Revised Report on

Preliminary Geotechnical Investigation
Proposed Mixed-Use Development
1200 King Road
(King Road and Highway 403)
Burlington, Ontario

Prepared For:
Alinea Land Corporation

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DS CONSULTANTS LTD.
1290 Arvin Avenue, Unit 4
Stoney Creek, Ontario, L8E 0H7
Telephone: (905) 264-9393
www.dsconsultants.ca

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1. INTRODUCTION

DS Consultants Ltd (DS) was retained by Alinea Land Corporation (the Client) to undertake a preliminary geotechnical investigation for the proposed mixed-use development on the property located at 1200 King Road (King Road and Highway 403), Burlington, Ontario (the Site).

The site is currently vacant of any structures and the east parcel of the site is covered by grass with some trees, while the west parcel of the site is densely populated with trees (forested). The preliminary geotechnical investigation was intended to cover the entire site, however, due to the dense population of trees on the west parcel and associated inaccessibility of conventional drilling equipment, this investigation was limited to the east parcel of the site. **Additional building location specific boreholes with bedrock coring will be undertaken once the finalized site plan/detail design becomes available.**

It is understood that the proposed project will consist of a mixed-use development including a mix of mid-rise and high-rise blocks. Based on the preliminary design information provided to DS, it is further understood that buildings in the high-rise blocks may include structures with a maximum of about fifty-three (53) storeys, featuring up to three (3) levels of basement/underground parking structure. The project is in the very early conceptual design stage and design details such as proposed grades, depth/elevation of lowest basement floor, etc. were not available at the time of preparation of this report.

A previous geotechnical investigation which included the advancement of eight boreholes extending to depths ranging from 6.50 to 9.55 m was carried out on the site in January 2011 by Soil-Mat Engineers & Consultants Ltd. (Soil-Mat) and the findings were issued in their report titled “Preliminary Geotechnical Investigation, Proposed Stadium/Commercial Development, King Road and Highway 403, Burlington (Aldershot), Ontario”, dated January 24, 2011. The borehole location plan and Borehole logs from the previous investigation by Soil-Mat are attached in **Appendix A** of this report.

The purpose of this geotechnical investigation was to obtain the subsurface conditions at six (6) boreholes (BH24-7, BH24-8, BH24-13, BH24-14, BH24-16, and BH24-17) completed by DS and from the findings at the boreholes provide geotechnical recommendations for the following:

1. Foundations
2. Floor slabs and permanent drainage
3. Excavations and groundwater control
4. Temporary shoring
5. Earth pressures
6. Earthquake considerations

Due to the limited depth and limited number of boreholes, the geotechnical comments and recommendations in this report are preliminary. Additional deep boreholes with rock coring are required for the geotechnical design of the proposed buildings as the design progresses and the overall site becomes more accessible.

This report is provided on the basis of the terms of reference presented above and, on the assumption, that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations can cater to the changed design.

The Site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for Alinea Land Corporation and its architect and designers. Use of this report by third party without DS Consultants Ltd. consent is prohibited.

2. FIELD AND LABORATORY WORK

As noted earlier, eight boreholes (Borehole Nos. 1 to 8) were drilled on the site by Soil-Mat in 2011 as part of a previous geotechnical investigation of the site. The field work for this investigation by DS was carried out between February 13 and 22, 2024. A total of six (6) boreholes (BH24-7, BH24-8, BH24-13, BH24-14, BH24-16 to BH24-17, see **Drawing 1** for borehole locations) were drilled/cored to depths ranging from 8.7 to 16.8 m below existing grade. BH24-7, BH24-8, BH24-16 and BH24-17 (BH24-13 and BH24-14 were terminated at 9.7 and 8.7m, respectively) were drilled to bedrock surface with solid/hollow stem continuous flight auger/mud rotary equipment by a drilling sub-contractor under the direction and supervision of DS personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. Upon encountering the bedrock surface, shale bedrock was cored from a depth of 12.3 to 15.5 m in BH24-7, from a depth of 13.8 to 16.8 m in BH24-8, from a depth of 7.7 to 10.7 m in BH24-16 and from a depth of 11.3 to 13.9 m in BH24-17. The bedrock was cored with HQ-2 double tube wireline equipment providing 63 mm dia. rock core samples. The coring was carried out under the full-time supervision of a representative from DS who identified and described the rock samples, noting and recording the percentages of total and solid rock core recovery, RQD values, fracture index and the percentage and thicknesses of hard layers.

The samples were logged in the field and returned to the DS laboratory for detailed examination by the project engineer and for laboratory testing. In addition to visual examination in the laboratory, all the soil samples were tested for moisture contents and results are presented on the respective borehole

logs. Five (5) selected soil samples (BH24-7/SS9, BH24-8/SS5&SS8, BH24-16/SS4, and BH24-17/SS8) were tested for grain size analyses and the gradation curves for the grain size analyses are presented on **Drawing 9**. The five (5) selected soil sample were also subjected to Atterberg Limits testing and the results are provided on **Drawing 10**.

Groundwater level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Monitoring wells were installed in BH24-7, BH24-16, and BH24-17 to allow for groundwater level monitoring.

The geodetic ground surface elevations at the locations of the boreholes/monitoring wells were established by DS using differential GPS system. It should be noted that the elevations at the as-drilled borehole/well locations were not provided by a professional surveyor and should be considered to be approximate.

3. SITE AND SUBSURFACE CONDITIONS

The subject site is located at the southwest quadrant of King Road and Highway 403, Burlington, Ontario. The site is currently vacant of any structures and the east parcel of the site is grassed with some trees while the west parcel is densely populated with trees (forested).

The borehole location plan is shown on **Drawing 1**. General notes on sample description are provided on **Drawing 1A**. The subsurface conditions in the boreholes by DS (BH24-7, BH24-8, BH24-13, BH24-14, BH24-16, and BH24-17) are presented in the individual borehole logs presented on **Drawings 2 to 7**. Location plan and borehole logs (Borehole Nos. 1 to 8) drilled by Soil-Mat are attached in **Appendix A**.

3.1 Soil and Bedrock Conditions

DS' boreholes encountered deeper bedrock surface depths than noted in Soil-Mat's boreholes (refer to **Appendix A** for Soil-Mat's borehole logs). The soil and bedrock conditions encountered in DS' boreholes are summarized as follows:

Topsoil:

A surficial layer of topsoil, about 180 mm to 230 mm thick, was found in boreholes BH24-8, BH24-13, and BH24-17. It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site. Shallow hand-dug test-pits should be carried out to calculate the amount of topsoil at site accurately.

Fill/Possible Fill Materials:

Fill materials generally consisting of silty clay to clayey silt with inclusions of rootlets, trace brick pieces and slag-like and clay tile-like inclusions was encountered from the ground surface at BH24-7 and extended to a depth of 1.5 m below existing ground surface. At BH24-13, BH24-14 and BH24-16, fill materials consisting silty clay with inclusions of gravel and trace rootlets were encountered below the

surficial topsoil and extended to a depth ranging from 0.8 to 1.0 m below existing ground surface. At the ground surface in BH24-17, a layer of silty clay to clayey silt with trace rootlets, trace topsoil, black organic stains followed by reddish brown silty sand with trace rootlets were encountered and extended to a depth of 1.5 m below existing ground surface. These materials may be fill materials from former operations on the site.

The fill/possible fill materials were firm to very stiff/loose to compact, as indicated by measured SPT 'N' values ranging from 7 to 16 blows per 300 mm penetration.

Cohesionless Silty Sand to Sand and Gravel to Gravelly Sand Deposits:

In BH24-8, cohesionless deposits of silty sand extending to a depth of 0.8 m followed by sand and gravel/gravelly sand extending to a depth of 1.9 m below existing ground surface were encountered below the surficial topsoil layer. The wet deposits were present in a loose to compact state, with measured SPT 'N' values ranging from 7 to 29 blows per 300 mm of penetration. The moisture content of the cohesionless sand/sand and gravel deposits ranged from 11 to 19 %.

Silty Clay to Clayey Silt Deposits:

Cohesive silty clay to clayey silt deposits were encountered below the fill/possible fill in BH24-7, BH24-13, BH24-14, BH24-16, and BH24-17, and extended to depths ranging from 0.8 to 6.0 m below existing ground surface. Trace black organic alluvial material was observed in cohesive silty clay to clayey silt deposit at 4.8 m depth in BH24-7.

SPT 'N' values measured within the cohesive silty clay to clayey silt ranged from 8 to 42 blows per 300 mm of penetration, indicating stiff to hard consistency. The moisture content of the cohesive silty clay to clayey silt ranged from 11 to 33 %.

Silty Clay Till Deposit:

A glacial cohesive silty clay till deposit was encountered below the sand and gravel/gravelly sand in BH24-8, below the fill in BH24-13 and below the silty clay to clayey silt deposit in the remaining boreholes and extended to depths ranging from 7.7 to 10.7 m below existing ground surface, i.e., depth of investigation in BH24-13 and BH24-14. The deposits contained some sand to sandy, trace gravel and occasional trace weathered shale pieces and inclusions of cobbles and boulders.

SPT 'N' values measured within the cohesive silty clay to clayey silt till ranged from 6 to over 50 blows per 300 mm of penetration, indicating firm to hard consistency. The moisture content of the cohesive silty clay to clayey silt till ranged from 9 to 22 %.

Grain size analyses of five (5) silty clay till soil samples (BH24-7/SS9, BH24-8/SS5&SS8, BH24-14/SS4 and BH24-17/SS8) were conducted, and the results are presented on **Drawings 9**, with the following fractions:

Clay: 27 to 45%
Silt: 46 to 51%
Sand: 7 to 22%
Gravel: 2 to 6%

Atterberg limits tests of the five (5) silty clay till soil Samples (BH24-7/SS9, BH24-8/SS5&SS8, BH24-14/SS4 and BH24-17/SS8) were also conducted. The results are shown on the borehole logs and **Drawing 10** and are summarized as follows:

Liquid limit (WL): 27.4 to 38.5%
Plastic limit (WP): 12.4 to 15.1%
Plasticity index (PI): 15.0 to 23.4

Sandy Silt Till Deposit:

A cohesionless deposit of sandy silt till was encountered below the silty clay till in BH24-7 and BH24-8 and extended to a depth of 12.0 and 10.8 m below existing ground surface, respectively. Inclusions of weathered shale fragments and cobbles were noted in the sandy silt till deposit.

The sandy silt till deposit was generally present in a very dense state, as indicated with measured SPT 'N' values over 50 blows per 300 mm of penetration. The moisture content of the cohesionless sandy silt till ranged from 8 to 10 %.

Gravel and Boulders:

A zone of gravel and boulders with silty clay inclusions was encountered below/at the bottom of the silty clay till deposit and extended to a depth of 11.3 m below existing ground surface. This zone contacted significant resistance to auger and core penetration.

SPT 'N' value in the deposit was over 50 blows per 300 mm of penetration.

Till/Shale Complex:

Below the sandy silt till in BH24-7 and BH24-8 a till/shale complex with a thickness of approximately 1.5 and 2.8 m, respectively was found overlying shale bedrock. This deposit was found to have generally a hard consistency/very dense relative density, with measured SPT 'N' values of over 50 blows per 300 mm of penetration or less. This deposit consisted of clayey silt till or sandy silt till mixed with highly weathered shale.

Shale Bedrock:

Shale bedrock was found at approximate depths ranging from 7.7 to 13.6 m in BH24-7, BH24-8, BH24-16, and BH24-17, corresponding to elevations 90.8 to 101.0 m, as presented in **Table 1** below.

The bedrock surface elevations vary significantly across the site. We highly recommend that additional boreholes be carried out to further define the profile of the bedrock surface.

Table 1: Depth and Elevation of Shale Bedrock Surface at DS' Borehole Locations

Borehole No.	Borehole Elevation	Depth of Shale Bedrock Surface below Existing Ground (m)	Approximate Elevation of Shale Bedrock Surface (m)	Notes
BH24-7	113.3	12.3	101.0	Bedrock was cored from 12.3 to 15.5 m
BH24-8	104.4	13.6	90.8	Bedrock was a cored from 13.8 to 16.8 m
BH24-16	104.5	7.7	96.8	Bedrock was a cored from 7.7 to 10.7 m
BH24-17	103.8	11.3	92.5	Bedrock was a cored from 11.3 to 13.9 m

As noted in Soil-Mat's report, the surface of the bedrock encountered at their borehole locations (Boreholes 1, 2 and 5) ranged from 7.5 to 8.8 m below the existing ground surface, (ground surface elevations taken at Soil-Mat's boreholes was referenced to a temporary benchmark as such, their corresponding elevations are not geodetic).

