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PROJECT NO.: SM 230902-G January 14, 2025

111 VICTORIA STREET INC.
18 Leawood Court
St. Catharines, Ontario
L2T 3R6

Attention: Jordan Plett

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
111 VICTORIA STREET
WELLAND, ONTARIO

Dear Mr. Plett,

Further to your authorisation Soil-Mat Engineers & Consultants Ltd. has completed the fieldwork, laboratory testing and report preparation for the above noted project. This work was conducted in general accordance with our proposal P230902, dated October 31, 2023. Our findings at the six [6] boreholes are presented in the following paragraphs.

1. INTRODUCTION

We understand that the project will involve the construction of a residential development consisting of a 4-storey residential building with a single basement level at 111 Victoria Street in Welland, Ontario. The development will also include an asphalt paved parking lot and associated servicing. The purpose of this geotechnical investigation work is to assess the subsurface soil conditions, and to provide our comments and recommendations with respect to the design and construction of the proposed development, from a geotechnical point of view.

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 may void the recommendations given in this report. If significant changes are made to the proposed design, this office must be consulted to review the new design with respect to the results of this investigation.

2. PROCEDURE

A total of six [6] sampled boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. The boreholes were advanced using continuous flight power auger equipment to termination at depths of between approximately 3.7 to 8.2 metres below the existing grade on July 16, 2024, under the direction of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD.

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 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 borings. Selected samples were also subjected to laboratory grain size analyses.

Upon completion of drilling, a groundwater monitoring well was installed at three [3] borehole locations, identified as Borehole Nos. 1, 3, and 5. The monitoring wells consisted of 50-millimetre PVC pipe screened in the lower 1.5 metres. The monitoring wells were encased in well filter sand up to approximately 0.3 metres above the screened portion, then with bentonite ‘hole pug’ to the surface and fitted with a protective steel ‘stick up’ casing. The remaining boreholes were backfilled in general accordance with Ontario Regulation 903, and the ground surface reinstated even with the surrounding grade.

The boreholes were located in the field by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD. The ground surface elevation at the borehole locations was referenced to a site-specific temporary benchmark, described as the base of the hydro pole located on Vicotria Street just south of the eastern entrance to the site. This temporary benchmark has been assigned an elevation of 100.00 metres. When available, topographic survey information should be forwarded onto this office so the borehole elevations can be updated to reflect this.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Log of Boreholes Nos 1 to 6, 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 subject property is located at 111 Victoria Street in Welland, Ontario. The site consists of a vacant land located on the corner of Vicotria Street and Hester Lane. The site is bounded by residential properties to the west and south, Hester Lane to the east, and Victoria Street to the north. The site is relatively flat and even with the existing roadways.

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

Topsoil

A surficial veneer of topsoil approximately 150 to 200 millimetres in thickness was encountered at all of the borehole locations. It is noted that the depth of topsoil may vary across the site and from the depths encountered at the borehole locations, and as such a conservative approach should be taken in estimating topsoil quantities across the site. It is also noted that the term ‘topsoil’ has been used from a geotechnical point of view and does not necessarily reflect its nutrient content or its ability to support plant life.

Clayey Silty/Silty Clay Fill

Clayey silt/silty clay fill soils were encountered beneath the topsoil layer at all borehole locations with the exception of Borehole No. 4. The fill materials were brown colour, contained trace to some amounts of gravel and sand, with occasional organic inclusions and construction debris. The fill materials were proven to depths of approximately 0.9 to 1.5 metres below the existing ground surface and were generally firm in consistency.

It is noted that the fill materials were of similar composition to the soils native to the area, and as such that the distinction from fill materials to native soils was somewhat indistinct, and material identified as fill may in fact be weathered/disturbed native soils, having been subjected to ongoing freeze-thaw cycles and traffic loads. Conversely, material identified as native soils may be well compacted, organic free fill.

Concrete Slab

A concrete slab was encountered beneath the topsoil and fill soils at Borehole Nos. 1, 2, and 5. The concrete slab was encountered at a depth of approximately 0.9 metres below the existing ground surface and was approximately 150 millimetres in thickness. The concrete encountered is associated with the previously demolished Vaughan Seed Company mill which was centrally located on the site.

Silty Clay/Clayey Silt

Native silty clay/clayey silt was encountered beneath the topsoil, fill materials and concrete slab at all of the borehole locations. The native cohesive soils encountered were brown in colour, transitioning to grey at approximately 3.1 to 4.0 metres, contained trace amounts of gravel. The native soils were generally stiff to very stiff in consistency, with an increasing clay content with depth. The native cohesive material was proven to termination of the boreholes at depths of approximately 3.7 to 8.2 metres below the existing ground surface.

A review of available published information [Quaternary Geology of Ontario, Southern Shet Map 2556] indicate the subsurface soils to consist of fine-textured glaciolacustrine deposits consisting of silt and clay with minor sand and gravel. This is consistent with our observations during drilling and our experience on in the area.

Groundwater Observations

All the borehole locations were recorded as being open and ‘dry’ upon completion of drilling. It is noted that insufficient time would have passed for the static ground water level to stabilise in the open boreholes. As noted above, ground water monitoring wells were installed at Borehole Nos. 1, 3, and 5, to allow for future measurements of the static groundwater level. The results of these readings have been summarised as follows;

TABLE A: GROUNDWATER ELEVATION

Groundwater Monitoring Well	Surface Elevation* (m)	July 26, 2024		August 9, 2024	
		Depth (m)	Elev* (m)	Depth (m)	Elev* (m)
BH/MW1	100.08	4.01	96.07	2.42	97.66
BH/MW3	100.10	1.10	99.00	1.37	98.73
BH/MW5	100.30	1.63	98.67	1.69	98.61

* - Elevations determined relative to a temporary benchmark with an assumed elevation.

In cohesive soils such as those encountered in our boreholes, the static groundwater level is typically indicated by a change in soil colour from brown to grey. Thus, based on our observations during drilling the static groundwater level is estimated to be at a depth of approximately 1 to 3 metres below the existing ground surface level, which may be in the vicinity of the anticipated depths of construction. It is anticipated the elevated groundwater levels observed in Monitoring Well No. 3 and 5 may be influenced by perched water within the more permeable fill soils. Further investigation such as the advancement of test excavations or conducting a hydrogeological study may allow for a more accurate estimate of the groundwater elevation.

