PROJECT NO: SM 135021-G

DECEMBER 18, 2017

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
53 PLAINS ROAD EAST
BURLINGTON, ONTARIO

PREPARED FOR:

VRANCOR GROUP OF COMPANIES

Soil-Mat

BY

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

130 LANCING DRIVE
HAMILTON, ONTARIO
L8W 3A1

PO BOX 40012, DERRY HEIGHTS PO
MILTON, ONTARIO
L9T 7W4

PROJECT NO: SM 135021-G

DECEMBER 18, 2017

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
53 PLAINS ROAD EAST
BURLINGTON, ONTARIO

PREPARED FOR:

VRANCOR GROUP OF COMPANIES

BY

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

130 LANCING DRIVE
HAMILTON, ONTARIO
L8W 3A1

PO BOX 40012, DERRY HEIGHTS PO
MILTON, ONTARIO
L9T 7W4

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

www.soil-mat.ca info@soil-mat.ca TF: 800.243.1922

Hamilton: 130 Lancing Drive L8W 3A1 T: 905.318.7440 F: 905.318.7455
Milton: PO Box 40012 Derry Heights PO L9T 7W4 T: 800.243.1922

PROJECT NO.: SM 135021-G

May 15, 2013
Reissued: December 18, 2017

VRANCOR GROUP OF COMPANIES
366 KING STREET WEST
HAMILTON, ONTARIO
L8P 1B3

Attention: Mr. Darko Vranich

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
53 PLAINS ROAD EAST, BURLINGTON, ONTARIO

Dear Mr. Vranich,

As requested Soil-Mat Engineers & Consultants is pleased to provide the following geotechnical investigation report for the above noted project. This report has been updated and reissued from our original report in 2013 in order to reflect the current ownership and project details. The investigation and reporting were undertaken in general accordance with our proposal P4944, dated November 23, 2012. Our comments and recommendations, based on our findings at the seven borehole locations are presented herein.

1. INTRODUCTION

We understand that the project will involve the construction of a new residential development including two 10 to 12-storey apartment buildings, each of which are to include up to two additional basement levels for parking purposes. The project will also involve the installation of associated underground services, and asphalt paved driveway and parking lot areas. The purpose of this geotechnical investigation was to determine the subsurface soil information at the seven borehole locations, and to interpret the results of this investigation with respect to the design and construction of the foundations and related earthworks for this project.

This report is based on the above summarised project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design, such as the addition of a second basement level, or additional storeys, may void the recommendations given in this report. If significant changes are made to the proposed design, then this office must be consulted to review the new design with respect to the results of this investigation. The information contained in this report does not reflect upon the environmental aspects of the site and therefore have not been addressed in this document.

2. PROCEDURE

A total of seven [7] sampled boreholes were advanced at the locations illustrated in the enclosed Drawing No. 1, Borehole Location Plan. The borings were put down using track-mounted drilling equipment on April 1, 2 and 3, 2013 under the direction and supervision of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD. The boreholes were advanced to termination at depths approximately 5.0 to 15.8 metres below the existing grade.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the Soil-Mat laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings. In addition, hand penetrometer tests were performed on selected cohesive soil samples.

Groundwater observations were made during the course of drilling in each borehole. At the completion of drilling a monitoring well was installed in Borehole No. 7 to allow for a determination of the static groundwater level. The monitoring well was installed to a depth of approximately 9.1 metres, screened in the lower 3.05 metres, backfilled with filter sand and a bentonite clay seal. The well was fitted with a flush mount casing even with the existing grade. The remaining boreholes were backfilled in general accordance with Ontario Regulation 903.

The boreholes were located in the field by a representative of SOIL-MAT ENGINEERS in consultation with our client. The ground surface elevation at the borehole locations was surveyed to a temporary site benchmark, described as the top of the manhole cover at the intersection of Plains Road East and Clearview Avenue. For convenience this temporary benchmark was assigned an elevation of 100.00 metres.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Log of Borehole Nos. 1 to 7, inclusive, following the text of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact planes of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The project site is located at 53 Plains Road East in Burlington, Ontario. The site is an 'L' shaped parcel bounded to the north by a small industrial/commercial park, northeast by existing residential dwellings, to the east by Clearview Avenue, to the south by Plains Road East, and to the west by Cooke Boulevard. The subject property is surfaced with maintained lawns toward the northern and eastern portions of the property with asphalt pavement covering the majority of the west side of the property. There is a single storey commercial building in the southwest corner of the site. The eastern portion of the property consists of a grass covered vacant lot [former site of a gasoline service station]. The topography of the site is generally flat and even with the adjacent roadways, with a maximum topographic relief across the site of approximately 0.6 meters.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Pavement Structure

Borehole Nos. 1 and 3 were advanced through the existing parking lot bordering the existing building at 53 Plains Road East. The Pavement Structure was found to consist of approximately 50 and 75 millimetres of asphaltic concrete over approximately 100 and 150 millimeters of compact gravel base material at these locations.

Topsoil

A surficial veneer of topsoil, approximately 50 to 100 millimetres in thickness, was encountered in Borehole Nos. 2, 4, 5, 6 and 7. It is noted that the depth of topsoil might vary across the site and from the depths encountered at the borehole locations. It should also be noted that the term 'topsoil' has been interpreted in this report from a geotechnical-engineering point of view. If it is to be used for landscaping purposes, its suitability should be confirmed by tests on representative samples for organic and nutrient content and therefore its ability to support plant growth.

Silty Fine Sand Fill

A Silty Fine Sand Fill was encountered underlying the pavement structure in Borehole Nos. 1 and 3, and underlying the topsoil veneer in Borehole Nos. 2, 4, 5, 6, and 7. The predominantly granular soil was found to be brown to reddish brown in colour, containing traces of fine gravel throughout the majority of the deposit with traces of clay at shallower depths. This soil was found to be in a generally very loose to very dense condition.

Native Silty Fine Sand

A Native Silty Fine Sand was encountered underlying the pavement structure in Borehole Nos. 3 and 4. The Native Silty Fine Sand is generally brown in colour and to contain traces of fine gravel and the occasional 'clayey' seam and was found to be in a generally loose to compact condition.

Native Silty Sand

A deposit of Native Silty Sand was encountered underlying the Silty Fine Sand Fill and the Native Silty Fine Sand at depths of between approximately 2.2 to 4.0 meters below the present grade. The Native Silty Sand is generally brown in colour and contains traces of fine to coarse gravel, occasional 'gravel-rich' layers, occasional cobbles, and was found to be in a generally compact to very dense condition. The native Silty Sand deposit was proven to termination in Borehole Nos. 2, 3, 4 and 7. It appears that the blow counts within the proposed founding level in Borehole No. 7 have been influenced via 'suction' resulting in soil disturbance during withdrawal of the solid stem augers.

