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PROJECT NO.: SM 190739-G March 23, 2020

LIV COMMUNITIES
1005 Skyview Drive, Suite 301
Burlington, Ontario
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Attention: Andrew Mulder
Executive Director of Land Development

GEOTECHNICAL INVESTIGATION AND PRELIMINARY HYDROGEOLOGICAL ASSESSMENT GLANCASTER GOLF COURSE PROPERTY HAMILTON, ONTARIO

Dear Mr. Mulder,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, laboratory testing, and report preparation in connection with the above noted project. The investigation and reporting were undertaken in general accordance with our proposal P8395, dated October 24, 2019. Our comments and recommendations, based on our findings at the fifteen [15] borehole locations, are presented in the following paragraphs.

1. INTRODUCTION

We understand that the project will involve the construction of a residential development consisting of townhouse blocks and single-family dwellings along asphalt paved roadways, including the installation of associated underground municipal services, and a stormwater management pond in the center-east of the property. The purpose of this geotechnical investigation work was 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. It is noted that the information contained in this report does not reflect upon the environmental aspects of the site, which are addressed in a separate Phase Two Environmental Site Assessment report.

2. PROCEDURE

A total of fifteen [15] 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 approximately 6.7 to 9.8 metres below the existing grade between January 7 and 10, 2020 under the direction and supervision of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Upon completion of drilling, groundwater monitoring wells were installed at six [6] borehole locations, identified as Borehole Nos. 1, 2, 7, 11, 13, and 14. It is noted that Borehole No. 11 had nested wells installed, consisting of two separate borings, referred to as Borehole Nos. 11a and 11b in this report. The monitoring wells consist of 50-millimetre PVC pipe, screened in the lower approximately 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 plug' 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 was reinstated flush with the surrounding 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, with hand penetrometer testing conducted on cohesive samples. In addition, selected samples were subjected to grain size analyses and Atterberg Limits testing.

The boreholes were located in the field by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., based on accessibility over the site due to sloped ground surfaces and clearance of underground services. The ground surface elevation at the borehole locations has been referenced to a benchmark with a known elevation, described as the top of the manhole cover at the corner of Twenty Road and Glancaster Road, as illustrated in the Borehole Location Plan. This benchmark has a geodetic elevation of 242.25 metres.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in the Log of Borehole Nos. 1 to 15, 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 consists of the former golf course located at 555 Glancaster Road in Hamilton, Ontario. The site is generally bordered by Twenty Road to the north, existing farmland to the east, and forested lands to the south and west. The grade is relatively uneven, with rolling hills and local depressions contributing to an overall topographic variation of approximately 4.5 metres across the site, as measured across the boreholes.

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

Topsoil

A surficial veneer of topsoil ranging between approximately 50 to 800 millimetres in thickness was encountered at all borehole locations. It is noted that the depth of topsoil may vary across the site and from the borehole locations. 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 ability to support plant life. The depth of topsoil at each borehole location has been summarised as follows:

TABLE A
SUMMARY OF TOPSOIL DEPTHS

Borehole No.	Topsoil Depth (mm)
1	250
2	400
3	400
4	400
5	500
6	100
7	125
8	300
9	50
10	50
11	100
12	50
13	800
14	500
15	500

Clayey Silt/Sandy Silt Fill

Clayey silt/sandy silt fill was encountered beneath the topsoil at Borehole Nos. 5, 6, 8, 9, 10, 12, 14, and 15. The fined grained granular to cohesive soil is brown in colour, contains trace fine to medium gravel and occasional organic inclusions, and is generally firm in consistency with occasional construction debris encountered in some locations. The clayey silt/sandy silt fill was proven to depths of approximately 1.4 to 4.1 metres where encountered.

Clayey Silt

Clayey silt was encountered beneath the topsoil or clayey silt/sandy silt fill at all borehole locations. The clayey silt soil is brown in colour, contains traces of, to some, clay and fine to medium gravel, and is generally in a firm to hard condition, with occasional organic deposits and staining in the upper levels, with occasional fine to medium sand seams. It is noted that the upper levels of the clayey silt have a reworked appearance. This reworked appearance would be associated from the cut/fill works completed to create the former golf course's topography. As such, some depth of reworked material should be expected across the site, which would be expected be deeper at elevated banks, berms, and hills, and less deep in low lying areas. The clayey silt was proven to termination at all borehole locations.

Grain size analyses were conducted on a total of eight [8] selected samples from across the site, the results of which can be found appended to the end of this report, and are summarised as follows:

TABLE A
SUMMARY OF GRAIN SIZE ANALYSES

Sample	Clay [%]	Silt [%]	Sand [%]	Gravel [%]	Effective Diameter [mm]	Estimated Permeability [cm/sec]	Estimated Infiltration Rate [mm/hr][1]
BH11 SS6	20	73	6	1	0.0008	10^{-7}	<12
BH11 SS7	16	79	5	0	0.001	10^{-6}	12
BH12 SS3	10	85	5	0	0.002	10^{-6}	12
BH12 SS9	15	84	1	0	0.001	10^{-6}	12
BH13 SS2	28	68	4	0	0.0008	10^{-7}	<12
BH13 SS4	25	64	10	1	0.0009	10^{-7}	<12
BH13 SS6	23	73	4	0	0.0008	10^{-7}	<12
BH14 SS6	23	73	3	1	0.0008	10^{-7}	<12

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[1] Ontario Ministry of Municipal Affairs and Housing (OMMAH). 1997. Supplementary Guidelines to the Ontario Building Code 1997. SG-6 Percolation Time and Soil Descriptions. Toronto, Ontario.

Atterberg Limits testing was also conducted on six [6] of the same selected samples which were subjected to grain size analyses. The results of these analyses are presented in the attached Drawing No. 2, Atterberg Limits, and summarised as follows:

TABLE B
SUMMARY OF ATTERBERG LIMITS

Sample	Depth [m]	Liquid Limit, W_L	Plastic Limit, W_P	Plasticity Index
BH11 SS7	6.4	19.4	14.8	4.6
BH13 SS2	1.1	28.4	19.2	9.2
BH13 SS4	2.6	18.3	21.3	0
BH13 SS6	4.9	23.8	15.8	8.0
BH14 SS6	4.9	22.5	14.8	7.7

The field and laboratory testing demonstrate the clayey silt deposit to be inorganic silts and clays of low plasticity. These results are consistent with our observations of the soils encountered across the site during drilling and our visual assessment of the recovered samples. It is noted that the permeabilities above are estimated based on the distribution of the grain size in each sample.

Groundwater Observations

All boreholes were noted as 'open' upon completion of drilling. In borehole Nos. 3 to 10, 12, 14, and 15, the water level in the borehole was noted at depths of 0.6 to 5.5 metres in the open boreholes. It is noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes, and the observed water levels at the borehole locations are likely a result of more permeable seams with the fieldwork being conducted during a wet period of the year. It is also noted that in cohesive soils such as those encountered in the boreholes, the static groundwater level generally coincides with the transition in colour from brown to grey, which was observed at depths of between 1 to 4 metres below the surrounding ground surface at the borehole locations.

As noted above, Borehole Nos. 1, 2, 7, 11a, 11b, 13, and 14 were fitted with monitoring wells to allow for measurement of the static groundwater level. The water levels in the monitoring wells were measured on February 19 and February 25, 2020. This data is summarised in the following table.

TABLE C – SUMMARY OF GROUNDWATER MEASUREMENTS

	MW-1	MW-2	MW-7	MW-11a	MW-11b	MW-13	MW-14
Surface Elevation [m]	240.25	238.84	238.87	238.04	238.01	239.75	239.83
Well depth [m]	6.1	6.1	6.1	6.1	3.0	6.1	6.1
February 19, 2020							
Groundwater Depth [m]	0.36	1.25	-0.44	0.47	0.53	0.17	0.79
Groundwater Elevation [m]	239.89	237.59	239.31	237.57	237.48	239.58	239.04
February 25, 2020							
Groundwater Depth [m]	0.23	1.29	-0.45	0.52	0.58	0.21	0.76
Groundwater Elevation [m]	240.02	237.55	239.32	237.52	237.43	239.54	239.07

Based on the measurements taken from the monitoring wells, the static groundwater elevation varies from 237.6 to 239.9 metres across the site, at depths ranging between approximately 0.17 to 1.29 metres below the existing grade. It is noted that in Borehole No. 7, the water level was measured to be above the existing grade, indicated by the negative groundwater measurement above, demonstrating a possible artesian groundwater condition.

4. HYDROGEOLOGICAL CONSIDERATIONS

The subsurface soil conditions, as described above, consist of a predominantly clayey silt/silt deposit, with varying clay and sand contents, and occasional sand seams. From the grain size analyses, as summarised in Table A above, the clay content for the samples is noted to range from a low as 10 per cent to as much as 28 per cent, demonstrating the generally stratified condition of the subsurface soils between more clayey and less clayey seams. Consequently, while the coefficient of permeability will tend to be low in the vertical direction due to the presence of very low permeability clayey layers and seams, the horizontal permeability can be two or more orders of magnitude higher.

The generally low permeability soils should allow for shallow excavations, perhaps on the order of up to 1 to 3 metres below the existing grades, depending on the presence of more permeable seams, weather conditions, etc. The rate of infiltration of groundwater into the open excavation would be relatively slow and this should be readily controlled for a short construction period, such as for the installation of service pipes, inlet/outlet structures, etc. However, where more permeable seams are encountered, more sophisticated methods of dewatering (eg. vacuum wellpoint systems, etc.) will be required. This will require appropriate planning and execution of construction by the contractor, and a more detailed hydrogeological assessment would be prudent once intended excavation depths across the proposed development are determined.

While the site subsoils are anticipated to behave primarily as cohesive soils with respect to groundwater infiltration, the more permeable layers and seams will create a high susceptibility to soil disturbance, such as from construction traffic, groundwater uplift conditions in excavations, frost, etc. Such disturbance would manifest in base instability, base heave, boiling, etc., which will be of particular concern for excavation and the long-term stability of the base and sides of the SWM pond. The water level in the pond will rise to its equilibrium position as observed in the monitoring wells, depending on weather conditions, etc. Its base will become further disturbed if water is pumped from the pond, or is allowed to drain to a lower level, thus creating an upward directed seepage condition [gradient] reducing the effective stresses, and therefore the strength of, the soils in the pond base. The storm water storage capacity will be limited since the natural ground water will tend to fill the pond, as noted above, to its equilibrium level compatible with environmental conditions. Alternatively, the use of a stabilised liner system could be employed to prevent the infiltration of groundwater into the SWM pond.

The following recommendations are provided for consideration in the design and construction of the proposed development.

- The site grading should be designed, where possible, to accommodate storm water surface flow in a similar fashion to the present topography
- Given the relatively low vertical permeability of the stratified clayey silt deposits, the use of on-site storm water infiltration systems would not be considered feasible for the property.
- It is anticipated that excavations for the installation of site services will extend to a depth of up to perhaps 2 to 4 metres below the present ground surface. It is anticipated that such excavations will intercept the shallow groundwater aquifer, thus potentially creating a “French Drain” and either raise or lower the near surface groundwater level along the pipe/service route. Consequently, if the aquifer is exposed in the service trench, measures will have to be implemented to mitigate/eliminate groundwater interference. These would include clay ‘cut-offs’ within the service trench fill encasing the pipe/service.
- As the installation of underground services is anticipated to intercept the shallow groundwater regime, it is recommended that the existing monitoring wells are utilised where possible to monitor the interference to the groundwater table, if any, during construction. The groundwater levels should continue to be monitored up to the start of construction activities to further determine natural groundwater fluctuations within the overburden soils.

- The founding levels of new residential dwellings should be designed as shallow as possible to be above the measured static groundwater levels across the site. As well the new structures should be provided with robust basement damp proofing and perimeter drainage systems. The perimeter drainage system should include an 'oversized' sump pit and a 'back-flow' prevention valve so that the sump pump will not cycle repeatedly within short time periods.
- In the event that a basement intercepts the groundwater table, an automatic back-up system should also be installed in order to ensure operation in the event of loss of power or mechanical failure of the primary pump. This can include a water-powered back-up system, which connects to the municipal water source and uses the available water pressure to create a venturi effect [siphon pump] to pump water from the sump pit. Such a water powered back up pump offers the benefit of being operational during power outages, as long as municipal water pressure is maintained, and low likelihood of mechanical failure. A backflow preventer should be installed on the water supply line before the system to prevent potential contamination into the municipal water system within the dwelling. Alternatively, generator powered and battery backup systems are also available, though it is noted that the battery systems will have a finite run time during prolonged power outages and generator systems would have additional electrical, mechanical and maintenance requirements.
- It may also be desirable in the above scenario to allow for the installation of a water level alarm system to alert the home owner in the event that the water level exceeds a specified threshold, such as the level of the top of the crawl space floor slab. This measure would allow for additional emergency actions to be taken prior to flooding occurring to a level that would impact or damage the furnace, or other equipment in the crawl space. Frequent inspection, as least annually, of the of the sump pump systems [both primary and back-up] should also be performed to confirm each system is in working order.

5. EXCAVATIONS

Excavations for the installation of foundations and underground services are anticipated to extend to depths of up to about 2 to 4 metres below the finished grade, into the native clayey silt encountered in the boreholes as described above. As noted above, the static groundwater level is generally within about 1.5 metres of the existing grade; however the generally low permeability subsurface soils should yield a relatively low rate of groundwater infiltration for short term excavations extending to as much as perhaps 1 to 3 metres below the measured static groundwater level, depending on the presence of more permeable seams. As well the final grading of the site versus the existing grades will affect the required depth of excavation below the existing grade, with an overall increase in the site grade being generally beneficial, tending to reduce the potential and extent of groundwater infiltration.

