GEOTECHNICAL INVESTIGATION REPORT
PROPOSED MIXED-USE DEVELOPMENT
1294 KINGSTON ROAD, 1848 AND 1852 LIVERPOOL ROAD
PICKERING, ONTARIO

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1 INTRODUCTION

Alston Associates (**AA**), the geotechnical division of Terrapex Environmental Ltd. **(Terrapex)** has been retained by the Altona Group to carry out a geotechnical investigation for the proposed mixed-use commercial and residential development. Authorization to proceed with this study was given by Mr. Muky Rajadurai of Altona Group.

We understand that Altona Group, owner of the site known municipally as 1294 Kingston Road, 1848 Liverpool Road, and 1852 Liverpool Road (“subject site”), is proposing the redevelopment and intensification of the subject site with a mixed use development that incorporates a 25-storey tower, a 12-storey midrise building, and a row of 3-storey townhouses. The proposal also commits to the restoration and adaptive reuse of the Old Liverpool House as well as new publicly accessible open space and improvements to the public realm.

The site is located at the northwest corner of Kingston Road and Liverpool Road in the City of Pickering; bounded by a single-storey house to the north, Kingston Road to the south, Liverpool Road to the east and two-storey houses and single-storey commercial buildings to the west. It is occupied by a two-storey historical building originally built as the Liverpool Arms Inn (Old Liverpool House) circa 1877 to 1879 and currently operating as the Liverpool John’s Pub and Restaurant, a single-storey commercial building and a residential-converted daycare facility.

According to the latest building scheme shown in the zoning set drawings, dated May 16, 2019, prepared by the project architect, Kirkor Architects + Planners (Kirkor), the historical Old Liverpool House will be relocated towards the southern property line and all other existing structures at the site will be demolished to make way for the new development, that will include three underground parking garage levels. The underground parking garage will extend under the proposed new construction and will take up almost the entire site, with the exception of the vicinity of the relocated Old Liverpool House. The approximate limits of the basement are shown in the Borehole Location Plan presented herein as Appendix B. The top of lowest basement floor will be situated approximately 9.2 m below the Finish Floor Elevations (FFE)) of the proposed buildings. Based on the proposed grading plan prepared by Stantec, we understand that the FFE of the proposed buildings will be in the range of 88.8 to 89.6 m. Accordingly, it is anticipated that the lowest basement floor slab will be situated at about elevation 80.0 m, and the building foundations will be situated at about elevation 78.5 m.

The fieldwork for the geotechnical study was conducted in conjunction with the hydrogeological investigation and Phase Two Environmental Site Assessment (ESA). The hydrogeological and environmental conditions at the site is reported under separate covers by **Terrapex**.

The purpose of this investigation was to characterize the subsurface soil and groundwater conditions, to determine the engineering properties of the various soil deposits underlying the site, and to provide geotechnical engineering recommendations pertaining to the proposed development.

This report presents the results of the investigation performed in accordance with the general terms of reference outlined above and is intended for the guidance of the client and the design architects or engineers only. It is assumed that the design will be in accordance with the applicable building codes and standards.

2 FIELDWORK

The fieldwork for this investigation was carried out during the period between January 2 and 7, 2019, and February 1, 7, 8 and 13, 2019. It consisted of nine exterior boreholes, denoted as MW1 through MW4, BH5, MW6 through MW8, and MW10, and one interior borehole MW9, advanced by drilling contractors commissioned by **AA**. The locations of the boreholes were chosen by **AA** to provide general coverage of the site for the proposed development, and are shown on the Borehole Location Plan enclosed in Appendix B.

Seven exterior boreholes, MW1 through MW4, BH5, MW6, were advanced within the footprint of the proposed basement and extended to depths ranging from 5.9 to 17.1 mbeg. The remaining two exterior boreholes, MW7 and MW8 were advanced south and west of the existing Old Liverpool House, respectively, and extended to approximate depths of about 5.9 and 15.3 mbeg. The interior borehole, MW9, was drilled in the basement of the Old Liverpool House as part of the Phase Two ESA; advanced to about 3.9 m below the basement level. The soil samples from MW9 were collected using direct-push technology; no Standard Penetration Tests were conducted at this location.

A total of 11 monitoring wells were installed at 9 borehole locations and their arrangements are summarized as follows:

- One single monitoring well was installed at each of Boreholes MW1, MW3, MW-6 through MW-10; and
- One pair of deep-shallow cluster wells were installed at each of Boreholes MW2 and MW4.

The wells were installed to determine the long-term groundwater level at the site and for use for the hydrological assessment and Phase Two ESA by **Terrapex**.

The ground surface elevations at the locations of the boreholes were obtained from the topographic survey, dated January 20, 2017, prepared by Mandarin Surveyors Limited.

Standard penetration tests (SPT) were carried out in the course of advancing all the boreholes, with the exception of the interior borehole MW9, to take representative soil samples and to measure penetration index values (N-values) to characterize the condition of the various soil materials. The number of blows of the striking hammer required to drive the split spoon sampler to 300 mm depth was recorded and these are presented on the logs as penetration index values.

Field Vane Tests (FVT) were carried out in the native clay soils in Borehole BH5. The FVT provided in-situ measurements on the undrained shear strength of the clay soil unit. Results of SPT and FVT measurements are shown on the borehole log sheets in Appendix C of this report.

Groundwater level observations were made in the monitoring wells on February 8 and 15, 2019. The results of the groundwater measurements are discussed in Section 4.5 of this report.

The fieldwork for this project was carried out under the supervision of experienced geotechnical and environmental technicians from this office who laid out the positions of the boreholes in the field; arranged locates of buried services; effected the drilling, sampling and in situ testing; observed groundwater conditions; and prepared field borehole log sheets.

3 LABORATORY TESTS

The soil samples retained from the split spoon sampler were properly sealed, labelled and brought to our laboratory. They were visually classified and water content tests were conducted on all soil samples retained from Boreholes MW3 and MW4. The results of the classification and water contents are presented on the borehole logs attached in Appendix C of this report.

Grain size analyses were carried out in our laboratory on three native soil samples; Atterberg Limits test on one soil sample. The test results are attached in Appendix D.

In addition, two soil samples were submitted to AGAT Laboratories for chemical analysis for pH and soluble sulphate. The results of these tests are enclosed in Appendix E; discussed in Section 5.10 of this report.

4 SUBSURFACE CONDITIONS

Details of the subsurface conditions contacted in the boreholes are given on the individual borehole logs enclosed in Appendix C.

It should be noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design, and therefore, should not be construed as exact planes of geological change.

4.1 Site Description

The site is located at the northwest corner of Kingston Road and Liverpool Road in the City of Pickering. It is bounded by a single-storey house to the north, Kingston Road to the south, Liverpool Road to the east and two-storey houses and single-storey commercial buildings to the west.

The site has an area of approximately 9,000 m^2 and is occupied by a two-storey historical building “Old Liverpool House” restaurant, a single-storey commercial building and a residential-converted daycare facility.

The ground surface topography of the site is relatively level. It has an overall gradient that slopes gently down from north to south. The ground surface elevations (el.) at the exterior borehole locations range between about el. 89.7 m at Borehole MW2 to el. 88.0 m at Borehole MW7.

4.2 Asphaltic Concrete Pavement

All the exterior boreholes were advanced through the asphaltic concrete pavement. The thickness of the asphaltic concrete at the borehole locations ranges from 50 to 200 mm.

4.3 Fill Materials

Fill material extending to depths ranging from 0.7 to 1.5 mbeg is present below the asphaltic concrete pavement in all the boreholes.

In general, the fill soils consist of brown to dark brown sand and gravel comprising the granular base for the pavement, underlain by dark brown to brown clayey silt and sandy silt with trace gravel and occasional pieces of brick, and organics.

Standard penetration resistance in the granular base fill materials provided N-values ranging from 8 to 50 blows per 125 mm of split spoon penetration, indicating loose to very dense compactness conditions. SPT in the clayey silt and sandy silt fill materials provided N-values ranging from 6 to 9, indicating firm to stiff consistencies.

The fill is generally dark brown to brown in color. The water content of the tested samples of the fill from Boreholes MW3 and MW4 ranges from approximately 1 to 19% by weight; generally being damp to slightly moist in appearance.

4.4 Native Soils

4.4.1 Silt and Clay, Silty Clay, Clayey Silt, and Sandy Silty Clay

Underneath the fill materials, silt and clay material with various amount of sand is present. It extends to depths ranging from approximately 3.5 mbeg at Borehole MW4 to 8.5 mbeg at Borehole MW2 and to the termination depths of Borehole MW8 through MW10.

The silt and clay deposit is varved, yellow-brown in color with oxidized lenses at shallow depths, becoming grey at approximate depths ranging from 3 to 4 mbeg. Trace to some gravel is present within the clay at lower depth of this stratum. The water content of the samples of the clay material from Boreholes MW3 and MW4 ranges from approximately 14 to 31% by weight.

Standard Penetration Resistance in the clay provided N-values generally ranging from weight-of-hammer per 600 mm of spoon penetration to 8; indicating very soft to firm consistencies. N-values ranging from 9 to 19 were occasionally recorded within this layer in Boreholes MW1, MW2, MW4, and BH5; possibly due to the presence of large gravel.

Sieve and hydrometer grain size analyses and Atterberg Limits test were carried out on one representative sample. The test results are enclosed in Appendix D as Figures 1 and 4, and summarized below.

Borehole Location	Sample Depth (mbeg) and No.	Sample Description	Gravel %	Sand %	Silt %	Clay %	Liquid Limit	Plasticity Index	Soil Classification
MW6	1.8 (Sample 3)	Yellow-brown Silt and Clay, trace Sand	0	2	62	36	42	23	Inorganic silt of intermediate plasticity

According to published empirical correlation between soil type and permeability, typical values of the Coefficient of Permeability (k) of the till soil are less than 10^{-7} cm/s; very low relative permeability.

Two FVTs were carried out in Borehole BH5 within the silt and clay layer. The undrained shear strength (S_u) of the tested silt and clay unit was measured to be in the range of 35 to 79+ kPa with the remoulded strength of 6 kPa; firm to stiff consistencies according to Table 3.3 of the Canadian Foundation Engineering Manual (CFEM), 4th Edition. The relatively high undrained shear strength values may be due to the presence of sand and gravel in the silt and clay layer. The test depths and S_u values of the silt and clay soil are shown on the borehole log.

A 2-m thick layer of brown to grey moist to wet water-bearing material consisting of sand and silt trace gravel and trace clay is present at depths ranging from 3 to 5 mbeg, within this soft to firm silt and clay layer in Borehole MW2. The SPT in the sand and silt layer provided N-values ranging from 7 to 19; indicating loose to compact compactness conditions.

According to published empirical correlation between soil type and permeability, typical values of the Coefficient of Permeability (k) of the sand and silt soil are less than 10^{-5} cm/s; low relative permeability.

4.4.2 Silty Sand and Gravelly Sand some Clay (Till)

Grey to dark grey silty sand some gravel some clay and gravelly sand, some silt, some clay (till) is present below the very soft to firm silt and clay material in Boreholes MW1 through MW4, BH5, MW6 and MW7. The depths to the top of the till layer ranges from 3.5 mbeg at Borehole MW4 to 8.5 mbeg at Boreholes MW2. The till layer extends to depths about 14.5 to 15.5 mbeg at Boreholes MW1, MW3, BH5, and MW7, to the termination depths of about 14.3 mbeg at Boreholes MW2 and MW6, and 17.1 mbeg at Borehole MW4.

The silty sand some gravel some clay and gravelly sand, some silt, some clay (till) is a glacial deposit and consists of a random mixture of soil particles ranging from clay to gravel, with the silt and sand being the predominant fractions. Cobbles and boulders are probably present but would not be representatively sampled with the equipment used in this investigation.

SPT in the silty sand some gravel some clay and gravelly sand, some silt, some clay till provided N-values generally ranging from 24 to 50 blows per 100 mm of split spoon penetration, indicating compact to very dense compactness conditions. An N-value of 5 of the till soil is recorded at a depth of about 6 mbeg in Borehole MW7.