Silty Clay

Native Silty Clay was encountered beneath the Native Silty Sand in Borehole Nos. 1, 5, and 6 at depths of 12.6, 11.8, and 12.7 meters, respectively. The grey cohesive soil was found to contain traces of fine gravel, traces of fine shale fragments, and occasional thin sand seams. The Native Silty Clay was proven to termination in the above listed borehole locations.

Hand penetrometer testing conducted on the recovered cohesive soil samples measured unconfined compressive strengths in the range of approximately 3.5 to greater than 4.5 kilograms per square centimetre [~ 3.5 to greater than 4.5 tons per square foot].

Groundwater Observations

Borehole Nos. 2, 3, and 4 were recorded to be 'dry' on completion of drilling. Groundwater was encountered in Borehole Nos. 1, 5, 6, and 7 at depths of 6.7, 7.3, 7.1, and 7.4 meters, respectively. It should be noted that some 'caving' occurred in Borehole Nos. 1, 5, and 6, and the measured groundwater levels may be slightly greater than that of the natural groundwater level on site. A groundwater monitoring well was installed in Borehole No. 7 and yielded a groundwater level of 7.27 to 7.45 meters below the existing grade upon measurements on April 9, 13 and 16, 2013. We note that the groundwater level is expected to fluctuate during the year, i.e. slightly higher during spring melt and slightly lower during the summer months.

4. FOUNDATION CONSIDERATIONS

The site conditions are suitable for support of the proposed structures on conventional spread footings founded in the undisturbed native compact to dense Silty Sand. Spread footings founded at depths of up to 6.0 metres below the existing grade may be designed using a factored Ultimate Limit State [ULS] bearing capacity of 450 kPa [~9,000 psf]. The allowable bearing stress at Serviceability Limit State [SLS] should be limited to 300 kPa [~6,000 psf], based on the total and differential settlements not exceeding 25 and 20 millimetres, respectively. Considering that the founding soils are 'granular' in nature, we expect that the settlement will be pseudo-elastic in nature, occurring as the loads are applied. The footings should have a minimum width of one metre with the design bearing value reducing linearly as a function of width, such that a theoretical footing of zero width would have a design bearing value of zero. We note that some additional excavation is required in the area of Borehole No. 7. In this regard we would recommend that a series of test pit excavations be advanced in the area of this boring should it be found to be located within a proposed building.

It is noted that the SLS value represents the Serviceability Limit State, which is governed by the tolerable deflection [settlement] based on the proposed building type, using unfactored load combinations. The ULS value represents the Ultimate Limit State and is intended to reflect an upper limit of the available bearing capacity of the founding soils in terms of geotechnical design, using factored load combinations. There is no direct relationship between ULS and SLS, rather they are a function of the soil type and the tolerable deflections for serviceability, respectively. The above dissertation assumes a typical building. Evidently, the bearing capacity values would be lower for very settlement sensitive structures and larger for more flexible buildings.

In areas where it will be necessary to provide adjacent footings at different founding elevations, the lower footing should be constructed before the higher footing is constructed, if possible, and the higher footing should be set below an imaginary line drawn up from the edge of the lower footing at 10 horizontal to 7 vertical. This practice will limit stress transfer from the higher footings to lower footings.

All footings exposed to the environment must be provided with a minimum of 1.2 metres of earth cover or equivalent insulation to protect against frost damage. This frost protection would also be required if construction were undertaken during the winter months. All footings and foundations should be designed and constructed in accordance with the current Ontario Building Code.

With foundations designed as outlined above and as required by the Building Code, and with careful attention paid to construction detail, total and differential settlements should be well within normally tolerated limits of 25 and 20 millimetres, respectively, for the type of building and occupancy expected.

It is imperative that a soils engineer be retained from this office to provide geotechnical engineering services during the excavation and foundation construction phases of the project. This is to observe compliance with the design concepts and recommendations of this report and to allow changes to be made in the event that subsurface conditions differ from the conditions identified at the Borehole locations.

Lateral earth pressures on the basement walls can be estimated on the basis of backfill [free draining granular material] unit weight, γ=20 kN/m^3, and a coefficient of lateral earth pressure, K = 0.35 if small lateral deformations are acceptable, or 0.5 in fill against rigid walls. Any additional pressures due to surcharge loading must be included in the design.

5. SEISMIC DESIGN CONSIDERATIONS

The structure shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 332/12. Based on the subsurface soil conditions encountered in this investigation the applicable Site Classification for the seismic design is D, Stiff Soil, based on the average soil characteristics for the site. A determination of seismic Site Class C, Dense Soil/Soft Rock may be available, however additional testing including a deep borehole to determine the depth to bedrock and/or site specific shear wave velocity testing would be required.

The seismic data, from Supplementary Standard SB-1 of the Ontario Building Code, for the Burlington, Ontario area are as follows.

$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
0.32	0.170	0.064	0.022	0.180

6. FLOOR SLAB CONSIDERATIONS

The building floor slabs may be constructed using conventional slab-on-grade techniques on a prepared Silty Clay or engineered fill subgrade. As with all concrete floor slabs, there is a tendency for the floor slabs to crack. The slab thickness, concrete mix design, the amount of steel and/or fibre reinforcement and/or wire mesh placed into the concrete slab, if any, will therefore be a function of the owner's tolerance for cracks in, and movements of, the slabs-on-grade, etc. The 'saw-cuts' in the concrete floors, for crack control, should extend to a minimum depth of 1/3 of the thickness of the slab.

A moisture barrier will be required under the floor slabs to act as a capillary break. A recommended moisture barrier consists of at least 200 millimetres of well-compacted 20 millimetre clear crushed stone. At a minimum the moisture barrier material should contain no more than 10 percent of material passing the No. 4 sieve.

Where 'non-damp' floor slabs are required, as for instance under sheet vinyl floor coverings, etc., extra efforts will be required to dampproof the floor slab, as with the additional provisions of a heavy 'poly' sheet, damp proofing sprays/membranes, drainage board products, etc. Where 'poly' sheets are used care should be taken to prevent puncturing and tearing and/or sufficiently heavy gauge sheeting specified. Alternatively a proprietary product, such as Delta-MS Underslab or WR Meadows membrane, may be considered in lieu of the 'poly' sheets.