Because of the method of drilling and sampling, the surface elevations of the bedrock can be different than indicated on the borehole logs. With augering, the auger may penetrate some of the more weathered shale and the coring may therefore begin below the bedrock surface. Commonly the overburden overlying the shale contains slabs of limestone which would give a false indication of the bedrock level. Similarly, the depth of weathering cannot be determined accurately due to the presence of limestone layers.

Shale bedrock was cored at four (4) borehole locations (BH24-7, BH24-8, BH24-16, and BH24-17). General comments on shale bedrock in the Greater Toronto Area are presented in **Appendix B**. Photographs of recovered bedrock cores are also presented in **Appendix B.**

Total Core Recovery (TCR):

The total core recovery indicates the total length of rock core recovered, expressed as a percentage of the actual length of the core run. The total core recovery in the corehole ranged from 0 to 100 %. However, it should be noted that 0 to 16 % recovery was from a fractured/weathered zones (Run 2, 3) between 13.0 and 13.7 m depth in BH24-7 and Run 1 between 11.6 and 12.4 depth in BH24-17, otherwise TCR was generally greater than ranged from 20 %.

Solid Core Recovery (SCR):

The solid core recovery is the total length of solid, full diameter rock core that was recovered, expressed as a percentage of the length of the core run. Solid core recovery ranged from 0 to 98 % and was generally consistent for the depths cored in BH24-8 and BH24-16. The SCR was very poor in Runs 1 to 3

in BH24-7 (0%) and Run 1 in BH24-17 (16%). The SCR index was generally influenced by the orientations of the fractures. SCR was low when fractures oblique to the borehole axis were intercepted.

Rock Quality Designation (RQD):

The rock quality designation index is obtained by measuring the total length of recovered rock core pieces which are longer than 100 mm and expressing their sum total length as a percentage of the length of the core run. RQD is a function of the frequency of joints, bedding plane partings and fractures in the rock cores. While the use of double tube core barrels provided reasonably good protection of the core during drilling and core retrieval, the fissile nature of the shale greatly influences the RQD values of the rock cores. Consequently, it is believed that the RQD values recorded underestimate the rock quality classification of the laminated fissile shale. The recorded RQD values in the cores ranged from 0 to 98 percent. RQD

Hard Layers:

Based on the visual examination of the rock cores, an attempt was made to identify and record the thickness and percentages of the relatively harder siltstone and limestone layers. The percentage of the "hard layers" per core run ranges between nil and 28 %. The thickness of these layers varied but was generally less than 250 mm, however, thicker layers to be as much as 750 to 900 mm have been observed at other sites in GTA. The layers are actually lenses and they can vary significantly in thickness over short distance. Encountering such thick layers should be anticipated. It is also common to encounter closely spaced groupings of thin strong limestone/siltstone layers which individually may only be 25 to 50 mm thick but collectively can be 1 m in thickness.

Methane Gas:

Methane gas is expected in the bedrock as indicated in **Appendix B**. Appropriate care and monitoring is essential in all confined bedrock excavations.

3.2 Groundwater Conditions

Monitoring wells were installed in boreholes (BH24-7, BH24-16, and BH24-17) for the long-term groundwater table monitoring. Stabilized groundwater was found in monitoring wells on March 5, 2024, at depths ranging from 0.9 to 2.3 m, corresponding to Elev. 101.6 to 111.0 m, as listed on **Table 2**:

Table 2: Groundwater Levels Observed in Monitoring Wells

Monitoring Well No.	Ground Surface Elevation or Top of Bsmt Finished Floor (m)	Date of Observation	Groundwater Depth (m)	Elevation of Groundwater (m)
BH24-7	113.3	March 5, 2024	2.3	111.0
BH24-16	104.5	March 5, 2024	0.9	103.6
BH24-17	103.8	March 5, 2024	2.2	101.6

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

A hydrogeology study is recommended to further explore the extent and the conditions of the groundwater, as well as recommended groundwater control.

Further groundwater monitoring should be carried out to confirm the groundwater conditions.

4. FOUNDATIONS

It is understood that the proposed project will consist of a mixed-use development including a mix of mid-rise and high-rise blocks. Based on the preliminary design information provided to DS, it is further understood that buildings in the high-rise blocks may include structures with a maximum of about fifty-three (53) storeys, featuring up to three (3) levels of basement/underground parking structure. The project is in the very early conceptual design stage and design details such as proposed grades, depth/elevation of lowest basement floor, etc. were not available at the time of preparation of this report. **Additional building location specific boreholes with bedrock coring will be undertaken once the finalized site plan/detail design becomes available.**

The measured groundwater levels on March, 202, in the monitoring wells were at depths ranging from 0.9 to 2.3 m, corresponding to Elev. 101.6 to 111.0 m. As such it is expected that the P1, P2 or P3 basement floor will be below the groundwater level.

Based on the boreholes, the overburden soils on the site had inconsistent bearing resistance, therefore the proposed building can best be supported on bedrock by footings/raft foundations together with drilled caissons.

It should be noted that conventional footings/raft foundations and drilled caissons are standard foundation support systems/construction methods for buildings of this scale.

4.1 Footings and Raft Foundations

Based on the information from boreholes (BH24-7, BH24-8, BH24-13, BH24-14, BH24-16 and BH24-17), footings/raft foundations founded below any fill, possible fill or disturbed materials on the natural undisturbed silty clay to clayey and silty clay/sandy silt (till), till-shale complex and shale bedrock can be designed for bearing capacity of 100 to 5000 kPa at SLS (Serviceability Limit States), and for a factored geotechnical resistance of 150 to 7500 kPa at ULS (Ultimate Limit States).

The bearing values and the corresponding founding elevations of the native soils and bedrock at the borehole locations are summarized in **Table 3**.

Table 3: Bearing Values and Founding Levels of Spread Footings/Raft Foundations

Borehole No.	Founding Soils	Ground Surface Elevation (m)	Bearing Capacity at SLS (kPa)	Bearing Capacity at ULS (kPa)	Minimum Depth below Existing Basement floor (m)	Founding Level at or Below Elevation (m)
BH24-7	Clayey Silt to Silty Clay	113.32	250	375	6.3	107.0
	Sandy Silt Till		500	750	10.8	102.5
	Weathered Shale		2500	3500	12.6	100.7
	Sound Shale		5000	7500	14.2	99.1
BH24-8	Silty Clay Till	104.4	150	225	2.2	102.2
	Sandy Silt Till		500	750	9.5	90.5
	Weathered Shale		2500	3500	13.9	107.1
	Sound Shale		5000	7500	15.5	88.9
BH24-13	Clayey Silt to Silty Clay	103.5	100	150	1.3	102.2
	Silty Clay Till		200	300	7.0	96.5
BH24-14	Silty Clay Till	105.5	150	225	0.8	104.7
			200	350	1.2	102.3
BH24-16	Silty Clay	104.5	200	350	1.3	103.2
	Silty Clay Till		500	750	6.0	98.5
	Weathered Shale		2500	3500	8.0	96.5
	Sound Shale		5000	7500	10.8	93.7
BH24-17	Clayey Silt to Silty Clay	103.8	200	350	1.8	102.0
	Silty Clay Till		500	750	8.5	95.3
	Weathered Shale		2500	3500	11.6	92.2
	Sound Shale		5000	7500	12.8	91.0

It should also be noted that a black organic alluvial material was encountered at 4.8 m depth in BH24-7, as such, footings should be founded below this layer.

4.2 Drilled Caissons in Bedrock

Depending on the depths of the bedrock surface relative to the lowest (P1, P2 or P3) FFE, excavations for conventional footings may not be practical. As such, in those cases consideration can be given to founding the building on drilled caissons installed into sound shale bedrock.

For compression capacity of the caissons in sound bedrock, the bearing capacity can consist of end bearing capacity and skin friction bearing capacity.

The end bearing capacity for the caissons in sound bedrock at minimum 1.5 m below the bedrock surface can be designed for 5.0 MPa at SLS and 7.0 MPa at ULS.

The skin friction bearing capacity can be calculated using skin friction values of 0.45 MPa at SLS and 0.63 MPa at ULS between caisson shaft and sound bedrock. Sound bedrock is considered to be 1.5 m below bedrock surface. The skin friction in the top 1.5 m weathered bedrock and in the soils must be ignored. The skin friction capacity will increase with the caisson socket depth in bedrock. The total bearing capacity (skin friction + end bearing) of the caissons should not exceed 12 MPa at SLS and 17 MPa at ULS.

Due to the presence of hard limestone/siltstone layers in the bedrock, bedrock coring will be required for the installation of the caissons. Considerations/allowances must also be put into the excavation contract for the removal of boulders and cobbles from the till soils.

For closely spaced caissons, group effect should be considered on the skin friction bearing capacity, using a reduction factor (Beta), Beta = 0.5 + 0.5*X/(2.5B). In the equation, X represents the centre-to-centre distance between adjacent caissons, and B is the diameter of the caissons. If the centre-to-centre distance between the adjacent caissons is equal to or greater than 2.5 times its diameter (2.5B), the group effect on skin friction bearing capacity can be ignored. Group effect on end bearing capacity of caissons can be ignored.

The presence of groundwater table in the overburden soils overlying the shale bedrock will make the construction of the caissons difficult. An oversize liner will be required and must be sealed in the underlying bedrock. Sealing of the liner will be difficult where limestone layers are present at the surface above the shale and coring of the limestone layer will be required to advance the casing. All caisson holes and bases must be inspected by this office on full time basis to ensure that the caisson bases are founded on sound bedrock and free from mud and loose/disturbed materials. The side of the caisson holes in bedrock must be clean and free from mud and other unsuitable materials to ensure that the design skin friction between the bedrock and the caisson concrete can be achieved. The caisson holes and bases can be inspected by down-hole camera. Tremie method will be required if the concrete is poured below water.

4.3 General Notes on Foundations

Raft foundations/footings and Drilled caissons designed to the specified bearing capacity values at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

Positive dewatering will be required for the installation of footings/raft foundations below the groundwater table. The groundwater table must be lowered to at least 1.0 m below the excavation base.

All foundations must be inspected by this office. The excavated footing/raft bases must be covered with 50 mm thick mud slab immediately after inspection and cleaning, in order to avoid disturbance of the founding soil due to weathering and construction activity.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

All foundations exposed to seasonal freezing conditions must have at least 1.2 m of soil cover for frost protection.

It should be noted that the recommended bearing capacities have been calculated by DS Consultants Ltd. from the borehole information for the preliminary design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by DS Consultants Ltd. to validate the information for use during the construction stage.

5. FLOOR SLAB AND PERMANENT DRAINAGE

For basement floor below the groundwater table, feasibility of installing underfloor and perimeter drainage must be evaluated in a hydrogeological study, to estimate the seepage rates into the drainage systems.

The basement floor slab can be supported on grade provided all fill and surficially loose/softened soils are removed and the base thoroughly proof rolled. The fill required to raise the grade can consist of inorganic soil, placed in shallow lifts, and compacted to 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

A moisture barrier consisting of at least 200 mm of 19 mm clear crushed stone should be installed under the floor slab. A perimeter and underfloor drainage system will be required. Typical drainage and backfill recommendations are illustrated on **Drawings 11** and **12** for shored excavation system and **Drawing 13** for open cut excavation.

The exposed subgrade will consist of cohesionless silty and sandy soils below the water table; all openings including the subgrade must be covered or wrapped with filter fabric, typically a Class II non-woven textile with a filtration opening size (F.O.S.) of 50 to 100 µm. Above the filter fabric, we recommend that 60 mm thick concrete sand be placed to prevent the loss of silt fines through the filter fabric. It is imperative that both the filter fabric and concrete sand are placed on the subgrade.

6. FROST PROTECTION

All footings exposed to seasonal freezing conditions must have at least 1.2 metres of soil cover for frost protection.

There is no official rule governing the required founding depth for footings below unheated basement floors. Certainly, it will not be greater than the 1.2 m required in Southern Ontario for exterior footings. Un-monitored experience indicates that a shallower depth ranging from 0.82 to 0.9 m for interior column footings and 0.4 m for wall footings has been successful where 2 or more basement levels apply. The 0.82 m depth is believed to be close to the minimum structural requirement for interior column footings. Adjacent to air shafts and entrance and exit doors, a footing depth of 1.2 m below floor level is required or, alternatively, insulation protection must be provided.

It is also emphasized that underfloor drainage (if possible) and/or an adequate free draining gravel base is required to minimize the risk of floor dampness. Floor dampness could lead to temporary icing and the risk of accidents.