The side of excavations through the native clayey silt soils above the static groundwater level should remain stable for the short construction period at slopes of 60 degrees to the horizontal. Where 'wet' seams are encountered or during wet weather the sides may have a tendency to slump in slopes as flat as 3 horizontal to 1 vertical, or flatter. Some minor infiltration of groundwater through more permeable seams and from surface runoff should be anticipated. However any such infiltration should be readily controlled with typical construction dewatering methods, i.e. pumping from sumps in the base of excavations.

Where deeper excavations are required, extending below the measured static groundwater level in the clayey silt soils, some difficulty may be encountered with base and side slope stability, groundwater control, etc. The sides of open cut excavations may tend to slump in to flatter stable inclinations. The base of excavations may have a tendency to become unstable, requiring the placement of coarse ballast stone material, additional bedding material, etc. Additional sumps may be required to control groundwater infiltration, and the use of more sophisticated groundwater control methods may be considered necessary for excavations deeper than about 3 metres below the present grade, or where more permeable seams are encountered. The presence of more permeable 'silty' seams would tend to exacerbate any difficulties associated with groundwater infiltration. In this regard it would be prudent to conduct a more detailed hydrogeological assessment to better evaluate how the subsurface soil and groundwater conditions will effect excavations for construction.

Notwithstanding the foregoing, all excavations must be made in compliance with the current Occupational Health and Safety Act, Regulations for Construction Projects. Excavation slopes steeper than 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 inspect the work.

We recommend that the invert elevations of any storm sewer pipes for rear yard catch basins be located above the proposed underside of footing elevations of adjacent townhouse structures, or that the trench excavations should be filled with 5 MPa 'lean mix' concrete product to the proposed underside of footing level where the excavations extend below an imaginary 10 horizontal to 7 vertical line extending outwards and down from a point 0.3 metres beyond the proposed townhouse foundations.

6. BACKFILL CONSIDERATIONS

The excavated materials will consist primarily of the native clayey silt soils encountered in the boreholes, as described above. These soils are generally considered suitable for use as engineered fill, trench backfill, etc., provided that they are free of organics, large cobbles, boulders, or other deleterious material, and that their moisture contents can be controlled to within 3 per cent of their standard Proctor optimum moisture content.

It is noted that the cohesive clayey silt soils are not considered to be free draining, and so should not be used where this characteristic is necessary. These soils will present difficulties in achieving effective compaction where access with compaction equipment is restricted. The native soils encountered are noted to range from slightly 'dry', near to, to 'wet' of their standard Proctor optimum moisture content. Some moisture conditioning may be required at the time of construction, depending upon the weather conditions. In particular where clayey silt soils are wet of optimum they are sensitive to disturbance and will present difficulties in achieving efficient compaction. In such cases moisture conditioning [drying] and/or modified compaction methods [thinner lifts, static rolling, etc.] may need to be implemented. The on site soils may become practically impossible to compact using conventional compaction equipment if they become wet during the 'wet' periods of the year.

As noted in Section 4 above, where groundwater is encountered in the service trenches it would be prudent to install regularly space clay 'cut-offs' within the backfill around the service pipes to prevent the granular bedding material from acting as a conduit. Such clay cut-offs should be installed in accordance with OPSD 802.095, using a suitable clay soil or alternatively a blend of 1 part bentonite chips to 3 parts OPSS Granular 'A'.

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. During extended periods of precipitation, excavated and stockpiled soils may become saturated to the point of being impossible to adequately compact. Stockpiled soils should be protected from rainfall by tarps and surficially-saturated soils removed, or mixed into the stockpile as part of moisture conditioning operations following rainfall events.

The native soils may require high compaction energy to achieve acceptable densities if the moisture content is not close to its standard Proctor optimum value. It is therefore very important that the placement moisture content 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 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 should be compacted to 100 per cent of its standard Proctor maximum dry density [SPMDD]. Backfill within service trenches, areas to be paved, etc., should be compacted to a minimum of 95 per cent of its SPMDD, and to 100 per cent of its SPMDD in the upper 1 metre below the design subgrade level. 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.

7. MANHOLES, CATCH BASINS AND THRUST BLOCKS

In the event that the manholes, catchbasins, valve chambers, etc. are founded on the native soils or suitable engineered fill, the bearing surfaces will be practically non-yielding under the anticipated loads. Proper preparation of the founding soils will tend to accentuate the protrusion of these structures above the pavement surface if compaction of the fill around these structures is not adequate, causing settlement of the surrounding paved surfaces. Conversely, the pavement surfaces may rise above the valve chambers and around manholes under frost action. To alleviate the potential for these types of differential movements, free-draining, non-frost susceptible material should be employed as backfill around the structures located within the paved roadway limits, and compacted to 100 per cent of its SPMDD.

The thrust blocks in the native soils may be conservatively sized as recommended by the applicable Ontario Provincial Standard Specification using a horizontal allowable bearing pressure of 150 kPa [~3,000 psf]. Any backfill required behind the blocks should be granular and should be compacted to 100 per cent of its standard Proctor maximum dry density.

8. PAVEMENT CONSIDERATIONS

All areas to be paved should be stripped of all organic or otherwise unsuitable materials. The exposed subgrade should be proofrolled with 3 to 4 passes of a loaded tandem 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 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 100 per cent of its standard Proctor maximum dry density.

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, or utilizing a purpose-built temporary construction haul road.

If construction is conducted under adverse weather conditions, additional subgrade preparation may be required. During wet weather conditions, such as typically experienced 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 Ontario Provincial Standard Specification [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 proposed pavement structure would be required to adequately support cars, trucks, and intermittent delivery and garbage trucks. For this project, a recommended pavement structure would consist of 300 millimetres of OPSS Granular 'B' sub-base course, 150 millimetres of OPSS Granular 'A' base course, 80 millimetres of Superpave 19.5, and 40 millimetres of Superpave 12.0. Notwithstanding, the pavement structure should conform to the relevant City of Hamilton requirements where they are to be assumed by the City. It is our opinion that this design is suitable for use on a residential roadway section, provided that the subgrade has been prepared as specified and is good and firm before the sub-base course material is placed. If the subgrade is soft, remedial measures as discussed above may have to be implemented and/or the sub-base thickness may have to be increased. The granular sub-base and base courses and asphaltic concrete layers should be compacted to OPSS or City of Hamilton requirements. A program of in-place density testing must be carried out to monitor that compaction requirements are being met. We note that this pavement structure is not to be considered as a construction roadway design.

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.

Asphalt paving of driveways should be consistent with the general recommendations provided above. Proper preparation of the subgrade soils is essential to good long-term performance of the pavement. Likewise, sufficient depth and compaction of granular base materials and adequate drainage will be important in achieving good long-term performance, i.e. preventing/limiting premature cracking, subgrade failure, rutting, etc. A recommended light duty pavement structure for residential driveways would consist of a minimum of 200 millimetres of OPSS Granular 'A' base course, compacted to 100 per cent standard Proctor maximum dry density, followed by a minimum of 50 millimetres of HL3 or HL3F asphaltic concrete, compacted to a minimum of 92 per cent of their Marshall maximum relative density [MRD].

9. HOUSE AND TOWNHOUSE CONSTRUCTION

The native soils encountered at the borehole locations are considered capable of supporting the loads associated with typical single family dwellings on conventional spread footings. This typically considers a nominal design bearing pressure of 75 kPa [~1,500 psf], however bearing pressures on the order of 150 kPa [~3,000 psf] SLS and 225 kPa [~4,500 psf] ULS may be considered within the native soils across most of the site. The founding surfaces must be hand cleaned of any loose or disturbed material, along with any ponded water, immediately prior to placement of foundation concrete.

In the event that site grading works result in engineered fill below founding elevations, the general recommendations presented in the Backfill Considerations above should be strictly adhered to, with compaction of suitable backfill materials to 100 per cent of their standard Proctor maximum dry density, verified by monitoring and testing by a representative of SOIL-MAT ENGINEERS present on a full time basis. If there is a short fall in the volume of fill required, then the source of imported fill should be reviewed for gradation, Proctor value, compatibility with existing fill, environmental characteristics and be approved by this office prior to use. Footings within quality engineered fill may be designed on the basis of a nominal bearing value of 100 kPa [~2,000 psf] SLS and 150 kPa [~3,000 psf] ULS.

The support conditions afforded by the native soils and/or engineered fill are generally not uniform across the building footprint, nor are the loads on the various foundations elements. As such it is recommended that consideration be given to the provision of nominal reinforcement in the footings and foundation walls to account for variable support and loading conditions. The use of nominal reinforcement is considered good construction practice as it will act to reduce the potential for cracking in the foundation walls due to minor settlements, heaving, shrinkage, etc. and will assist in resisting the pressures generated against the foundation walls by the backfill. Such nominal reinforcement is an economical approach to the reduction and prevention of costly foundation repairs after completion and later in the life of the buildings. This reinforcement would typically consist of two continuous 15M steel bars placed in the footings [directly below the foundation wall], and similarly two steel bars placed approximately 300 millimeters from the top of the foundation walls at a minimum, depending on ground conditions exposed during construction. These reinforcement bars would be bent to reinforce all corners and under basement windows, and be provided with sufficient overlap at staggered splice locations. At ‘steps’ in the foundations and at window locations, the reinforcing steel should transition diagonally, rather than at 90 degrees, to maintain the continuous tensile capacity of the reinforcement. Where footings are founded on, or partially on, engineered fill the above provision for nominal reinforcement would be required.

All basement foundation walls should be suitably damp proofed, including the provision of a ‘dimple board’ type drainage product, and provided with a perimeter drainage tile system outlet to a gravity sewer connection or positive sump pit a minimum of 150 millimetres below the basement floor slab. The clear stone material surrounding the weeping tile should be completely and continuously surrounded with a geotextile material to prevent the migration of fines from the foundation wall backfill and subsoils into the clear stone product. In the event that sump pit systems are required we would recommend that the sump pump system should be constructed with an ‘oversized’ reservoir and a ‘back-flow’ prevention valve so that the sump pump will not cycle repeatedly within short time periods. In addition, as noted in Section 4 above, it should also be considered to provide suitable backup systems, such as a water or battery powered pump.

All footings exposed to the environment must be provided with a minimum of 1.2 meters of earth or equivalent insulation to protect against frost penetration. This frost protection would also be required if construction were undertaken during the winter months. All footings must be proportioned to satisfy the requirements of the Ontario Provincial Building Code.

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 outlined in this report, and to allow changes to be made in the event that subsurface conditions differ from the conditions identified at the borehole locations.

10. STORMWATER MANAGEMENT POND CONSIDERATIONS

We understand that the proposed development will include the construction of a stormwater management [SWM] pond in the center-east portion of the site, in the area of Borehole Nos. 11 and 13. In this area, the static groundwater level is estimated to be within 1 metre of the current grade. As such, the base may potentially become locally unstable as a function of the pond base elevation versus the groundwater level and prevailing weather conditions. Such instability would be exacerbated by repeated travel of heavy construction equipment. These conditions will be made worse during wet weather, and so it is recommended that site works be conducted during the dry summer months of the year, where possible. It would be reasonable to conduct the initial grading of the SWM pond to perhaps 0.5 to 1.0 metre above the final base contours. These initial 'pre-grade' contours could then be maintained during construction of site grading and servicing and then the pond completed near the end of site servicing works. This would have the benefit of providing a demonstration of how the pond can be expected to perform in the long-term and allow any necessary changes to be made to the design prior to completion of construction.

Another design consideration in the long-term performance of the SWM pond will be the need to accommodate the infiltration/exfiltration of natural groundwater to allow the pond to provide the maximum storage volume for storm water detention. Given the observed static groundwater levels it is anticipated that groundwater movement will be infiltration into the pond as a function of the design base elevation, permanent pool elevation, and seasonal fluctuation in groundwater levels. The low permeable clayey silt soils will yield a low rate of infiltration in the short-term, but in the long-term [over yearly cycles] the groundwater must be expected to stabilise near the levels as estimated above. As such, further long-term monitoring of the existing wells at Borehole Nos. 11 and 13 may be warranted to further investigate the anticipated groundwater level in the area.

Based on information available to date, it would appear that the most appropriate approach to the seepage conditions and storm water management on this site would be to provide a low permeability layer over the base of the pond to resist the infiltration of groundwater, and of sufficient weight to resist any hydrostatic uplift pressures. This could be readily accomplished through the use of a re-compacted clay liner comprised of the clayey silt soils native to the area.

An impermeable compacted clay liner would consist of a sufficiently plastic clay soil, with a recommended minimum clay content of 20 per cent and plasticity index of 7 or more. Based on the grain size analyses presented above, some of the on-site clayey silt soils may be considered suitable for use in the construction of a low permeable or impermeable liner at the base of the SWM pond to resist the infiltration of groundwater, although this varies both with depth and between borehole locations. This may be readily accomplished by working the clayey silt in the base of the pond to a depth of perhaps 0.5 metres, such as with a heavy disc, to break apart any natural structure or layering. The liner material should be moisture conditioned to be within 2 per cent below to 4 per cent above optimum moisture content and compacted in place to 95 per cent of standard Proctor maximum dry density [SPMDD]. In the event that the clayey silt at the base of the pond has insufficient clay content or plasticity or too many sandy seams to simply be reworked, however, more clayey soils may have to be imported from other parts of the site or from off-site to construct this liner. In order to make that determination, a representative of SOIL-MAT ENGINEERS should be on-site during excavation of the proposed ponds.

Alternatively, weighed down proprietary liners could be considered, however the material suppliers of such materials (such as Layfield, Terrafix, Suprema) would have to be consulted for recommendations on the appropriate product and installation methods for the site conditions. Such artificial liners would not require compaction efforts and could be weighed down with practically any available soil or granular material.