Curing of the slab-on-grade must be carefully specified to ensure that slab curl is minimised. This is especially critical during the hot summer months of the year when the surface of the slab tends to dry out quickly while high moisture conditions in the moisture barrier or water trapped on top of any 'poly' sheet at the saw cut joints and cracks, and at the edges of the slabs, maintains the underside of the slab in a moist condition.

It is also important that the concrete mix design provide a limiting water/cement ratio and total cement content, which will mitigate moisture related problems with low permeance floor coverings, such as debonding of vinyl and ceramic tile. It is equally important that excess free water not be added to the concrete during its placement as this could increase the potential for shrinkage cracking and curling of the slab.

It is recommended that a permanent perimeter drainage tile system be provided around the basement walls of the structures to prevent the buildup of water against the foundation walls. The perimeter drainage systems should consist of 150 mm diameter perforated pipe, surrounded with 200 millimetres of 20 millimetres clear stone, and the clear stone in turn encased by a heavy filter geotextile product. The suppliers of the filter geotextile should be consulted as to the type best suited for this project.

This office should examine the installation of the drainage system. Even a small break in the filtering materials could result in loss of fines into the drains with attendant performance difficulties, including settlements of the ground surface. The exterior grade around the structure should be sloped away from the structure to prevent the ponding of water against the foundation walls. The enclosed Drawing No. 2 shows schematics of the typical requirements for drainage and backfill against foundation walls.

7. EXCAVATIONS

Excavations for the installation of building foundations and underground services are generally expected to extend to depths of approximately 6.0 metres below the existing grade. Excavations through the fill material and native soils should be relatively straightforward, with the sides remaining stable for the short construction period at 45 degrees to the horizontal or steeper. Where wet seams are encountered, or during wet weather, the sides of the excavation in the fine grained granular soil may have a tendency to 'slump' into slopes as flat as 3 horizontal to 1 vertical.

Where excavations extend close to the property lines the proximity of excavations to adjacent below and above grade structures, sidewalks and roadways, etc. should be evaluated to ensure that these structures are not undermined. The use of excavation support, such as soldier piles and timber lagging, steel sheet piles, etc. may be considered to facilitate excavations to the property line. This office should be contacted for specific comment in the event that such excavation shoring methods are utilised.

As noted above, the static groundwater level in the monitoring well was found to be at a depth of approximately 7.3 to 7.4 metres below the existing grade. It should be possible to adequately control any minor infiltration and collection of groundwater within the anticipated 6.0 metre deep excavations with conventional construction dewatering techniques, such as pumping from sumps in the base of the excavation. More water should be expected when connections are made with existing services. Surface water should be directed away from the excavations.

The base of the excavations in the compact to very dense Silty Fine Sand and Silty Sand encountered in the upper levels of the boreholes should generally remain firm and stable. Therefore, standard pipe bedding may be provided, as typically specified by the Ontario Provincial Standard Specification will be satisfactory, compacted to 95 per cent standard Proctor density. Should excavation bases encounter any very loose or loose fill materials [or the loose native soils in the area of Borehole No. 7], some additional work may be required to stabilise the excavation base, such as the placement of a compacted well graded granular material or the provision of additional bedding material or additional compaction of the excavation base. Special attention should be paid to compaction under the pipe haunches.

It is noted that construction equipment should be restricted as much as possible from travelling on the competed excavation base. Ideally final excavations should be made from a level above the design founding level. Where construction equipment is required to travel on the excavation base it would be prudent to provide a layer of coarse crushed granular material, such as OPSS Granular B, in order to provide a stable working surface.

8. BACKFILL CONSIDERATIONS

The majority of excavated soil will consist of fill material or the Native Silty Fine Sand and Silty Sand. The native soils and select portions of the fill materials are considered suitable for use as engineered fill, trench backfill, etc., provided that the material is free of organics and organic staining, and that its moisture content can be controlled to within 3 percent of its standard Proctor optimum moisture content.

It is noted that the on-site soils are not considered to be free draining and therefore should not be used where this characteristic is necessary, such as foundation walls, etc. The use of free draining, well-graded granular material, such as an Ontario Provincial Standard Specification [OPSS] Granular B, Type II (crushed bedrock), is recommended for backfill against foundation. This material is more readily compacted in restricted access areas, and generally presents a more positive support condition for interior floor slabs and exterior concrete sidewalks.

We note that where backfill material is placed near or slightly above its optimum moisture content, the potential for long term settlements due to the ingress of groundwater and collapse of the fill structure is reduced. Correspondingly, the shear strength of the 'wet' backfill material is also lowered, thereby reducing its ability to support construction traffic and therefore impacting roadway construction. If the soil is well dry of its optimum value, it will appear to be very strong when compacted, but will tend to settle with time as the moisture content in the fill increases to equilibrium condition. It is therefore very important that the placement moisture content of the backfill soils be within 3 percent of its standard Proctor optimum moisture content during placement and compaction to minimise long term subsidence [settlement] of the fill mass. Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 per cent of its optimum moisture content and meet the necessary environmental guidelines.

A representative of SOIL-MAT should be present on-site during the backfilling and compaction operations to confirm the uniform compaction of the backfill material to project specification requirements. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance near the end of compaction 'runs'. All structural fill and service trench backfill should be compacted to 100 per cent standard Proctor maximum dry density. A method should be developed to assess compaction efficiency employing the on-site compaction equipment and backfill materials during construction.

9. PAVEMENT STRUCTURE DESIGN CONSIDERATIONS

All areas to be paved must be cleared of all topsoil and unsuitable materials and the exposed subgrade proofrolled with 3 to 4 passes of a loaded tandem-axle truck in the presence of a representative of Soil-Mat Engineers & Consultants Ltd., immediately prior to the placement of the sub-base material. Any areas of distress revealed by this or other means should be subexcavated and replaced with suitable backfill material. Where the subgrade condition is poorer it may be necessary to implement more aggressive stabilisation methods, such as the use of coarse aggregate [50 millimetre clear stone, 'rip rap' stone, black rock, etc.] 'punched' into the soft areas. It may also be prudent to consider the provision of a heavy geofabric over the subgrade to act as a separator between the subgrade and granular base materials. In such case it is recommended that a non-woven product be specified.

The need for subexcavations of softened subgrade materials will be reduced if construction is undertaken during dry periods of the year and careful attention is paid to the compaction operations. As noted above the on site soils are sensitive to disturbance and moisture and may present difficulty for roadway construction during 'wet' periods of the year. Should pavement construction be undertaken during 'wet' periods of the year it should be anticipated that greater stabilisation efforts will be required and/or additional depth of OPSS Granular B, Type II sub-base course material may be required.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and to prevent softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved areas.