Geotechnical Laboratory Testing

As noted above, two [2] selected samples of the recovered soils were subjected to grain size analyses including sieve and hydrometer tests. The results of these grain size analyses have been appended to the end of this report and summarised as follows;

Sample	Sample Depth [m]	Clay [%]	Silt [%]	Sand [%]	Gravel [%]	Estimated Permeability K [cm/sec]	Estimated Infiltration Rate [mm/hr]
BH3SS7	6.0	42	52	5	1	10^{-8}	<10
BH6SS3	1.5	44	54	2	0	10^{-8}	<10

The results indicate the native soil to consist of silt and clay with trace amounts of sand and gravel. According to the Unified Soil Classification System these soils are generally classified as M.L. – inorganic silts and very fine sands to C.L. – Inorganic clays of low to medium plasticity. It is noted that these soils are of very low permeability and would not be supportive of LID stormwater management measures, such as infiltration galleries or permeable pavement systems.

4. FOUNDATION CONSIDERATIONS

The subsoils encountered in the boreholes demonstrate a relatively shallow and thin desiccated crust, with strength dropping off swiftly with increasing depth. This profile is commonly seen in Welland. With a single basement level, it is anticipated that the proposed structure will have a founding level on the order of approximately 3 metres below the existing ground surface. The soil conditions encountered at these depths are generally considered suitable to support the proposed structure on conventional spread footings founded in the undisturbed native silty clay/clayey silt soils, below any fill or otherwise unsuitable material, considering an SLS bearing capacity of 100 kPa [~2,000 psf] and ULS bearing capacity of 150 kPa [~3,000 psf], base on the total and differential settlement not exceeding 20 to 25 millimetres, respectively. Slightly higher bearing capacities, on the order of 150 kPa [~3,000 psf] SLS and 225 kPa [~4,500 psf] ULS, may be realized by limiting the founding depth of the structure to 1.2 metres below the existing ground surface. If the foundations for the proposed structure at these bearing capacities result in foundations that cover more than 50 per cent of the structure's footprint, then a raft foundation may be considered with the founding depth at 3 metres and an SLS bearing capacity of 100 kPa [~2,000 psf] and ULS bearing capacity of 150 kPa [~3,000 psf], alternatively, the raft slab may be designed considering a modulus of subgrade reaction of 20 MN/m^3 [~74 pci] where a flexible design approach is considered. Should the proposed founding level of the building be planned to be deeper than 3 metres below the existing grade, this office should be contacted to provide advice on the bearing capacity of the soils for the proposed foundations. Similarly, if investigation of increased bearing capacities through the application of ground improvement technologies is desired, this office should be contacted.

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 combination. The ULS value represents the Ultimate Limit State and is intended to reflect the 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 more flexible buildings.

The support conditions afforded by the founding soils are usually not uniform across the site, neither are the loads on the various foundation elements. It is therefore recommended that the footings and foundation walls be structurally reinforced to account for potential variable support conditions. 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 the 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 Ontario Building Code, and with careful attention paid to construction detail, the total and differential settlements should be well within normally tolerated limits of 25 and 20 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.

5. SEISMIC DESIGN CONSIDERATIONS

The structure shall be designed according to Section 4.1.8 of the Ontario Building Code, Ontario Regulation 203/24, which takes effect in January 2025. Based on the subsurface soil conditions encountered in this investigation, the applicable Site Classification for the seismic design is Site Class D – Stiff Soil, based on the average soil characteristics for the site. It is noted that site specific shear wave velocity testing may further refine the applicable seismic design values, however, on the preliminary basis considering a seismic site class of D, the 2%-in-50 year seismic hazard values for the site from the National Building Code 2020 would be as follows:

$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	$S_a(5.0)$	$S_a(10.0)$	PGA	PGV
0.435	0.343	0.19	0.0866	0.0222	0.00677	0.277	0.225

6. EXCAVATIONS

It is anticipated that excavations for the construction of foundations and underground services will extend to depths of up to approximately 3 to 4 metres, through the any surficial fill materials to the native silty clay/clayey silt soils. Excavations into the native silty clay/clayey silt soils, above the static groundwater table should be relatively straight forward, with the excavation sides remaining stable for short periods at 60 degrees to the horizontal. Where wet seams are encountered, or during periods of extended precipitation, and where the excavations extend below the static groundwater level, the sides of the excavation may have a tendency to locally 'slough in' to as flat as 3 horizontal to 1 vertical, or flatter.

Notwithstanding the foregoing, all excavations must comply with the current Occupational Health and Safety Act and Regulations for Construction Projects. Excavation slopes steeper then those required in the Safety Act must be supported or a trench box must be provided, and a senior geotechnical engineer from this office should monitor the work. With respect to the Act, the native clayey silt/silty clay soils would be considered Type 2 Soils.

With the proposed excavations extending to depths of up to 3 to 4 metres for foundations within the silty clay/clayey silt some groundwater infiltration should be anticipated, as well as from surface run off into open excavations, especially during the 'wet' times of the year. The rate of infiltration is expected to be relatively low, such that it is possible to control such infiltration into the excavations using conventional construction 'dewatering' techniques, such as pumping from sumps and ditches. More infiltration should be anticipated when connections are made to existing services and where the excavations extended below the existing ground water table. Should greater rates of infiltration be experienced it may be necessary to implement more sophisticated groundwater control methods.

Based on the conditions to date, the anticipated dewatering volumes are likely to be less then 50,000 L/ day, however could exceed this rate and thus require and EASR filing. It is not expected that dewatering volumes would exceed 400,000 L/day and so a Permit to Take Water [PTTW] would not be required. A more detailed hydrogeological assessment should be completed once the construction details of the proposed building have been established to further assess the construction dewatering requirements.

7. BACKFILL CONSIDERATIONS

The excavated material will consist of primarily of the silty clay/clayey silt encountered in the boreholes, as described above. These soils are generally considered suitable for use as engineered fill, trench backfill, etc., provided they are free of organics, large construction debris, cobbles/boulders, or otherwise deleterious materials, and that their moisture contents can be controlled to within 3 per cent of their standard proctor optimum moisture content. Some selective sorting to remove organics, debris, and other unsuitable materials should be expected.