The final design interior pond slopes constructed using the on-site clayey silt should be at 4 horizontal to 1 vertical, or flatter, and the exterior slopes of any berms, where required, at 3 horizontal to 1 vertical, or flatter. Should steeper slopes be required it will be necessary to provide some form of stabilisation, such as with the placement of coarse 'rip-rap' stone, or proprietary product such as Turfstone or Cable-Crete. In fact, it is recommended that all interior pond slopes be provided with at least some form of nominal stabilisation/protection to control erosion/loss of ground. Above the extended pond level this may consist of appropriate vegetation. It is anticipated that topsoil will be placed within the SWM pond area and 'seeded' to provide stabilisation and erosion protection.

It is also noted that appropriate care and effort will be required by the contractor around inlet and outlet structures to ensure the impermeable liner is continuous and avoid the potential of 'piping'. In this regard the clay liner should be completely constructed prior to the installation of inlet/outlet structures. If necessary a bentonite clay material could be utilised within the fill around any structures to provide a continuous impermeable seal.

12. 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 of 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 affect 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, please do not hesitate to contact the undersigned.

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

Zachary van Galen, B. Eng. Mgmt., EIT
Junior Engineer

Adam Roemmele, P. Eng.
Project Engineer

LICENSED PROFESSIONAL ENGINEER
Mar 23, 2024
A.D. ROEMMELE
100212893
PROVINCE OF ONTARIO

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

Enclosures:	Drawing No. 1, Borehole Location Plan Log of Borehole Nos. 1 to 15, inclusive Drawing No. 2, Plasticity Chart Grain Size Analysis Nos. 1 to 8, inclusive
Distribution:	LIV Communities [1, plus pdf]

LEGEND

⊕ BH# Borehole Location

⊕ TBM Geodetic Benchmark
Top of manhole cover
Geodetic Elevation of 242.25 m.

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 190739-G.

2. Borehole locations are approximate.

SOIL-MAT
ENGINEERS & CONSULTANTS LTD.

Glancaster Golf Course
Property
Hamilton, Ontario

Borehole Location Plan

Project No. SM 190739-G

Date: January 2020

Drawn: LC | Checked: ZVG

SM 190739-G Borehole Location Plan

Drawing No. 1a

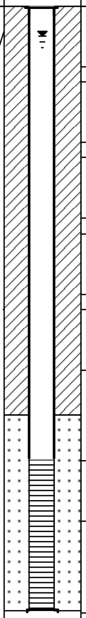
Log of Borehole No. 1

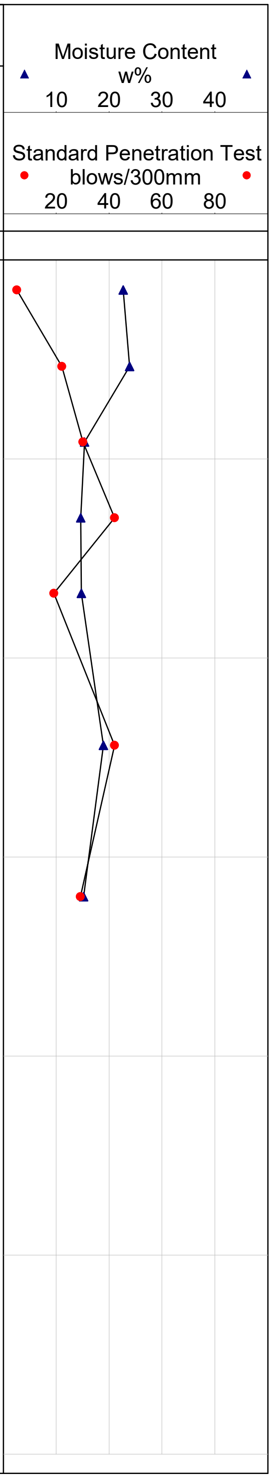
Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4783329
E: 586941

Elevation (m)	Description
240.25	Ground Surface
240.00	**Topsoil** Approximately 250 millimetres of topsoil.
	Clayey Silt Brown, trace to some sand, occasional sandy seams, trace gravel, reworked appearance with occasional organics in upper levels, very stiff to hard.
237.20	Transition to Grey.
233.50	End of Borehole

SAMPLE Type	Number	Blow Counts	Blows/300mm
SS	1	2,2,3,3	5
SS	2	3,11,11,15	22
SS	3	9,11,19,22	30
SS	4	11,19,23,30	42
SS	5	5,8,11,13	19
SS	6	12,19,23,27	42
SS	7	10,16,13,22	29





NOTES:

1. Borehole was advanced using solid stem auger equipment on January 7, 2020 to termination at a depth of 6.7 metres.

2. Borehole was 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 and the following groundwater level readings have been measured:

Drill Method: Solid Stem Augers
Drill Date: January 7, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

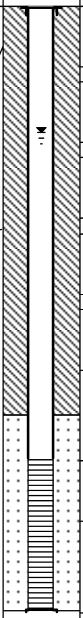
Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 2

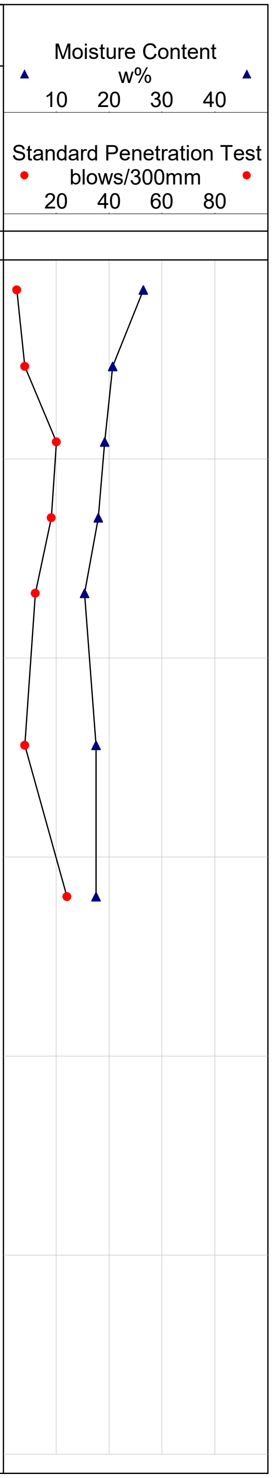
Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4783265
E: 587192

Depth	Elevation (m)	Description
ft 0 / m 0	238.84	Ground Surface
	238.44	**Topsoil** Approximately 400 millimetres of topsoil.
		Clayey Silt Brown, trace to some sand, occasional sandy seams, trace gravel, reworked appearance with occasional organics in upper levels, stiff to hard.
	236.60	Transition to Grey.
	232.10	End of Borehole



SAMPLE						
Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	1,2,3,2	5	▨		
SS	2	1,3,5,8	8	▨		
SS	3	6,9,11,16	20	▨		
SS	4	6,8,10,12	18	▨		
SS	5	2,6,6,8	12	▨		
SS	6	1,3,5,10	8	▨		
SS	7	6,8,16,18	24	▨	>4.5	



NOTES:

1. Borehole was advanced using solid stem auger equipment on January 7, 2020 to termination at a depth of 6.7 metres.

2. Borehole 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 and the following groundwater level readings have been measured:

Drill Method: Solid Stem Augers
Drill Date: January 7, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4783176
E: 587067

Depth	Elevation (m)	Description
0 ft / 0 m	239.12	Ground Surface
	238.72	**Topsoil** Approximately 400 millimetres of topsoil.
		Clayey Silt Brown, trace to some sand, occasional sandy seams, trace gravel, reworked appearance with occasional organics in upper levels, firm to hard.
	236.50	Transition to Grey.
	229.40	End of Borehole

NOTES:

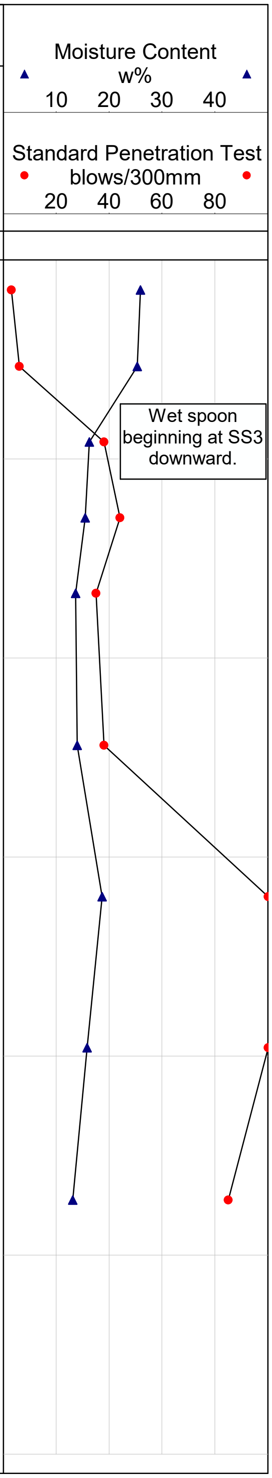
1. Borehole was advanced using solid stem auger equipment on January 7, 2020 to termination at a depth of 9.8 metres.

2. Borehole was recorded as open and 'wet' at a depth of 0.6 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.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	1,1,2,1	3	▨		
SS	2	1,1,5,10	6	▨	>4.5	
SS	3	9,18,20,28	38	▨	>4.5	
SS	4	12,21,23,20	44	▨	>4.5	
SS	5	10,16,19,23	35	▨		
SS	6	11,18,20,18	38	▨		
SS	7	33,50/6"	100	▨		
SS	8	28,50/6"	100	▨	>4.5	
SS	9	18,39,46,35	85	▨	>4.5	



Wet spoon beginning at SS3 downward.

Drill Method: Solid Stem Augers
Drill Date: January 7, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

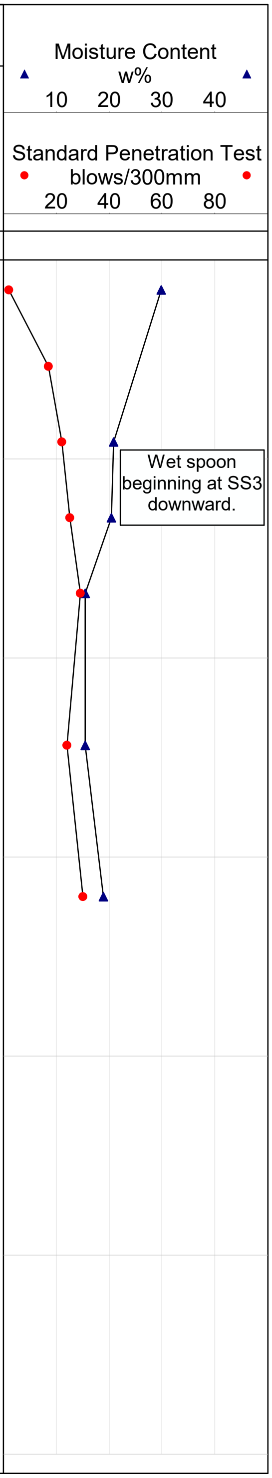
Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 4

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4783196
E: 586888

Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
ft m 0	241.13		Ground Surface								
	240.73		**Topsoil** Approximately 400 millimetres of topsoil.		SS	1	0,0,2,2	2	▨		
			Clayey Silt Brown, trace to some sand, occasional sandy seams, trace gravel, reworked appearance with occasional organics in upper levels, very stiff to hard.		SS	2	2,5,12,12	17	▨	>4.5	
					SS	3	6,10,12,19	22	▨		
					SS	4	8,9,16,22	25	▨		
					SS	5	10,14,15,22	29	▨	3.5	
	237.00		Transition to Grey.								
					SS	6	7,12,12,20	24	▨		
					SS	7	6,12,18,22	30	▨		
	234.40		End of Borehole								



Wet spoon beginning at SS3 downward.

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 7, 2020 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'wet' at a depth of 0.6 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.

Drill Method: Solid Stem Augers
Drill Date: January 7, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

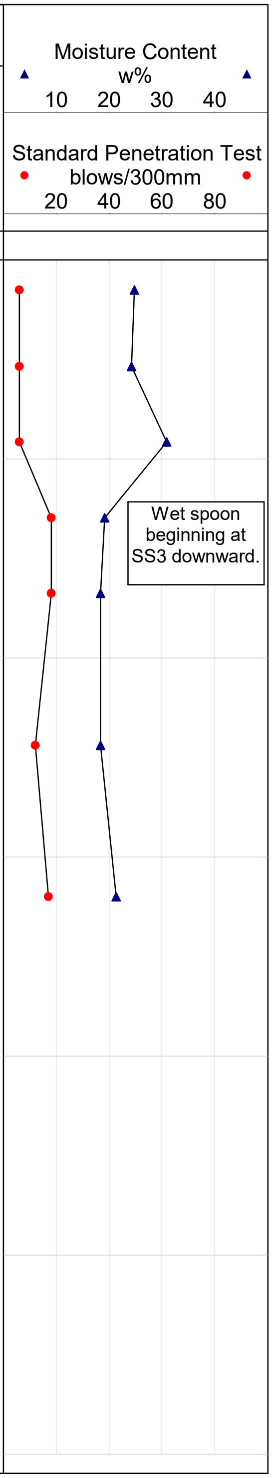
Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 5

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4783036
E: 587126

Depth (m)	Elevation (m)	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0	237.90		Ground Surface								
	237.40		**Topsoil** Approximately 500 millimetres of topsoil.		SS	1	1,3,3,5	6	▨		
1			**Clayey Silt/Sandy Silt Fill** Brown, trace gravel, occasional organics, firm.		SS	2	2,3,3,5	6	▨		
2	235.70				SS	3	2,3,3,7	6	▨		
			Clayey Silt Grey, trace to some sand, occasional sandy seams, trace gravel, mottled in upper levels, firm to very stiff.		SS	4	4,7,11,11	18	▨	3.75	
3					SS	5	5,7,11,11	18	▨		
5					SS	6	5,5,7,8	12	▨	>4.5	
6	231.20				SS	7	5,10,7,6	17	▨		
7			End of Borehole								



NOTES:

1. Borehole was advanced using solid stem auger equipment on January 7, 2020 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'wet' at a depth of 3 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.

