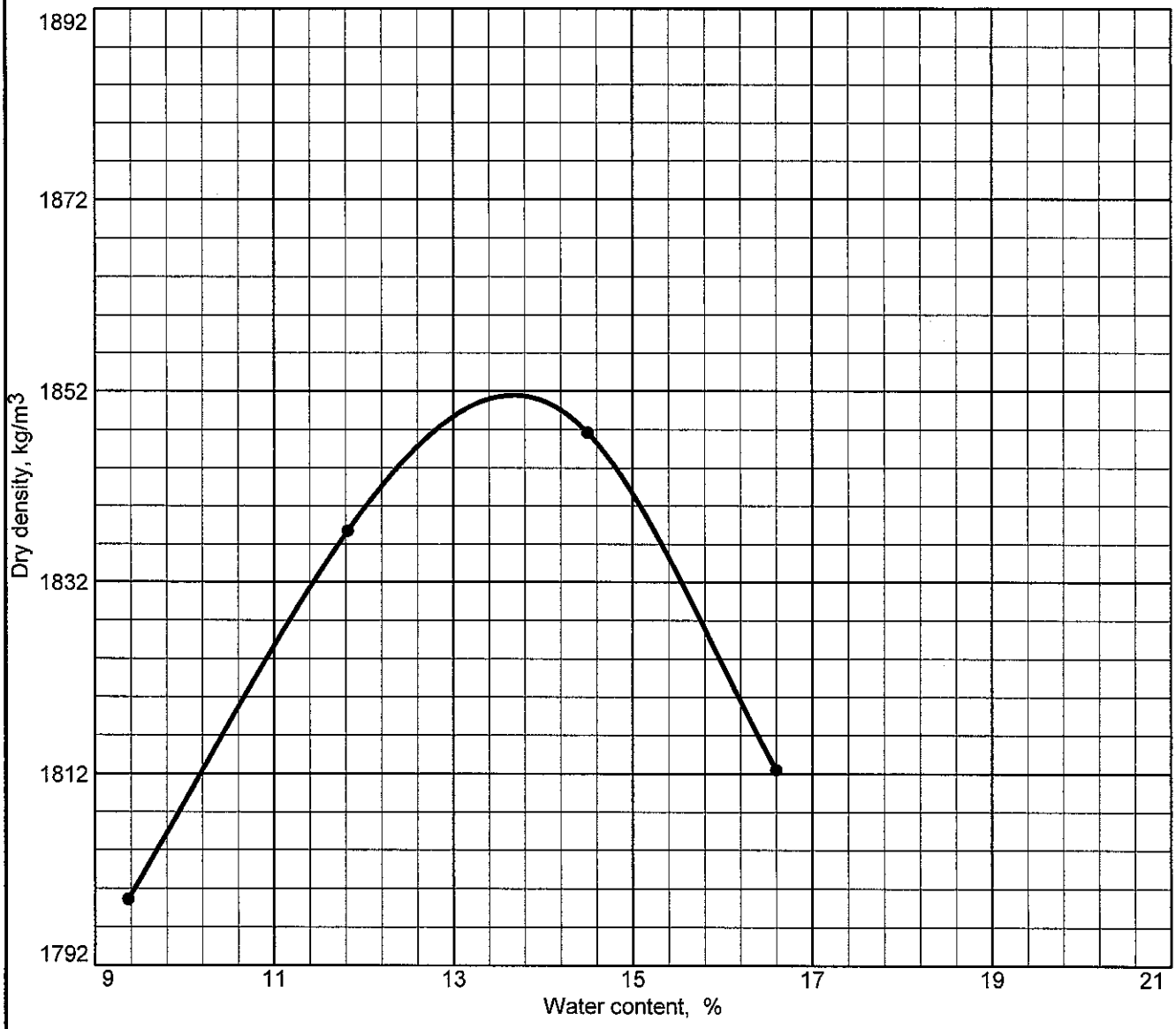
Reported on April 02, 2012

GRAIN SIZE DISTRIBUTION TEST REPORT

SOIL PROBE LTD.