It is noted that the silty clay/clayey silt soils encountered are highly frost susceptible and not considered to be free draining, and therefore should not be used where this characteristic is necessary. These soils will be more difficult to achieve effective compaction where access with compaction equipment is restricted. The on-site silty clay/clayey silt soils encountered are generally considered to be near to slightly 'wet' of their standard Proctor optimum moisture content. Some moisture conditioning may be required depending on the weather conditions at the time of construction. These soils are considered to be sensitive to high moisture conditions and will be almost impossible to effectively compact when they become well 'wet' of their optimum. After times of heavier precipitation, any near-surface wet, saturated, or softened material should be allowed to air-dry or to be removed and disposed of.

The use of a free draining granular material, such as an Ontario Provincial Standard Specification [OPSS] Granular 'B', Type II (crushed limestone bedrock) or approved alternative, are preferred in areas of restricted access, such as the building footprint and the building foundations. Granular materials are more efficiently compacted in such areas, and generally provide a more positive support condition for the 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. The silty clay/clayey silt may require high compaction energy to achieve acceptable densities if the moisture content is not close to it standard Proctor optimum value. Its is therefore very important that the placement moisture of the backfill soils be within 3 per cent of their standard Proctor optimum moisture content during placement and compaction to minimise long term subsidence [settlement] of the fill mass. Any imported fill required in the 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, backfill within service trenches, areas to be paved, etc., should be placed in loose lifts not exceeding 300 millimetres and compacted to a minimum of 98 per cent of its standard Proctor maximum dry density [SPMDD]. The appropriate compaction equipment should be employed based on soil type, i.e., pad-toe for cohesive soils and smooth drum/vibratory plate for granular soils. A method should be developed to assess compaction efficiency employing the on-site compaction equipment and backfill materials during construction.

8. FLOOR SLAB AND PERMANENT DRAINAGE

Depending on the proposed depth of the single basement level, it may be necessary to either construct the basement as a water-tight 'bath tub', or anticipate continuous groundwater removal from a perimeter and sub-slab weeping tile system connected to a large sump outfitted with primary and backup sump pump systems.

Where the finished basement floor is less than 300 millimetres above the finished exterior grade, and 'bath tub' waterproof foundation construction is not used, a perimeter and sub-slab weeping tile system should be used to prevent the build up of water against the foundations and under the basement floor slab. A continuous neoprene 'water stop' gasket should be installed between the footing/raft slab and perimeter foundation walls. Where provided, the perimeter drainage system should consist of 100-

millimetre diameter perforated pipe, encased in a geofabric sock and covered with a minimum of 200 millimetres of a 20-millimetre clear crushed stone product in turn entirely enveloped in a heavy filter geotextile product. The sub-slab drains should be similarly constructed on nominal 4 to 6 metre centres at least 300 millimetres under the floor slab. The suppliers of the filter geotextile should be consulted as to the best type suited to this project. Great care should be taken during the installation of the drains, as 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 and slab. The perimeter and underfloor drains should outlet to a sump pit through separate connections a minimum of 150 millimetres below the underside of the finished floor. The exterior grade around the structure should be sloped away from the foundation, and provided with a low permeability surficial soil deposit to prevent infiltration of precipitation immediately adjacent to the foundation walls. The enclosed Drawing No. 2 shows schematics of the typical design requirements for construction of a basement with perimeter and sub-slab drainage.

If water-tight foundations are to be used, the provision of a continuous neoprene ‘water stop’ gasket should be installed between the perimeter footings/raft slab and the foundation walls, and between the foundation walls and floor slab. Consideration should be given to the use of a concrete waterproofing admixture for all concrete elements below the groundwater level. The floor slab should be designed to resist hydrostatic uplift with the groundwater level at the perimeter grade of the structure.

The basement floor slab may be constructed using conventional slab-on-grade techniques on a prepared subgrade. The exposed subgrade surface should be well compacted in the presence of a representative of SOIL-MAT ENGINEERS. Any soft ’spots’ delineated during this work must be sub-excavated and replaced with quality backfill material compacted to a minimum of 98 per cent of its SPMDD. Granular fill, such as an imported OPSS Granular ‘B’, Type II (crushed limestone bedrock) or approved alternative, is preferred within the building footprint due to its relative insensitivity to weather conditions, ease in achieving the required degree of compaction, its quick response to applied stresses.

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 fiber 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, movements of, the slabs-on-grade, etc. The ‘saw-cuts’ in the concrete floor, for crack control, should extend to a minimum depth of 1/3 of the thickness of the slab and be cut 24 hours after the slab has been cast.

A moisture barrier will be required under the floor slabs such as the placement of at least 200-milimetres of well compacted 20-millimetre clear crushed stone. At a minimum the moisture barrier material should contain no more then 10 percent passing the No. 4 sieve. Where ‘non-damp’ floor slabs are required, as for instance under sheet vinyl floor coverings, etc., or in the case of water-tight foundations, extra efforts will be required to damp proof 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 a sufficiently heavy gauge material be provided. The floor finish product supplier should be consulted regarding the requirement for such a non-damp condition.

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 month 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 sawcut joints and cracks, and at the edges of the slabs, maintains the underside of the slab in a moist condition. It is 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.

The elevator pit extending below the basement floor level of the proposed structure should be designed to be water-tight, and be constructed to resist hydrostatic uplift with the static groundwater level conservatively set at the finished floor level of the basement.

9. PAVEMENT CONSIDERATIONS

All areas to be paved should be stripped of all topsoil, along with any otherwise unsuitable materials. The exposed subgrade should be well compacted and proof rolled with 3 to 4 passes of a loaded tandem truck in the presence of a senior 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 must be sub-excavated and replaced with suitable backfill material. Alternatively, the soft areas may be stabilised by placing coarse crushed stone and ‘punching’ it into the soft areas. The need for the treatment of softened subgrade will be reduced if construction is undertaken during the dry summer months and careful attention is paid to the compaction operations. The fill over shallow utilities cut into or across paved areas must also be compacted to a minimum of 98 per cent of its SPMDD.

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 mitigate 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 should be taken to ensure that the subgrade is not unduly disturbed by construction traffic. These measures would include minimising the amount of heavy traffic travelling over the subgrade, such as during the placement of granular base layers.