Drill Method: Solid Stem Augers
Drill Date: January 7, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 6

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4783037
E: 587015

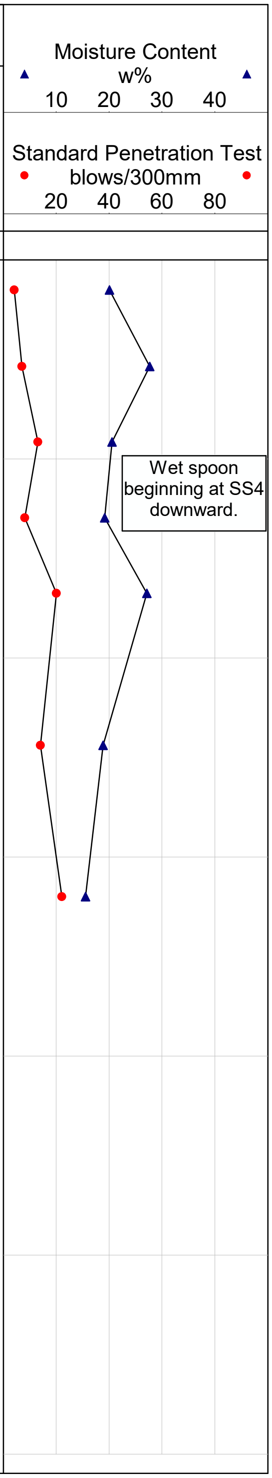
Depth	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
ft m 0	239.87		Ground Surface								
			Topsoil Approximately 100 millimetres of topsoil.		SS	1	1,2,2,3	4	▨		
	238.40		**Silty Clay/Sandy Silt Fill** Brown, trace gravel, occasional organics, firm.		SS	2	2,3,4,7	7	▨	2.75	
					SS	3	2,5,8,12	13	▨	4.25	
	237.30		**Clayey Silt** Brown, trace to some sand, occasional sandy seams, trace gravel, mottled in upper levels, stiff to very stiff.		SS	4	3,3,5,14	8	▨		
			Transition to Grey.		SS	5	6,10,10,12	20	▨	2.0	
					SS	6	6,6,8,14	14	▨		
					SS	7	6,10,12,28	22	▨	>4.5	
	233.20		End of Borehole								

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 7, 2020 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'wet' at a depth of 1.2 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.



Wet spoon beginning at SS4 downward.

Drill Method: Solid Stem Augers
Drill Date: January 7, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

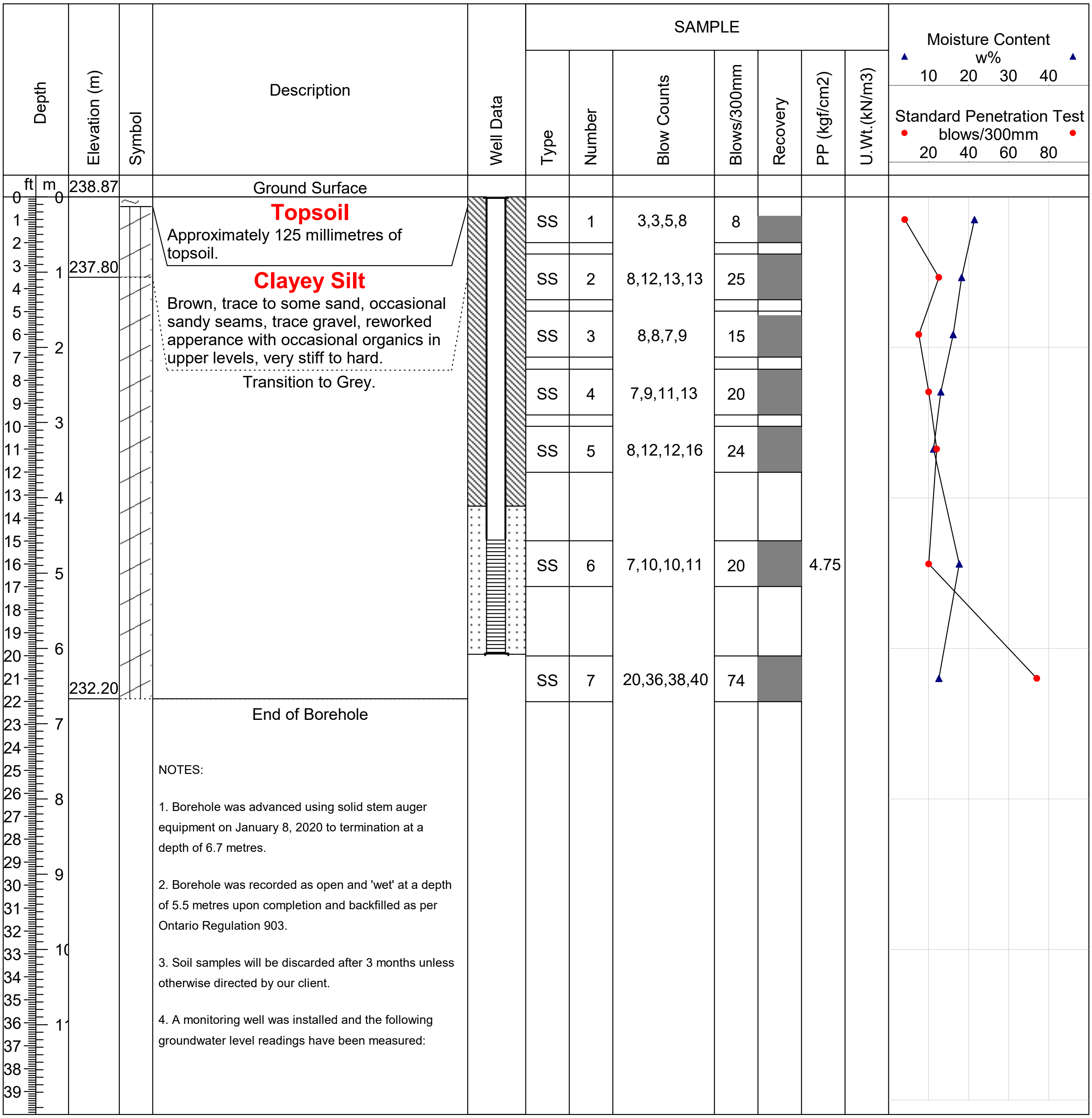
Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 7

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782957
E: 586850



Elevation (m)	Description
238.87	Ground Surface
	Topsoil Approximately 125 millimetres of topsoil.
237.80	**Clayey Silt** Brown, trace to some sand, occasional sandy seams, trace gravel, reworked apperance with occasional organics in upper levels, very stiff to hard. Transition to Grey.
232.20	End of Borehole

SAMPLE						
Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	3,3,5,8	8	■		
SS	2	8,12,13,13	25	■		
SS	3	8,8,7,9	15	■		
SS	4	7,9,11,13	20	■		
SS	5	8,12,12,16	24	■		
SS	6	7,10,10,11	20	■	4.75	
SS	7	20,36,38,40	74	■		

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 8, 2020 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'wet' at a depth of 5.5 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 and the following groundwater level readings have been measured:

Drill Method: Solid Stem Augers
Drill Date: January 8, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 8

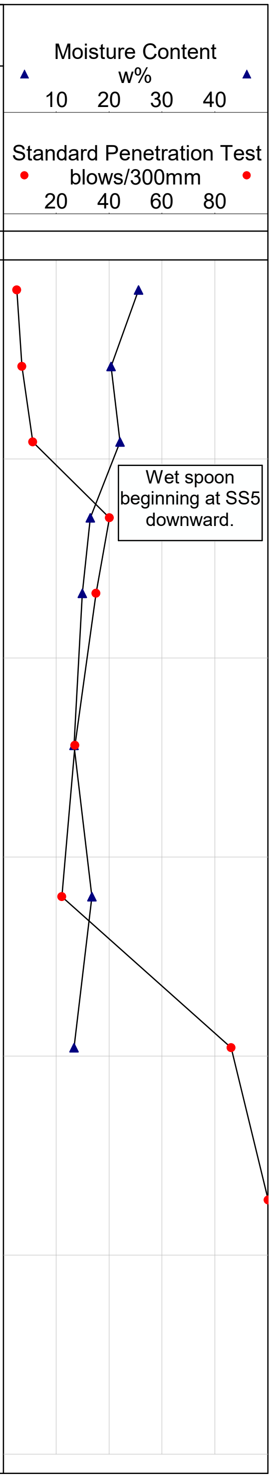
Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782859
E: 587113

Elevation (m)	Description
239.82	Ground Surface
239.52	**Topsoil** Approximately 300 millimetres of topsoil.
238.40	**Clayey Silt/Sandy Silt Fill** Brown, trace gravel, occasional organics, firm to stiff.
236.80	**Clayey Silt** Brown, trace to some sand, occasional sandy seams, trace gravel, mottled in upper levels, very stiff to hard. Transition to Grey.
230.10	End of Borehole

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	2,2,3,3	5	▨		
SS	2	2,4,3,4	7	▨	2.0	
SS	3	2,4,7,14	11	▨		
SS	4	12,18,22,29	40	▨	>4.5	
SS	5	7,17,18,24	35	▨	>4.5	
SS	6	8,13,14,21	27	▨		
SS	7	8,10,12,12	22	▨	3.25	
SS	8	20,36,50/6"	86	▨		
SS	8	50/6"	100			



Wet spoon beginning at SS5 downward.

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 8, 2020 to termination on assumed bedrock at a depth of 9.8 metres.

2. Borehole was recorded as open and 'wet' at a depth of 1.2 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.

Drill Method: Solid Stem Augers
Drill Date: January 8, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

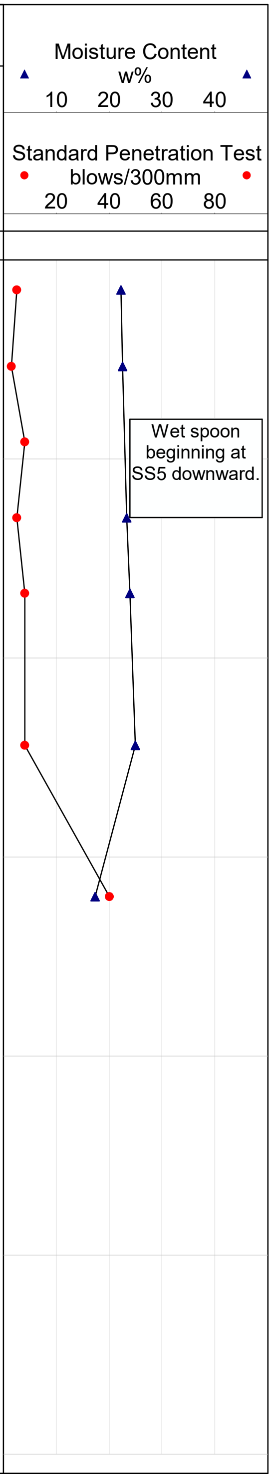
Log of Borehole No. 9

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782767
E: 586920

Depth	Elevation (m)	Symbol	Description	Well Data
ft 0 / m 0	236.85		Ground Surface	
			Topsoil Approximately 50 millimetres of topsoil.	
			Clayey Silt/Sandy Silt Fill Brown, trace gravel, occasional organics and construction debris, soft to firm.	
	232.70		**Clayey Silt** Grey, trace to some sand, occasional sandy seams, trace gravel, stiff to hard.	
	230.10		End of Borehole	

SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	3,3,2,3	5			
SS	2	2,1,2,2	3			
SS	3	2,3,5,1	8			
SS	4	2,2,3,3	5		1.0	
SS	5	2,3,5,3	8		3.0	
SS	6	3,3,5,5	8			
SS	7	18,20,20, 50/6"	40		2.0	



Wet spoon beginning at SS5 downward.

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 8, 2020 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'wet' at a depth of 1.2 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.

Drill Method: Solid Stem Augers
Drill Date: January 8, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

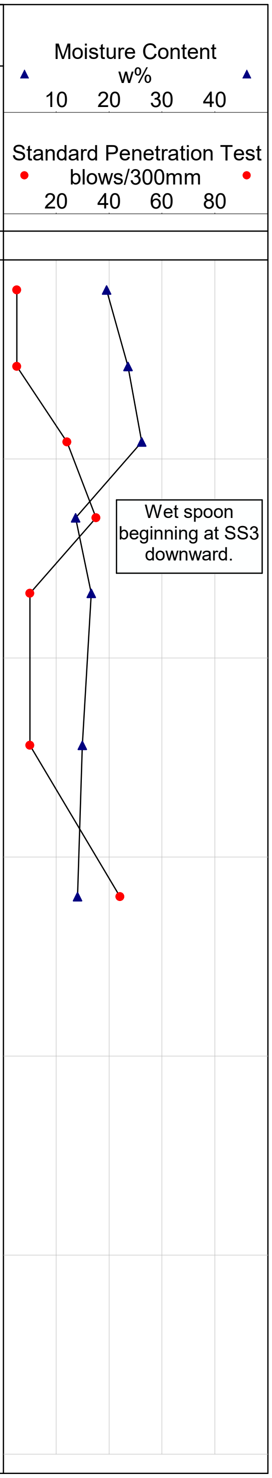
Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 10

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities
Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782752
E: 586770

Elevation (m)	Description
240.46	Ground Surface
	Topsoil Approximately 50 millimetres of topsoil.
239.00	**Clayey Silt/Sandy Silt Fill** Brown, trace gravel, occasional organics, firm.
238.20	**Clayey Silt** Brown, trace to some sand, occasional sandy seams, trace gravel, mottled in upper levels, stiff to hard. Transition to Grey.
233.80	End of Borehole

Type	Number	Blow Counts	Blows/300mm
SS	1	3,2,3,4	5
SS	2	3,2,3,4	5
SS	3	7,11,13,14	24
SS	4	14,15,20,16	35
SS	5	3,4,6,8	10
SS	6	4,4,6,9	10
SS	7	9,16,28,50	44



Wet spoon beginning at SS3 downward.