Sieve and hydrometer grain size analyses were carried out on two representative samples. The test results are enclosed in Appendix D as Figures 2 and 3, and summarized below.

Borehole Location	Sample Depth (mbegs and No.	Sample Description	Gravel %	Sand %	Silt %	Clay %
MW3	7.9 (Sample 9)	Grey Silty SAND, some Gravel, some Clay (Till)	16	34	26	14
BH5	7.9 (Sample 6)	Grey Gravelly SAND, some Silt, some Clay (Till)	24	46	18	12

According to published empirical correlation between soil type and permeability, typical values of the Coefficient of Permeability (k) of the sandy or gravelly till materials ranges from 10^{-5} to 10^{-6} cm/s; very low relative permeability values.

We note that within the till layer, numerous soil units situated above or near the assumed founding level, at about 10 mbeg, appeared wet during drilling and they are summarized as below:

- Borehole MW4 – Silty sand some gravel some clay (till) situated between 5.5 and 11.5 mbeg;
- Borehole BH5 – Gravelly sand some silt some clay (till) situated between 7.0 and 8.5 mbeg;
- Borehole BH5 – Medium to coarse-grained sand and gravel trace silt soil situated between 9.8 and 11.4 mbeg;
- Borehole MW6 – Sand seams within the Silty sand some gravel some clay (till) situated between 10.3 and 13.2 mbeg;
- Borehole MW6 – Silty sand some gravel some clay (till) situated between 7.2 and 13.1 mbeg.

The wetness of these materials can be an indication of localized water-bearing and medium permeability conditions.

4.5 Bedrock

Grey shale bedrock of the Georgian Bay Formation underlies the till in Boreholes MW1, MW3, MW4, and BH5; positioned below an approximate depth of about 16.0 m mbeg, corresponding to approximate elevations of about 72.0 to 73.1 m.

The presence of the shale bedrock was proven by drilling and sampling. The degree of weathering of bedrock was not determined with the sampling method used in this investigation. Core sampling of the bedrock was not undertaken. Based on our experience, at minimum the upper 1 to 1.5 m thick zone of the shale is considered to be weak and weathered.

SPT in the shale provided N-values ranging from 50 blows per 25 mm of split spoon penetration to 50 blows per 100 mm of split spoon penetration. The water content of tested sample of the shale sample from Borehole MW3 is 10% by weight.

4.6 Groundwater

Groundwater levels in the monitoring wells were measured on February 8 and 15, 2019. The measured groundwater levels are shown in the following table.

Borehole No.	Ground Elevation (m)	February 8, 2019		February 15, 2019	
		Groundwater Depth (mbeg)	Groundwater Elevation (m)	Groundwater Depth (mbeg)	Groundwater Elevation (m)
MW1	88.7	-	-	3.27	85.4
MW2 (deep well)	89.7	-	-	3.56	86.1
MW2A (shallow well)	89.7	-	-	3.28	86.4
MW3	88.5	3.98	84.5	3.75	84.8
MW4 (deep well)	89.2	3.52	85.7	3.32	85.9
MW4A (shallow well)	89.2	2.88	86.3	2.34	86.9
MW6	88.7	-	-	3.65	85.1
MW7	88.0	-	-	1.77	86.2
MW8	88.2	1.94	86.3	2.08	86.1
MW9	86.7	-	-	0.55	86.2
MW10	88.5	2.05	86.5	2.11	86.4

Based on our field observations, the water content of the various soil units, and the change in soil colour from brown to grey, it is anticipated that the long term groundwater level is situated in the grey silty clay till soil below depths ranging from approximately 2 to 4 mbgs.

It should be noted that groundwater levels are subject to seasonal fluctuations. A higher groundwater level condition will likely develop in the spring and following significant rainfall events.

5 DISCUSSION AND RECOMMENDATIONS

The following discussions and recommendations are based on the factual data obtained from the boreholes advanced at the site by **AA** and are intended for use by the client and design architects and engineers only.

The investigation has revealed that the site is underlain by surficial fill material, followed by very soft to firm silt and clay material, underlain by compact to very dense silty sand some gravel some clay and gravelly sand, some silt, some clay (till) material, followed by shale bedrock. On the basis of our fieldwork and laboratory tests, the following comments and recommendations are made.

Contractors bidding on this project or conducting work associated with this project should make their own interpretation of the factual data and/or carry out their own investigations.

5.1 Excavation

Based on the borehole findings, excavation for the basement and foundations is not expected to pose any unusual difficulty. Excavation of the soils at this site can be carried out with heavy hydraulic excavators.

All excavations must be carried out in accordance with Occupational Health and Safety Act (OHSA) of Ontario. With respect to OHSA, the fill materials are expected to conform to Type 3 soil classification, as is very soft to firm silt and clay soil above the groundwater table. The very soft to firm silt and clay soils that are situated below the groundwater table are classified as Type 4 soil. The compact to very dense till soil can be classified as Type 2 soil.

Temporary excavations for slopes in Type 3 soil should not exceed 1.0 horizontal to 1.0 vertical or flatter. Excavations in the compact to very dense till soil may be cut with vertical side-walls within the lower 1.2 m height of excavation and 1.0 horizontal to 1.0 vertical above this height. In the event very loose and/or soft soils are encountered at shallow depths or within zones of persistent seepage, it will be necessary to flatten the side slopes as necessary to achieve stable conditions. Side slopes of excavations extending below the groundwater table should not be any steeper than 3 horizontal to 1 vertical.

For excavations through multiple soil types, the side slope geometry is governed by the soil with the highest number designation. Excavation side-slopes should not be unduly left exposed to inclement weather.

Where workers must enter excavations extending deeper than 1.2 m below grade, the excavation side-walls must be suitably sloped and/or braced in accordance with the OHSA and Regulations for Construction Projects.

It should be noted that the till soils are non-sorted sediments and therefore may contain boulders. Provisions should be made in the excavation and foundation installation contracts for the removal of possible boulders.

It is anticipated that the basement walls of the proposed development will extend to the north, east and west property limits and sufficient space will not be available to slope the sidewalls of the basement excavation; as such it will be necessary to shore the excavation walls. A soldier-pile and wood lagging or a secant-pile (continuous caisson) wall may be used as the shoring system. Shoring recommendations are provided in Section 5.7 of this report.

Where space permits, temporary open cut may be used for basement excavations. The safe side slope angle for open excavations should conform to the OHSA requirements.

Groundwater seepage will occur during basement excavation. The contractor should make his or her own assessment for temporary control of groundwater seepage into the excavation, as well as to maintain basal stability of the subgrade during excavation stage.

5.1 Groundwater Control

According to Kirkor’s architectural plans for the proposed development dated May 16, 2019, the lowest basement floor slab will be situated at about elevation 80.0 m. and it is anticipated that the foundations of the building will be situated at about elevation 78.5 m.

The boreholes revealed that, at or above the proposed lowest basement floor, water bearing loose to compact sand and silt is present at depths ranging from 3 to 5 mbeg in Borehole MW2 and wet glacial till soil consisting of sand with various amounts of silt and gravel are present in Boreholes MW4, BH5 and MW6. It is possible that these (and similar) soils are present in other locations and at various depths across the site. In this regard, in the event a shoring system consisting of soldier-pile and wood lagging walls is preferred, it will be necessary to dewater the water bearing sand and gravel deposits prior to excavation into these soils. It will also be necessary to install geotextile behind the lagging boards in the granular fill layer as well as in the sandy and gravelly soil strata to prevent migration of such soils into the excavations.

Groundwater yield from the fill materials is not expected to be significant. According to published empirical correlation between soil types and the coefficient of permeability values (k), the native silty sand and gravelly sand some clay till material is expected to have very low permeability coefficients; the groundwater yield from these soils is expected to be small. As such, it is anticipated that adequate control of groundwater seepage during basement and foundation excavations can be achieved by pumping from filtered sumps in the bases of the excavations.

In the event it is necessary to dewater the water bearing soils for the construction of basement, it will be necessary to determine the construction dewatering requirements and to collect the information required for the application for Permit to Take Water (PTTW) from the Ontario Ministry of the Environment, Conservation and Parks (MECP); formerly known as the Ministry of the Environment and Climate Change. The hydrogeological report should be referred to in this regard.

To minimize the requirements for dewatering of the water bearing sand and silt soils at the site during foundation construction and throughout the life of the building, consideration may be given to using a secant pile wall as the shoring system. The wall should extend below the lowest excavation depth with sufficient penetration into the till soil such that groundwater seepage into the excavation can be minimized. In the event a long-term groundwater cut-off system is preferred, the caisson wall should extend into the shale bedrock with sufficient penetration.

The shoring contractor should make his or her own assessment for temporary control of groundwater seepage into the excavation, taking into considerations for the excavation method through the water bearing soils and the concreting technique for installing the piles below the groundwater table.

Surface water should be directed away from open excavations.

Assuming that the exterior basement walls of the proposed building will be poured up against the shored sides of the excavations, prefabricated drainage sheets (Terradrain® 600 or equivalent) must be placed continuously against the shoring walls. These should drain through drainage ports in the basement walls into a perimeter solid pipe and channel all the water into a sump pit in the building. The maximum spacing of the drainage ports must not exceed 6 m, subject to confirmation at the time of construction.

Based on the measured groundwater levels from the monitoring wells, it is expected that groundwater at the site is situated below shallow depths of about 2 to 4 mbeg. As such, it will be necessary to waterproof the basement walls; at a minimum of 0.5 m above the highest groundwater level measured from the monitoring wells. In this regard, we recommend that waterproofing be installed from el. 87 m (approximately 0.5 m above the measured groundwater level from Borehole MW10) to the bottom of the basement wall.

Sub-floor weeping pipes 100 mm in diameter should be placed under the slab-on-grade at a maximum spacing of 8 m (subject to confirmation at the time of construction). The weeping tiles must be wrapped with filter fabric and covered with a minimum of 150 mm of clear stone. They should be placed a minimum of 0.5 m below the basement floor slab.

The perimeter and sub-floor drains must be connected to a positive frost free outlet from which the water can be removed, or connected to a sump located in the lowest level of the basement. The water from the sump must be pumped out to a suitable discharge point.

Typical details of perimeter and underfloor drainage systems are included in Appendix F of this report.

The installation of the perimeter and sub-floor drains as well as the outlet must conform to the applicable plumbing code requirements.

5.2 Reuse of On-site Excavated Soil

On-site excavated native soils are considered suitable (from a geotechnical perspective) for reuse as backfill or engineered fill material, provided any unsuitable materials are excluded from the backfill, and that their water content is controlled to within 2% of its optimum water content as determined by Standard Proctor test, and the materials are effectively compacted with heavy vibratory pad-type rollers. In areas of narrow trenches or confined spaces such as around manholes, foundations, foundation walls, etc., the use of aggregate fill such as Granular 'B' (OPSS 1010) is required if there is to be post-construction grade integrity.

It should be noted that some of the on-site native soils are wetter than their optimum moisture contents. These materials should be dried sufficiently prior to use as backfill / engineered fill in order to achieve the specified degree of compaction.

5.3 Foundation Design

According to information provided by Kirkor, the historical Old Liverpool House will be moved towards the southern property line and the site will be redeveloped into a mixed-use commercial and residential complex that incorporates a 25-storey tower, a 12-storey midrise building, and a row of 3-storey townhouses constructed over three underground parking garage levels. .

5.3.1 Two Residential Buildings and the Townhouses

Three levels of underground parking garage are planned to be constructed beneath the two residential buildings and the townhouses; it is anticipated that the foundations would be positioned at about elevation 78.5 m.

According to the subsurface investigation findings from the six boreholes, MW1 through MW6, drilled within the limits of the proposed basement, the material encountered at the anticipated foundation founding level will generally consist of very dense silty sand till material. This material is considered satisfactory bearing material and the use of shallow foundation system consisting of conventional spread and strip footings is feasible to support the proposed structures.