7. EARTH, ROCK, AND WATER PRESSURES

The design of basement walls can incorporate the conventional design in the overburden using the earth pressure coefficient K_1=0.40. In the bedrock, the earth pressure coefficient K can be reduced to K_2=0.25.

The lateral earth/rock pressure acting at any depth on basement walls can be calculated as follows:

In soil: $p = K_1 (\gamma_1 h_1 + q) + p_w$

In rock: $p = K_2 (\gamma_1 H_1 + q + \gamma_2 h_2) + p_w$

where p = lateral earth and water pressure in kPa acting at depth h_1 or h_2

K_1, K_2 = earth pressure coefficients, K_1=0.40 for overburden soil; K_2=0.25 for bedrock

γ_1 = unit weight of overburden soil, assuming 21 kN/m^3 above the water table and 11 kN/m^3 below the water table

γ_2 = unit weight of rock below water, assuming 13 kN/m^3

h_1 = Depth in overburden soil, below ground surface

H_1 = thickness of soil above rock

h_2 = Depth in rock, below rock surface

q = value of surcharge in kPa

p_w = hydrostatic water pressure.

When the foundation wall is poured against the caisson wall, the foundation wall as well as the caisson wall should be designed for hydrostatic pressure, even though a drainage board is provided between the basement wall and the caisson wall.

8. EXCAVATION AND GROUNDWATER CONTROL

Excavation of the overburden will be relatively straightforward; however, obstructions and boulder should be expected. Excavation of the shale can be carried out using the heaviest available single tooth ripper equipment. The limestone beds are frequent and may overlay the shale bedrock surface at some locations. It will be necessary to utilize jackhammer type equipment to "open" the limestone layers for the ripper.

The groundwater level measured in the installed monitoring wells was found at depths ranging from 0.9 to 2.3 m below existing grade, corresponding to Elev. 101.6 to 111.0 m. Dewatering will be required prior to any excavations below the groundwater table. Groundwater is expected in shale bedrock through the fractures which will also require dewatering, should excavations penetrate the bedrock.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the fill, possible fill materials, firm to stiff clayey silt to silty clay and silty clay till deposit and any sandy silt till soils can be classified as Type 3 Soil above the groundwater table and Type 4 Soil below groundwater table. The very stiff to hard silty clay till can be classified as Type 2 Soil above the groundwater table and Type 3 Soil below the groundwater table.

It should be noted that the till is a non-sorted sediment and therefore may contain boulders. Provisions must be made in the excavation contract for the removal of possible boulders in the till or obstructions in the fill material.

The select inorganic fill and native soils can be re-used as general construction backfill, provided its water content is within two percent of its optimum water content. Loose lifts of soil, which are to be compacted, should not exceed 200 mm.

Imported granular fill, which can be compacted with hand held equipment, should be used in confined areas. Underfloor fill should be compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill should be used.

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface or be covered with tarpaulins to minimize moisture uptake.

9. TEMPORARY SHORING

The proposed excavations may be supported by a temporary shoring system consisting of timber lagging and soldier piles. A tightly braced caisson wall may be required to support adjacent structures. The requirement for caisson walls to support adjacent structures is given on **Drawing 14.**

The shoring system must be designed in accordance with the 4th Edition of the Canadian Foundation Engineering Manual. The surcharge loading from adjacent structures must be considered. The soil parameters estimated to be applicable for this design are as follows:

1) Earth Pressure Coefficient for shoring:

   (a) where movement must be minimal K=0.45

   (b) where minor movement (.002H) can be tolerated K=0.32

   (c) passive earth pressure for soldier piles (unfactored) Kp=3.0 for compact to dense/very stiff to hard soils, Kp=4.0 for weathered shale and Kp= 5.0 for sound shale

2) For stability check

   $\phi = 30°$

   C = 0

   $\gamma = 21$ kN/m^3

   surcharge is to be determined by shoring contractor.

3) For rock anchors

   An allowable bond stress of 250 kPa for weathered shale bedrock, and 500 kPa for sound shale bedrock can be used for the design of anchors.

Allowable bond value of 50 to 75 kPa for the stiff to hard and compact to very dense soils are suggested for post-grouted anchors.

However, the suggested bond values are preliminary since the contractor's installation methods and grouting procedures will determine the actual soil to concrete bond value. Hence, the contractor must decide on a capacity and confirm its availability by field load testing. Gravity poured concrete can result in low bond values while pressure grouted anchors will give higher values and produce a more satisfactory anchor. All anchors must be tested as indicated in the Foundation Manual, 4th edition.

Casing will be required during the construction of the tiebacks to prevent caving of soils. The soldier piles should be installed in pre-augered holes taken below the deepest excavation. The holes should be filled with concrete below the excavation level and half bag mix above the base of the excavation. The

concrete strength must be specified by the shoring designer. Temporary liners may be required to help prevent the sand from caving during the installation period.

Positive measures may be required to prevent the loss of soil through the spaces between the lagging boards. This could probably be achieved by placing well-graded sand and gravel behind the lagging boards or by installing a geotextile filter cloth. Soil anchors will be required to support the shoring. The anchors must be of a length that meets the Canadian Foundation Manual recommendations.

It is important to note that the minimum length lies beyond the (45 - ϕ/2 + .15H) line drawn from the base of the soldier pile and the overall stability of the system must be checked at each anchor level, where ϕ is the soil friction angle and H is the shoring height.

The top anchor must not be placed lower than 3.0 metres below the top of level ground surface. Anchors will require casing when penetrating through wet sand and silt layers.

The contractor must decide the anchor capacity and confirm its availability. All anchors must be tested as indicated in the Canadian Foundation Engineering Manual, 4th edition.

Adhesion on the buried caisson shaft or behind the shoring system must be neglected when designing this shoring system.

Movement of the shoring system is inevitable. Vertical movements will result from the vertical load on the soldier piles resulting from the inclined tiebacks and inward horizontal movement results from earth and water pressures. The magnitude of this movement can be controlled by sound construction practices, and it is anticipated that the horizontal movement will be in the range of 0.1 to 0.25% of the shoring height (H). Vertical movements increase the horizontal movements because of the reduced stress in the inclined anchors and must be kept well below this value.

To ensure that movements of the shoring are within an acceptable range, monitoring must be carried out. Vertical and horizontal targets on the soldier piles must be located and surveyed before excavation begins.

Weekly readings during excavation should show that the movements will be within those predicted; if not, the monitoring results will enable directions to be given to improve the shoring.

10. EARTHQUAKE CONSIDERATIONS

Based on the existing borehole information and according to Table 4.1.8.4.A of OBC 2012, the subject Site for the proposed development with up to 3 levels of basement/underground parking can be classified as “Class C” for seismic site response. For any building with P3 basement floor below bedrock surface, seismic “Class B” may be available provided additional boreholes and field shear wave velocity measurements are to be carried out to confirm the “Class B” classification.

11. GENERAL COMMENTS AND LIMITATIONS OF REPORT

DS Consultants Ltd. (DS) should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, DS will assume no responsibility for interpretation of the recommendations in the report. The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to DS at the time of preparation. Unless otherwise agreed in writing by DS, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the Site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

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. DS 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 accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

DS CONSULTANTS LTD



Osbert (Ozzie) Benjamin, P.Eng.
Senior Geotechnical Engineer



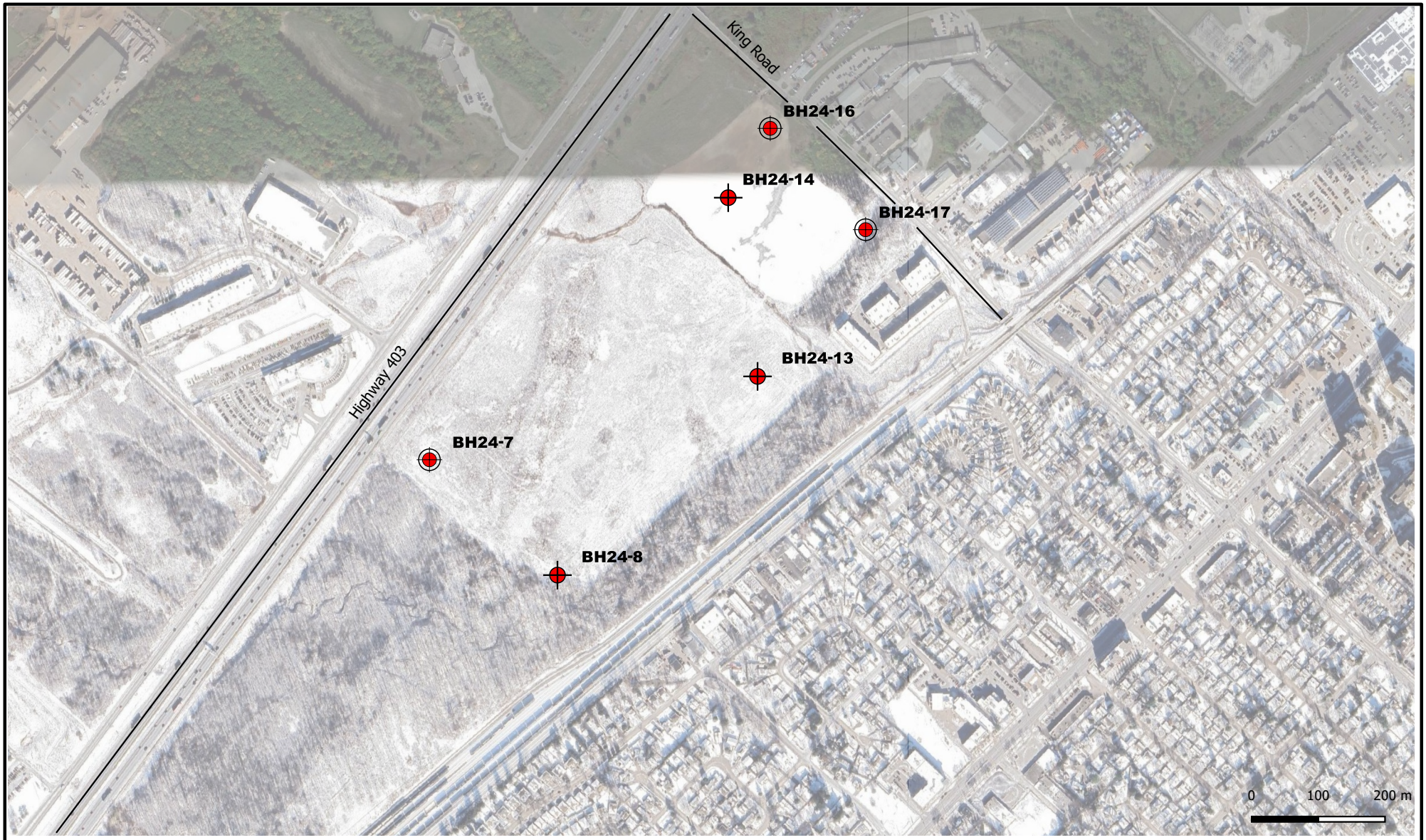
Fanyu Zhu, Ph.D., P.Eng.
Principal Engineer



Shabbir Bandukwala, M.Eng., P.Eng.
Principal Engineer

Drawings

J:\2023 Projects\23-487-602 Geo - 1200 King Road, Burlington, ON\Geotechnical\QGIS\1-QGIS\Figure 1 Borehole Location Plan.qgs Mar-08 10:59



Legend

- Borehole
- Monitoring Well

DS CONSULTANTS LTD.
6221 Highway 7, UNIT 16
Vaughan, Ontario L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

Client: ALINEA LAND CORPORATION

Project: PRELIMINARY GEOTECHNICAL INVESTIGATION
1200 King Road, Burlington, ON

Title: **BOREHOLE LOCATION PLAN**

N

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	O.B	K.T	March 2024
Rev: 0	Scale: As Shown	Project No.: 23-487-602	Figure No.: 1

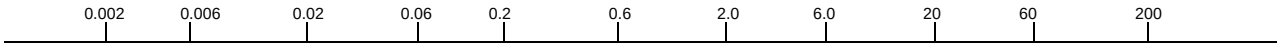
Image/Map Source: *Google Satellite Image*

Drawing 1A: Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by DS also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

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LOG OF BOREHOLE BH24-7

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797296.61 E 593460

DRILLING DATA
Method: Hollow Stem Auger/Mud Rotary
Diameter: 200mm
Date: Feb-22-2024