Figure 16

PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
0.6-2.8 m							7.6	68.1

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 1852 kg/m^3 Optimum moisture = 13.7 %	Bulk Sample (Fill+Native Till)

Project No. SP-3256 **Client:** Saw-Whet Golf Course

Project: Proposed Residential Subdivision (Saw-Whet Golf Course) 1401 Bronte Road, Oakville, Ontario

● **Location:** Borehole # 3 Depth 0.6-2.8 m

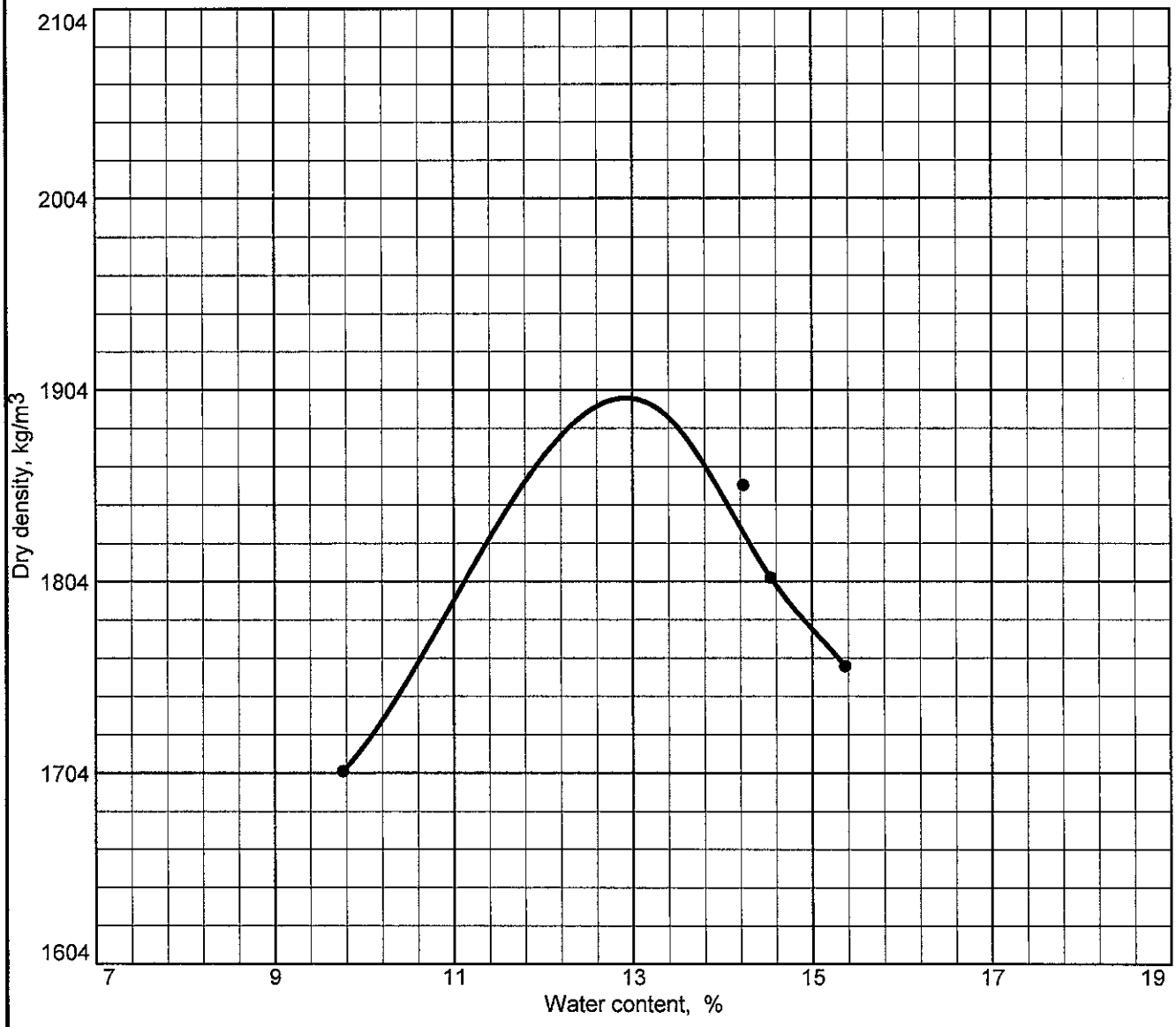
Remarks:
Sampled by: Harshit
On April 02, 2012

PROCTOR TEST REPORT

SOIL PROBE LTD.

Figure 17

PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
0.76-2.8 m							3.7	72.1

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 1900 kg/m^3 Optimum moisture = 12.9 %	Bulk Sample (Fill+Native Till)

Project No. SP-3256 **Client:** Saw-Whet Golf Course

Project: Proposed Residential Subdivision (Saw-Whet Golf Course) 1401 Bronte Road, Oakville, Ontario

● **Location:** Borehole # 8 Depth 0.76-2.8 m

Remarks:

Sampled by: Harshit

Reported on April 02,2012

PROCTOR TEST REPORT

SOIL PROBE LTD.

Figure 18