Footings founded at or below elevation 78.5 m may be dimensioned for a soil bearing resistance at

Serviceability Limit States (SLS) of 600 kPa, and a factored geotechnical bearing resistances at Ultimate Limit States (ULS) of 900 kPa, for vertical and centric loads.

Footings installed in unheated areas of the underground garage should be provided with sufficient soil cover or equivalent artificial thermal insulation; for frost protection purposes. For three levels unheated basements, the recommended minimum founding depth is 0.8 m for interior column footings and 0.6 m for exterior footings. Adjacent to air shafts and entrance and exit doors, a footing depth of 1.2 m below floor surface level is required.

5.3.2 Relocated Old Liverpool House

According to the subsurface investigation findings, very soft to firm silt and clay soil is present below the fill material. The depths to the top of this layer range from 0.7 to 1.5 mbeg, and extend to depths ranging from approximately 3.5 mbeg at Borehole MW4 to 8.5 mbeg at Borehole MW2, and the termination depths of Borehole MW8 through MW10.

The silt and clay soil is considered unsatisfactory bearing material to support the historical and sensitive Old Liverpool House structure. It will be necessary to support the structure on deep foundations such as drilled piers (caissons) advanced into the compact to very dense till soil; below the soft silt and clay soils.

Drilled piers founded a minimum of 1.5 m into the very dense sandy silt till soil may be designed as end bearing units for bearing resistance at SLS of 1,000 kPa; factored geotechnical bearing resistance at ULS of 1,200 kPa.

It will be necessary to install temporary liners during the drilling of the caisson holes; to prevent ingress of groundwater seepage as well as caving of the wet clayey and sandy soils during the drilling of the caisson holes. Furthermore, it will be necessary to pour concrete in the drilled holes immediately after drilling to prevent accumulation of groundwater in the drilled holes. The temporary liners should be withdrawn in such a manner that there is sufficient head of concrete to prevent water and soils ingress into the caisson holes.

5.3.3 General Considerations

All exterior footings and footings in unheated areas should be provided with at least 1.2 m of soil cover or equivalent artificial thermal insulation for frost protection purposes.

The geotechnical bearing resistance values stated above are for vertical loads (no inclination) and no eccentricity. The total and differential settlements of foundations designed in accordance with the bearing resistance values recommended above should not exceed the conventional limits of 25 mm and 19 mm, respectively.

Due to variations in the consistency of the founding soils and/or softening caused by excavation disturbance and/or seasonal frost effects, all foundation founding materials must be evaluated by the Geotechnical Engineer prior to placing foundation concrete to ensure that the soil exposed at the excavation base is consistent with the design geotechnical bearing resistance.

In the event necessary, the stepping of the footings at different elevations should be carried out at an angle no steeper than 2 horizontal (clear horizontal distance between footings) to 1 vertical (difference in elevation) and no individual footing step should be greater than 0.6 m.

Rainwater or groundwater seepage entering the foundation excavations must be pumped away (not allowed to pond). The foundation subgrade soils should be protected from freezing, inundation and equipment traffic at all times. If unstable subgrade conditions develop, **AA** should be contacted in order to assess the conditions and make appropriate recommendations.

The native soils tend to weather and deteriorate rapidly on exposure to atmosphere or surface water, so construction scheduling should consider the amount of excavation left exposed to the elements, during foundation preparation. **AA** recommends that footings placed on the exposed native soil should be poured on the same day as they are excavated, after removal of all unsuitable founding materials and approval of the bearing surface. Alternatively, a concrete mud slab could be used to protect a bearing surface where footing construction is to be delayed.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided.

5.4 Concrete Slab-on-Grade

5.4.1 Underground Parking Garage

The subgrade below the proposed basement floor slab should consist of native till which is adequate to support a slab-on-grade construction. Subgrade preparation should include the removal of any weak or disturbed soils. After removal of all unsuitable materials, the subgrade should be proof-rolled. The proof-rolling operation should be witnessed by the Geotechnical Engineer. Any soft or unsuitable subgrade areas which deflect significantly should be sub-excavated and replaced with suitable approved earth fill material compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD).

Provided the subgrade, under-floor fill and granular base are prepared in accordance with the above recommendations, the Modulus of Subgrade Reaction (Ks) for floor slab design will be 25,000 kPa/m.

5.4.2 Relocated Old Liverpool House

The subgrade below the proposed floor slab of the relocated building should consist of variable fill soil which is adequate to support a slab-on-grade construction. Subgrade preparation should include the removal of any weak or disturbed soils. After removal of all unsuitable materials, the subgrade should be proof-rolled. The proof-rolling operation should be witnessed by the Geotechnical Engineer. Any soft or unsuitable subgrade areas which deflect significantly should be sub-excavated and replaced with suitable approved earth fill material compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD).

Provided the subgrade, under-floor fill and granular base are prepared in accordance with the above recommendations, the Modulus of Subgrade Reaction (Ks) for floor slab design will be 20,000 kPa/m.

5.4.3 General Considerations

Where new fill is required, excavated materials from the site or similar clean imported fill material may be used, free from organic or deleterious matter. Oversize particles (cobbles, boulders) larger than 150 mm should be discarded from the fill material. The fill material should not be frozen and should not be too wet for efficient compaction (water content at optimum or 2 percent greater than optimum). The fill placement should not be performed during winter months when freezing temperatures occur persistently or intermittently. All fill placed below the slab on grade areas of the building must be placed in lifts of 200 mm thickness or less.

It is recommended that a combined moisture barrier and a levelling course, having a minimum thickness of 200 mm and comprised of free draining material such as 19 mm clear stone (OPSS 1004) compacted by vibration to a dense state be used as a base for the slab-on-grade.

The soils at the site are susceptible to frost effects which would have the potential to deform hard landscaping adjacent to the building. At locations where the new structures are expected to have flush entrances, care must be taken in detailing the exterior slabs/sidewalks, providing insulation/drainage/ non-frost susceptible backfill to maintain the flush threshold during freezing weather conditions.

5.5 Elevator Pits

Elevator pit(s) in general are constructed at a minimum depth of 1.5 m below the lowest basement floor slab, and therefore, we anticipate the top of elevator pit slab will be situated at approximately 10.7 mbeg and the founding level of the elevator pit will be about 11.7 mbeg.

As the elevator pits will extend into the soils below the sub-floor drainage system, it is not recommended to install permanent dewatering systems (weeping tiles) surrounding the bases of the elevators, due to continuous dewatering requirements. It is recommended to waterproof the bases and the walls of the elevator pits, and design the pits for hydrostatic uplift and lateral hydrostatic pressures.

5.6 Lateral Earth Pressures

Parameters used in the determination of earth pressure acting on temporary shoring walls are defined below.

Soil Parameters

Parameter	Definition	Units
Φ'	angle of internal friction	degrees
γ	bulk unit weight of soil	kN/m^3
K_a	active earth pressure coefficient (Rankine)	dimensionless
K_o	at-rest earth pressure coefficient (Rankine)	dimensionless
K_p	passive earth pressure coefficient (Rankine)	dimensionless

The appropriate un-factored values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

Soil Parameter Values

Soil	Parameter				
	Φ’	γ	K_a	K_p	K_o
Fill Materials	28°	20	0.36	2.77	0.53
Silt and Clay	Very soft - 25° Firm to stiff - 28°	17 18	0.41 0.36	2.44 2.77	0.58 0.53
Sandy Silt (Till)	34°	21	0.28	3.54	0.44

The design earth pressures in compacted backfill should be augmented with the dynamic effects of the compaction efforts, which typically are taken as a uniform 12 kPa pressure over the entire depth below grade where the calculated earth pressure based on the above earth pressure factors is less than 12 kPa.

Walls or bracings subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following formula:

$P = K [\gamma h + q]$

Where P = lateral pressure in kPa acting at a depth h (m) below ground surface

K = applicable lateral earth pressure coefficient (**use K_0 for foundation wall design**)

γ = bulk unit weight of backfill (kN/m^3)

h = height at any point along the interface (m)

q = the complete surcharge loading (kPa)

This equation assumes that positive drainage is provided behind the basement walls.

Subsurface walls that are subject to unbalanced earth and hydrostatic pressures must be designed to resist a pressure that can be calculated based on the following formula:

$P = K [\gamma (h - h_w) + \gamma' h_w + q] + \gamma_w h_w$

Where P = lateral pressure in kPa acting at a depth h (m) below ground surface

K = applicable lateral earth pressure coefficient

H = height at any point along the interface (m)

h_w = depth below the groundwater level at point of interest (m)

γ = bulk unit weight of backfill (kN/m^3)

γ' = the submerged unit weight (kN/m^3) of exterior soil ($\gamma' = \gamma - \gamma_w$)

γ_w = unit weight of water, assume a value of 9.8 kN/m^3

q = the complete surcharge loading (kPa)

Resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction (**R**) depends on the normal load on the soil contact (**N**) and the frictional resistance of the soil (**tan Φ’**) expressed as: **R = N tan Φ’**. This is an ultimate resistance value and does not contain a factor of safety.

5.7 Shoring Design

The site is located at the northwest corner of Kingston Road and Liverpool Road in the City of Pickering; bounded by a single-storey house to the north, Kingston Road to the south, Liverpool Road to the east and two-storey houses and single-storey commercial buildings to the west. The excavation of up to three levels of basement will require a temporary shoring system. A soldier-pile and wood lagging or a continuous secant-pile wall may be used as the temporary shoring system for the excavation.

The design of temporary shoring for the support of the excavation walls must account for the presence of structures and buried services on the adjacent properties, and the existing subsurface conditions at the site.

The lateral restraining force for the shoring system may be provided by employing either rakers or tieback anchors. The latter is favourable because they do not protrude into the excavations as is the case with rakers. The use of tieback anchors will depend on whether permission is obtained to extend the anchors to the required distance on to the neighbouring properties.

To prevent possible caving of soils, the tie back anchors should be drilled with a hollow stem auger, and anchors installed and concrete/cement grout poured through the liner.

It will be necessary to install temporary liners for the excavation of the soldier pile holes. The shoring contractor must provide construction method(s) to overcome any groundwater seepage into the pile holes during excavation and subsequent concreting of the piles to comply with good construction practice.

It may also be necessary to locally install geotextile fabrics behind the lagging boards to prevent migration of any sandy soils into the excavation. The geotextile filter should also be jammed into any seepage points where material loss is occurring.

The shoring design should be based on the procedure detailed in the latest edition of the Canadian Foundation Engineering Manual.

The active earth pressure coefficient; Ka to be used for the design of the shoring system, should be as follows:

= 0.4 where adjacent building footings or buried services fall within an envelope formed by a 60^0 line drawn from the base of the excavation wall to the ground surface.

= 0.3 where adjacent building footings or buried services fall outside an envelope formed by a 60^0 line drawn from the base of the excavation wall to the ground surface.

= 0.25 where adjacent building footings or buried services are outside an envelope formed by a 45^0 line drawn from the base of the excavation wall to the ground surface.

The minimum depth of penetration (d) of soldier piles may be estimated from the following expression:

$$\mathbf{R = NB}\ (\tfrac{1}{2}\gamma \mathbf{d^2K_p})$$

where **R** = required toe resistance

K_p = passive earth pressure coefficient = 3.54

N = factor according to three dimensional effect around an isolated pile, use 2.0 for cohesive materials

B = diameter of concrete filled hole

d = required penetration depth

γ = bulk unit weight of soil = 22 kN/m^3

Raker footings should be designed in accordance with the design principals for shallow foundations subject to inclined loading. All raker footings should be located outside the zone of influence of the buried portion of soldier piles, and at a distance of no less than 1.5D from the piles, where D = Depth of penetration of the piles below the base of the excavation. No excavation should be made within two footings widths of the raker footings, on the side opposite the rakers.

Anchors extended into sandy clayey silt till soils may be designed based on a soil/grout bond value of 75 kPa. The use of this value is dependent on the anchor installation method and grouting procedures. Gravity poured concrete can result in low bond values, while pressure grouted anchors will give higher values and produce a more satisfactory anchor.