REF. NO.: 23-487-602
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
113.3							
0.0	**FILL:** silty clay to clayey silt, trace rootlets, trace brick pieces, reddish brown, moist, stiff trace slag-like & clay tile like pieces at 0.15m		1	SS	8		113
			2	SS	9		112
111.8							
1.5	**CLAYEY SILT TO SILTY CLAY:** trace sand, trace gravel, reddish brown, moist, stiff		3	SS	10		
			4	SS	8	▽	111
			5	SS	10		110
	trace black organic alluvial material at 4.8m		6	SS	10		109
107.3							108
6.0	**SILTY CLAY TILL:** trace to some sand, trace gravel, trace cobble/boulders, grey, moist, very stiff to hard		7	SS	23		107
			8	SS	37		106
							105

W. L. 111.0 m
Mar 05, 2024

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH24-7

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797296.61 E 593460

DRILLING DATA
Method: Hollow Stem Auger/Mud Rotary
Diameter: 200mm
Date: Feb-22-2024

REF. NO.: 23-487-602
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY CLAY TILL: trace to some sand, trace gravel, trace cobble/boulders, grey, moist, very stiff to hard(Continued)	9	SS	20	104	6 16 51 27
10					103	
102.8						
10.5	**SANDY SILT TILL:** trace clay, trace gravel, trace cobble fragment, reddish brown, moist, very dense	10	SS	50/ 50mm		
11					102	
101.3						
12.0	**CLAYEY SILT TILL/SHALE COMPLEX:** trace sand, trace weathered shale pieces, trace gravel, reddish brown, moist, hard	11	SS	50/ 100mm	101	
101.0						
12.3		R1	RC			
100.7	**SHALE BEDROCK:** Queenstion Formation, reddish brown, weathered	R2	RC			
12.6						
13 100.3	Limestone zone					
13.0	TCR=100%, SCR=50%, RQD=0% Hard layers=100%, Maximum hard layer thickness=250mm	R3	RC		100	
	TCR=0%, SCR=0%, RQD=0% Hard layers=0%, Maximum hard layer thickness=0mm	R4	RC			
99.7						
99.6						
13.7	no recovery	R5	RC			
14	TCR=0%, SCR=0%, RQD=0% Hard layers=25%, Maximum hard layer thickness=0mm					
99.1					99	
14.2	weathered shale with fractured limestone zone	R6	RC			
	TCR=100%, SCR=75%, RQD=0% Hard layers=0%, Maximum hard layer thickness=0mm					
15	TCR=23%, SCR=23%, RQD=0% Hard layers=28%, Maximum hard layer thickness=100mm (Limestone zone)					
97.8	TCR=100%, SCR=98%, RQD=82%				98	
15.5	Hard layers=2%, Maximum hard layer thickness=25mm					
	END OF BOREHOLE:					
	Notes: 1) 50mm dia. monitoring well installed upon completion. 2) Water Level Readings: Date: Water Level(mbgl): Mar. 5, 2024 2.3					

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)
SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ε=3% Strain at Failure

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LOG OF BOREHOLE BH24-8

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797123.47 E 593652.88

DRILLING DATA
Method: Hollow Stem Auger/Mud Rotary
Diameter: 200mm
Date: Feb-14-2024

REF. NO.: 23-487-602
ENCL NO.: 3

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	ELEVATION
104.4 / 0.0	**TOPSOIL:** 200mm				104
104.2 / 0.2	**SILTY SAND:** trace clay, trace gravel, reddish brown, wet, loose	1	SS	7	
103.6 / 0.8	**SAND AND GRAVEL TO GRAVELLY SAND:** trace silt, trace clay, brown to reddish brown, wet, compact	2	SS	29	103
102.5 / 1.9	**SILTY CLAY TILL:** some sand, trace gravel, brown to grey, moist, stiff to hard trace weathered shale fragments at 2.3m grey below 2.6m	3	SS	14	
		4	SS	22	102
		5	SS	32	101
		6	SS	12	100
		7	SS	15	99
		8	SS	27	98
95.2 / 9.2	**SANDY SILT TILL:** some clay, trace gravel, trace shale fragments, reddish brown, moist, very dense	9	SS	50/75mm	97
93.6 / 10.8	**SANDY SILT TILL/SHALE COMPLEX:** some clay, frequent weathred shale fragments, reddish brown, moist, very dense	10	SS	50/75mm	96
					95
					94
					93

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	2	10	46	42
	3	19	49	29

GROUND WATER CONDITIONS

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG-2021-FINAL 23-487-602.GPJ DS.GDT 24-3-12

LOG OF BOREHOLE BH24-8

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797123.47 E 593652.88

DRILLING DATA
Method: Hollow Stem Auger/Mud Rotary
Diameter: 200mm
Date: Feb-14-2024

REF. NO.: 23-487-602
ENCL NO.: 3

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
	SANDY SILT TILL/SHALE COMPLEX: some clay, frequent weathred shale fragments, reddish brown, moist, very dense(Continued)		11	SS	100/ 130mm		92
90.8							91
90.6	**SHALE BEDROCK:** Queenston Formation, reddish brown, weathered		12	SS	100/ 75mm		
13.8	TCR=100%, SCR=100%, RQD=93% Hard layers=20%, Maximum hard layer thickness=50mm		R1	RC			90
89.1							
15.3	TCR=100%, SCR=98%, RQD=98% Hard layers=15%, Maximum hard layer thickness=50mm		R2	RC			89
87.6							88
16.8	**END OF BOREHOLE:**						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

DS SOIL LOG-2021-FINAL 23-487-602.GPJ DS.GDT 24-3-12

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

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LOG OF BOREHOLE BH24-13

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797421.13 E 593952.02

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Feb-13-2024

REF. NO.: 23-487-602
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
103.5 / 0.0	**TOPSOIL:** 230mm						
103.2 / 0.2	**FILL:** silty clay, trace rootlets, trace gravel, reddish brown, moist, very stiff		1	SS	15		103
102.5 / 1.0	**CLAYEY SILT TO SILTY CLAY:** some sand, trace gravel, reddish brown, moist, very stiff silty sand lenses at 1.5m		2	SS	15		102
			3	SS	22		
101.2 / 2.3	**SILTY CLAY TILL:** some sand, trace gravel, grey, moist, firm to hard		4	SS	22		101
			5	SS	14		100
			6	SS	6		99
			7	SS	10		98
			8	SS	47		97
			9	SS	15		96
93.8 / 9.7	**END OF BOREHOLE:** Notes: 1) Borehole wet at bottom on completion of drilling.						95
							94

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG-2021-FINAL 23-487-602.GPJ DS.GDT 24-3-12

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Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH24-14

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797689.31 E 593908.31

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Feb-13-2024

REF. NO.: 23-487-602
ENCL NO.: 5

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
105.5 / 0.0	**TOPSOIL:** 180mm				
105.3 / 0.2	**FILL:** silty clay, trace rootlets, trace sand, reddish brown, moist, stiff	1	SS	11	105
104.7 / 0.8	**SILTY CLAY TILL:** some sand, trace gravel, reddish brown to grey, moist, very stiff to hard weathered shale fragments at 1.5m	2	SS	16	
		3	SS	19	104
	grey below 2.3m	4	SS	18	103
		5	SS	20	102
		6	SS	15	101
		7	SS	43	100
		8	SS	50/ 50mm	99
96.8 / 8.7	weathered shale inclusions at 8.5m	9	SS	50/ 25mm	98
	END OF BOREHOLE: Notes: 1) Borehole wet at bottom on completion of drilling.				97

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%) — GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ε=3% Strain at Failure

DS SOIL LOG-2021-FINAL 23-487-602.GPJ DS.GDT 24-3-12

DS CONSULTANTS LTD.
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH24-16

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797793.95 E 593971.77

DRILLING DATA
Method: Hollow Stem Auger/Mud Rotary
Diameter: 200mm
Date: Feb-15-2024

REF. NO.: 23-487-602
ENCL NO.: 6

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
104.5												
104.3 0.2	**TOPSOIL:** 200mm											
	FILL: silty clay, trace rootlets, trace gravel, reddish brown and grey, moist, stiff to very stiff		1	SS	12		104					
103.5 1.0	**SILTY CLAY:** trace sand, trace gravel, reddish brown to grey, moist, very stiff to hard		2	SS	16	▽	103	W. L. 103.6 m Mar 05, 2024				
2	grey below 1.8m		3	SS	42		102					2 7 46 45
3			4	SS	17							
100.0 4.5	**SILTY CLAY TILL:** trace sand, trace gravel, trace cobble fragments, grey, moist, very stiff to hard		5	SS	17		101					
4			6	SS	29		100					
5							99					
6			7	SS	50/ 75mm		98					
96.8 7.7			8	SS	50/ 100mm		97					
7	**SHALE BEDROCK:** Queenston Formation, reddish brown, weathered TCR=100%, SCR=92%, RQD=58% Hard layers=15%, Maximum hard layer thickness=50mm		R1	RC			96					
8												
95.3 9.2	TCR=98%, SCR=83%, RQD=57% Hard layers=17%, Maximum hard layer thickness=75mm		R2	RC			95					
9												
93.8 10.7	**END OF BOREHOLE:** Notes: 1) 50mm dia. monitoring well installed upon completion. 2) Water Level Readings: Date: Water Level(mbgl): Mar. 5, 2024 0.9						94					
10												

DS SOIL LOG-2021-FINAL 23-487-602.GPJ DS.GDT 24-3-12

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

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LOG OF BOREHOLE BH24-17

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797641.88 E 594114.42

DRILLING DATA
Method: Solid Stem/Mud Rotary
Diameter: 150mm
Date: Feb-17-2024

REF. NO.: 23-487-602
ENCL NO.: 7

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	ELEVATION
103.8					
0.0 / 102.9	**POSSIBLE FILL:** silty clay to clayey silt, trace rootlets, trace topsoil, black organic stain, reddish brown, moist, firm	1	SS	7	103
0.9 / 102.3	**POSSIBLE FILL:** silty sand, trace rootlets, reddish brown, moist, compact	2	SS	11	
1.5	**CLAYEY SILT TO SILTY CLAY:** trace sand, trace gravel, brown to greyish brown, moist, very stiff silty sand seam at 1.9m	3	SS	18	102
		4	SS	21	
		5	SS	24	101
97.8		6	SS	15	100
6.0	**SILTY CLAY TILL:** some sand to sandy, trace gravel, trace cobble/boulders, grey, moist, very stiff to hard	7	SS	17	99
		8	SS	34	98
		9	SS	64	97
93.1					96
10.7 / 92.5	**GRAVEL AND BOULDERS:** with silty clay inclusions	10	SS	50/130mm	95
11.3 / 92.2	**SHALE BEDROCK:** Queenston formation, reddish brown, weathered TCR=16%, SCR=16%, RQD=0%	R1	RC		94
11.6					93
					92

W. L. 101.6 m
Mar 05, 2024

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
5	21	47	27

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

DS SOIL LOG-2021-FINAL 23-487-602.GPJ DS.GDT 24-3-12

LOG OF BOREHOLE BH24-17

PROJECT: Preliminary Geotechnical Investigation
CLIENT: Alinea Land Corporation
PROJECT LOCATION: 1200 King Road, Burlington, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1 N 4797641.88 E 594114.42