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 8, 2020 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'wet' at a depth of 1.2 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.

Drill Method: Solid Stem Augers
Drill Date: January 8, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

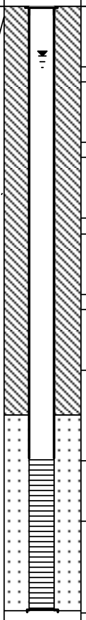
Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

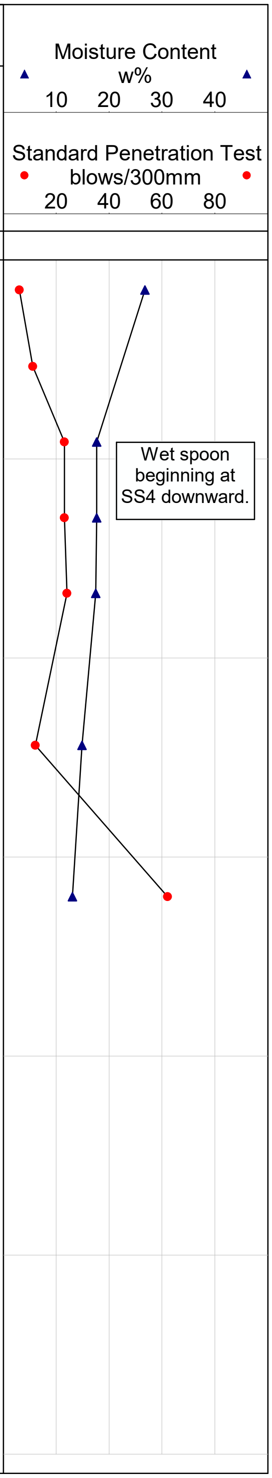
Log of Borehole No. 11a

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities
Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782653
E: 587061

Depth (m)	Elevation (m)	Description
0	238.04	Ground Surface
		Topsoil Approximately 100 millimetres of topsoil.
		Clayey Silt Brown, trace to some sand, occasional sandy seams, trace gravel, reworked appearance with occasional organics in upper levels, stiff to hard.
	236.20	Transition to Grey.
	231.30	End of Borehole



Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	3,3,3,3	6	▇		
SS	2	2,2,9,15	11	▇		
SS	3	10,12,11,12	23	▇		
SS	4	9,11,12,13	23	▇		
SS	5	6,11,13,16	24	▇	>4.5	
SS	6	3,4,8,14	12	▇	>4.5	
SS	7	16,30,32,35	62	▇		



Wet spoon beginning at SS4 downward.

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 9, 2020 to termination at a depth of 6.7 metres.

2. Borehole was 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 and the following groundwater level readings have been measured:

Drill Method: Solid Stem Augers
Drill Date: January 9, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

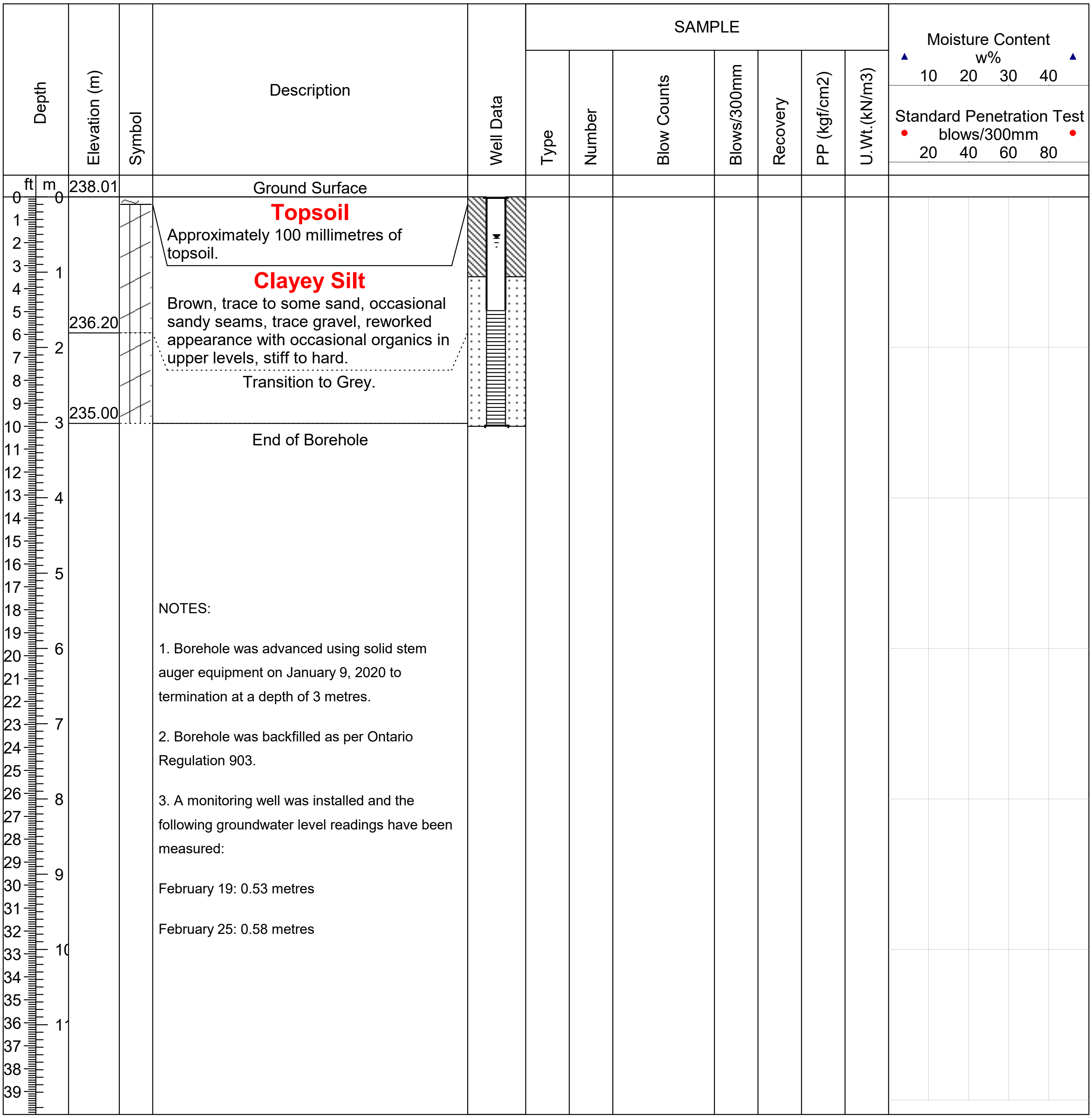
Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 11b

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782653
E: 587061



Ground Surface

Topsoil

Approximately 100 millimetres of topsoil.

Clayey Silt

Brown, trace to some sand, occasional sandy seams, trace gravel, reworked appearance with occasional organics in upper levels, stiff to hard.

Transition to Grey.

End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 9, 2020 to termination at a depth of 3 metres.

2. Borehole was backfilled as per Ontario Regulation 903.

3. A monitoring well was installed and the following groundwater level readings have been measured:

February 19: 0.53 metres

February 25: 0.58 metres

Drill Method: Solid Stem Augers
Drill Date: January 9, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 12

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782633
E: 586807

Elevation (m)	Description
240.20	Ground Surface
	Topsoil Approximately 50 millimetres of topsoil.
	Clayey Silt/Sandy Silt Fill Brown, trace gravel, occasional organics, firm.
238.80	**Clayey Silt** Brown, trace to some sand, occasional sandy seams, trace gravel, mottled in upper levels, very stiff to hard.
236.80	Transition to Grey.
230.40	End of Borehole

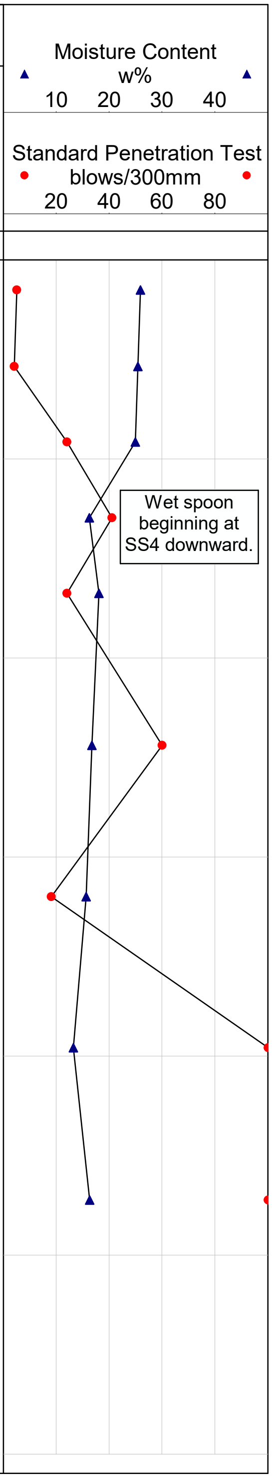
NOTES:

1. Borehole was advanced using solid stem auger equipment on January 8, 2020 to termination at a depth of 9.8 metres.

2. Borehole was recorded as open and 'wet' at a depth of 1.0 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.

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	2,2,3,4	5	▨		
SS	2	2,2,2,2	4	▨		
SS	3	7,11,13,20	24	▨		
SS	4	16,19,22,26	41	▨		
SS	5	4,8,16,20	24	▨	4.5	
SS	6	4,10,50/6"	60	▨	>4.5	
SS	7	4,6,12,18	18	▨		
SS	8	18,50/6"	100	▨	>4.5	
SS	9	50/6"	100	▨		



Wet spoon beginning at SS4 downward.

Drill Method: Solid Stem Augers
Drill Date: January 8, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

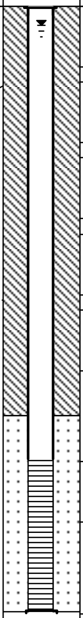
Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 13

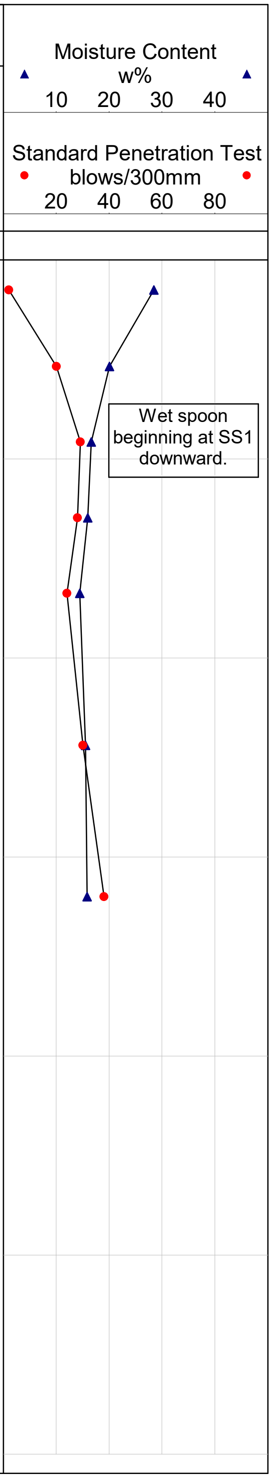
Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782532
E: 586989

Depth (m)	Elevation (m)	Description
0	239.75	Ground Surface
0 – 0.8	238.95	**Topsoil** Approximately 800 millimetres of topsoil.
0.8 – 6.7		**Clayey Silt** Brown, trace to some sand, occasional sandy seams, trace gravel, reworked appearance with occasional organics in upper levels, very stiff to hard.
2.95	236.80	Transition to grey.
6.7	233.00	End of Borehole



Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	1,1,1,1	2			
SS	2	4,10,10,15	20			
SS	3	10,11,18,23	29		>4.5	
SS	4	9,11,17,28	28		3.5	
SS	5	9,11,13,13	24			
SS	6	5,10,20,28	30		>4.5	
SS	7	11,16,22,28	38			



Wet spoon beginning at SS1 downward.