It will be necessary to perform load tests on the tiebacks to confirm the bond stresses assumed in the design of anchors.

Movement of the shoring system is inevitable. Vertical movements will result from the vertical loads on the soldier piles resulting from the inclined tiebacks and inward horizontal movement will result from the earth and water pressures. The magnitude of this movement can be controlled by sound construction practices. The lateral and vertical movement of the shoring system must be monitored especially at locations in which settlement sensitive structures are present, to ensure that movements are kept within acceptable range.

5.8 Pavement Design

5.8.1 On-Grade Construction

The boreholes advanced at the site revealed that the subgrade for the pavement will consist of fill material. The subgrade should be thoroughly proof-rolled and re-compacted to ensure uniformity in subgrade strength and support. Lift thicknesses should not exceed 200 mm in a loose state and the excavated site material should be compacted using heavy vibratory rollers. As an alternative, if suitable on-site native material is not available, the upper part of the subgrade could be improved by placing imported granular material.

Soils used as engineered fill should be free from organics and/or other unsuitable material. The engineered fill must be placed in lifts not exceeding 200 mm in thickness and compacted to at least 98% SPMDD for the upper 1,000 mm and 95% below this level.

Given the frost susceptibility and drainage characteristics of the subgrade soils, the following pavement design is recommended.

Minimal Asphaltic Concrete Pavement Structure Design

Pavement Layer	Compaction Requirements	Light Duty Asphalt Minimum Component Thickness	Heavy Duty Asphalt Minimum Component Thickness
Surface Course Asphaltic Concrete	as per OPSS 310	40 mm Hot-Laid HL3 (OPSS 1150)	40 mm Hot-Laid HL3 (OPSS 1150)
Binder Course Asphaltic Concrete	as per OPSS 310	40 mm Hot Laid HL8 (OPSS 1150)	60 mm Hot-Laid HL8 (OPSS 1150)
Granular Base	100% SPMDD*	150 mm Granular 'A' (OPSS 1010) or 19 mm Crusher Run Limestone	150 mm Granular 'A' (OPSS 1010) or 19 mm Crusher Run Limestone
Granular Subbase	100% SPMDD*	200 mm Granular 'B' Type II (OPSS 1010) or 50 mm Crusher Run Limestone	300 mm Granular 'B' Type II (OPSS 1010) or 50 mm Crusher Run Limestone

*Note: Standard Proctor Maximum Dry Density (ASTM-D698).

The subgrade must be compacted to at least 98% of SPMDD for at least the upper 600 mm and 95% below this level. The granular base and sub-base materials should be compacted to a minimum of 100% SPMDD.

The long-term performance of the proposed pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible when fill is placed and that the subgrade is not disturbed and weakened after it is exposed.

Control of surface water is a significant factor in achieving good pavement life. Grading adjacent to the pavement areas must be designed so that water is not allowed to pond adjacent to the outside edges of the pavement or curb. In addition, the need for adequate drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum gradient of three percent) to provide effective drainage toward subgrade drains. Sub-drains are recommended to intercept excess subsurface moisture at the curb lines and catch basins. The invert of sub-drains should be maintained at least 0.3 m below subgrade level.

Additional comments on the construction of pavement areas are as follows:

- As part of the subgrade preparation, the proposed pavement areas should be stripped of vegetation, topsoil, unsuitable earth fill and other obvious objectionable material. The subgrade should be properly shaped and sloped as required, and then proof-rolled. Loose/soft or spongy subgrade areas should be sub-excavated and replaced with suitable approved material compacted to at least 98% of SPMDD.
- Where new fill is needed to increase the grade or replace disturbed portions of the subgrade, excavated inorganic soils or similar clean imported fill materials may be used, provided their moisture

content is maintained within 2 % of the soil's optimum moisture content. All fill must be placed and compacted to not less than 98% of SPMDD.

- For fine-grained soils, as encountered at the site, the degree of compaction specification alone cannot ensure distress free subgrade. Proof-rolling must be carried out and witnessed by **AA** personnel for final recommendations of sub-base thicknesses.
- In the event that pavement construction takes place in the spring thaw, the late fall, or following periods of significant rainfall, it should be anticipated that an increase in thickness of the granular sub-base layer will be required to compensate for reduced subgrade strength.

5.8.2 Above Parking Garage Roof

The pavement above the parking garage roof slab may be comprised of a minimum of 75 mm thick layer of granular 'A' topped with asphaltic concrete having a minimum thickness of 80 mm (40 mm HL8 and 40 mm HL3). The asphaltic concrete materials should be rolled and compacted in accordance with OPSS 310 requirements.

The critical section of pavement will be at the transition between the pavement on grade and the pavement above the garage roof slab. In order to alleviate the detrimental effects of dynamic loading / settlement / pavement depression in the backfill to the rigid garage roof structure, it is recommended that an approach type slab be constructed at the entrance/exit points, by extending the granular sub-base to greater depths along the exterior garage wall.

5.9 Earthquake Design Parameters

The Ontario Building Code (2012) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.18.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

The parameters for determination of the Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the Ontario Building Code (2012). The classification is based on the determination of the average shear wave velocity in the top 30 metres of the site stratigraphy, where shear wave velocity (V_s) measurements have been taken. In the absence of such measurements, the classification is estimated on the basis of empirical analysis of undrained shear strength or penetration resistance. The applicable penetration resistance is that which has been corrected to a rod energy efficiency of 60% of the theoretical maximum or the (N_{60}) value.

Based on the borehole information, the subsurface stratigraphy generally comprises surficial fill material, followed by very soft to firm silt and clay native material, underlain by compact to dense silty sand some gravel some clay and gravelly sand, some silt, some clay till material, followed by shale bedrock. Based on the above, the site designation for seismic analysis is Class C according to Table 4.1.8.4.A from the quoted code.

The site specific 5% damped spectral acceleration coefficients, and the peak ground acceleration factors are provided in the 2012 OBC - Supplementary Standard SB-1 (September 14, 2012), Table 1.2, location Pickering, Ontario.

5.10 Chemical Characterization of Subsurface Soil

Two soil samples obtained from Boreholes MW3 and MW4 were submitted to AGAT Laboratories for pH index test and water-soluble sulphate content to determine the potential of attacking the subsurface concrete. The test results are summarized below:

Soil Parameter	MW3: 10.8 mbeg (Sample 11)	MW4: 9.5 mbgs (Sample 10)
pH	7.83	7.78
Water-soluble Sulphate (%)	0.0409	0.0270

The pH of the tested samples indicates a slight alkalinity. The concentration of water-soluble sulphate content of the tested samples is below the CSA Standard of 0.1% water-soluble sulphate (Table 12 of CSA A23.1, Requirements for Concrete Subjected to Sulphate Attack). Special concrete mixes against sulphate attack is therefore not required for the sub-surface concrete of the proposed buildings.

The Certificate of Analysis provided by the analytical chemical testing laboratory is contained in Appendix E of this report.

6 LIMITATIONS OF REPORT

The Limitations of Report, as quoted in Appendix 'A', are an integral part of this report.

Yours respectfully,

alston associates
A Division of Terrapex Environmental Ltd.

LICENSED PROFESSIONAL ENGINEER
V. NERSESIAN
33778705
17/05/2019
PROVINCE OF ONTARIO

Vic Nersesian, P.Eng.
Vice President, Geotechnical Services

APPENDIX A

LIMITATIONS OF REPORT

Limitations of Report

The conclusions and recommendations in this report are based on information determined at the inspection locations. Soil 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 soil investigation.

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 details of alignment and elevations stated in the report. Since all details of the design may not be known to us, in our analysis certain assumptions had to be made as set out in this report. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

This report was prepared for Altona Group by Alston Associates, the geotechnical division of Terrapex Environmental Ltd. The material in it reflects Alston Associates judgement in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions which the Third Party may make based on it, are the sole responsibility of such Third Parties.

We recommend, therefore, that we be retained during the final design stage to review the design drawings and to verify that they are consistent with our recommendations or the assumptions made in our analysis. We recommend also that we be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the test holes. In cases where these recommendations are not followed, the company’s responsibility is limited to accurately interpreting the conditions encountered at the test holes, only.

The comments given in this report on potential construction problems and possible methods are intended for the guidance of the design engineer, only. The number of inspection locations may not be sufficient to determine all the factors that may affect construction methods and costs. 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.

APPENDIX B

BOREHOLE LOCATION PLAN

TERRAPEX

BOREHOLE LOCATION PLAN

1294 KINGSTON ROAD, 1848 AND
1852 LIVERPOOL ROAD
PICKERING, ONTARIO

CLIENT

ALTONA GROUP

LEGEND

- ⊕ MONITORING WELL
- ● BOREHOLE
- ▬ ▬ APPROXIMATE LIMITS OF BASEMENT

0 25m 50m
(APPROXIMATE)

SOURCE: VUMAP, FIRST BASE SOLUTIONS, 2018 IMAGERY.

PROJECT #	18-204
SCALE	AS SHOWN
DATE	FEBRUARY 2019
DRAWN SF	CHECKED
DRAWING #	DRAWING 1

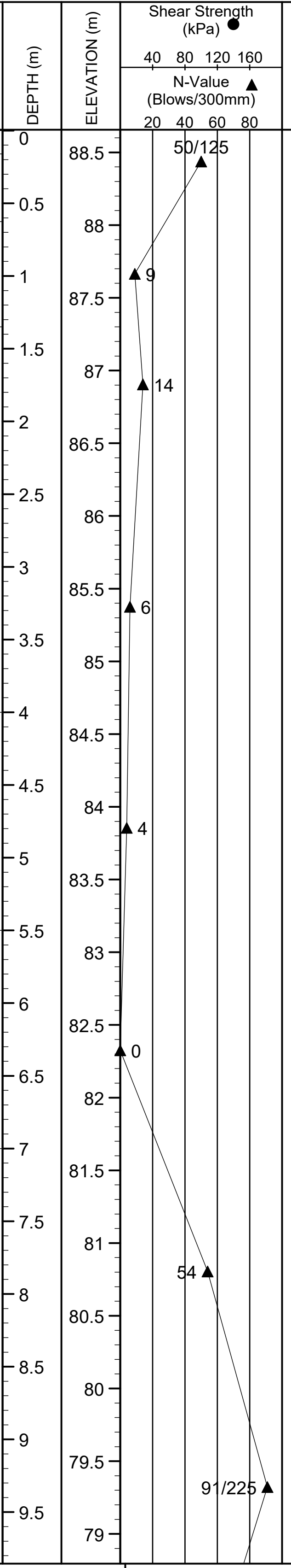
APPENDIX C

BOREHOLE LOG SHEETS

CLIENT: Altona Group	METHOD: Hollow Stem Auger and Split Spoon	**BH No.: MW1**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN / ELEV. (m) 88.65	
LOCATION: 1294 Kingston Road, Pickering	NORTHING: / EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON

GWL (m)	SOIL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SPT(N)	REMARKS
	150 mm Asphaltic Concrete				
	(FILL) brown to dark brown coarse to fine sand some gravel, trace brick fragments	1	SPLIT SPOON	50/ 125	Groundwater measured at 3.27 m below ground surface on February 15, 2019
	(FILL) dark brown silty clay	2	SPLIT SPOON	9	Bentonite Hollow Stem augers used to start drilling at MW1
▽	varved SILTY CLAY slightly moist yellow -brown grey ------ yellow -brown oxidized lenses	3 4	SPLIT SPOON	14 6	Mud rotary drilling started at 3.5 m depth
	grey CLAY some gravel wet	5	SPLIT SPOON	4	
	grey SANDY SILTY CLAY some gravel	6	SPLIT SPOON	0	Weight of hammer/450 mm
	grey SILTY SAND some gravel some clay (TILL)	7 8	SPLIT SPOON	54 91/ 225	