The most severe loading conditions on the subgrade typically occur during the course of construction, therefore precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. Soil-Mat should be given the opportunity to review the final pavement structure design and subdrain scheme prior to construction to ensure that they are consistent with the recommendations of this report.

TABLE A
RECOMMENDED PAVEMENT STRUCTURES

LAYER DESCRIPTION	COMPACTION REQUIREMENTS	LIGHT DUTY SECTIONS	HEAVY DUTY [TRUCK ROUTE]
Asphaltic Concrete Wearing course OPSS HL 3 or HL 3A	97 percent Marshall	65 millimetres	40 millimetres
Binder Course OPSS HL 8	97 percent Marshall		65 millimetres
Base Course OPSS Granular A	100% SPMDD	150 millimetres	150 millimetres
Sub-base Course OPSS Granular B Type II	100% SPMDD	200 millimetres	350 millimetres

* SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698.

The suggested pavement structures outlined in Table A are based on subgrade parameters estimated on the basis of visual and tactile examinations of the on-site soils and past experience. The outlined pavement structure may be expected to have an approximate ten-year life, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, then site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

Depending on the arrangement of light duty and heavy duty pavement sections, the transition between sections may present some difficulty for contractors. In this regard, consideration might be given to a slightly increased light duty pavement structure consisting of 50 millimetres of HL8 binder course and 40 millimetres of HL3 surface course asphaltic concrete. This structure will provide for a continuous depth of surface course asphalt allowing for ease of construction. As well such a structure would have an improved performance over an increased design life. Such an arrangement of asphalt layers would also allow for future rehabilitation with a 'mill and pave' type operation.

To minimise segregation of the finished asphalt mat, the asphalt temperature must be maintained uniform throughout the mat during placement and compaction. All too often, significant temperature gradients exist in the delivered and placed asphalt with the cooler portions of the mat resisting compaction and presenting a honeycomb surface. As the spreader moves forward, a responsible member of the paving crew should monitor the pavement surface, to ensure a smooth uniform surface. The contractor can mitigate the surface segregation by 'back-casting' or scattering shovels of the full mix material over the segregated areas and raking out the coarse particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

10. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are only intended to describe conditions at the borehole locations. Contractors placing bids or undertaking this project should carry out due diligence in order to verify the results of this investigation and to determine how the subsurface conditions will effect their operations.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, then please do not hesitate to contact the undersigned.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

FOR Michael Brown, B. Eng, EIT

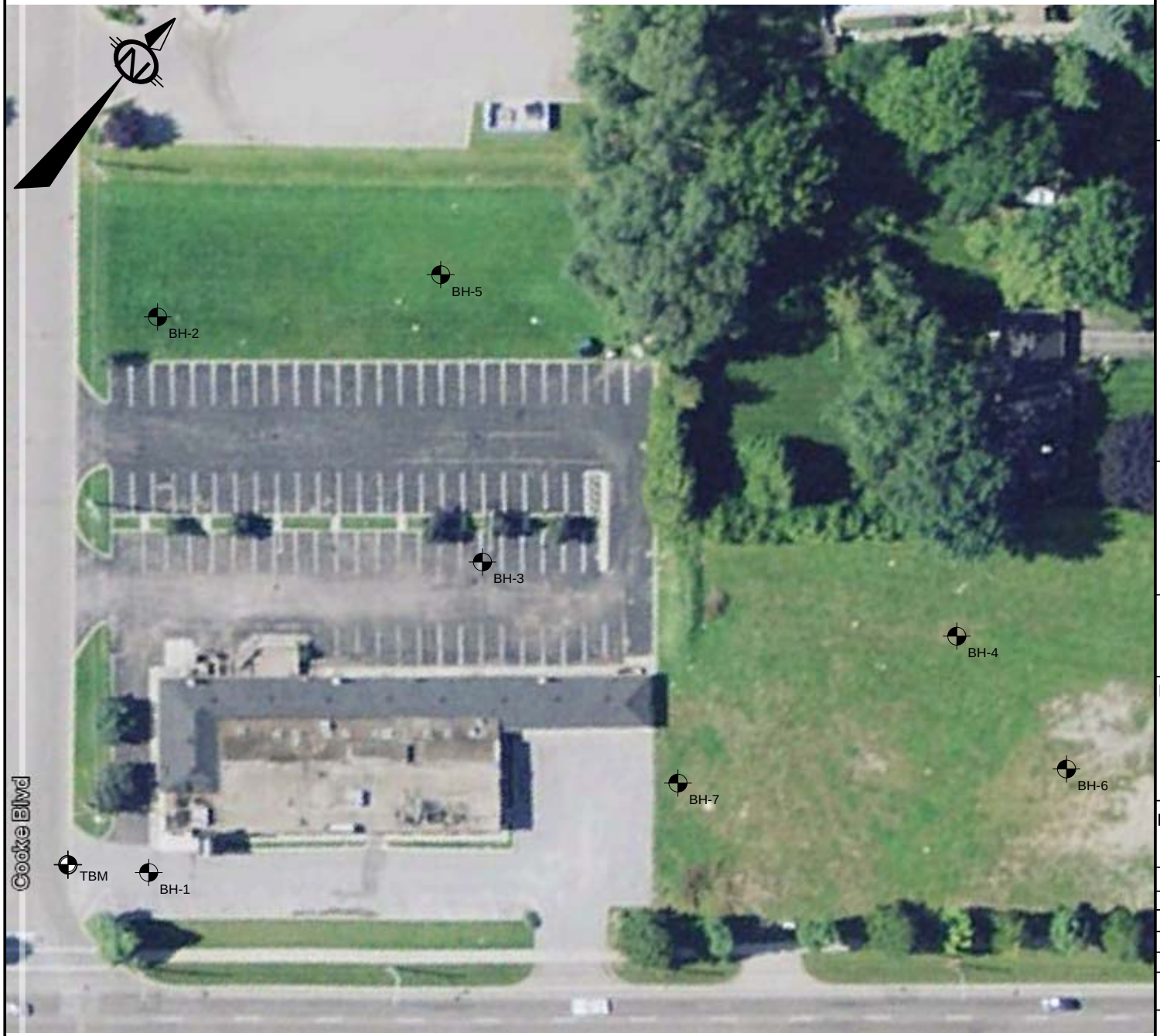
LICENSED PROFESSIONAL ENGINEER
DEC 19/17
S. R. SEARS
PROVINCE OF ONTARIO

Stephen R. Sears, B. Eng. Mgmt., P. Eng.
Senior Engineer

Ian Shaw, P. Eng.
Review Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Log of Borehole Nos. 1 to 7, inclusive
Drawing No. 2, Typical Design Requirements Drainage and Backfill for Basement Walls

Distribution: VRANCOR GROUP OF COMPANIES [1, plus pdf]



LEGEND

BH-# Borehole

TBM Temporary Benchmark
[Top of manhole cover in intersection of Cooke Blvd and Plains Rd. E, assumedelevation of 100.00 metres]

NOTES:

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. supplemental report number SM 135021-G
2. Borehole locations are approximate.
3. Soil samples will be discarded after 3 months unless directed otherwise by client.
4. Image obtained from Google 2010 Digital Globe

Soil-Mat
Engineers & Consultants Ltd.