DRILLING DATA
Method: Solid Stem/Mud Rotary
Diameter: 150mm
Date: Feb-17-2024

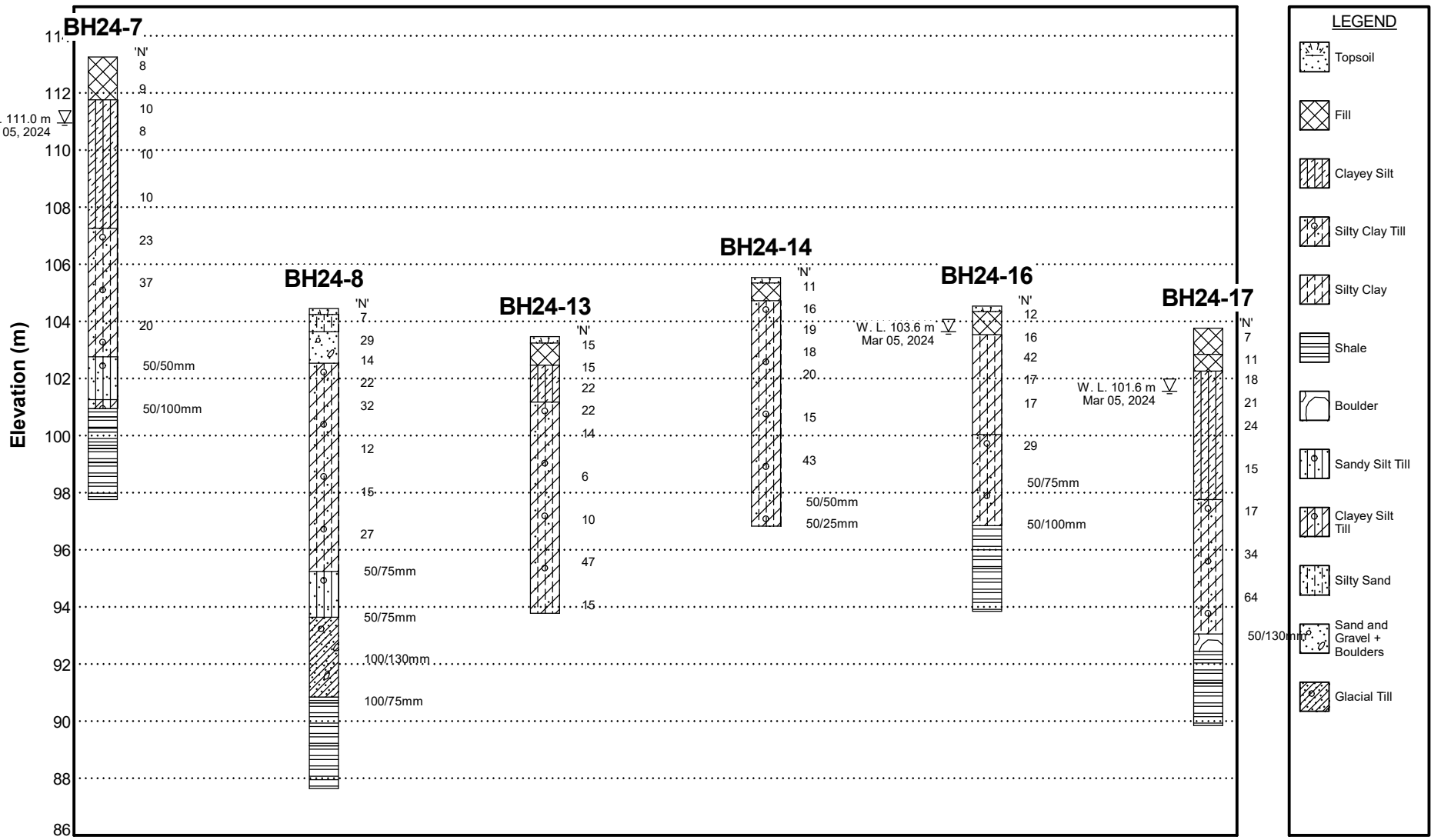
REF. NO.: 23-487-602
ENCL NO.: 7

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.4	Hard layers=1%, Maximum hard layer thickness=10mm		R2	RC								
12.4	TCR=46%, SCR=46%, RQD=31% Hard layers=15%, Maximum hard layer thickness=50mm(Continued)						91					
13	TCR=100%, SCR=56%, RQD=52% Hard layers=6%, Maximum hard layer thickness=50mm		R3	RC								
89.9							90					
13.9	**END OF BOREHOLE:** Notes: 1) 50mm dia. monitoring well installed during drilling. 2) Water Level Readings: Date: Water Level(mbgl): Mar. 5, 2024 2.2											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG-2021-FINAL 23-487-602.GPJ DS.GDT 24-3-12



Distance Along Baseline (Not to Scale)

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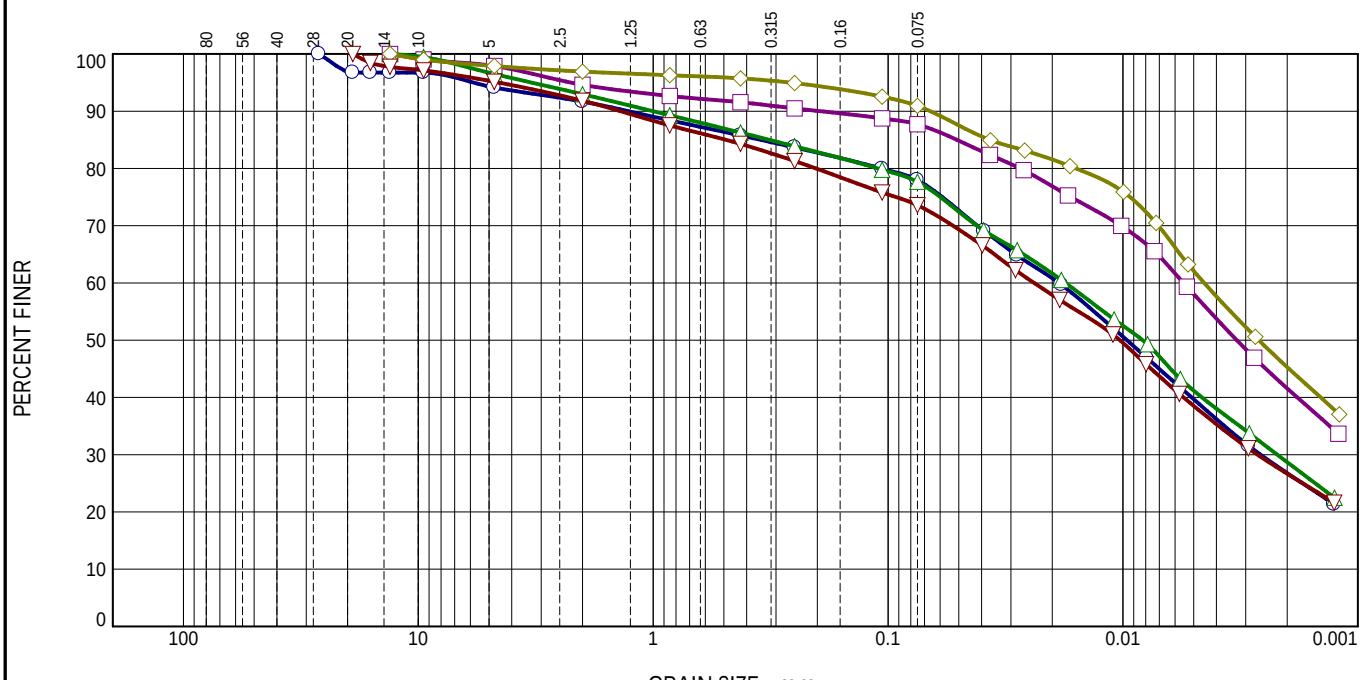
Generalized Sub-surface Profile

DRAWING NO.	8
JOB NO.	23-487-602
DATE	March 11, 2024

DS FENCE (M) 23-487-602.GPJ DS.GDT 3/11/24

Particle Size Distribution Report

ASTM D422



	% +75mm	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	3.3	2.6	2.4	5.9	7.8	51.2	26.8
□	0.0	0.0	2.1	3.3	3.0	3.9	46.1	41.6
△	0.0	0.0	3.5	3.5	6.7	8.6	49.0	28.7
◇	0.0	0.0	2.1	1.0	1.2	4.8	45.6	45.3
▽	0.0	0.0	4.9	3.3	7.5	10.7	46.9	26.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	28.1	13.1	0.3485	0.0187	0.0096	0.0026				
□	36.9	13.9	0.0509	0.0055	0.0033					
△	29.0	13.0	0.3204	0.0176	0.0082	0.0022				
◇	38.5	15.1	0.0370	0.0045	0.0026					
▽	27.4	12.4	0.4911	0.0239	0.0103	0.0027				

Material Description	USCS	AASHTO
○ Silty clay till, some sand, trace gravel	CL	A-6(9)
□ Silty clay till, some sand, trace gravel	CL	A-6(19)
△ Silty clay till, some sand, trace gravel	CL	A-6(10)
◇ Silty clay till, trace sand, trace gravel	CL	A-6(21)
▽ Silty clay till, sandy, trace gravel	CL	A-6(8)

Project No. 23-487-602 Client: Alinea Land Corporation

Project: Preliminary Geotechnical Investigation, 1200 King Rd., Burlington, ON

○Location: BH24-7 SS9 Sample Number: VM-5132

□Location: BH24-8 SS5 Sample Number: VM-5132

△Location: BH24-8 SS8 Sample Number: VM-5132

◇Location: BH24-16 SS4 Sample Number: VM-5132

▽Location: BH24-17 SS8 Sample Number: VM-5132

Remarks:

○F.M.=0.77

□F.M.=0.42

△F.M.=0.66

◇F.M.=0.25

▽F.M.=0.80

DS CONSULTANTS LTD.

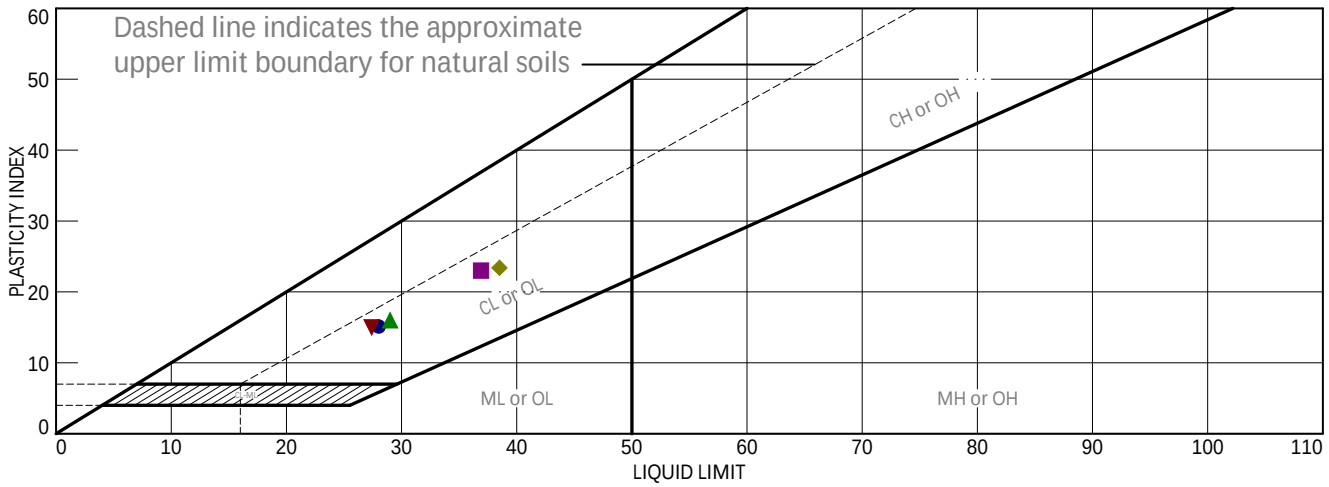
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

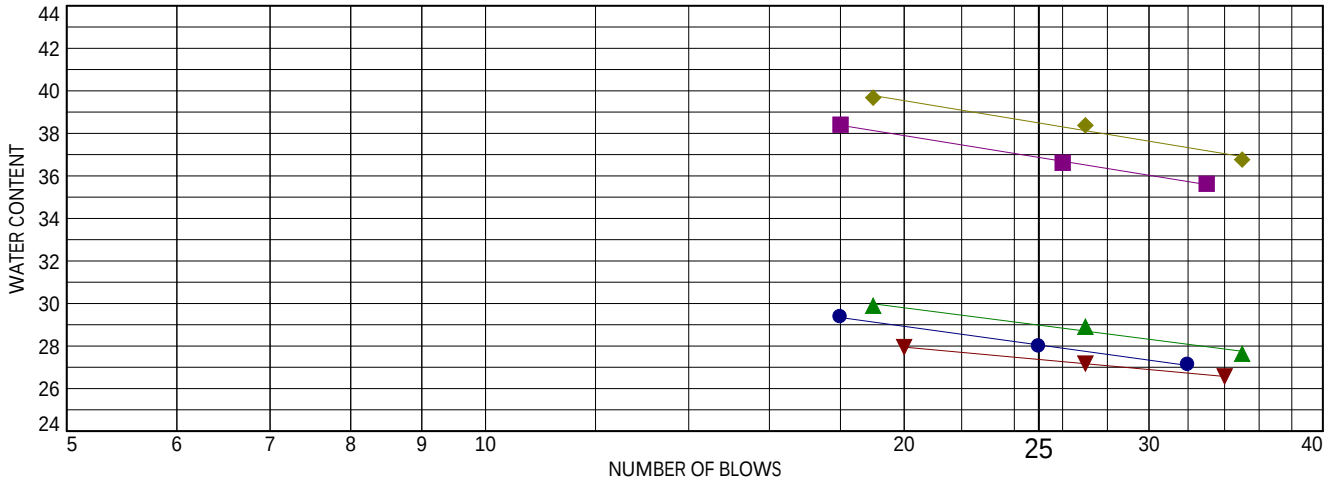
CCIL

Figure: 9

Tested By: Helen/Nisha Checked By: Jordan

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty clay till, some sand, trace gravel	28.1	13.1	15.0	85.8	78.0	CL
■	Silty clay till, some sand, trace gravel	36.9	13.9	23.0	91.6	87.7	CL
▲	Silty clay till, some sand, trace gravel	29.0	13.0	16.0	86.3	77.7	CL
◆	Silty clay till, trace sand, trace gravel	38.5	15.1	23.4	95.7	90.9	CL
▼	Silty clay till, sandy, trace gravel	27.4	12.4	15.0	84.3	73.6	CL