If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. During wet weather conditions, such as during the Fall and Spring months, or during colder winter weather, it should be anticipated that additional subgrade preparation will be required, such as additional depth of OPSS Granular ‘B’, Type II (crushed limestone bedrock) sub-base material. It is also important that the sub-base and base granular layers of the pavement structure be placed as soon as possible after exposure, preparation, and approval of the exposed subgrade.

The suggested pavement structures outlined in Table A below 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-to-fifteen-year lifespan, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

TABLE B – TYPICAL SUGGESTED PAVEMENT STRUCTURES

LAYER DESCRIPTION	**COMPACTION REQUIREMENTS**	**LIGHT DUTY SECTIONS**	**HEAVY DUTY [TRUCK ROUTE]**
Asphaltic Concrete Wearing course OPSS HL 3 or HL 3A	Min. 92 % Marshall MRD	40 millimetres	40 millimetres
Binder Course OPSS HL 8	Min. 92 % Marshall MRD	50 millimetres	80 millimetres
Base Course OPSS Granular A	100% SPMDD	150 millimetres	150 millimetres
Sub-base Course OPSS Granular B Type II	100% SPMDD	300 millimetres	450 millimetres

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

Depending on the anticipated traffic, a reduced light duty asphalt structure consisting of 65 millimetres of HL3 surface course may also perform sufficiently. This would be reasonable in areas subjected only to light vehicles such as cars for parking. Such a structure may have a reduced lifespan if subjected to heavier vehicles, and would also not allow for 'mill and pave' type operations for future rehabilitation.

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 course 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 material in it reflects SOIL-MAT ENGINEERS' best judgement in light of the information available to it at the time of preparation. The subsurface descriptions and borehole information are intended to describe conditions at the borehole locations only. It is the contractors' responsibility to determine how these conditions will affect the scheduling and methods of construction for the project. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SOIL-MAT ENGINEERS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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, please do not hesitate to contact the undersigned.

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

Kevin Reid, B. Eng., EIT
Junior Engineer

Stephen R. Sears, B.Eng. Mgmt. P. Eng., QP$_{ESA}$
Senior Engineer

LICENSED PROFESSIONAL ENGINEER
JAN 14/25
S. R. SEARS
PROVINCE OF ONTARIO

Enclosures: Drawing No. 1, Borehole and Monitoring Well Location Plan
Log of Borehole Nos. 1 to 6, inclusive
Drawing No. 2, Basement Perimeter Drainage with Underfloor Drains

Distribution: 111 VICTORIA STREET INC [pdf]

LEGEND

BH/MW # — Borehole and Monitoring Well Location

TBM — Temporary Benchmark
Base of Hydro pole
Assigned elevation = 100.00m

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 230902-G.

2. Borehole locations are approximate.

SOIL-MAT
ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Proposed Residential
Development
111 Victoria Street
Welland, Ontario

Borehole and Monitoring
Well Location Plan

Project No. SM 230902-G

Date: January, 2024

Drawn: KJR

Checked: SRS

Drawing No. 1

Log of Borehole No. 1

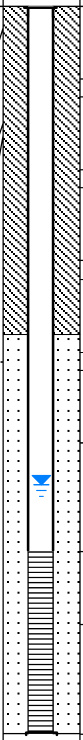
Project No: SM 230902
Project: Phase Two ESA
Location: 111 Victoria Street, Welland
Client: 111 Victoria Street Inc.

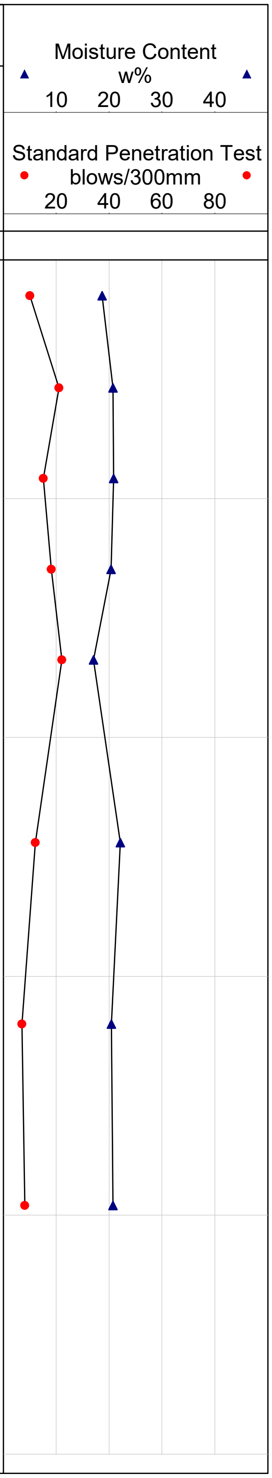
Project Manager: Peter Markesic, B.Sc.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4760757
E: 643283

Depth (m)	Elevation (m)	Description
0	100.08	Ground Surface
	99.90	**Topsoil** Approximately 150 millimetres of topsoil.
	99.10	**Clayey Silt/Silty Clay Fill** Brown, with some sand and gravel, stiff.
		Concrete Slab Previous building floor slab.
		Silty Clay/Clayey Silt Brown, trace gravel, stiff to very stiff.
	97.10	Transition to grey in colour
	91.80	End of Borehole

Type	Number	Blow Counts	Blows/300mm	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	18,5,5,5	10		
SS	2	34,9,12,11	21		
SS	3	5,6,9,11	15	4.5	
SS	4	6,9,9,13	18	4.5	
SS	5	4,10,12,14	22	4.5	
SS	6	3,6,6,7	12	4.0	
SS	7	2,3,4,6	7	2.0	
SS	8	1,3,5,6	8	1.5	

Well Data





NOTES:

1. Borehole was advanced using solid stem auger equipment on July 16, 2024 to termination at a depth of 8.2 metres.

2. Borehole was recorded as open and 'wet' at a depth of 4.6 metres upon completion and backfilled as per Ontario Regulation 903.