NOTES:

1. Borehole was advanced using solid stem auger equipment on January 9, 2020 to termination at a depth of 6.7 metres.

2. Borehole was 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 and the following groundwater level readings have been measured:

Drill Method: Solid Stem Augers
Drill Date: January 9, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

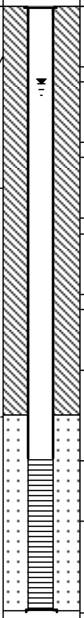
Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 14

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities

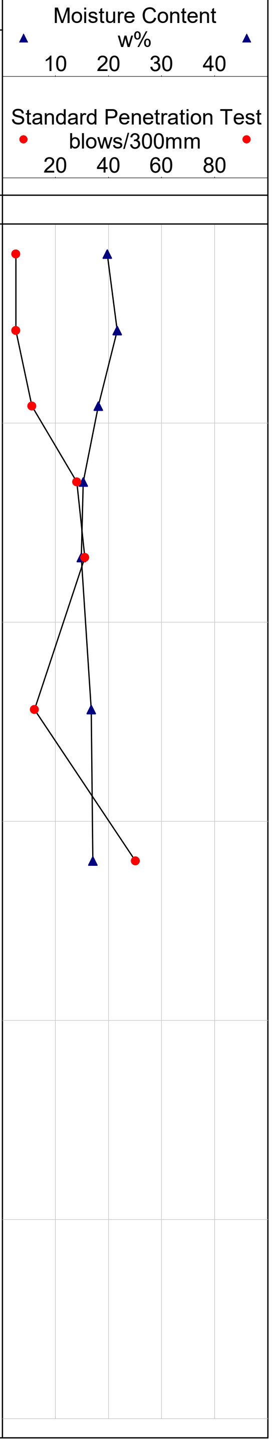
Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782456
E: 586757

Elevation (m)	Description
239.83	Ground Surface
239.33	**Topsoil** Approximately 500 millimetres of topsoil.
238.00	**Clayey Silt/Sandy Silt Fill** Brown, trace gravel, occasional oganics, firm to stiff.
235.70	**Clayey Silt** Brown, trace to some sand, occasional sandy seams, trace gravel, mottled in upper levels, stiff to hard.
233.10	Transition to Grey.
	End of Borehole



SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	2,2,3,4	5	▇		
SS	2	1,2,3,4	5	▇		
SS	3	1,4,7,11	11	▇		
SS	4	6,14,14,23	28	▇	>4.5	
SS	5	6,14,17,21	31	▇	>4.5	
SS	6	2,5,7,8	12	▇	2.0	
SS	7	11,18,32,50	50	▇		



NOTES:

1. Borehole was advanced using solid stem auger equipment on January 10, 2020 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'wet' at a depth of 4.3 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 and the following groundwater level readings have been measured:

February 19: 0.79 metres

Drill Method: Solid Stem Augers
Drill Date: January 10, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

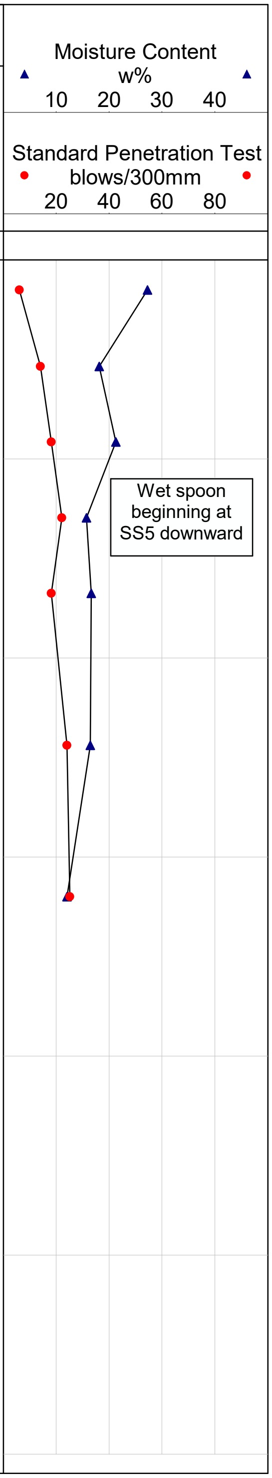
Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1

Log of Borehole No. 15

Project No: SM 190739-G
Project: Proposed Residential Development
Location: 555 Glancaster Road, Ancaster
Client: LIV Communities
Project Manager: Ian Shaw, P. Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4782369
E: 586884

Elevation (m)	Description
239.57	Ground Surface
239.07	**Topsoil** Approximately 500 millimetres of topsoil.
238.50	**Clayey Silt/Sandy Silt Fill** Brown, trace gravel, occasional organics, firm to stiff.
237.00	**Clayey Silt** Brown, trace to some sand, occasional sandy seams, trace gravel, mottled in upper levels, stiff to very stiff.
232.90	Transition to Grey.
	End of Borehole

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	1,2,4,6	6	▨		
SS	2	4,5,9,11	14	▨	3.0	
SS	3	8,9,9,12	18	▨		
SS	4	7,9,13,19	22	▨		
SS	5	12,10,8,6	18	▨	4.0	
SS	6	7,11,13,16	24	▨	>4.5	
SS	7	4,9,16,16	25	▨	4.5	



NOTES:

1. Borehole was advanced using solid stem auger equipment on January 10, 2020 to termination at a depth of 6.7 metres.

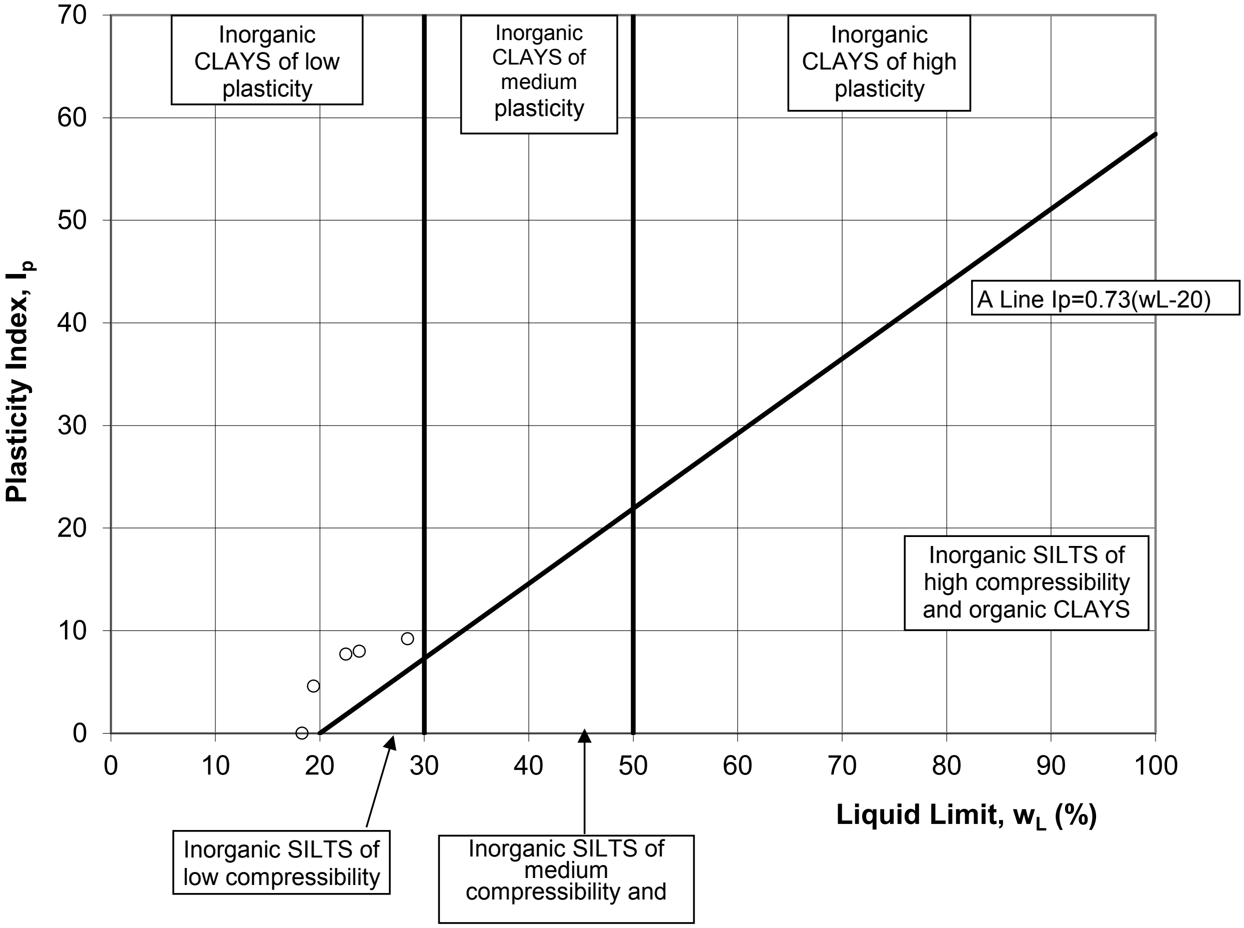
2. Borehole was recorded as open and 'wet' at a depth of 2.1 metres upon completion and backfilled as per Ontario Regulation 903.

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

Drill Method: Solid Stem Augers
Drill Date: January 10, 2020
Hole Size: 150 millimetres
Drilling Contractor: Terra Firma Environmental Services Ltd.

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Geodetic
Field Logged by: LC
Checked by: ZRV
Sheet: 1 of 1



Atterberg Limits

Sample No.		Sample Location	Liquid Limit wL	Plastic Limit wp	Plasticity Index Ip
007-20	BH11 SS7		19.4	14.8	4.6
005-20	BH13 SS2		28.4	19.2	9.2
009-20	BH13 SS4		18.3	21.3	0.0
006-20	BH13 SS6		23.8	15.8	8.0
008-20	BH 14 SS6		22.5	14.8	7.7

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

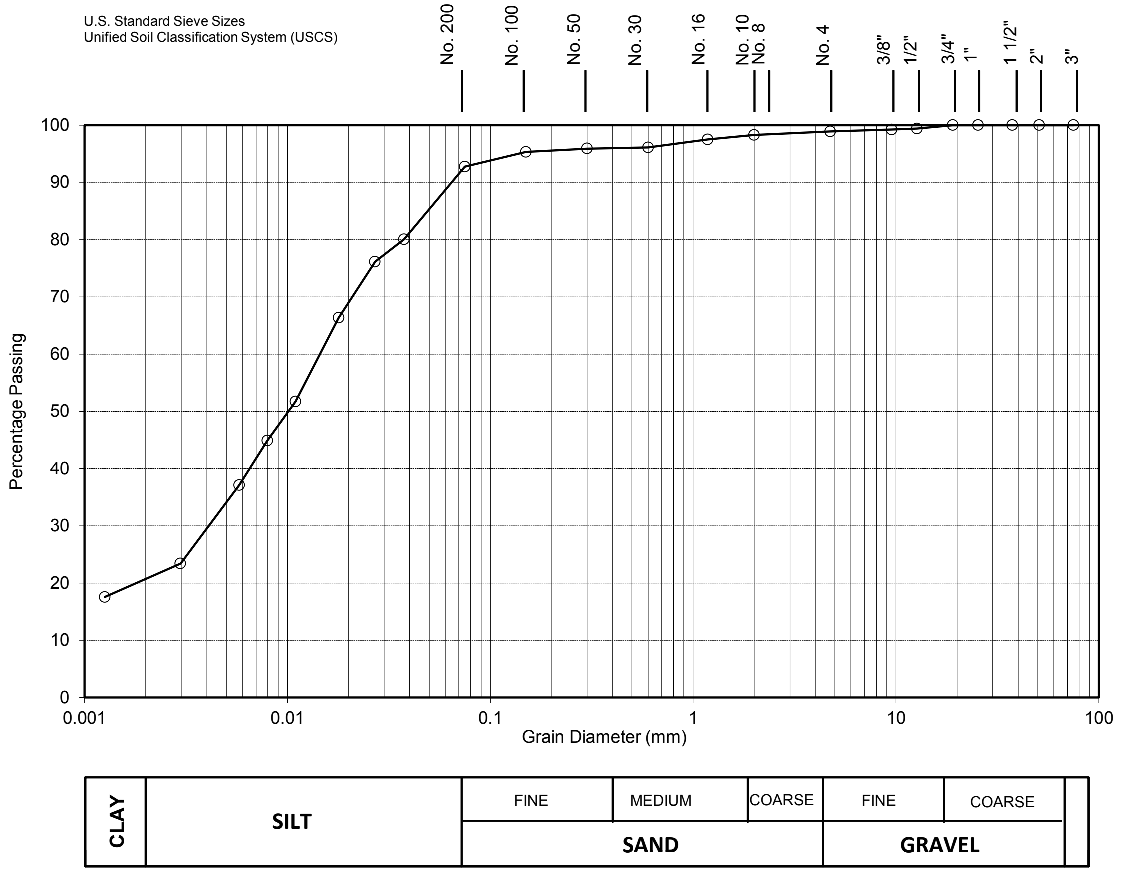
Glancaster Golf Course Property

Atterberg Limits

Client: **LIV Communities**

Project No.: **SM 190739-G** January, 2020 **Drawing No. 2**

Mechanical & Hydrometer Analyses



Lab No.: **024-20**

Sample No.: 6

Borehole No.: 11

Notes: Depth 15'