CLIENT
Branthaven Homes

PROJECT TITLE
Geotechnical Investigation
53 Plains Road East
Burlington, Ontario

DRAWING TITLE
Borehole Location Plan

PROJECT No.	SM 135021-G
SCALE	N.T.S.
DATE	March 2013
CHECKED	IS
DRAWN	MB

FILENAME
135021-G Borehole Location Plan.kcw

DRAWING No. 1

Project No: SM 135021-G

Log of Borehole No. 1

Project: Proposed Residential Developement

Project Manager: Ian Shaw, P. Eng.

Location: 53 Plains Road E., Burlington, ON

Borehole Location: See Drawing No. 1

Client: Branthaven Homes

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		99.82		Ground Surface								
0	0			**Pavement Structure** Approximately 75 millimeters of asphaltic concrete over approximately 100 millimeters of compact granular base material								
				Silty Fine Sand Fill Brown to reddish brown, occasional clayey seams in upper level, trace of fine gravel, very loose to loose		SS	1	2,2,3	5			
						SS	2	1,2,2	4			
	2					SS	3	2,1,1	2			
						SS	4	0,1,2	3			
		95.82		**Native Silty Sand** Brown, trace of fine to coarse gravel, occasional gravel-rich layers, dense to compact		SS	5	7,13,25	38			
	4											
						SS	6	6,6,24	30			
	6											
						SS	7	6,8,8	16			
	8											
						SS	8	2,5,6	11			
		89.82										

Moisture Content
w%
10 20 30 40

Standard Penetration Test
blows/300mm
20 40 60 80

Drill Method: Hollow-Stem Auger
Drill Date: Apr. 1/13
Hole Size: 150mm
Drill Contractor: Davis

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark
Field Logged by: Mike Brown
Checked by: IS
Sheet: 1 of 2

Project No: SM 135021-G

Log of Borehole No. 1

Project: Proposed Residential Developement

Project Manager: Ian Shaw, P. Eng.

Location: 53 Plains Road E., Burlington, ON

Borehole Location: See Drawing No. 1

Client: Branthaven Homes

Soil-Mat

SUBSURFACE PROFILE

Native Silty Sand

Brown, trace of fine to coarse gravel, occasional gravel-rich layers, dense to compact

87.23

Silty Clay

Grey, traces of very fine gravel, traces of shale fragments, occasional sand seams, stiff to hard

84.12

End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 1, 2013 to termination at a depth of 17.2 metres.

2. Borehole was recorded as 'caved' at a depth of 7.3 and 'wet' at a depth of 6.7 metres upon completion of drilling and backfilled as per Ontario Regulation 903.

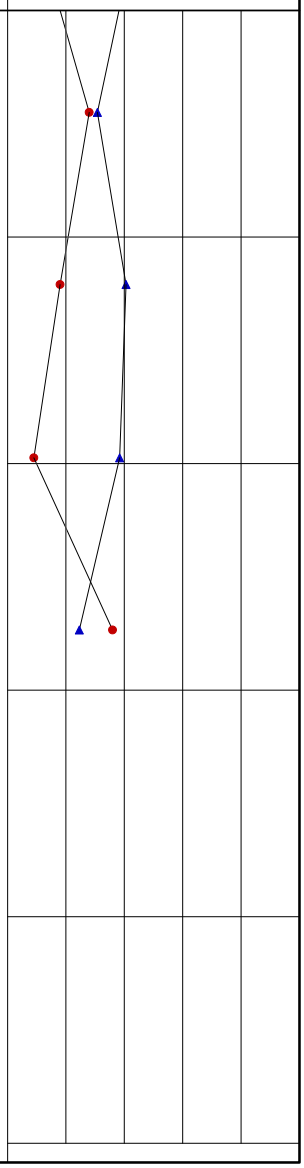
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	9	6,12,16	28			
SS	10	9,9,9	18			
SS	11	3,4,5	9		4.0	
SS	12	9,15,21	36		4.5	

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80



Drill Method: Hollow-Stem Auger

Drill Date: Apr. 1/13

Hole Size: 150mm

Drill Contractor: Davis

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark

Field Logged by: Mike Brown

Checked by: IS

Sheet: 2 of 2

Project No: SM 135021-G

Log of Borehole No. 2

Project: Proposed Residential Developement

Project Manager: Ian Shaw, P. Eng.

Location: 53 Plains Road E., Burlington, ON

Borehole Location: See Drawing No. 1

Client: Branthaven Homes

Soil-Mat

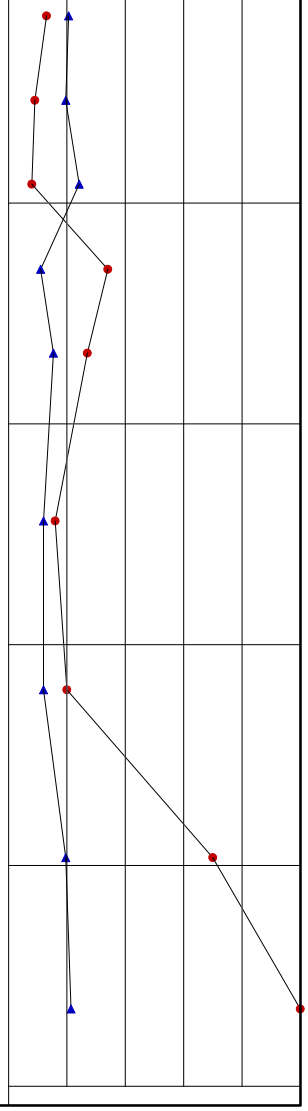
SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		100.00	Ground Surface								
0	0		***Topsoil*** Approximately 50 millimeters over		SS	1	2,3,5,8	13			
2			***Silty Fine Sand Fill*** Brown to reddish brown, occasional clayey seams in upper level, trace of fine gravel, loose to compact		SS	2	4,4,5	9			
4					SS	3	7,4,4	8			
6	2	97.85									
8			***Native Silty Sand*** Brown, fine to medium in grade, traces of fine to coarse gravel, occasional gravel-rich layers, occasional cobbles, dense to compact		SS	4	7,18,16	34			
10					SS	5	15,13,14	27			
12	4										
14											
16					SS	6	5,8,8	16			
18											
20	6				SS	7	5,10,10	20			
22			NOTES:								
24			1. Borehole was advanced using solid stem auger equipment on April 1, 2013 to termination at a depth of 9.4 metres.								
26	8		2. Borehole was recorded as 'dry' upon completion of drilling and backfilled as per Ontario Regulation 903.		SS	8	22,31,39	70			
28			3. Soil samples will be discarded after 3 months unless otherwise directed by our client.								
30					SS	9	28,50/5"	100			
32		90.25									
			End of Borehole								