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

4. A monitoring well was installed. The following free groundwater level readings have been measured:

5. July 26, 2024 - 4.01 metres below the existing ground surface

Drill Method: Solid Stem Augers
Drill Date: July 16, 2024
Hole Size: 150 millimetres
Drilling Contractor: Elite Drilling

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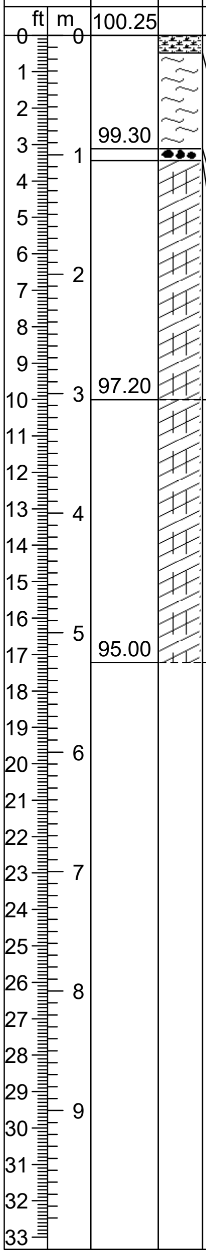
Datum: Temporary Benchmark
Field Logged by: GG
Checked by: PM
Sheet: 1 of 1

Log of Borehole No. 2

Project No: SM 230902
Project: Phase Two ESA
Location: 111 Victoria Street, Welland
Client: 111 Victoria Street Inc.

Project Manager: Peter Markesic, B.Sc.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4760737
E: 643285

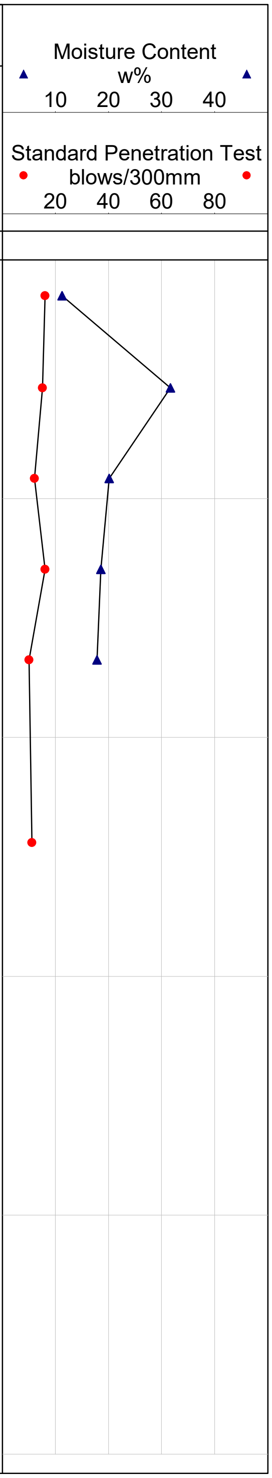


Elevation (m)	Description
100.25	Ground Surface
	Topsoil Approximately 150 millimetres of topsoil.
	Clayey Silt/Silty Clay Fill Brown, trace gravel, occasional organic inclusions, stiff.
99.30	**Concrete Slab** Previous building floor slab.
	Silty Clay/Clayey Silt Brown, trace gravel, occasional organic inclusions in the upper levels, stiff to very stiff.
97.20	Transition in colour to grey, stiff.
95.00	End of Borehole

Well Data

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	4,7,9,7	16	▨		
SS	2	6,2,13,4	15	▨		
SS	3	7,5,7,10	12	▨	>4.5	
SS	4	5,7,9,11	16	▨	>4.5	
SS	5	0,3,7,10	10	▨	>4.5	
SS	6	3,6,5,8	11	▨	3.0	



NOTES:

1. Borehole was advanced using solid stem auger equipment on July 16, 2024 to termination at a depth of 5.2 metres.

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

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

Drill Method: Solid Stem Augers
Drill Date: July 16, 2024
Hole Size: 150 millimetres
Drilling Contractor: Elite Drilling

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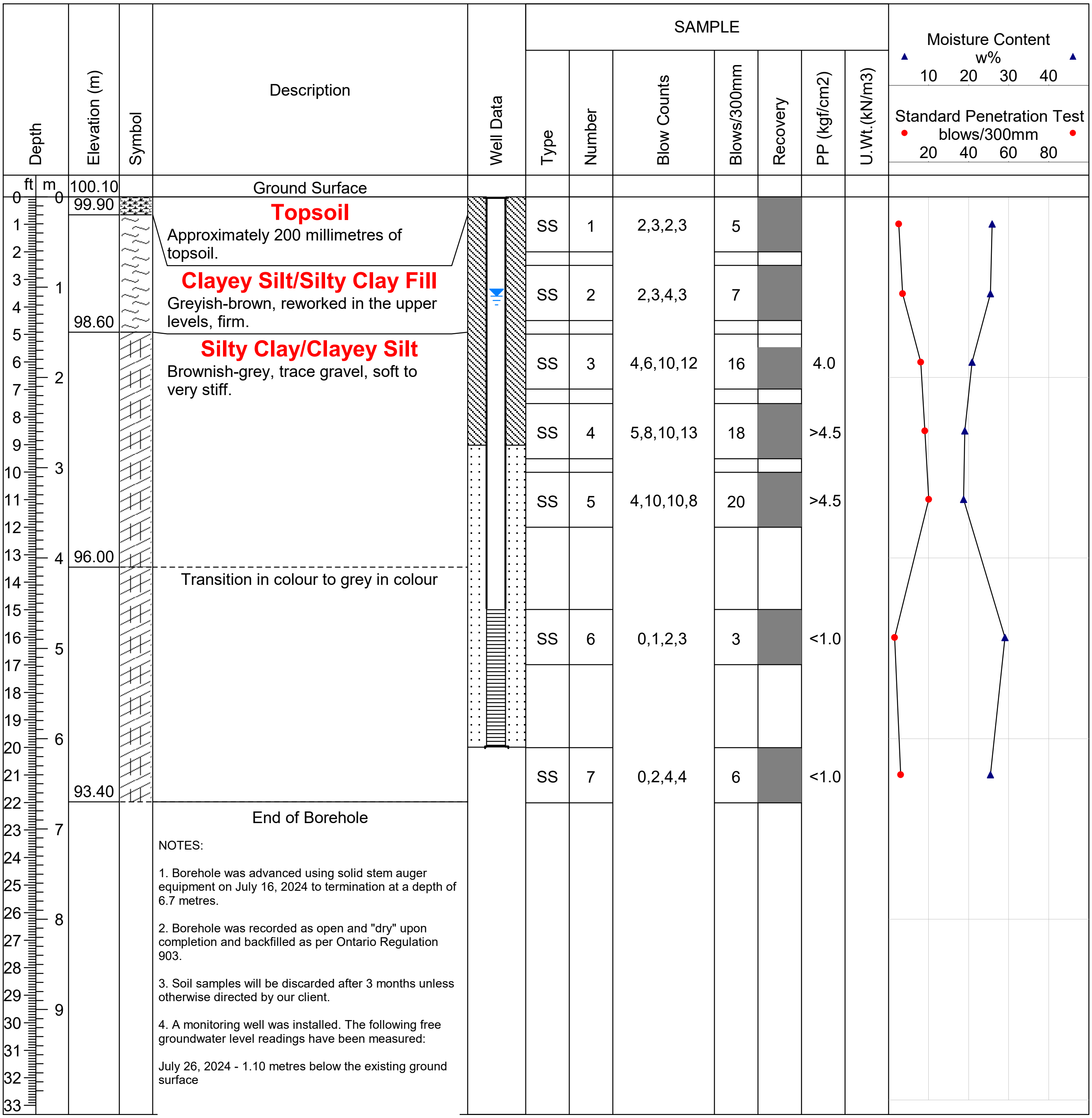
Datum: Temporary Benchmark
Field Logged by: GG
Checked by: PM
Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM 230902-E
Project: Phase Two ESA
Location: 111 Victoria Street, Welland
Client: 111 Victoria Street Inc.