CLAY [%]: **20**

SILT [%]: **73**

SAND [%]: **6**

GRAVEL [%]: **1**

D_{10} (Effective Diam. in mm): **0.0008**

Soil Description: **Brown Clayey Silt w/ traces of Sand and Gravel**

M.L. - Inorganic silts, clayey silts with slight plasticity

Estimated Infiltration Rate [mil/hr] : **< 10**

Estimated Permeability, k [cm/s] **10^{-7}**

Coefficient of Uniformity C_U: **18.8**

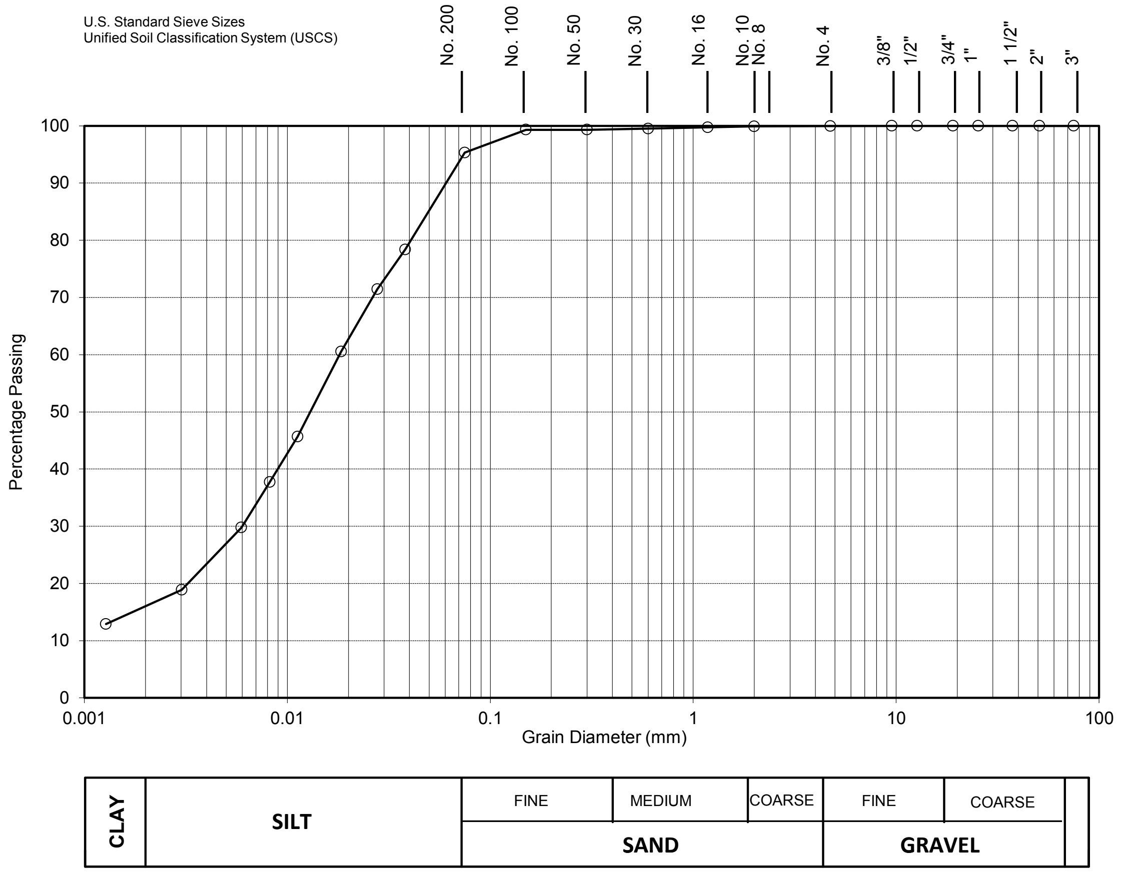
Coefficient of Curvature C_C: **1.3**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Glancaster Golf Course, Hamilton, Ontario

January 2020 | **Grain Size Analysis No. 1** | **Project No.: SM 190739-T**

Mechanical & Hydrometer Analyses



Lab No.: 027-20

Sample No.: 7

Borehole No.: 11

CLAY [%]: **16**

SILT [%]: **79**

SAND [%]: **5**

GRAVEL [%]: **0**

D_{10} (Effective Diam. in mm): **0.001**

Notes: Depth 20'

Soil Description: **Brown Silt w/ some Clay and traces of Sand**

M.L. - Inorganic silts, clayey silts with slight plasticity

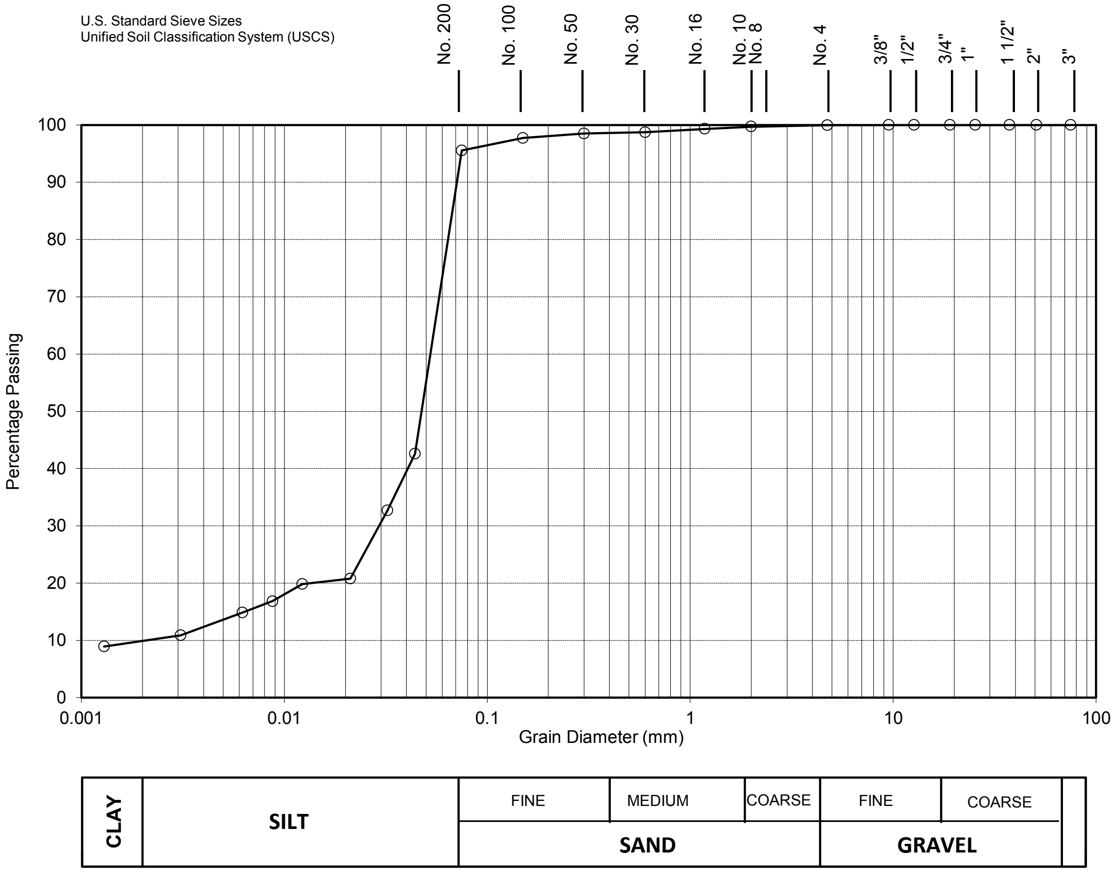
Estimated Infiltration Rate [mil/hr] :	**10 to 15**	Estimated Permeability, k [cm/s]	**10^{-6}**
Coefficient of Uniformity C_U:	**19.0**	Coefficient of Curvature C_C:	**1.9**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Glancaster Golf Course, Hamilton, Ontario

January 2020	**Grain Size Analysis No. 2**	**Project No.: SM 190739-T**

Mechanical & Hydrometer Analyses



Lab No.:	017-20	Notes: Depth 5'			
Sample No.:	3				
Borehole No.:	12				
CLAY [%]:	10	Soil Description:	Brown Silt w/ some Clay and traces of Sand M.L. - Inorganic silts, silts with slight plasticity		
SILT [%]:	85				
SAND [%]:	5				
GRAVEL [%]:	0	Estimated Infiltration Rate [mil/hr] :	15 to 20	Estimated Permeability, k [cm/s]	10^{-6}
D_{10} (Effective Diam. in mm):	0.002	Coefficient of Uniformity C_U:	25.0	Coefficient of Curvature C_C:	9.0

Soil-Mat Engineers & Consultants Ltd.

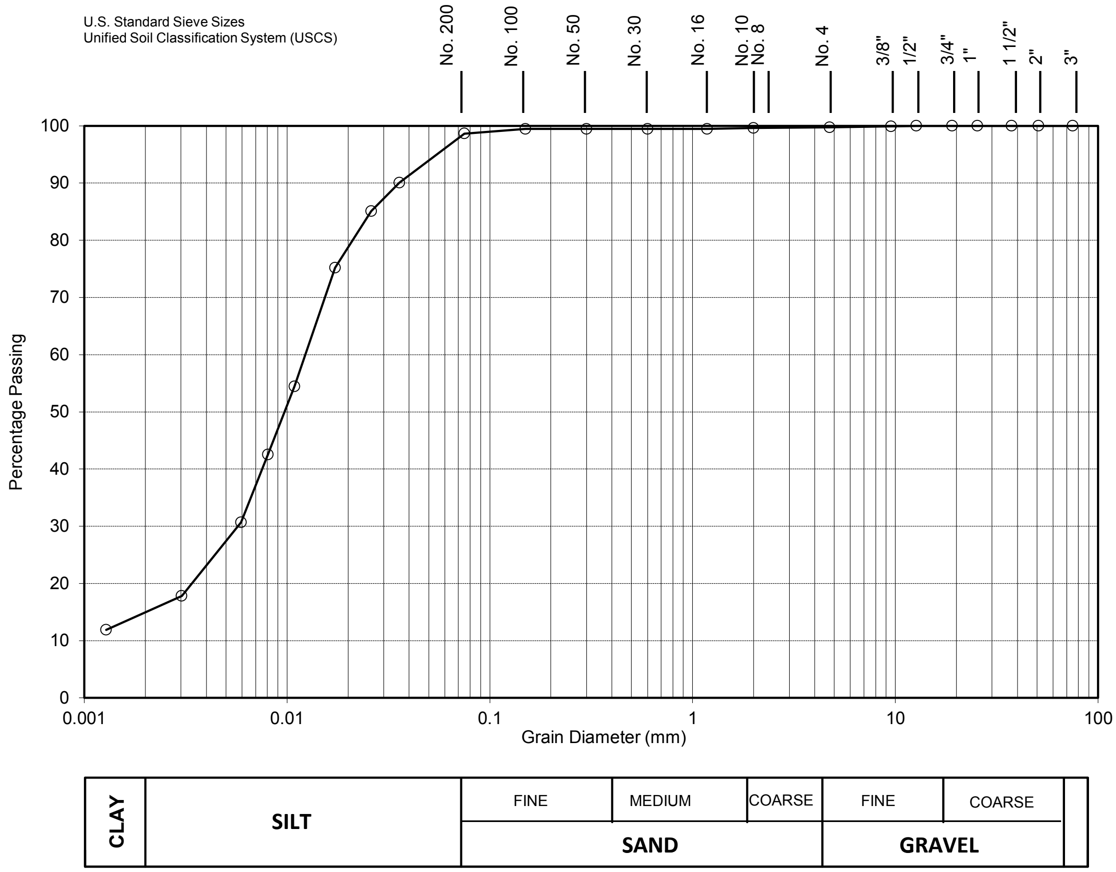
Glancaster Golf Course, Hamilton, Ontario

January 2020

Grain Size Analysis No. 3

Project No.: SM 190739-T

Mechanical & Hydrometer Analyses



Lab No.:	**026-20**	Notes: Depth 30 '			
Sample No.:	9				
Borehole No.:	12				
CLAY [%]:	**15**	Soil Description:	**Brown Silt w/ some Clay and traces of Sand** **M.L. - Inorganic silts, clayey silts with slight plasticity**		
SILT [%]:	**84**				
SAND [%]:	**1**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mil/hr] :	**10 to 15**	Estimated Permeability, k [cm/s]	**10^{-6}**
D_{10} (Effective Diam. in mm):	**0.001**	Coefficient of Uniformity C_U:	**12.0**	Coefficient of Curvature C_C:	**3.0**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

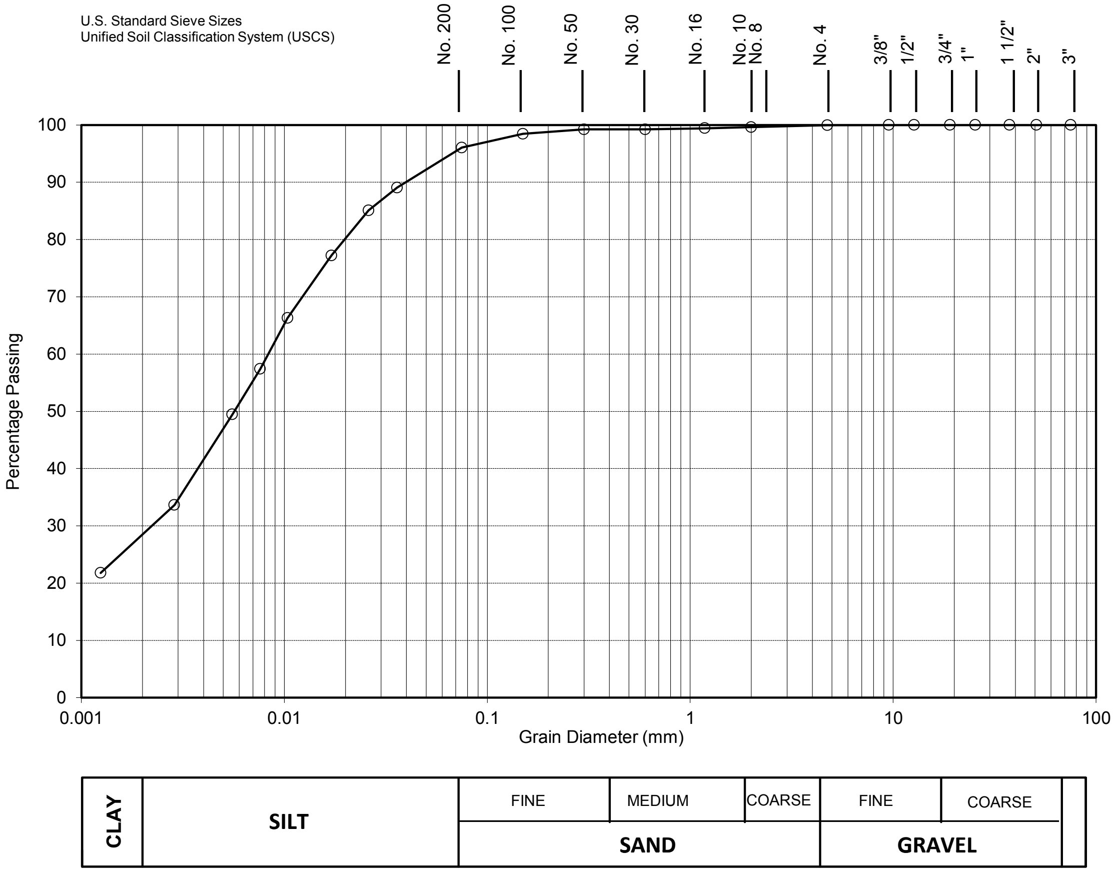
Glancaster Golf Course, Hamilton, Ontario