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80



Drill Method: Solid-Stem Auger

Drill Date: Apr. 1/13

Hole Size: 150mm

Drill Contractor: Determination

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark

Field Logged by: Mike Brown

Checked by: IS

Sheet: 1 of 1

Project No: SM 135021-G

Log of Borehole No. 3

Project: Proposed Residential Developement

Project Manager: Ian Shaw, P. Eng.

Location: 53 Plains Road E., Burlington, ON

Borehole Location: See Drawing No. 1

Client: Branthaven Homes

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	99.54	Ground Surface
0	0	99.34	**Pavement Structure** — Approximately 50 millimeters of asphaltic concrete over approximately 150 millimeters of compacted granular base material
6	2	95.54	**Silty Fine Sand** — Brown to reddish brown, occasional clayey seams in upper level, trace of fine gravel, loose
14	4	94.54	**Native Silty Sand** — Brown, trace of fine to coarse gravel, occasional gravel-rich layers, occasional cobbles, dense
16	4		End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 1, 2013 to termination at a depth of 5.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and backfilled as per Ontario Regulation 903.

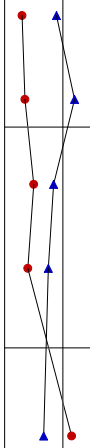
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	3,2,4	6			
SS	2	5,3,4	7			
SS	3	4,5,5	10			
SS	4	4,4,4	8			
SS	5	7,12,11	23			

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Hollow-Stem Auger

Drill Date: Apr. 1/13

Hole Size: 150mm

Drill Contractor: Davis

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark

Field Logged by: Mike Brown

Checked by: IS

Sheet: 1 of 1

Project No: SM 135021-G

Log of Borehole No. 4

Project: Proposed Residential Developement

Project Manager: Ian Shaw, P. Eng.

Location: 53 Plains Road E., Burlington, ON

Borehole Location: See Drawing No. 1

Client: Branthaven Homes

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	100.30	Ground Surface
		100.10	**Pavement Structure** — Approximately 50 millimeters of asphaltic concrete over approximately 150 millimeters of compacted granular base material
2			**Silty Fine Sand** — Brown to reddish brown, occasional clayey seams in upper level, trace of fine gravel, loose to compact
4	2		
6			
8			
10			
12	4	96.30	**Native Silty Sand** — Brown, trace of fine to coarse gravel, occasional gravel-rich layers, very dense
14			
16		95.30	End of Borehole
18			
20	6		
22			
24			
26	8		
28			
30			
32			

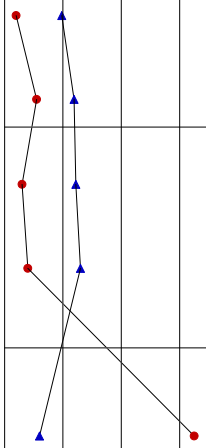
SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	4,2,2	4			
SS	2	3,5,6	11			
SS	3	3,3,3	6			
SS	4	4,4,4	8			
SS	5	7,15,50/5"	65			

Well Data

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80



NOTES:

1. Borehole was advanced using solid stem auger equipment on April 1, 2013 to termination at a depth of 5.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Hollow-Stem Auger

Drill Date: Apr. 1/13

Hole Size: 150mm

Drill Contractor: Davis

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark

Field Logged by: Mike Brown

Checked by: IS

Sheet: 1 of 1

Project No: SM 135021-G

Project: Proposed Housing Developement

Location: 53 Plains Road E., Burlington, ON

Client: Branthaven Homes

Log of Borehole No. 5

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

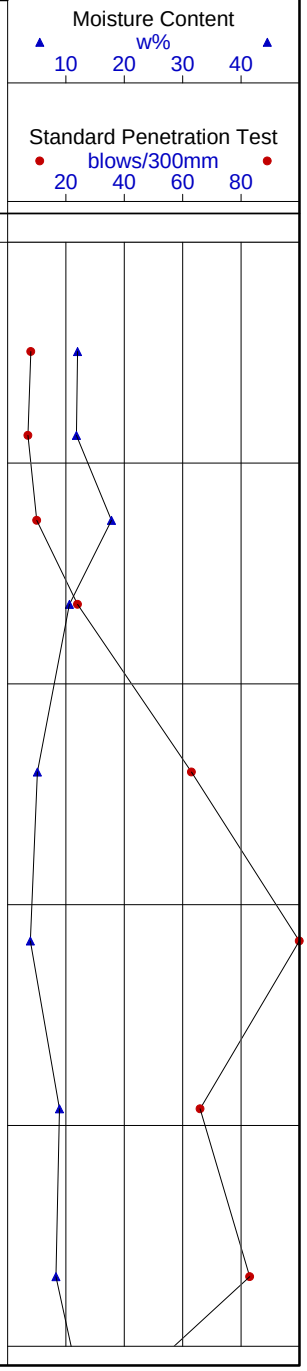
Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	100.10	Ground Surface
			Topsoil Approximately 100 millimeters over
			Silty Fine Sand Fill Brown to reddish brown, occasional clayey seams in upper level, trace of fine gravel, loose to very dense
		97.20	
			Native Silty Sand Brown, trace of fine to coarse gravel, occasional gravel-rich layers, occasional cobbles, compact to very dense
		90.10	

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	6,3,5	8			
SS	2	4,4,3	7			
SS	3	4,5,5	10			
SS	4	9,10,14	24			
SS	5	35,31,32	63			
SS	6	50/5"	100			
SS	7	44,41,25	66			
SS	8	18,33,50/5"	83			



Drill Method: Hollow-Stem Auger
Drill Date: Apr. 2/13
Hole Size: 150mm
Drill Contractor: Davis

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark
Field Logged by: Mike Brown
Checked by: IS
Sheet: 1 of 2

Project No: SM 135021-G

Project: Proposed Housing Developement

Location: 53 Plains Road E., Burlington, ON

Client: Branthaven Homes

Log of Borehole No. 5

Project Manager: Ian Shaw, P. Eng.