Project Manager: Peter Markesic, B.Sc.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4760722
E: 643284



Elevation (m)	Description
100.10	Ground Surface
99.90	**Topsoil** Approximately 200 millimetres of topsoil.
98.60	**Clayey Silt/Silty Clay Fill** Greyish-brown, reworked in the upper levels, firm.
96.00	**Silty Clay/Clayey Silt** Brownish-grey, trace gravel, soft to very stiff.
	Transition in colour to grey in colour
93.40	End of Borehole

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	2,3,2,3	5			
SS	2	2,3,4,3	7			
SS	3	4,6,10,12	16		4.0	
SS	4	5,8,10,13	18		>4.5	
SS	5	4,10,10,8	20		>4.5	
SS	6	0,1,2,3	3		<1.0	
SS	7	0,2,4,4	6		<1.0	

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 16, 2024 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and "dry" upon completion and backfilled as per Ontario Regulation 903.

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

4. A monitoring well was installed. The following free groundwater level readings have been measured:

July 26, 2024 - 1.10 metres below the existing ground surface

Drill Method: Solid Stem Augers
Drill Date: July 16, 2024
Hole Size: 150 millimetres
Drilling Contractor: Elite Drilling

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Datum: Temporary Benchmark
Field Logged by: GG
Checked by: PM
Sheet: 1 of 1

Log of Borehole No. 4

Project No: SM 230902-E
Project: Phase Two ESA
Location: 111 Victoria Street, Welland
Client: 111 Victoria Street Inc.

Project Manager: Peter Markesic, B.Sc.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4760728
E: 643277

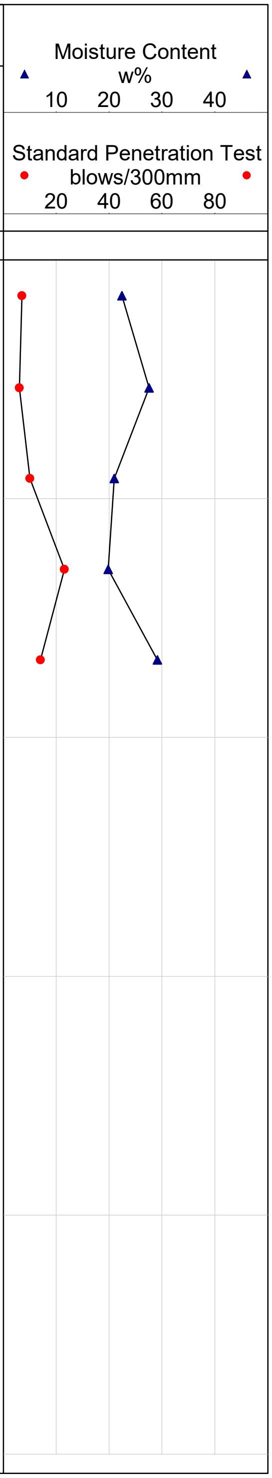
Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
99.81	Ground Surface								
99.60	**Topsoil** Approximately 150 millimetres of topsoil.		SS	1	6,4,3,4	7	▨		
	Silty Clay/Clayey Silt Brown, trace gravel, firm to very stiff.		SS	2	2,2,4,5	6	▨		
			SS	3	2,4,6,9	10	▨	>4.5	
			SS	4	4,9,14,17	23	▨	>4.5	
96.80	Transition to grey in colour		SS	5	4,7,7,8	14	▨	3.0	
96.10	End of Borehole								

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 16, 2024 to termination at a depth of 3.7 metres.

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

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



Drill Method: Solid Stem Augers
Drill Date: July 16, 2024
Hole Size: 150 millimetres
Drilling Contractor: Elite Drilling