January 2020

Grain Size Analysis No. 4

Project No.: SM 190739-T

Mechanical & Hydrometer Analyses



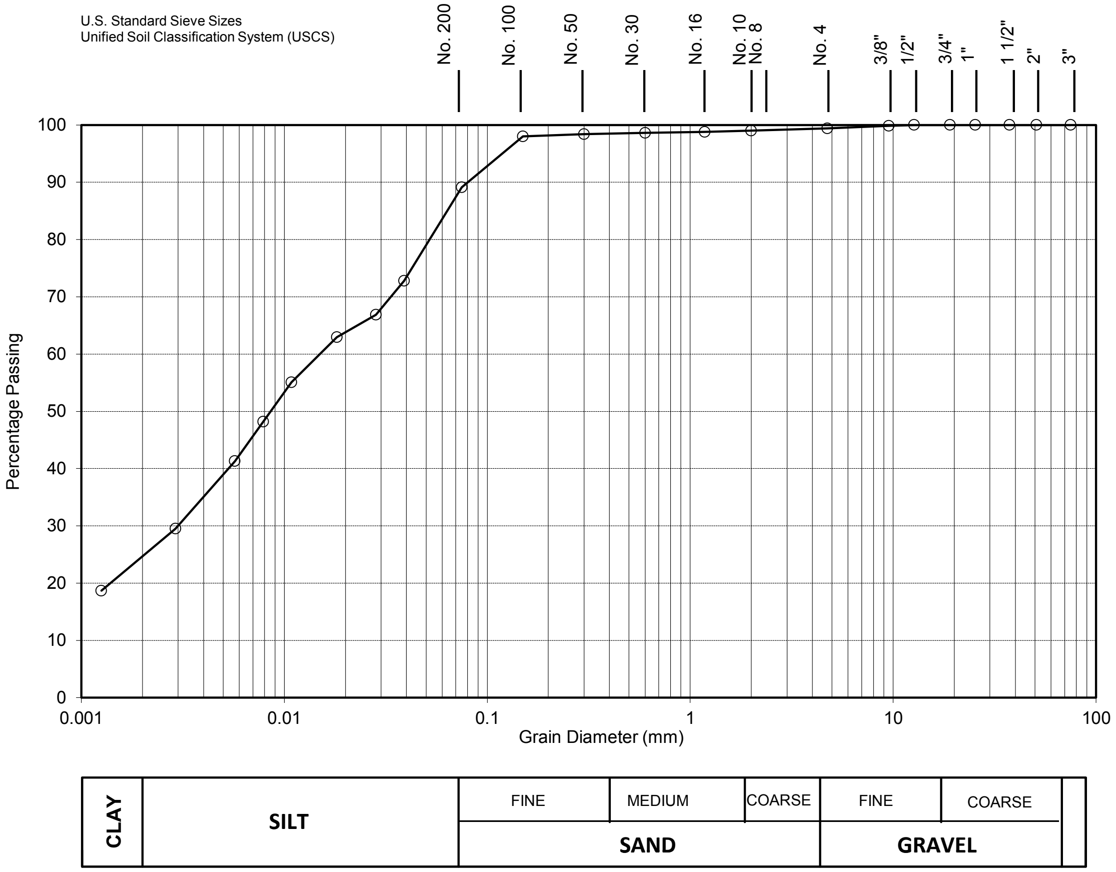
Lab No.:	**018-20**	Notes: Depth 2.5'			
Sample No.:	2				
Borehole No.:	13				
CLAY [%]:	**28**	Soil Description:	**Brown Clayey Silt w/ traces of Sand** **M.L. - Inorganic silts, clayey silts with slight plasticity**		
SILT [%]:	**68**				
SAND [%]:	**4**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mil/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0008**	Coefficient of Uniformity C_U:	**10.6**	Coefficient of Curvature C_C:	**0.7**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Glancaster Golf Course, Hamilton, Ontario

January 2020	**Grain Size Analysis No. 5**	**Project No.: SM 190739-T**

Mechanical & Hydrometer Analyses



Lab No.:	**025-20**	Notes: Depth 7.5'	
Sample No.:	4		
Borehole No.:	13		
CLAY [%]:	**25**	Soil Description:	**Brown Clayey Silt w/ some sand and traces of Gravel** **M.L. - Inorganic silts, clayey silts with slight plasticity**
SILT [%]:	**64**		
SAND [%]:	**10**		
GRAVEL [%]:	**1**	Estimated Infiltration Rate [mil/hr] : **< 10**	Estimated Permeability, k [cm/s] **10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0009**	Coefficient of Uniformity C_U: **17.8**	Coefficient of Curvature C_C: **0.6**

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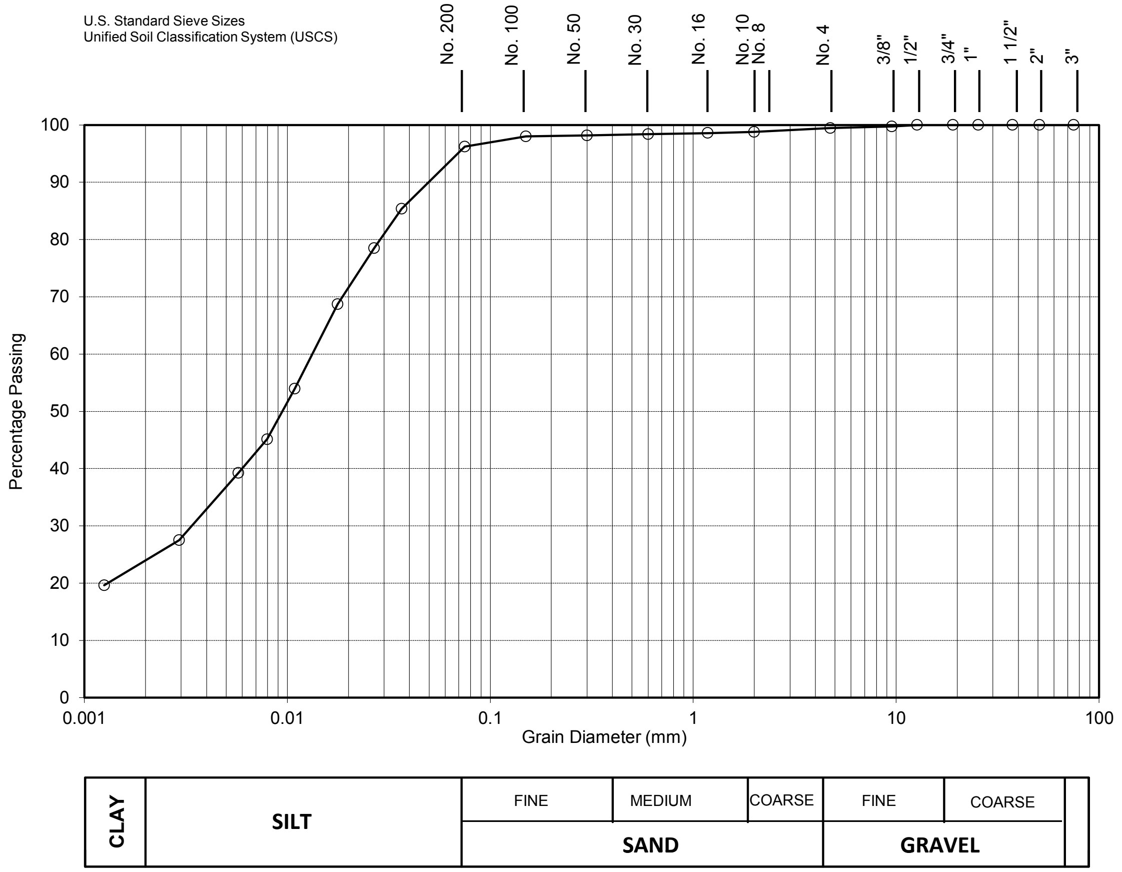
Glancaster Golf Course, Hamilton, Ontario

January 2020	**Grain Size Analysis No. 6**	**Project No.: SM 190739-T**

Mechanical & Hydrometer Analyses



Lab No.:	**019-20**	Notes: Depth 15'			
Sample No.:	6				
Borehole No.:	13				
CLAY [%]:	**23**	Soil Description:	**Brown Clayey Silt w/ traces of Sand** **M.L. - Inorganic silts, clayey silts with slight plasticity**		
SILT [%]:	**73**				
SAND [%]:	**4**				
GRAVEL [%]:	**0**	Estimated Infiltration Rate [mil/hr] :	**< 10**	Estimated Permeability, k [cm/s]	**10^{-7}**
D_{10} (Effective Diam. in mm):	**0.0008**	Coefficient of Uniformity C_U:	**17.5**	Coefficient of Curvature C_C:	**1.0**

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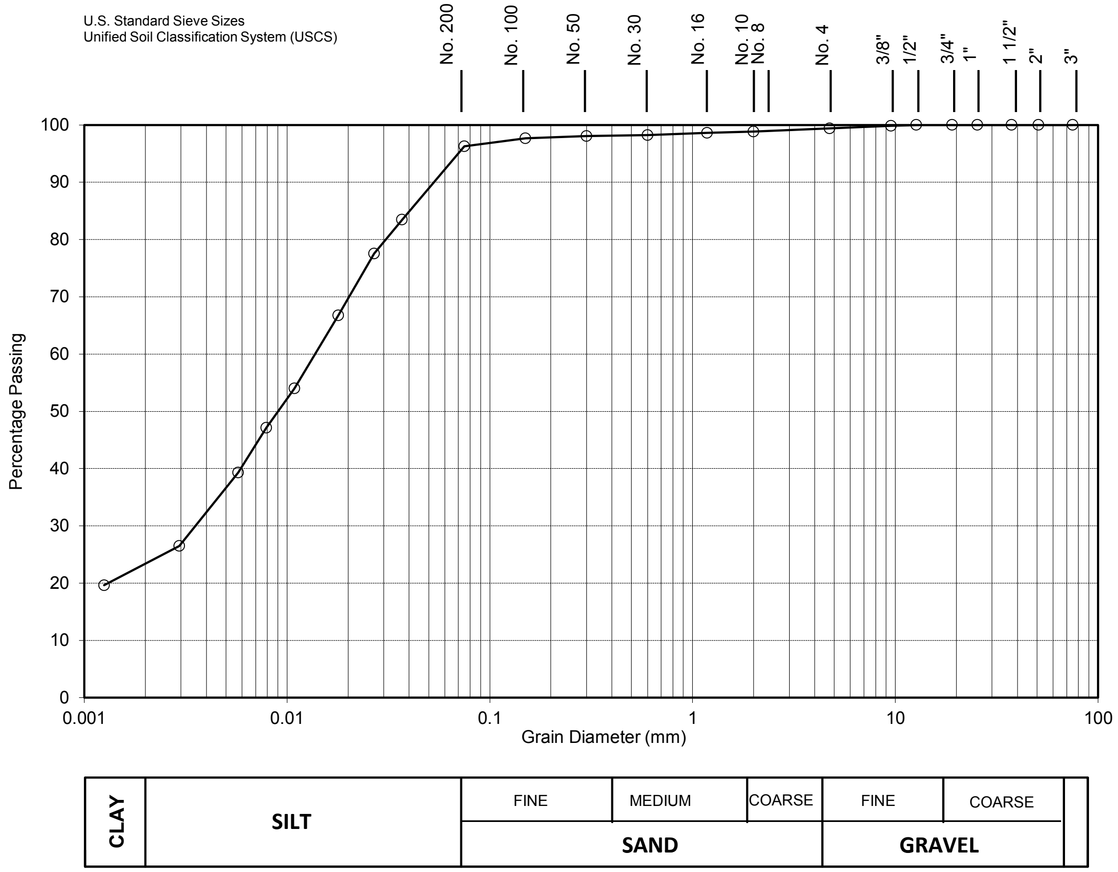
Glancaster Golf Course, Hamilton, Ontario

January 2020 | **Grain Size Analysis No. 7** | **Project No.: SM 190739-T**

Mechanical & Hydrometer Analyses



Lab No.:	023-20	Notes: Depth 15'			
Sample No.:	6				
Borehole No.:	14				
CLAY [%]:	23	Soil Description:	**Brown Clayey Silt w/ traces of Sand and Gravel** **M.L. - Inorganic silts, clayey silts with slight plasticity**		
SILT [%]:	73				
SAND [%]:	3				
GRAVEL [%]:	1	Estimated Infiltration Rate [mil/hr] :	< 10	Estimated Permeability, k [cm/s]	10^{-7}
D_{10} (Effective Diam. in mm):	0.0008	Coefficient of Uniformity C_U:	18.8	Coefficient of Curvature C_C:	1.1

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Glancaster Golf Course, Hamilton, Ontario

January 2020	**Grain Size Analysis No. 8**	**Project No.: SM 190739-T**