Borehole Location: See Drawing No. 1

Soil-Mat

SUBSURFACE PROFILE

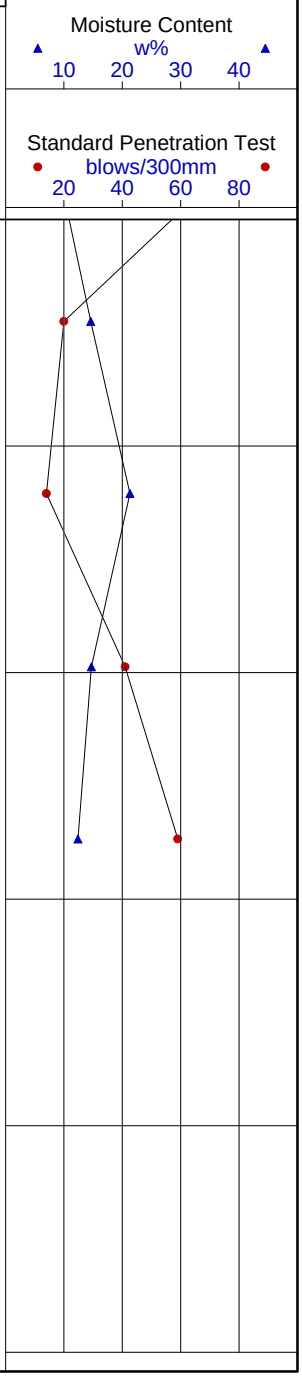
Depth	Elevation [m]	Description
0		***Native Silty Sand*** Brown, trace of fine to coarse gravel, occasional gravel-rich layers, occasional cobbles, compact to very dense
88.35		
12		***Silty Clay*** Grey, trace of fine gravel, traces of shale fragment, occasional sand seams, stiff to hard
14		
84.40		
16		End of Borehole
18		

NOTES:

1. Borehole was advanced using solid stem auger equipment on April 2, 2013 to termination at a depth of 15.7 metres.
2. Borehole was recorded as 'caved' at a depth of 8.5 and 'wet' at a depth of 7.3 metres upon completion of drilling and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	9	6,8,12	20			
SS	10	6,6,8	14			
SS	11	19,18,23	41		4.25	
SS	12	18,23,36	59		>4.5	



Drill Method: Hollow-Stem Auger
Drill Date: Apr. 2/13
Hole Size: 150mm
Drill Contractor: Davis

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark
Field Logged by: Mike Brown
Checked by: IS
Sheet: 2 of 2

Project No: SM 135021-G

Log of Borehole No. 6

Project: Proposed Residential Developement

Project Manager: Ian Shaw, P. Eng.

Location: 53 Plains Road E., Burlington, ON

Borehole Location: See Drawing No. 1

Client: Branthaven Homes

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		99.97	Ground Surface								
0	0		***Topsoil*** Approximately 100 millimeters over ***Silty Fine Sand Fill*** Brown to reddish brown, occasional clayey seams in upper level, trace of fine gravel, loose		SS	1	4,3,3,3	6			
2											
4					SS	2	3,4,3,3	7			
6	2										
8					SS	3	2,3,3,5	6			
		96.97									
10			***Native Silty Sand*** Brown, trace of fine to coarse gravel, occasional gravel-rich layers, occasional cobbles, compact to very dense		SS	4	4,8,9,8	17			
12	4										
14											
16					SS	5	9,15,33,31	48			
18											
20	6				SS	6	19,45,42, 25	87			
22											
24											
26	8				SS	7	10,17,17, 14	34			
28											
30					SS	8	6,9,15,17	24			
32		89.97									

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Drill Method: Hollow-Stem Auger

Drill Date: Apr. 3/13

Hole Size: 150mm

Drill Contractor: Determination

Datum: Temporary Benchmark

Field Logged by: Mike Brown

Checked by: IS

Project No: SM 135021-G

Log of Borehole No. 6

Project: Proposed Residential Developement

Project Manager: Ian Shaw, P. Eng.

Location: 53 Plains Road E., Burlington, ON

Borehole Location: See Drawing No. 1

Client: Branthaven Homes

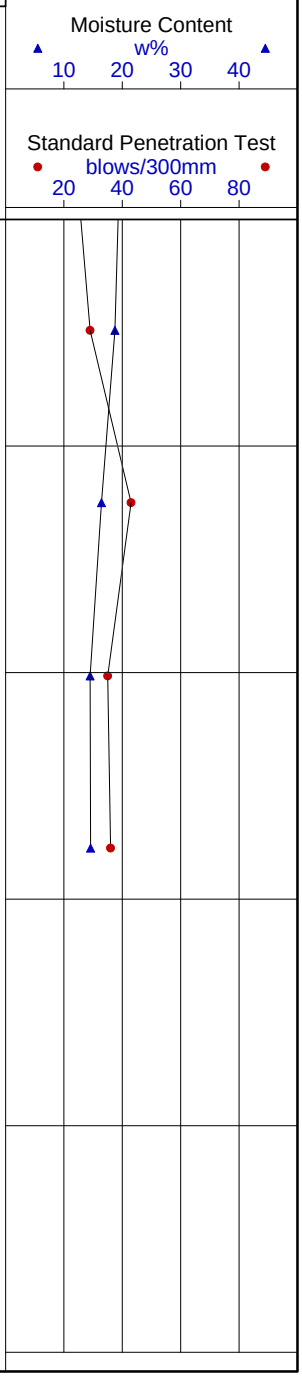
Soil-Mat

SUBSURFACE PROFILE

Depth	Elevation [m]	Symbol	Description	Well Data
12	87.27		**Native Silty Sand** Brown, trace of fine to coarse gravel, occasional gravel-rich layers, occasional cobbles, compact to very dense	
14	84.12		**Silty Clay** Grey, trace of fine gravel, trace of shale fragments, occasional sand seams, stiff to hard	
16			End of Borehole	
18			NOTES: 1. Borehole was advanced using solid stem auger equipment on April 3, 2013 to termination at a depth of 17.2 metres. 2. Borehole was recorded as 'caved' at a depth of 7.3 and 'wet' at a depth of 7.1 metres upon completion of drilling and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.	