Project No. 23-487-602 Client: Alinea Land Corporation

Project: Preliminary Geotechnical Investigation, 1200 King Rd., Burlington, ON

●Location: BH24-7 SS9 Sample Number: VM-5132

■Location: BH24-8 SS5 Sample Number: VM-5132

▲Location: BH24-8 SS8 Sample Number: VM-5132

◆Location: BH24-16 SS4 Sample Number: VM-5132

▼Location: BH24-17 SS8 Sample Number: VM-5132

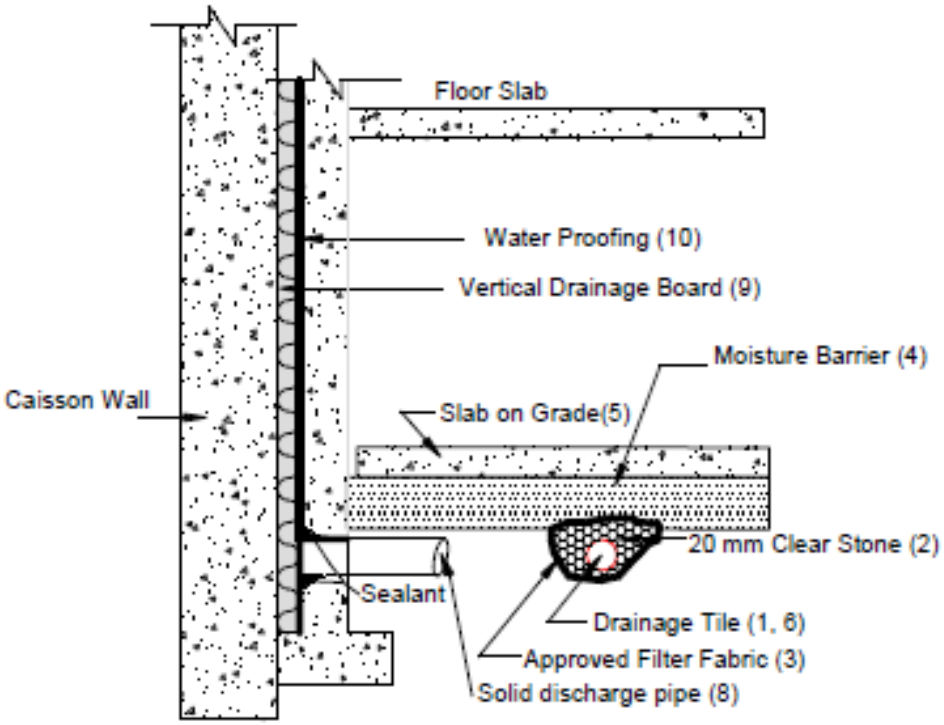
DS CONSULTANTS LTD.
Geotechnical ❖ Environmental ❖ Materials ❖ Hydrogeology
CCIL

Remarks:
●Sampled on February 22, 2024
■Sampled on February 14, 2024
▲Sampled on February 14, 2024
◆Sampled on February 15, 2024
▼Sampled on February 17, 2024

Figure: 10

Tested By: Nisha Checked By: Jordan

Project: 23-487-602 **Drawing No. 11**



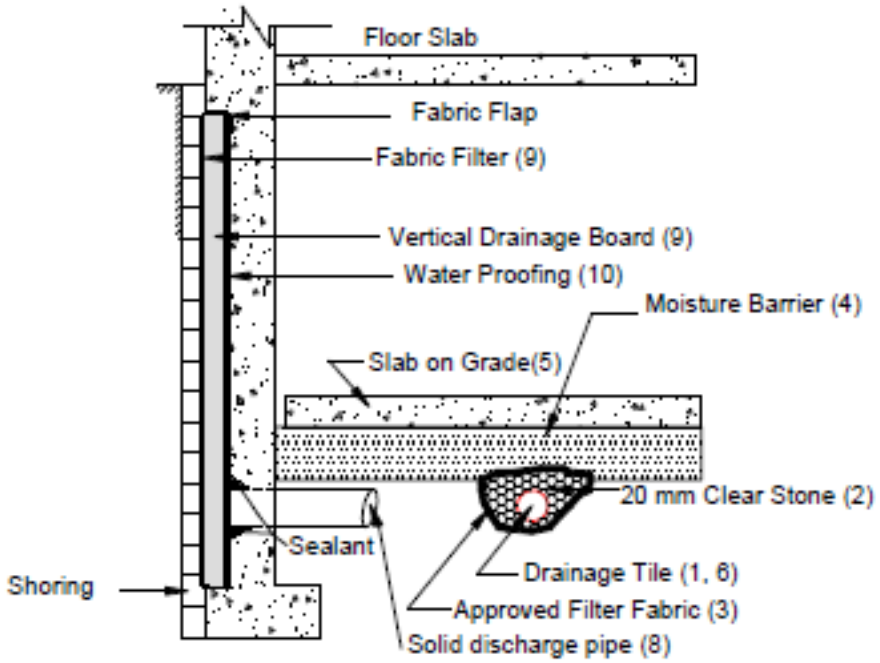
EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board mira-drain 6000 or eqivalent with filter cloth should be continous from bottom to 1.2 m below exterior finished grade.
10. The basement walls must be water proofed using bentonite or equivalent water-proofing system.
11. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System
(not to scale)

Project: 23-487-602 **Drawing No. 12**

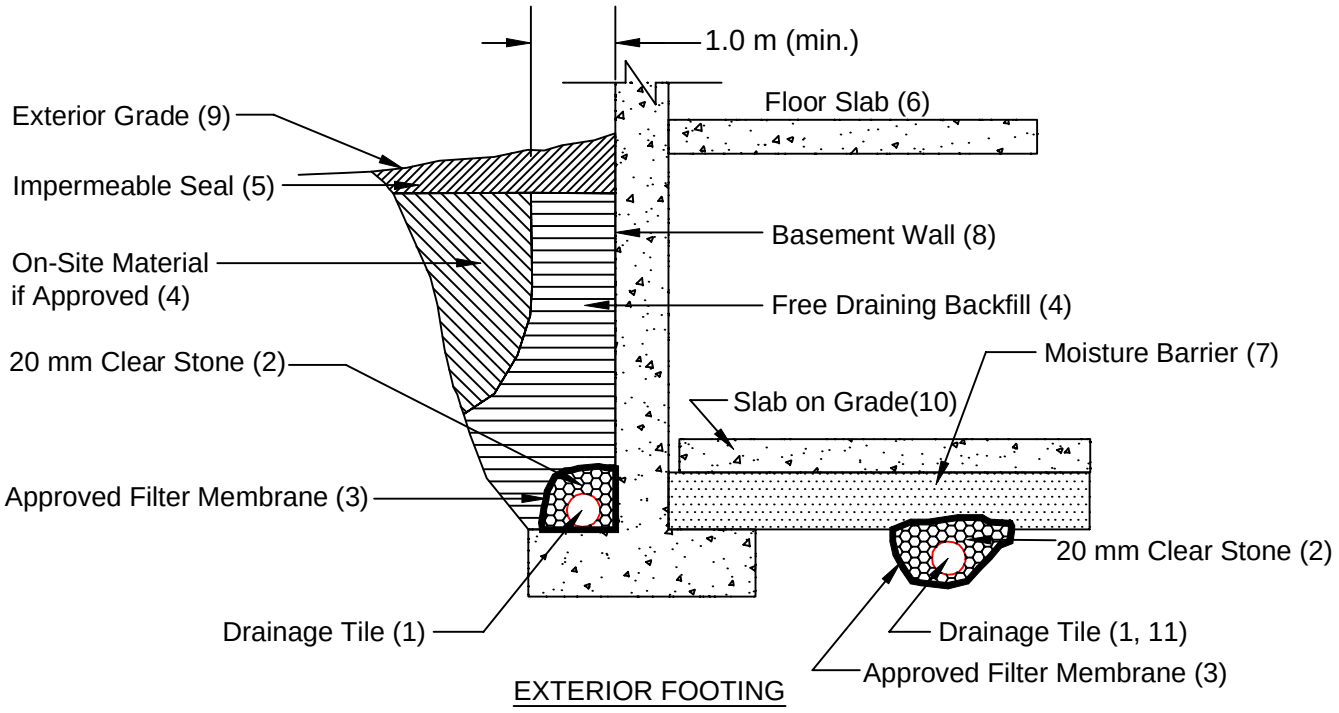


EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minium of 1.2 m below exterior finished grade.
10. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
11. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System
(not to scale)



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed /water proofed.
9. Exterior grade to slope away from building.
10. Slab on grade should not be structurally connected to the wall or footing.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details.

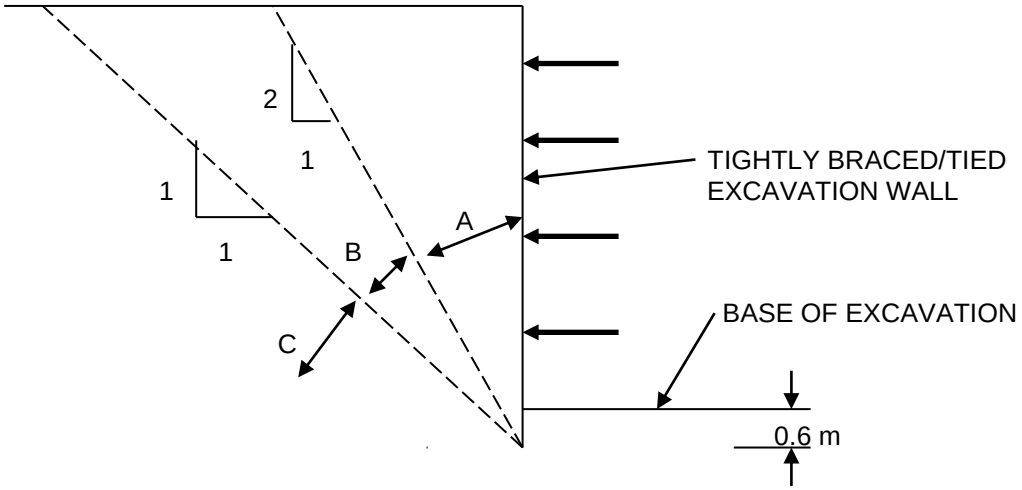
DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)

Project: 23-487-602 **Drawing 14**

Guidelines for Underpinning in Soil and Excavation Support

Existing foundations located within Zone A normally require underpinning, especially for heavy structures. For some foundations in Zone A, it may be possible to eliminate underpinning and control foundation movement by tightly braced excavation walls, such as caisson walls.



Zone A Foundations located within this zone normally require underpinning. Horizontal and vertical pressures on the excavation wall of non underpinned foundations must be considered

Zone B Foundations located within this zone normally do not require underpinning. Horizontal and vertical pressures on the excavation wall of non underpinned foundations must be considered

Zone C Underpinning to structures is normally founded in this zone. Lateral pressure from underpinning is not normally considered

(Reference: Figure 26.27 from Canadian Foundation Engineering Manual, 4th Edition)

Appendix A

BOREHOLE PLAN AND PREVIOUS BOREHOLE LOGS
SOIL-MAT 2011 INVESTIGATION



LEGEND

BH-# Borehole

TBM Temporary Benchmark [Top nut of hydrant on west side of King Road, approximately 140m south of Highway 403, assumed elevation of 100 metres]

Subject Site Boundary

NOTES:

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. report number SM 114018-G
2. Borehole locations are approximate.
3. Soil samples will be discarded after 3 months unless directed otherwise by client.
4. Image obtained from Google 2011 Digital Globe

Soil-Mat
Engineers & Consultants Ltd.

CLIENT
Paletta International Corporation

PROJECT TITLE
Geotechnical Investigation
King Road & Highway 403
Burlington, Ontario

DRAWING TITLE
Borehole Location Plan

PROJECT No.	SM 114018-G
SCALE	N.T.S.
DATE	January 2011
CHECKED	IS
DRAWN	PM

FILENAME
114018 Borehole Location Plan.kcw

DRAWING No. 1

Project No: SM 114018-G

Project: 403 & King Road

Location: Burlington, Ontario

Client: Paletta International Corporation

Log of Borehole No. 1

Borehole Location: See Drawing No. 1

Project Manager: Ian Shaw, P. Eng.