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Sheet: 1 of 1

Log of Borehole No. 5

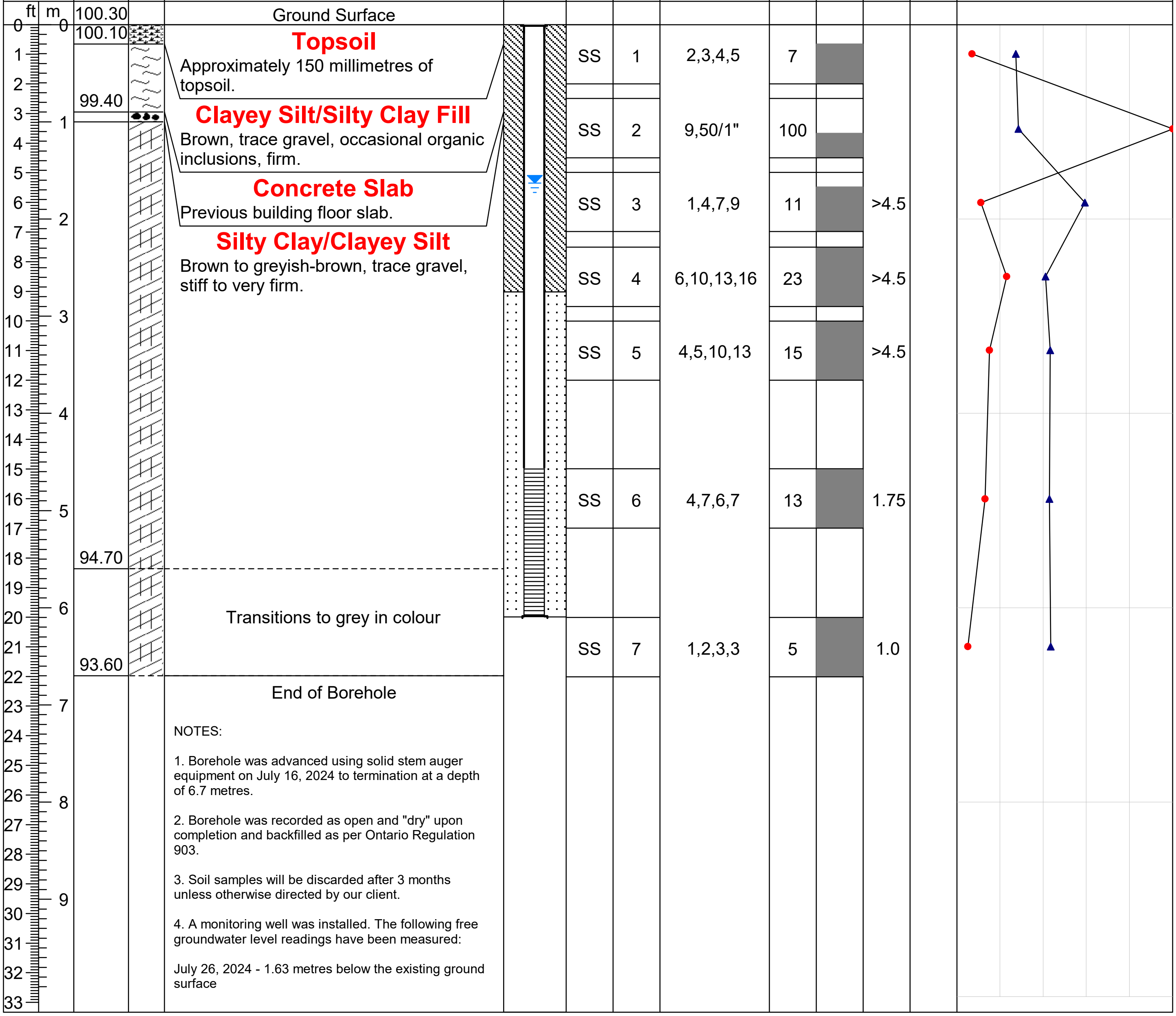
Project No: SM 230902-E
Project: Phase Two ESA
Location: 111 Victoria Street, Welland
Client: 111 Victoria Street Inc.

Project Manager: Peter Markesic, B.Sc.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4760738
E: 643275

Depth	Elevation (m)	Description
0	100.30	Ground Surface
	100.10	**Topsoil** Approximately 150 millimetres of topsoil.
		Clayey Silt/Silty Clay Fill Brown, trace gravel, occasional organic inclusions, firm.
	99.40	**Concrete Slab** Previous building floor slab.
		Silty Clay/Clayey Silt Brown to greyish-brown, trace gravel, stiff to very firm.
	94.70	Transitions to grey in colour
	93.60	End of Borehole

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	2,3,4,5	7			
SS	2	9,50/1"	100			
SS	3	1,4,7,9	11		>4.5	
SS	4	6,10,13,16	23		>4.5	
SS	5	4,5,10,13	15		>4.5	
SS	6	4,7,6,7	13		1.75	
SS	7	1,2,3,3	5		1.0	



NOTES:

1. Borehole was advanced using solid stem auger equipment on July 16, 2024 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and "dry" upon completion and backfilled as per Ontario Regulation 903.

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

4. A monitoring well was installed. The following free groundwater level readings have been measured:

July 26, 2024 - 1.63 metres below the existing ground surface

Drill Method: Solid Stem Augers
Drill Date: July 16, 2024
Hole Size: 150 millimetres
Drilling Contractor: Elite Drilling

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Datum: Temporary Benchmark
Field Logged by: GG
Checked by: PM
Sheet: 1 of 1

Log of Borehole No. 6

Project No: SM 230902-E
Project: Phase Two ESA
Location: 111 Victoria Street, Welland
Client: 111 Victoria Street Inc.

Project Manager: Peter Markesic, B.Sc.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4760753
E: 643276

Elevation (m)	Description
100.03	Ground Surface
99.80	**Topsoil** Approximately 150 millimetres of topsoil.
99.00	**Clayey Silt/Silty Clay Fill** Brown, trace gravel, firm.
	Silty Clay/Clayey Silt Brown, trace gravel, occasional organic inclusions, soft to very stiff.
96.90	Transition to grey in colour
96.30	End of Borehole

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	1,2,2,2	4	▨		
SS	2	2,1,4,7	5	▨		
SS	3	4,8,11,14	19	▨	>4.5	
SS	4	6,8,9,10	17	▨	>4.5	
SS	5	4,5,6,8	11	▨	4.0	

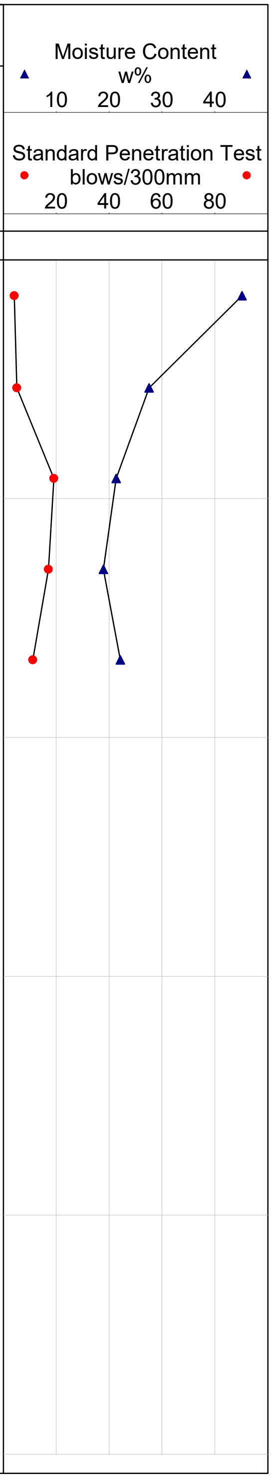
Well Data

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 16, 2024 to termination at a depth of 3.7 metres.