Water Content (%)
PL W.C. LL
20 40 60 80

Well Construction

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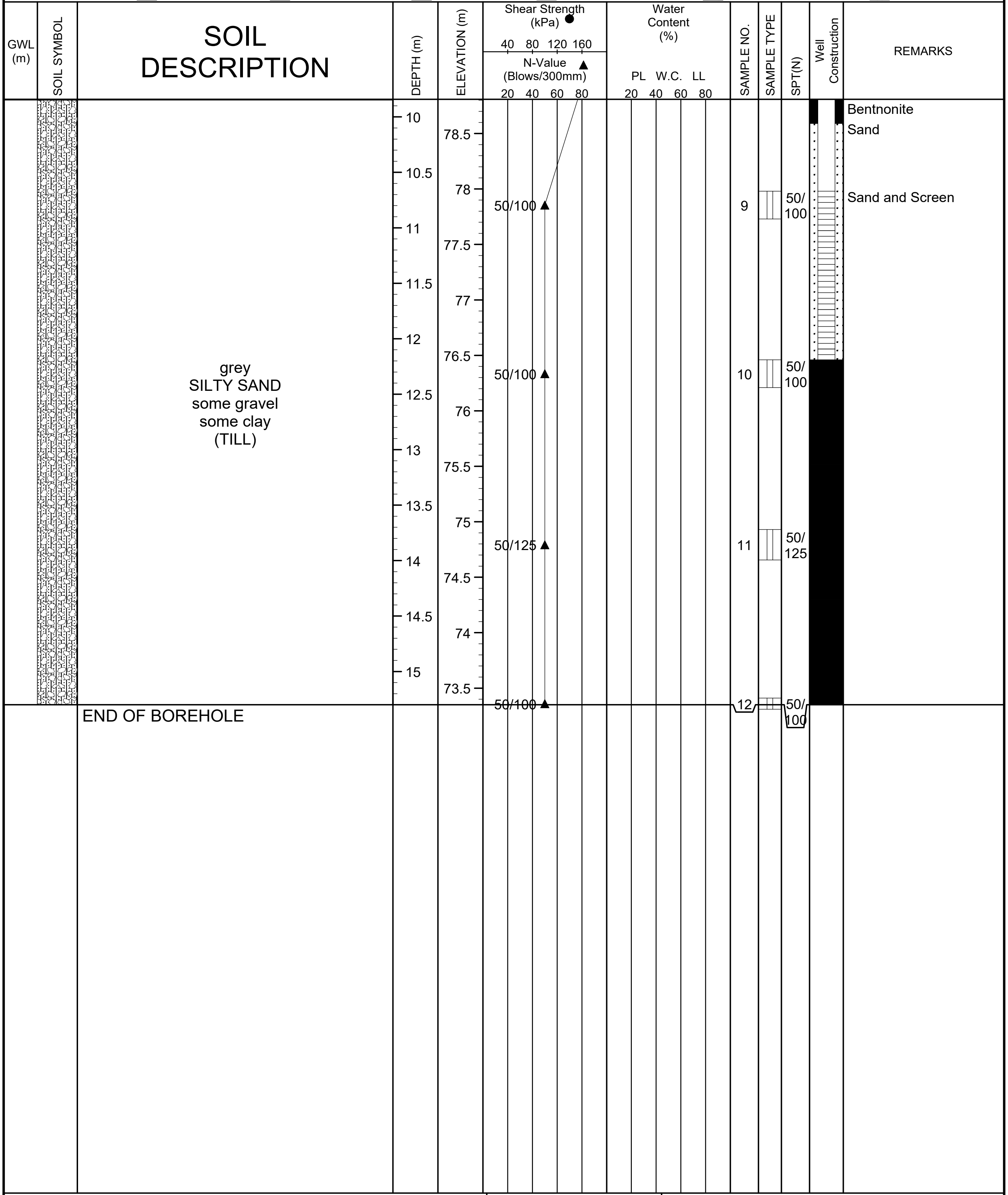
LOGGED BY: JA	DRILLING DATE: 13 January, 2019
REVIEWED BY: VN	Page 1 of 2

CLIENT: Altona Group
METHOD: Hollow Stem Auger and Split Spoon
PROJECT: Liverpool House Condos
PROJECT ENGINEER: VN
ELEV. (m) 88.65

BH No.: MW1

LOCATION: 1294 Kingston Road, Pickering
NORTHING:
EASTING:
PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON



grey
SILTY SAND
some gravel
some clay
(TILL)

END OF BOREHOLE

SAMPLE NO.	SAMPLE TYPE	SPT(N)
9	SPLIT SPOON	50/ 100
10	SPLIT SPOON	50/ 100
11	SPLIT SPOON	50/ 125
12	SPLIT SPOON	50/ 100

REMARKS:
Bentnonite
Sand
Sand and Screen

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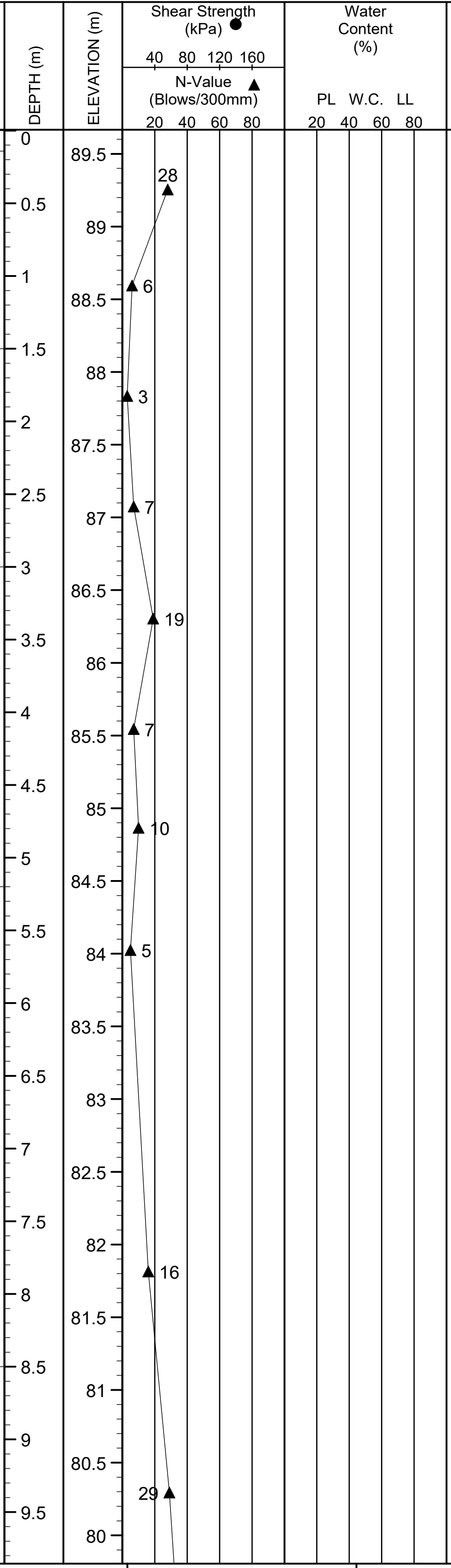
CLIENT: Altona Group	METHOD: Hollow Stem Auger and Split Spoon	**BH No.: MW2**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN ELEV. (m) 89.66	
LOCATION: 1294 Kingston Road, Pickering	NORTHING: EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON

SOIL DESCRIPTION

GWL (m)	SOIL DESCRIPTION	
	100 mm Asphaltic Concrete	
	(Fill) silty and gravelly sad, moist	
	brown varved SILTY CLAY moist	
▼	SAND and SILT trace gravel trace clay	brown -grey, moist to wet ------ grey, wet
	grey SILTY CLAY some gravel	
	grey SILTY SAND some gravel some clay (TILL)	



SAMPLE NO.	SPT(N)
1A	28
1B	
2	6
3	3
4	7
5	19
6	7
7	10
8	5
9	16
10	29

Well Construction

REMARKS

Groundwater measured at 3.56 m below ground surface on February 15, 2019.

Bentonite

Hollow stem augering used st start drilling at MW2

Mud rotary drilling started at 8.0 m depth.

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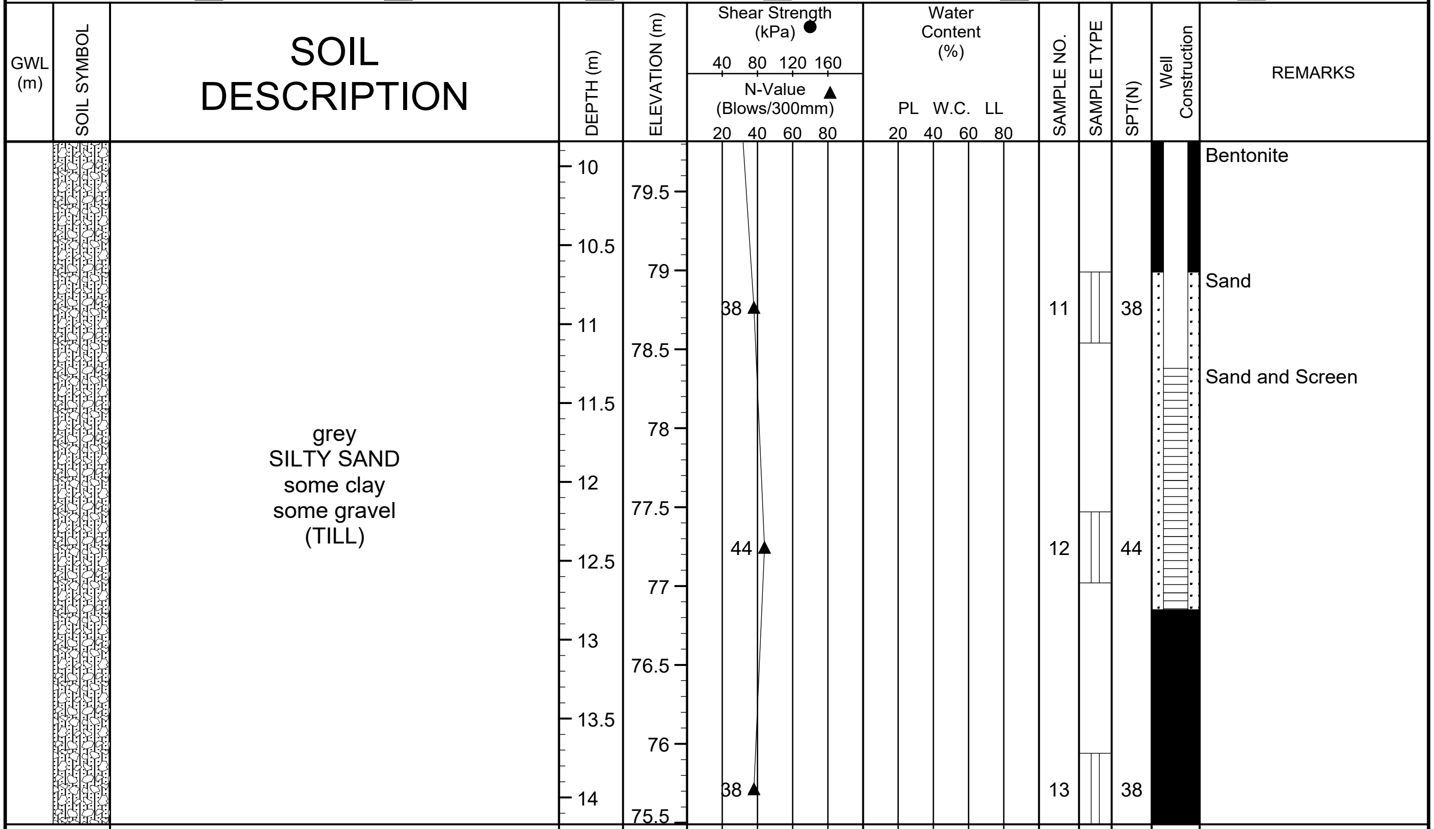
CLIENT: Altona Group	METHOD: Hollow Stem Auger and Split Spoon	**BH No.: MW2**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN ELEV. (m) 89.66	
LOCATION: 1294 Kingston Road, Pickering	NORTHING: EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE AUGER DRIVEN CORING DYNAMIC CONE SHELBY SPLIT SPOON



grey
SILTY SAND
some clay
some gravel
(TILL)