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description	Well Data
0	0	98.96	Ground Surface	
		98.66	***Topsoil*** Approximately 300 millimetres	
2			***Silty Clay*** Brownish red,trace sand and fine gravel, hard	
4		97.56		
6	2	96.86	***Silty Sand*** Brown, medium to fine grained, with some gravel, occasional thin silty clay seams, saturated, compact	
8				
10			***Silty Clay*** Brown to grey, trace fine gravel, wet to saturated, firm to soft	
12		95.16		
14	4		***Silty Clay*** Grey, trace gravel and shale fragments, very stiff	
16				
18		93.06		
20	6	92.56	***Sandy Silt*** Brownish red, some gravel, dense	
22			***Silty Clay Till*** Grey, occasional gravel, occasional shale fragments, hard	
24				
26	8	91.16 91.06	***Queenston Shale*** Red, severely weathered, hard	
28			End of Borehole	
30				
32	10			
34				
36				
38				

SAMPLE

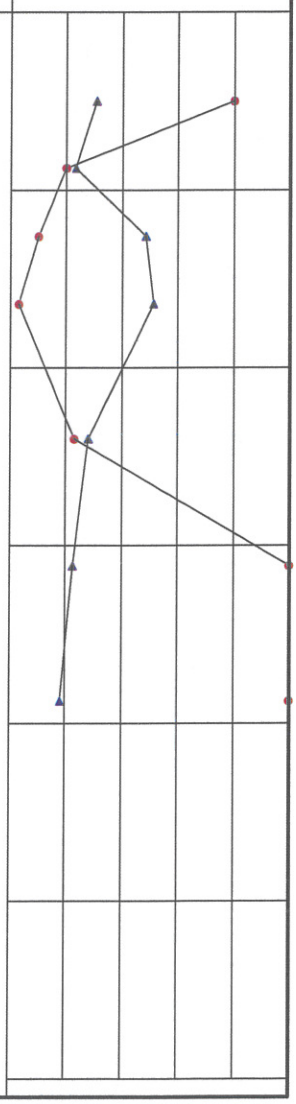
Type	Number	Blow Counts	Blows/300mm	Recovery
SS	1	4,45,35	80	
SS	2	11,9,11 Wet Spoon	20	
SS	3	3,4,6 Wet Spoon	10	
SS	4	1,1,2 Wet Spoon	3	
SS	5	4,8,15 Wet Spoon	23	
SS	6	26, 50/75mm Wet Spoon	100+	
SS	7	36, 50/150mm Wet Spoon	100+	

PP (kgf/cm2)

U.Wt.(kN/m3)

Moisture Content w% 10 20 30 40

Standard Penetration Test blows/300mm 20 40 60 80



NOTES:

1. Borehole advanced using solid stem continuous flight auger equipment on January 21, 2011 to termination at a depth of 7.9 metres.
2. Free groundwater at a depth of 1.5 metre on completion and borehole backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after three months unless otherwise directed by our client.

Drill Method: Solid Stem Auger

Drill Date: January 21, 2011

Hole Size: 150mm

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

Datum: Temporary Benchmark

Checked by: IS

Sheet: 1 of 1

Project No: SM 114018-G

Project: 403 & King Road

Location: Burlington, Ontario

Client: Paletta International Corporation

Log of Borehole No. 2

Borehole Location: See Drawing No. 1

Project Manager: Ian Shaw, P. Eng.

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description	Well Data
0	0	100.65	Ground Surface	
			Topsoil Approximately 150 millimetres	
			Silty Clay Brown, with some grey in the lower level, trace gravel and shale fragments, hard to stiff	
		96.85		
			Silty Clay Grey, trace gravel, and shale fragments, stiff to firm	
		95.15		
			Silty Clay Till Grey to reddish grey, trace to some gravel and shale fragments, very stiff to hard	
		93.15		
26	8	92.75	**Queenston Shale** Red, severely weathered, occasional more resistant grey layers, hard	
			End of Borehole	

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery
SS	1	5,11,15	26	
SS	2	11,25,15	40	
SS	3	4,5,7	12	
SS	4	4,5,6	11	
SS	5	6,9,14	23	
SS	6	40, 50/150mm	100+	

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

Moisture Content
w%
10 20 30 40

Standard Penetration Test
blows/300mm
20 40 60 80

NOTES:
1. Borehole advanced using solid stem continuous flight auger equipment on January 21, 2011 to termination at a depth of 7.9 metres.
2. Borehole dry on completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after three months unless otherwise directed by our client.

Drill Method: Solid Stem Auger

Drill Date: January 21, 2011

Hole Size: 150mm

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

Datum: Temporary Benchmark

Checked by: IS

Sheet: 1 of 1

Project No: SM 114018-G

Project: 403 & King Road

Location: Burlington, Ontario

Client: Paletta International Corporation

Log of Borehole No. 3

Borehole Location: See Drawing No. 1

Project Manager: Ian Shaw, P. Eng.

Soil-Mat

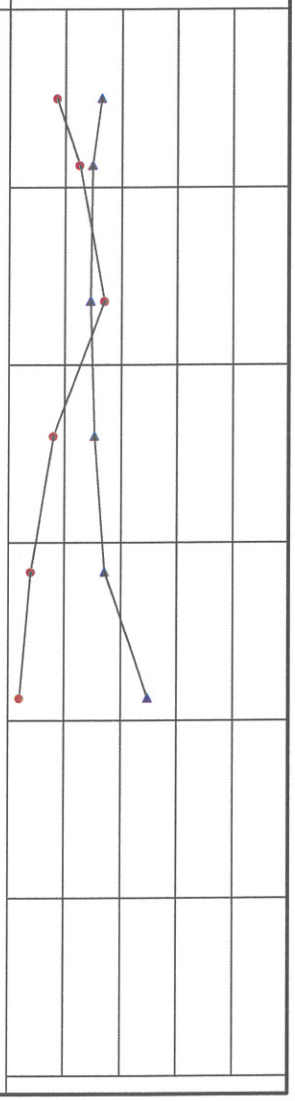
SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0	0	105.13	Ground Surface							
0	0		**Topsoil** Approximately 150 millimetres							
2			**Silty Clay** Reddish brown to brown, trace gravel and shale fragments, weathered, very stiff	SS	1	5,7,10	17			
4										
6	2			SS	2	8,11,14	25			
8		102.33								
10			Grey, trace gravel and shale fragments, hard to very stiff	SS	3	7,14,20	34			
12	4									
14				SS	4	5,7,9	16			
16		99.73								
18			**Silty Clay** Grey, trace fine gravel, 'wet', firm to soft							
20	6			SS	5	3,3,5	8			
22										
24										
26	8	97.03		SS	6	1,2,2	4			
28			End of Borehole							
30										
32	10									
34										
36										
38										

Moisture Content w% (10, 20, 30, 40)

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



NOTES:

1. Borehole advanced using solid stem continuous flight auger equipment on January 21, 2011 to termination at a depth of 8.1 metres.
2. Borehole dry on completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after three months unless otherwise directed by our client.

Drill Method: Solid Stem Auger

Drill Date: January 21, 2011

Hole Size: 150mm

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Sheet: 1 of 1

Project No: SM 114018-G

Project: 403 & King Road

Location: Burlington, Ontario

Client: Paletta International Corporation

Log of Borehole No. 4

Borehole Location: See Drawing No. 1

Project Manager: Ian Shaw, P. Eng.

Soil-Mat

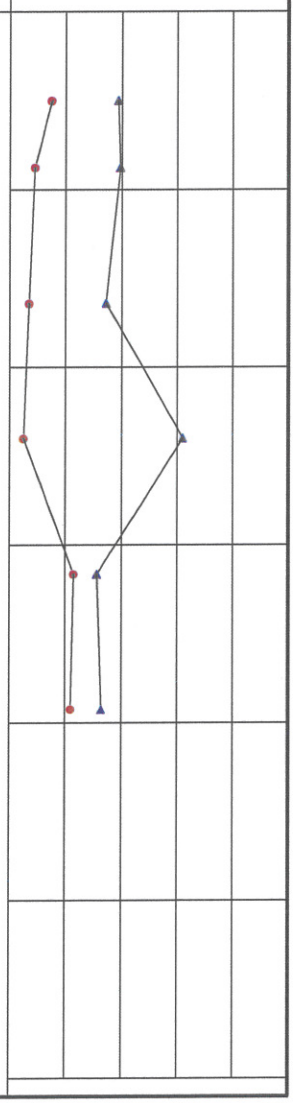
SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	Elevation [m]	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	107.01	Ground Surface							
0 / 0		***Topsoil*** Approximately 100 millimetres							
2 /		***Silty Clay*** Reddish brown to brown, trace gravel, thin coarse sand seams in the lower level, weathered, very stiff to stiff	SS	1	5,7,8	15			
4 /									
6 / 2			SS	2	3,4,5	9			
8 /									
10 /			SS	3	2,3,4 Wet Spoon	7			
12 /									
14 / 4	102.71	***Clayey Silt*** Grey, some sand and fine gravel, trace to some organic material and black organic staining, 'wet', firm to soft	SS	4	3,3,2 Wet Spoon	5			
16 /	101.81								
18 /		***Silty Clay Till*** Grey, trace to some gravel and shale fragments, very stiff							
20 / 6			SS	5	5,9,14 Wet Spoon	23			
22 /									
24 /									
26 / 8	98.91		SS	6	6,10,12 Wet Spoon	22			
28 /		End of Borehole							
30 /									
32 / 10									
34 /									
36 /									
38 /									

Moisture Content w% (10 20 30 40)

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



NOTES:

1. Borehole advanced using solid stem continuous flight auger equipment on January 21, 2011 to termination at a depth of 8.1 metres.
2. Free groundwater at a depth of 3 metres on completion and borehole backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after three months unless otherwise directed by our client.

Drill Method: Solid Stem Auger

Drill Date: January 21, 2011

Hole Size: 150mm

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Sheet: 1 of 1

Project No: SM 114018-G

Project: 403 & King Road

Location: Burlington, Ontario

Client: Paletta International Corporation

Log of Borehole No. 5

Borehole Location: See Drawing No. 1

Project Manager: Ian Shaw, P. Eng.

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0	0	99.13	Ground Surface							
0	0		***Topsoil*** Approximately 200 millimetres							
4		97.83	***Silty Sand*** Brown, with some gravel, trace clay, possibe fill, saturated, loose	SS	1	4,1,4 Wet Spoon	5			
6	2		***Silty Clay*** Brown to grey, trace gravel and shale fragments, weathered, hard to very stiff	SS	2	14,20,24 Wet Spoon	44			
10				SS	3	5,10,14 Wet Spoon	24			
12	4	95.13								
14			***Silty Clay*** Grey, trace fine gravel, 'wet', soft to firm	SS	4	2,2,2 Wet Spoon	4			
20	6			SS	5	2,3,5 Wet Spoon	8			
22		92.13								
24			***Silty Clay Till*** Grey, trace to some fine gravel and shale fragments, hard	SS	6	7,15,22 Wet Spoon	37			
26	8									
28		90.33								
30		89.93	***Queenston Shale*** Red, severely weathered, occasional more resistant grey layers, hard	SS	7	50/75mm Wet Spoon	100+			
32	10		End of Borehole							
34										
36										
38										

Moisture Content w% (10, 20, 30, 40)

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

NOTES:

1. Borehole advanced using solid stem continuous flight auger equipment on January 21, 2011 to termination at a depth of 9.2 metres.
2. Free groundwater at a depth of 1 metre on completion and borehole backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after three months unless otherwise directed by our client.

Drill Method: Solid Stem Auger

Drill Date: January 21, 2011

Hole Size: 150mm

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Sheet: 1 of 1

Project No: SM 114018-G

Project: 403 & King Road

Location: Burlington, Ontario

Client: Paletta International Corporation

Log of Borehole No. 6

Borehole Location: See Drawing No. 1

Project Manager: Ian Shaw, P. Eng.