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

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



Drill Method: Solid Stem Augers
Drill Date: July 16, 2024
Hole Size: 150 millimetres
Drilling Contractor: Elite Drilling

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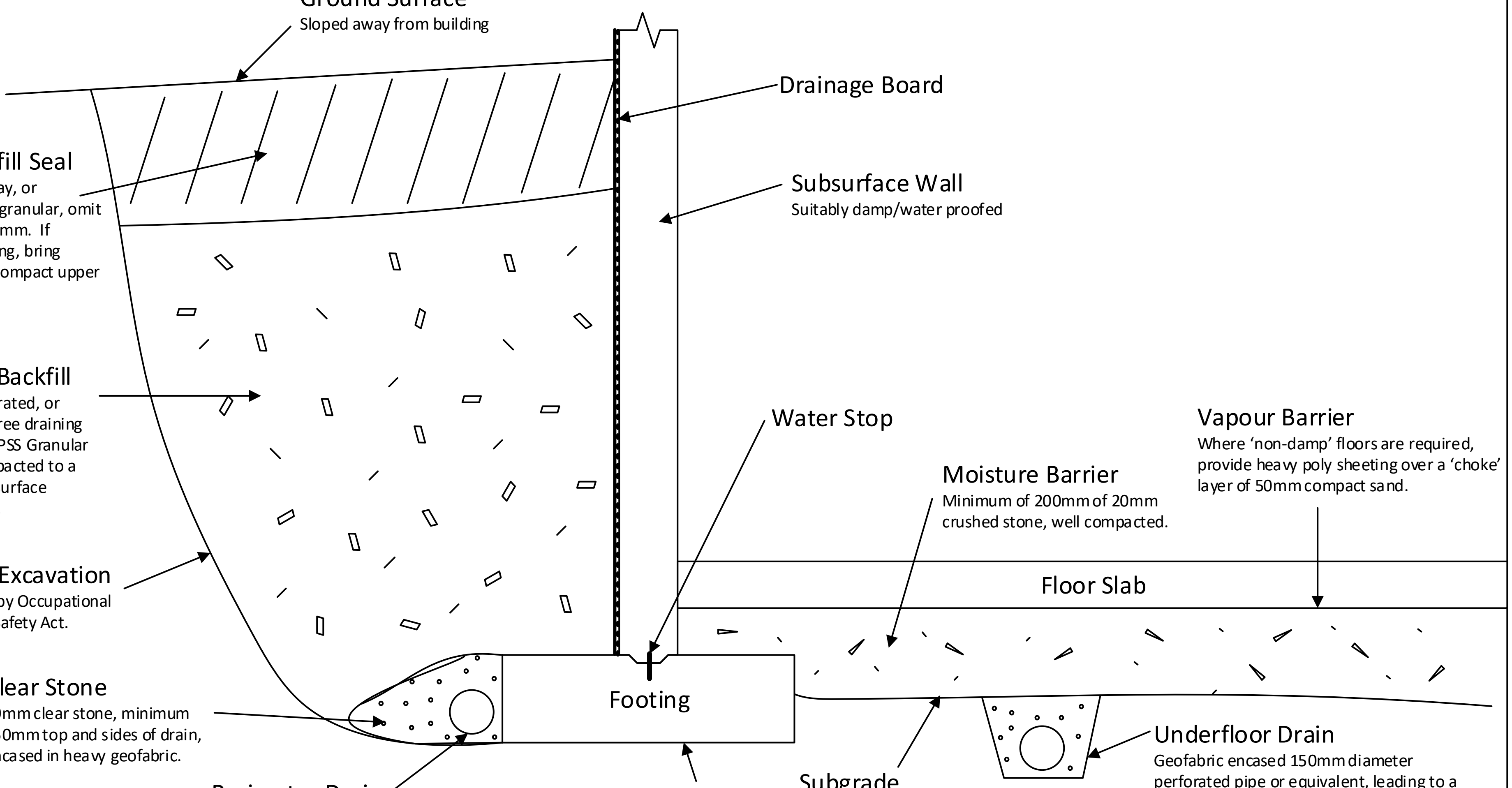

Ground Surface
Sloped away from building

Drainage Board

Impermeable Backfill Seal
Well compacted clay/silty clay, or equivalent. If original soil is granular, omit seal and compact upper 600mm. If pavement adjacent to building, bring Granular 'B' to surface and compact upper 1 metre to 100% SPMDD.

Subsurface Wall
Suitably damp/water proofed

Select Compacted Backfill
Free of organic, frozen, saturated, or otherwise unsuitable soil. Free draining granular material, such as OPSS Granular 'B' (Type II) preferred. Compacted to a minimum of 95% SPMDD if surface settlement can be tolerated.

Water Stop

Vapour Barrier
Where 'non-damp' floors are required, provide heavy poly sheeting over a 'choke' layer of 50mm compact sand.

Moisture Barrier
Minimum of 200mm of 20mm crushed stone, well compacted.

Limit of Excavation
As required by Occupational Health and Safety Act.

Clear Stone
20mm clear stone, minimum 150mm top and sides of drain, encased in heavy geofabric.

Underfloor Drain
Geofabric encased 150mm diameter perforated pipe or equivalent, leading to a positive sump or outlet. Invert at least 300mm below underside of floor slab. Pipe placed in parallel rows on nominal 4-6m centres.

Perimeter Drain
150mm diameter weeping tile or pipe equivalent, leading to positive sump or outlet. Invert at least 150mm below underside of floor slab.

Pour flush with original undisturbed soil.

Subgrade
Competent native soil or well compacted fill.

NOT TO SCALE

Soil-Mat

Soil-Mat Engineers & Consultants Ltd.

Project No.:	SM 230902-G
Date:	January 2025

Typical Design Requirements
Drainage and Backfill for Basement Walls With Underfloor Drains

Drawing No. 2