SAMPLE NO.	SPT(N)
11	38
12	44
13	38

REMARKS:
Bentonite
Sand
Sand and Screen

END OF BOREHOLE

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CLIENT: Altona Group

METHOD: Hollow Stem Auger and Split Spoon

BH No.: MW2A

PROJECT: Liverpool House Condos

PROJECT ENGINEER: VN

ELEV. (m) 89.66

LOCATION: 1294 Kingston Road, Pickering

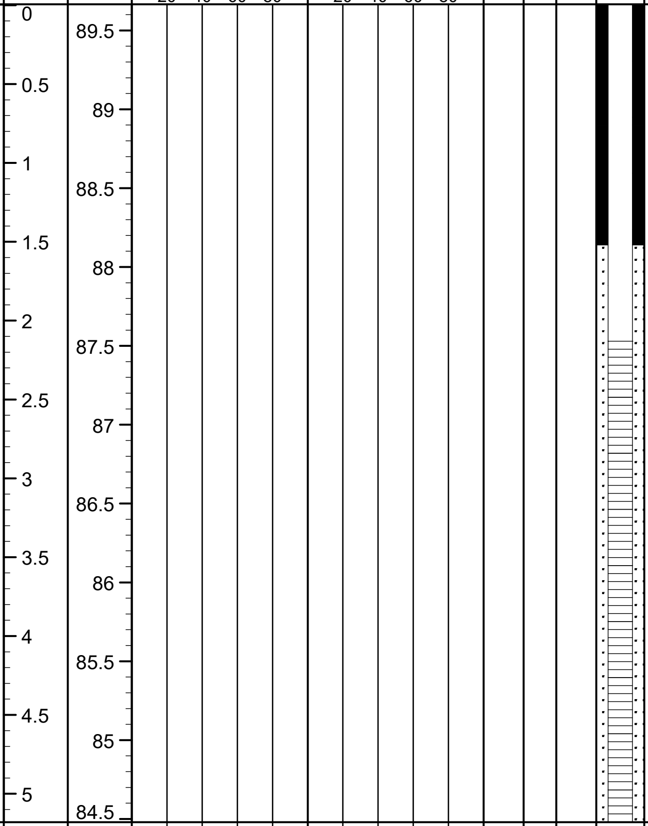
NORTHING:

EASTING:

PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◢ DRIVEN ⧓ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) ● 40 80 120 160 / N-Value (Blows/300mm) ▲ 20 40 60 80	Water Content (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
▼ (3.28)		For soil stratigraphy refer to MW2									Groundwater measured at 3.28 m below ground surface on February 15, 2019. Bentonite Sand Sand and Screen
		END OF BOREHOLE									



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DRILLING DATE: 8 February, 2019

REVIEWED BY: VN

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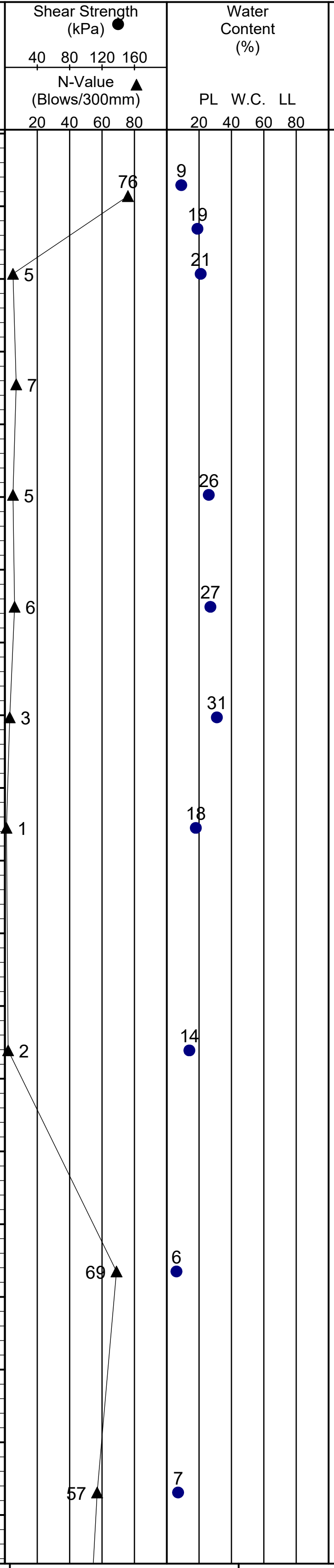
CLIENT: Altona Group
PROJECT: Liverpool House Condos
LOCATION: 1294 Kingston Road, Pickering
METHOD: Hollow Stem Auger and Split Spoon
PROJECT ENGINEER: VN
ELEV. (m) 88.52
NORTHING:
EASTING:

BH No.: MW3

PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◢ DRIVEN ⧓ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON

GWL (m)	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)
	150 mm Asphaltic Concrete	0	88.5
	450 mm Granular Base	0.5	88
	(FILL) dark brown to brown sandy silty clay		
	SILTY CLAY trace sand trace gravel varved, brown -grey, moist ------ brown -grey, wet ------ grey, wet	1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7	87.5 87 86.5 86 85.5 85 84.5 84 83.5 83 82.5 82 81.5
▽ (≈3.75)			
	grey SILTY SAND some gravel some clay (TILL)	7.5 8 8.5 9 9.5	81 80.5 80 79.5 79



SAMPLE NO.	SAMPLE TYPE	SPT(N)	Water Content (%)
1A	⌶	76	9
1B	⌶		19
2	⌶	5	21
3	⌶	7	
4	⌶	5	26
5	⌶	6	27
6	⌶	3	31
7	⌶	1	18
8	⌶	2	14
9	⌶	69	6
10	⌶	57	7

Well Construction

REMARKS

Groundwater measured at 3.75 m below ground surface on February 15, 2019.

Bentonite

Sand

Sand and Screen

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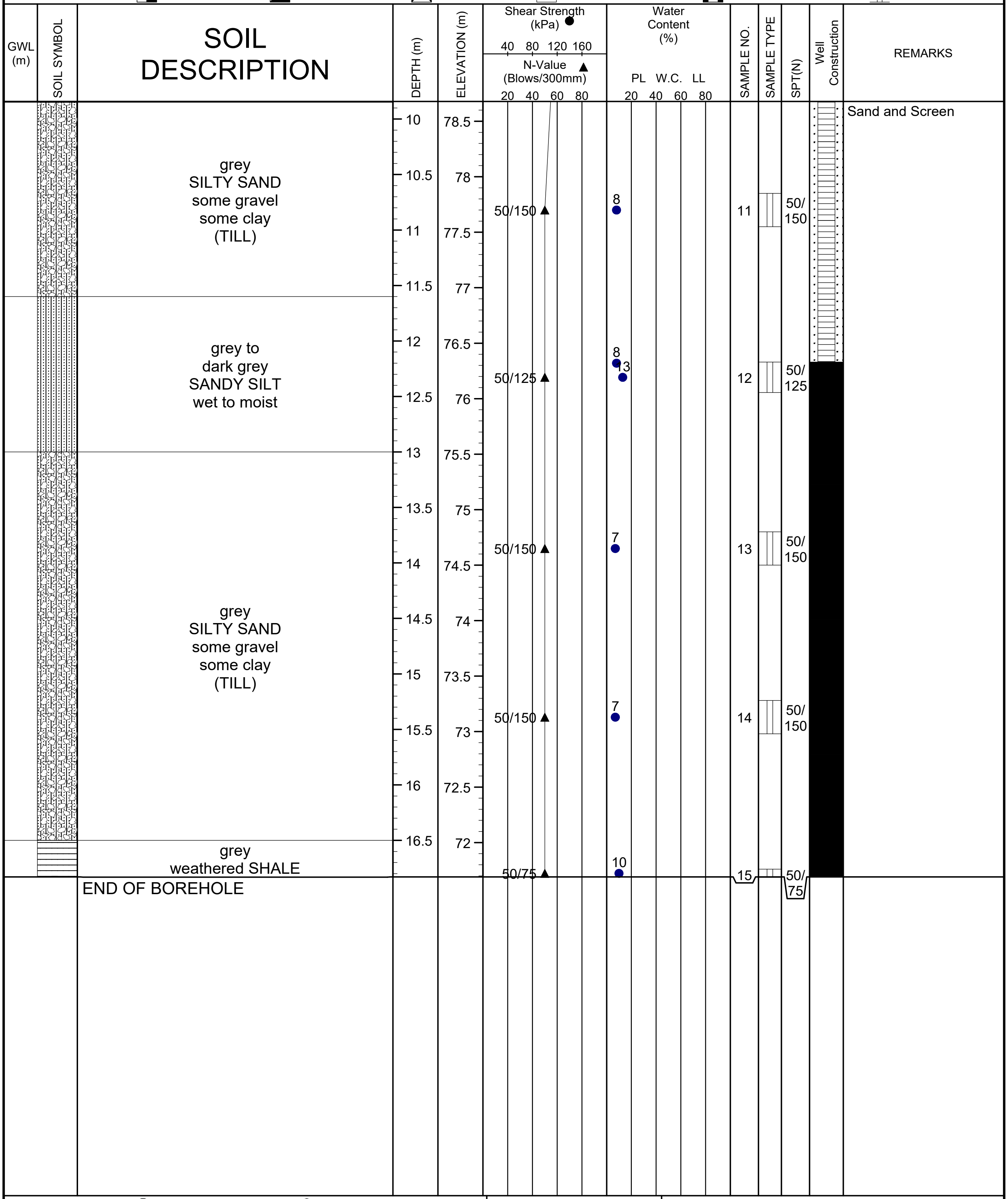
CLIENT: Altona Group	METHOD: Hollow Stem Auger and Split Spoon	**BH No.: MW3**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN ELEV. (m) 88.52	
LOCATION: 1294 Kingston Road, Pickering	NORTHING: EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◪ DRIVEN ⧗ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON



grey
SILTY SAND
some gravel
some clay
(TILL)

grey to
dark grey
SANDY SILT
wet to moist

grey
SILTY SAND
some gravel
some clay
(TILL)