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	9	8,12,17,20	29			
SS	10	15,21,22, 19	43			
SS	11	9,12,23,30	35		4.5	
SS	12	8,15,21,31	35		3.5	



Drill Method: Hollow-Stem Auger
Drill Date: Apr. 3/13
Hole Size: 150mm
Drill Contractor: Determination

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark
Field Logged by: Mike Brown
Checked by: IS
Sheet: 2 of 2

Project No: SM 135021-G

Log of Borehole No. 7

Project: Proposed Residential Developement

Project Manager: Ian Shaw, P. Eng.

Location: 53 Plains Road E., Burlington, ON

Borehole Location: See Drawing No. 1

Client: Branthaven Homes

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	100.06	Ground Surface
			Topsoil Approximately 75 millimeters over
			Silty Fine Sand Fill Brown to reddish brown, occasional clayey seams in upper level, trace of fine to coarse gravel, occasional cobbles, loose to compact
12	4	96.06	
			Native Silty Sand Brown, trace of fine to coarse gravel, occasional cobbles, very loose to compact
			NOTES:
			1. Borehole was advanced using solid stem auger equipment on April 3, 2013 to termination at a depth of 9.7 metres.
			2. A monitoring well was installed upon the completion of drilling and the following free groundwater levels have been measured: April 9, 2013- 7.45 m; April 13, 2013- 7.27m; April 16, 2013- 7.39m
			3. Soil samples will be discarded after 3 months unless otherwise directed by our client.
32		90.31	End of Borehole

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery
SS	1	1,3,3,4	6	
SS	2	1,2,2,3	4	
SS	3	0,1,3,2	4	
SS	4	3,6,6,5	12	
SS	5	1,1,1,1	2	
SS	6	3,2,3,3	5	
SS	7	7,10,8,10	18	
SS	8	5,5,10,12	15	

Well Data | PP (kgf/cm2) | U.Wt.(kN/m3)

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80

Drill Method: Hollow-Stem Auger

Drill Date: Apr. 3/13

Hole Size: 150mm

Drill Contractor: Determination

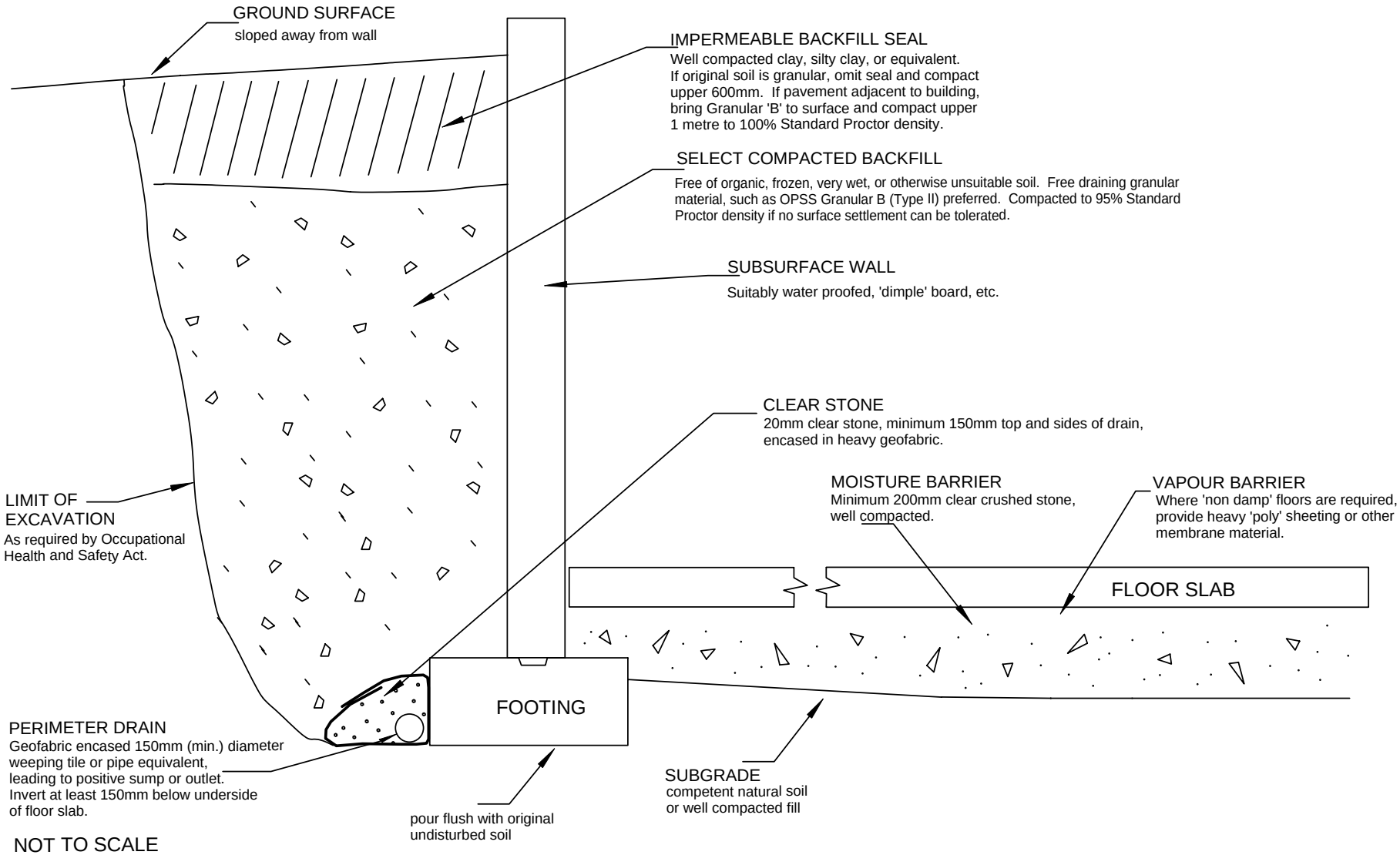
SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Temporary Benchmark

Field Logged by: Mike Brown

Checked by: IS

Sheet: 1 of 1



NOT TO SCALE

Soil-Mat

Soil-Mat Engineers & Consultants Ltd.

Typical Design Requirements
Drainage and Backfill for Basement Walls

Project No.:	SM 135021-G
Date:	April 2013

DRAWING No. 2