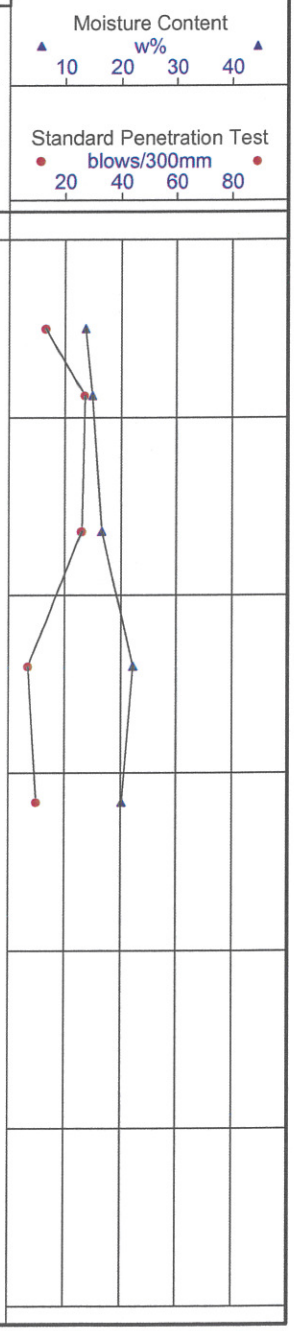
Soil-Mat

SUBSURFACE PROFILE

Depth (ft / m)	Elevation [m]	Symbol	Description	Well Data
0 / 0	97.55		Ground Surface	
			Topsoil Approximately 100 millimetres	
	96.15		***Silty Clay Fill*** Brown, with gravel, occasional medium to coarse grained sand, stiff	
2 / 2			***Silty Clay*** Brown to grey, trace to some fine gravel and shale fragments, weathered, very stiff	
	93.55		***Silty Clay*** Grey, trace fine gravel and shale fragments, 'wet', firm	
4 / 4				
6 / 6	91.05		End of Borehole	
8 / 8			NOTES: 1. Borehole advanced using solid stem continuous flight auger equipment on January 21, 2011 to termination at a depth of 6.5 metres. 2. Borehole dry on completion backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after three months unless otherwise directed by our client.	
10 / 10				

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	6,6,7	13			
SS	2	7,12,15	27			
SS	3	7,11,15	26			
SS	4	3,3,4	7			
SS	5	3,4,6	10			



Drill Method: Solid Stem Auger

Drill Date: January 21, 2011

Hole Size: 150mm

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Project No: SM 114018-G

Project: 403 & King Road

Location: Burlington, Ontario

Client: Paletta International Corporation

Log of Borehole No. 7

Borehole Location: See Drawing No. 1

Project Manager: Ian Shaw, P. Eng.

Soil-Mat

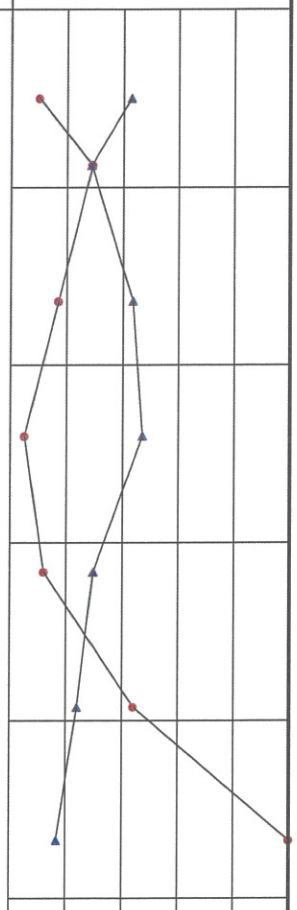
SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	97.18		Ground Surface								
0 – 4 / 0 – 1.22	95.88		***Silty Clay*** Brownish red, some fine gravel, possible fill, stiff		SS	1	2,4,6	10			
4 – 12 / 1.22 – 3.66	93.18		***Silty Clay*** Brown to grey, trace to some fine gravel, weathered, very stiff		SS SS	2 3	11,14,15 7,8,9	29 17			
12 – 20 / 3.66 – 6.10	90.48		***Silty Clay*** Grey, trace fine gravel, 'wet', soft to stiff		SS SS	4 5	2,2,3 5,5,7	5 12			
20 – 30 / 6.10 – 9.14	87.63		***Silty Clay Till*** Grey, trace to some fine gravel and shale fragments, hard		SS SS	6 7	8,16,28 17,32, 50/100mm	44 100+			
30 – 32 / 9.14 – 9.75			End of Borehole								

Moisture Content w% (10, 20, 30, 40)

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



NOTES:

1. Borehole advanced using solid stem continuous flight auger equipment on January 21, 2011 to termination at a depth of 9.55 metres.
2. Borehole dry on completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after three months unless otherwise directed by our client.

Drill Method: Solid Stem Auger

Drill Date: January 21, 2011

Hole Size: 150mm

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Project No: SM 114018-G

Project: 403 & King Road

Location: Burlington, Ontario

Client: Paletta International Corporation

Log of Borehole No. 8

Borehole Location: See Drawing No. 1

Project Manager: Ian Shaw, P. Eng.

Soil-Mat

SUBSURFACE PROFILE

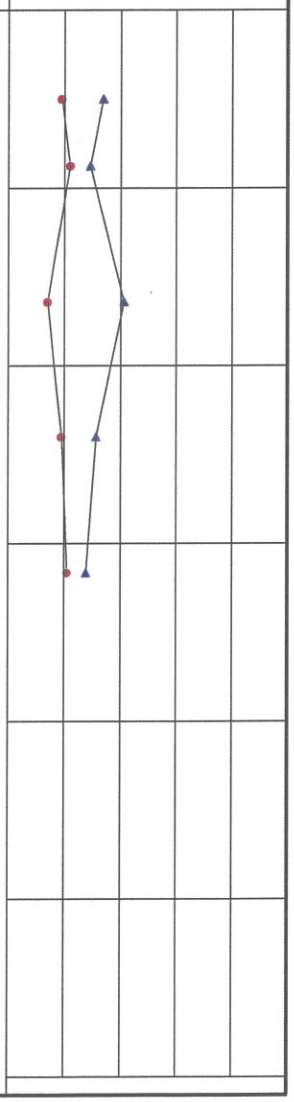
Depth (ft / m)	Elevation [m]	Symbol	Description	Well Data
0 / 0	97.72		Ground Surface	
			Topsoil Approximately 150 millimetres	
			Silty Clay Reddish brown to brown to grey, trace to some fine gravel, weathered, very stiff	
2 / 2				
4 /				
6 /				
8 /				
10 /				
12 / 4	93.72			
			Silty Clay Till Grey, trace to some fine gravel and shale fragments, very stiff to hard	
16 /				
18 /				
20 / 6	91.22			
			End of Borehole	
24 /			NOTES: 1. Borehole advanced using solid stem continuous flight auger equipment on January 21, 2011 to termination at a depth of 6.5 metres. 2. Free groundwater at a depth of 5.5 metres on completion and borehole backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after three months unless otherwise directed by our client.	
26 / 8				
28 /				
30 /				
32 / 10				
34 /				
36 /				
38 /				

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	7,9,10	19			
SS	2	4,8,14	22			
SS	3	4,6,8 Wet Spoon	14			
SS	4	6,7,12 Wet Spoon	19			
SS	5	5,8,13 Wet Spoon	21			

Moisture Content
w%
10 20 30 40

Standard Penetration Test
blows/300mm
20 40 60 80



Drill Method: Solid Stem Auger

Drill Date: January 21, 2011

Hole Size: 150mm

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Appendix B

GENERAL COMMENTS - BEDROCK IN GREATER TORONTO AREA
PHOTOGRAPHS OF ROCK CORES

General Comments – Bedrock in Greater Toronto Area

The bedrock that makes spread footings or caissons a popular choice for high-rise foundation support is a shale or shale limestone composition. The highest member, the Queenston Formation, is generally found west of Toronto, while the Georgian Bay Formation underlies most of Metro Toronto, with the Collingwood Formation east of Toronto. The Queenston is, relatively speaking, the weaker of the three formations that are likely to support caissons or footings.

The Georgian Bay as well as the Queenston and Collingwood Formation are of Middle Ordovician Age. It is defined as the rock unit that overlies the bluish grey shales of the Collingwood Formation and is in turn overlain by the red shale of the Queenston Formation. The Georgian Bay Formation consists of bluish and grey shale with interbeds of sandstone, limestone and dolostone. Towards the west where the Georgian Bay formation underlies the Queenston Formation, the limestone content increases significantly and limestone and/or sandstone may comprise as much as 70 to 90 percent of the bedrock. The hard layers are usually less than about 100 to 150 mm thick, but some layers are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at some sites. The layers are actually lenses and they can vary significantly in thickness over short distances.

The upper portion of the bedrock is commonly weathered for a depth of 600 to 1000 mm and within this weathered zone hard limestone layers or lenses are common. These hard limestone layers can result in contractual problems for augers and can provide misleading bedrock elevations. Where the weathering is more extensive a shale till layer may be found above the bedrock. In the sound bedrock, the limestone, sandstone, dolostone is hard to very hard.

Stress relief features such as folds and faults are common in the bedrock. In these features, the rock is heavily fractured and sheared, and contains layers of shale rubble and clay. Weathering is much deeper than the surrounding rock in these features and often there is a lateral migration of the stress relief features resulting in sound unweathered bedrock overlying fractured and weather bedrock. The stress relief features are usually in the order of 4 to 6 m wide, but the depth can vary from 4 to 5 m to in excess of 10 m. These features occur randomly.

The bedrock contains significant high locked in horizontal stresses. These stresses can impose significant loads on tunnel walls but the slower rate of construction for basements allows for a relaxation of these stresses and they are not normally a problem for basement construction.

Groundwater seepage below the top 1000 mm is generally small, however, at several locations in Toronto and Mississauga large quantities have been encountered.

Bedding joints in the bedrock are very close-to-close, smooth planar in the shale and rough planar in the limestone. Significant vertical jointing is common.

Where the bedrock was cored, a detailed description of the rock core is appended to the borehole log.

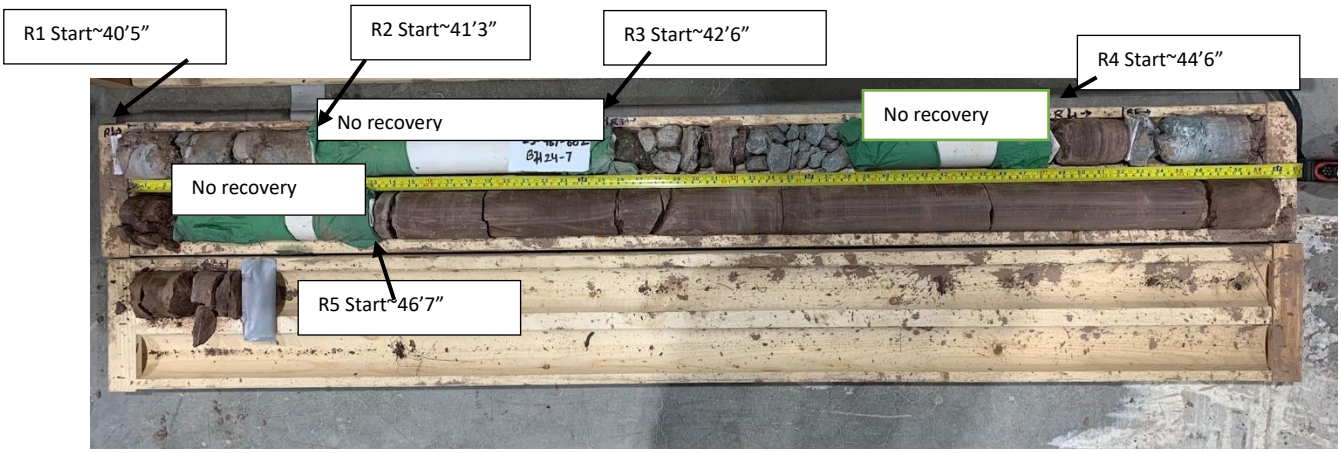
Design features related to the bedrock are discussed in other sections of this report, and these general comments must be considered with these comments.

Methane gas exists in the bedrock, normally below the top 1000 mm and more concentrated with depth. Appropriate care and monitoring are essential in all confined bedrock excavations, particularly caissons and tunnels.

23-487-602-R

BH 24-7

R1: ~40’5” ~41’3”
R2: ~41’3” ~42’6”
R3: ~42’6” ~44’6”
R4: ~44’6” ~44’10”
R5: ~44’10” ~46’7”
R6: ~46’7” ~50’8”



BH 24-8

R1: ~46’4” ~51’2”
R2: ~51’2” ~56’2”



BH 24-16

R1: ~25’5” ~30’5”
R2: ~30’5” ~35’5”



BH 24-17

R1: ~35’1” ~38’
R2: ~38’ ~40’8”
R3: ~40’8” ~45’8”