grey
weathered SHALE

END OF BOREHOLE

SAMPLE NO.	SAMPLE TYPE	SPT(N)
11	⌶	50/150
12	⌶	50/125
13	⌶	50/150
14	⌶	50/150
15	⌶	50/75

REMARKS: Sand and Screen

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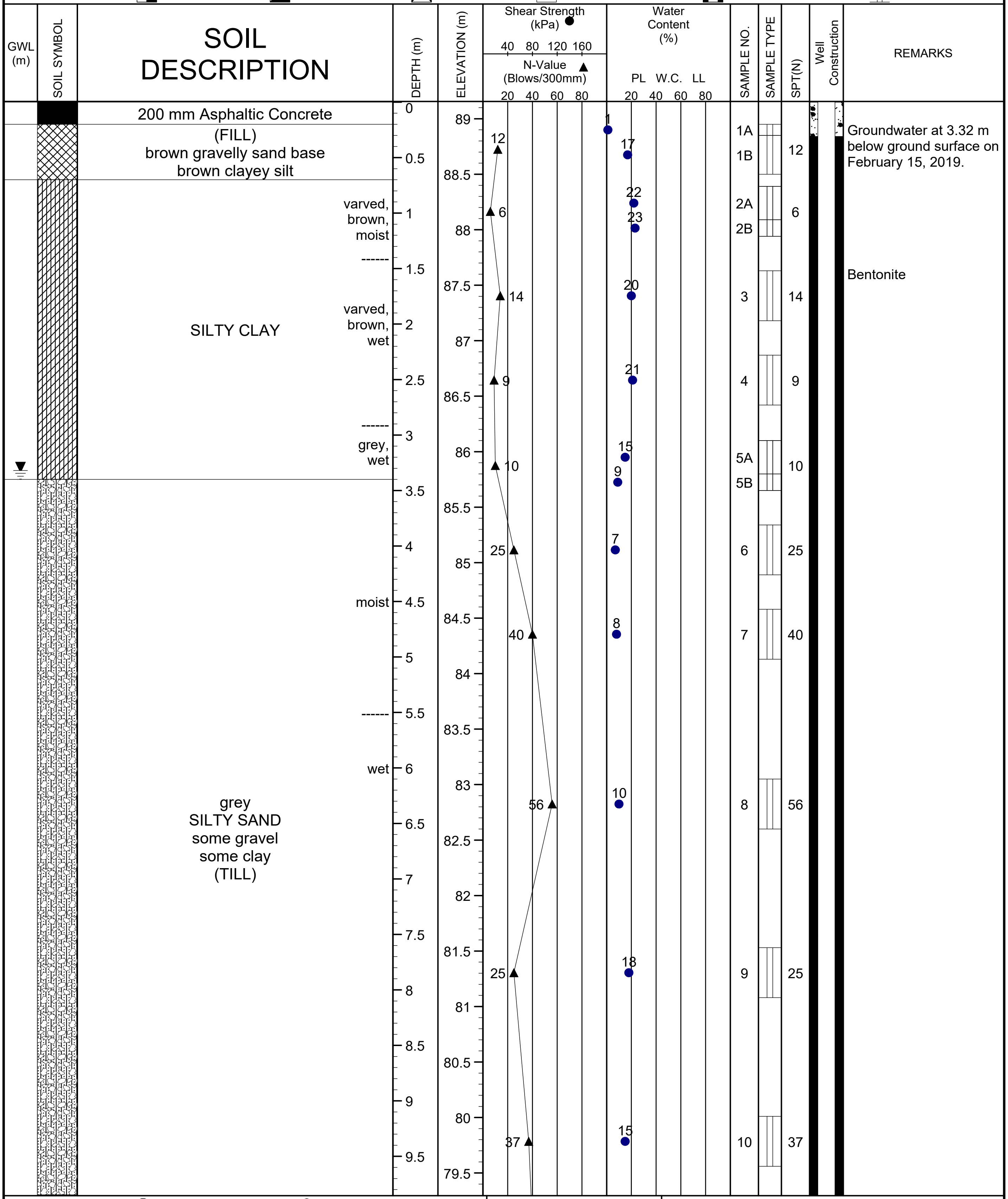
REVIEWED BY: VN	Page 2 of 2

CLIENT: Altona Group
PROJECT: Liverpool House Condos
LOCATION: 1294 Kingston Road, Pickering
METHOD: Hollow Stem Auger and Split Spoon
PROJECT ENGINEER: VN
ELEV. (m) 89.15
NORTHING:
EASTING:

BH No.: MW4

PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◩ DRIVEN ⧗ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON



200 mm Asphaltic Concrete

(FILL)
brown gravelly sand base
brown clayey silt

SILTY CLAY
varved, brown, moist
------
varved, brown, wet
------
grey, wet

grey
SILTY SAND
some gravel
some clay
(TILL)
moist
------
wet

SAMPLE NO.	SPT(N)	N-Value	Water Content (%)
1A			1
1B	12	12	17
2A			22
2B	6	6	23
3	14	14	20
4	9	9	21
5A			15
5B	10	10	9
6	25	25	7
7	40	40	8
8	56	56	10
9	25	25	18
10	37	37	15

REMARKS:
Groundwater at 3.32 m below ground surface on February 15, 2019.

Bentonite

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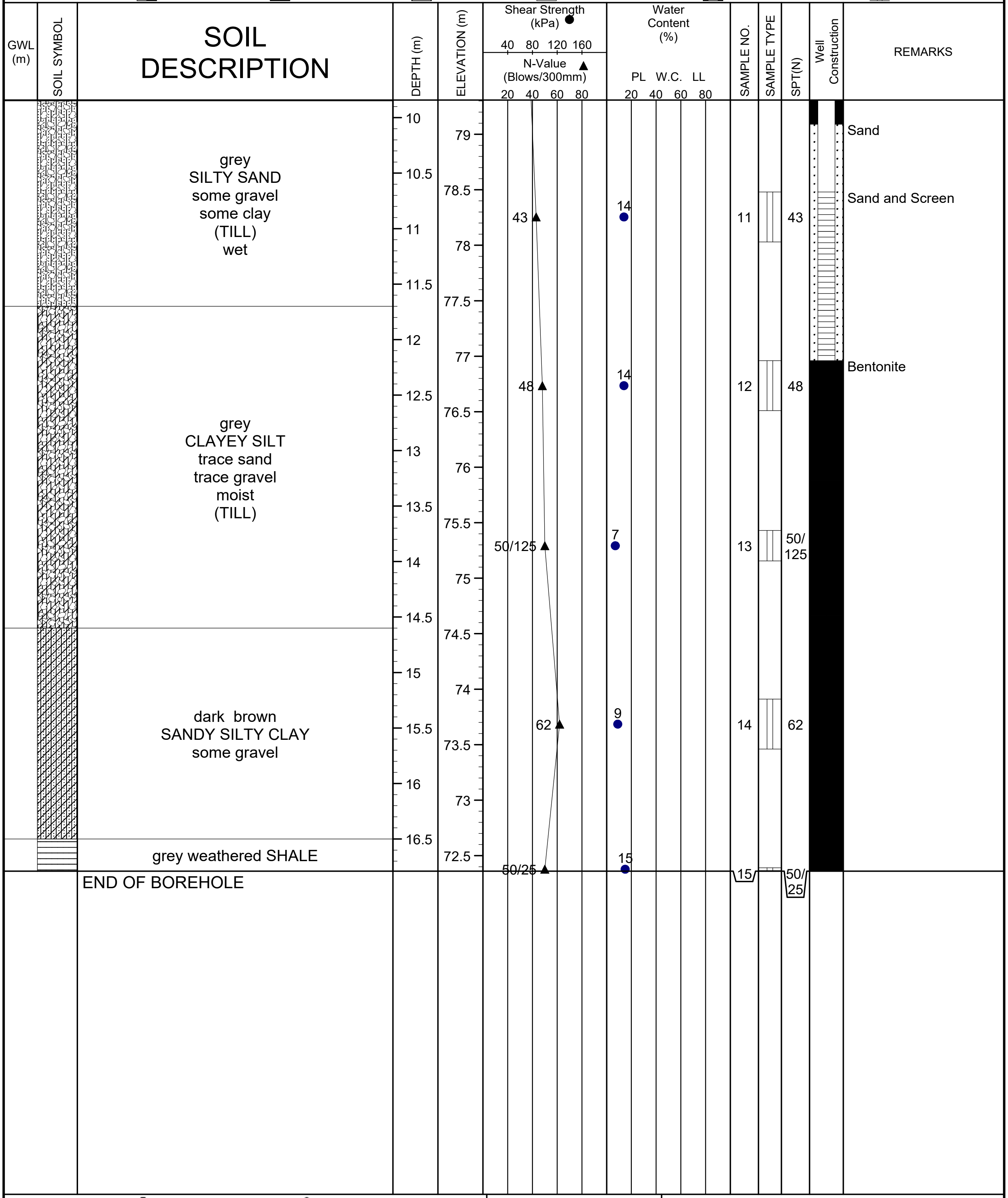
geotechnical division of TERRAPEX

LOGGED BY: DM
REVIEWED BY: VN
DRILLING DATE: 2 January, 2019

CLIENT: Altona Group	METHOD: Hollow Stem Auger and Split Spoon	**BH No.: MW4**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN / ELEV. (m) 89.15	
LOCATION: 1294 Kingston Road, Pickering	NORTHING: / EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◢ DRIVEN ⧗ CORING ▀ DYNAMIC CONE ▯ SHELBY Ⅱ SPLIT SPOON



grey
SILTY SAND
some gravel
some clay
(TILL)
wet

grey
CLAYEY SILT
trace sand
trace gravel
moist
(TILL)

dark brown
SANDY SILTY CLAY
some gravel

grey weathered SHALE

END OF BOREHOLE

SAMPLE NO.	SPT(N)	N-Value	Water Content (%)
11	43	43	14
12	48	48	14
13	50/ 125	50/125	7
14	62	62	9
15	50/ 25	50/25	15

REMARKS:
Sand
Sand and Screen
Bentonite

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DRILLING DATE: 2 January, 2019	REVIEWED BY: VN
	Page 2 of 2

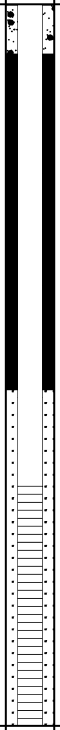
CLIENT: Altona Group
METHOD: Hollow Stem Auger and Split Spoon

BH No.: MW4A

PROJECT: Liverpool House Condos
PROJECT ENGINEER: VN
ELEV. (m) 89.15
LOCATION: 1294 Kingston Road, Pickering
NORTHING:
EASTING:
PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◢ DRIVEN ⧗ CORING ▀ DYNAMIC CONE ▯ SHELBY 工 SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) ● 40 80 120 160 N-Value (Blows/300mm) ▲ 20 40 60 80	Water Content (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
			0	89							Concrete Groundwater at 2.34 m below ground surface on February 15, 2019.
			0.5 1	88.5 88							Bentonite
▼		For stratigraphy please refer to MW4	1.5 2 2.5	87.5 87 86.5							Sand
			3 3.5 4 4.5	86 85.5 85							Sand and Screen
		END OF BOREHOLE									



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geotechnical division of TERRAPEX

LOGGED BY: DM
DRILLING DATE: 2/3 January, 2019
REVIEWED BY: VN

CLIENT: Altona Group
METHOD: Hollow Stem Auger and Split Spoon

BH No.: 5

PROJECT: Liverpool House Condos
PROJECT ENGINEER: VN
ELEV. (m) 88.42
LOCATION: 1294 Kingston Road, Pickering
NORTHING:
EASTING:
PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON

GWL (m) | SOIL SYMBOL | SOIL DESCRIPTION | DEPTH (m) | ELEVATION (m) | Shear Strength (kPa) ● / N-Value (Blows/300mm) ▲ | Water Content (%) PL W.C. LL | SAMPLE NO. | SAMPLE TYPE | SPT(N) | Well Construction | REMARKS

SOIL DESCRIPTION

150 mm Asphaltic Concrete

450 mm Granular Base

(FILL) dark brown silty clay
some organics

SILTY CLAY
trace to
some sand
trace gravel

varved,
brown

moist
to wet

------

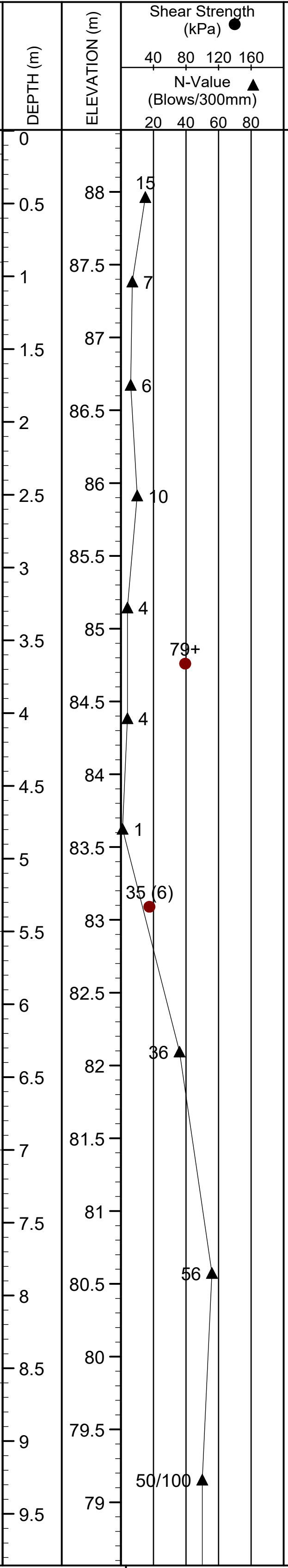
grey

dark grey
SANDY SILTY CLAY
trace gravel
(TILL)

dark grey
GRAVELLY SAND
some silt
some clay
(TILL)
moist to wet

dark grey SILTY SAND
trace to some clay
trace to some gravel
(TILL), moist

SAMPLE NO.	SPT(N)
1A 1B	15
2	7
3	6
4A 4B	10
5	4
6A 6B	4
7	1
8	36
9	56
10	50/100



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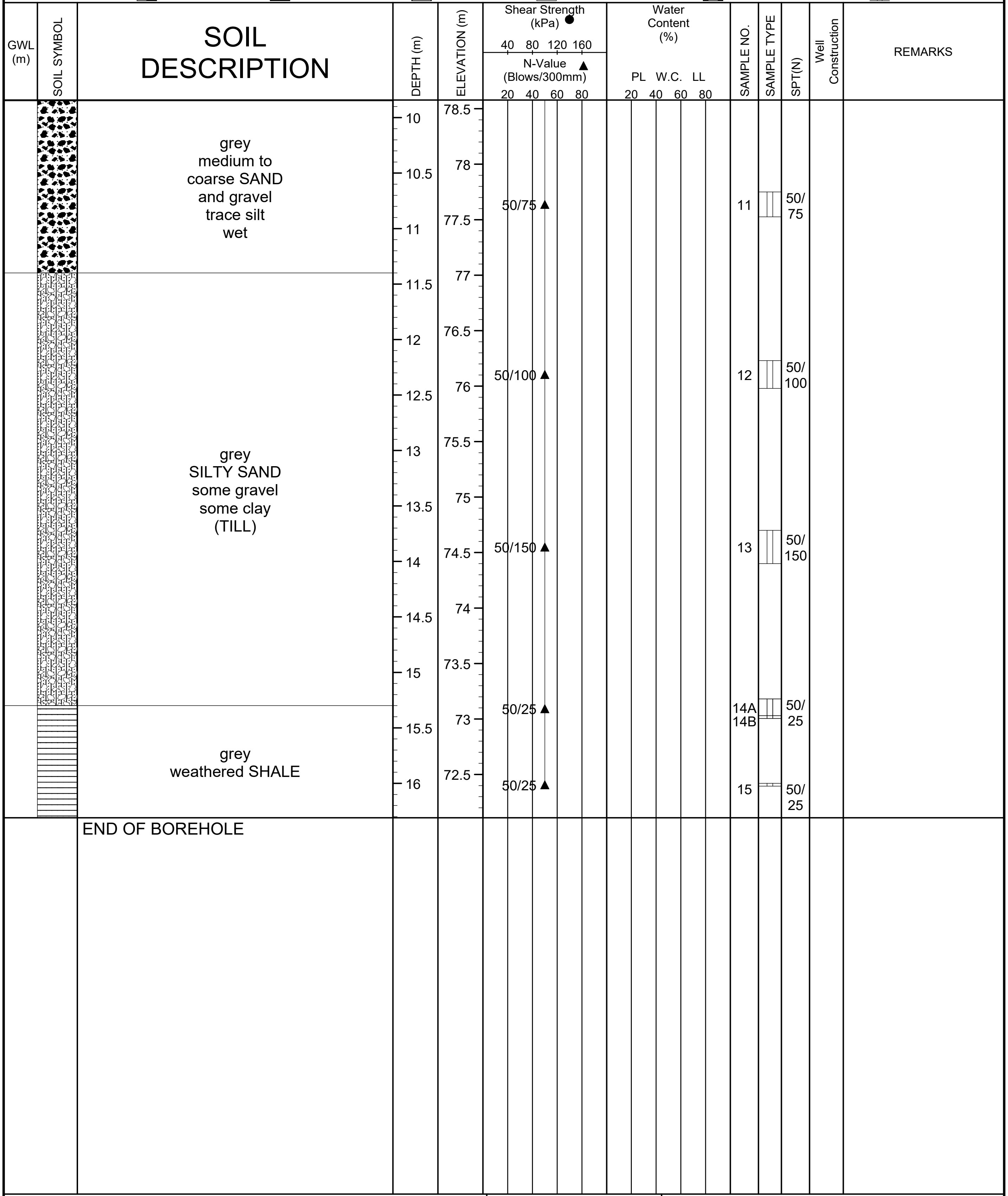
LOGGED BY: DM
DRILLING DATE: 3/4 January, 2019
REVIEWED BY: VN

CLIENT: Altona Group
METHOD: Hollow Stem Auger and Split Spoon
PROJECT: Liverpool House Condos
PROJECT ENGINEER: VN
ELEV. (m) 88.42

BH No.: 5

LOCATION: 1294 Kingston Road, Pickering
NORTHING:
EASTING:
PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON



grey
medium to
coarse SAND
and gravel
trace silt
wet

grey
SILTY SAND
some gravel
some clay
(TILL)

grey
weathered SHALE

END OF BOREHOLE

SAMPLE NO.	SPT(N)
11	50/75
12	50/100
13	50/150
14A 14B	50/25
15	50/25

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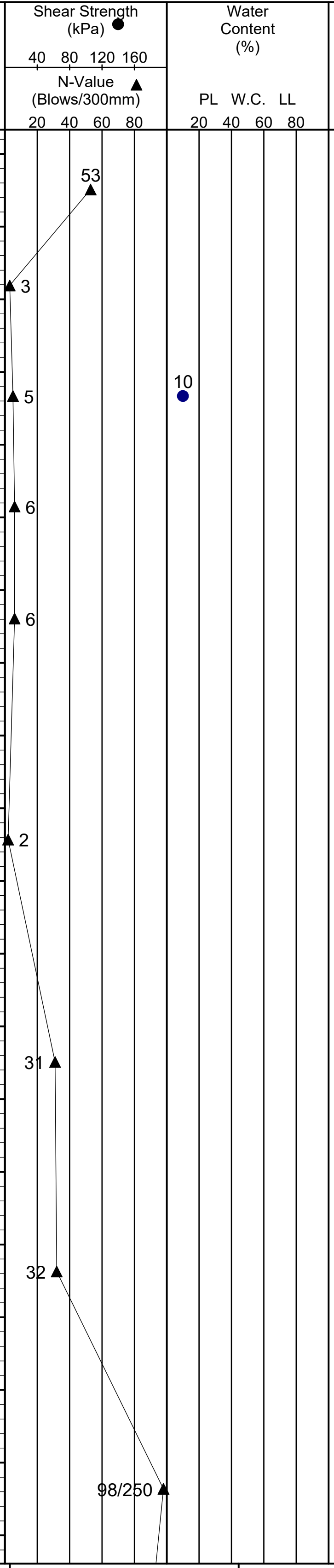
LOGGED BY: DM
DRILLING DATE: 3/4 January, 2019
REVIEWED BY: VN

CLIENT: Altona Group	METHOD: Hollow Stem Auger and Split Spoon	**BH No.: MW6**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN ELEV. (m) 88.66	
LOCATION: 1294 Kingston Road, Pickering	NORTHING: EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◩ DRIVEN ⧗ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		100 mm Asphaltic Concrete	0						Groundwater at 3.65 m below ground surface on February 15, 2019.
		(FILL) brown sandy silt some gravel, damp	0.5	88.5 88	1		53		
		SILT and CLAY trace to some sand moist varved, yellow -brown ------ brown -grey	1 1.5 2 2.5 3 3.5 4 4.5 5	87.5 87 86.5 86 85.5 85 84.5 84 83.5	2 3 4 5 6		3 5 6 6 2		Bentonite
▼									
		grey SILTY SAND some clay some gravel (TILL) slightly moist	5.5 6 6.5 7 7.5 8 8.5 9 9.5	83 82.5 82 81.5 81 80.5 80 79.5 79	7 8 9		31 32 98/ 250		



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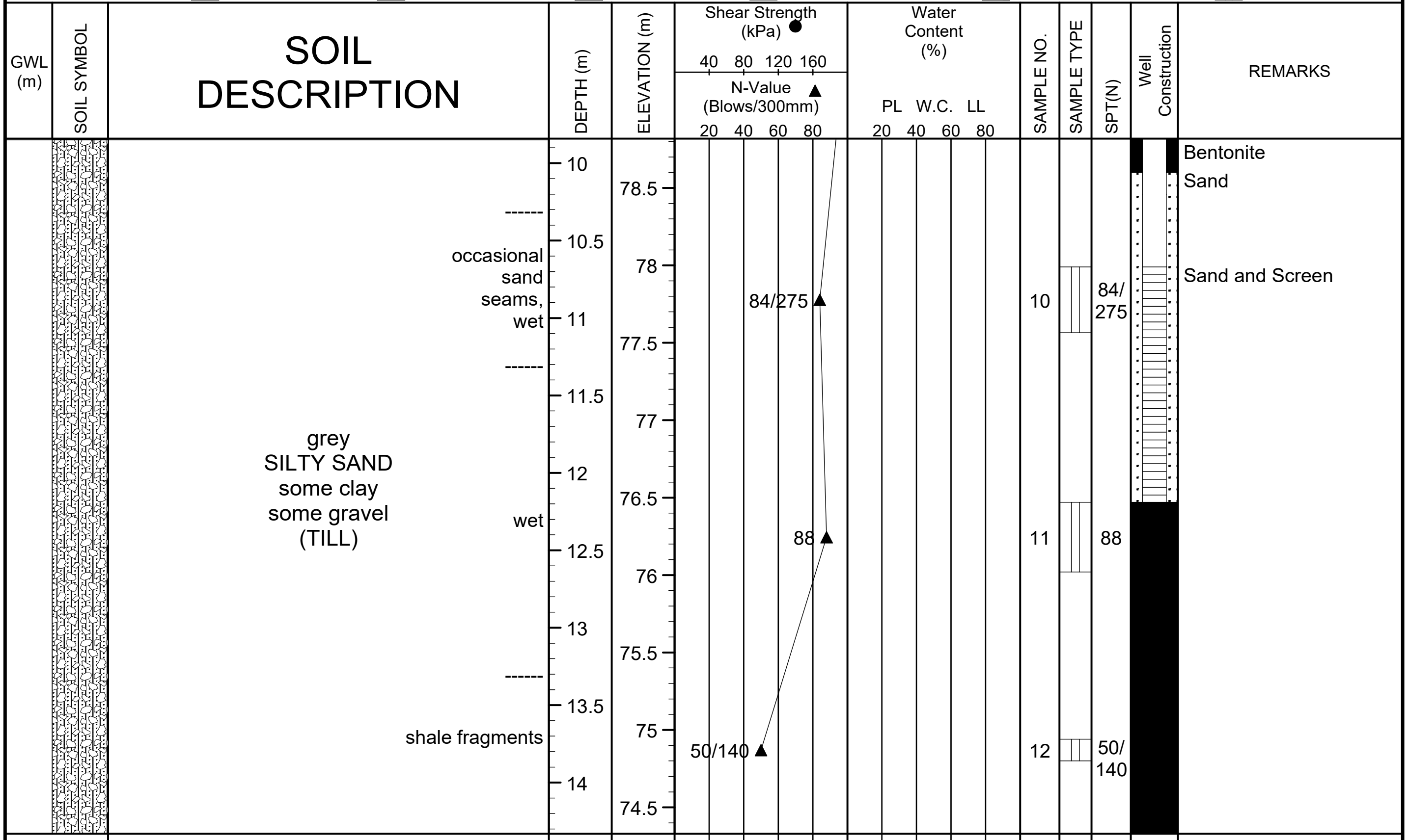
LOGGED BY: JA	DRILLING DATE: 2 February 2019
REVIEWED BY: VN	Page 1 of 2

CLIENT: Altona Group
PROJECT: Liverpool House Condos
LOCATION: 1294 Kingston Road, Pickering
METHOD: Hollow Stem Auger and Split Spoon
PROJECT ENGINEER: VN
ELEV. (m) 88.66
NORTHING:
EASTING:

BH No.: MW6

PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON



SOIL DESCRIPTION

grey
SILTY SAND
some clay
some gravel
(TILL)

------
occasional sand seams, wet
------
wet
------
shale fragments

END OF BOREHOLE

SAMPLE NO.	SPT(N)
10	84/ 275
11	88
12	50/ 140

REMARKS
Bentonite
Sand
Sand and Screen

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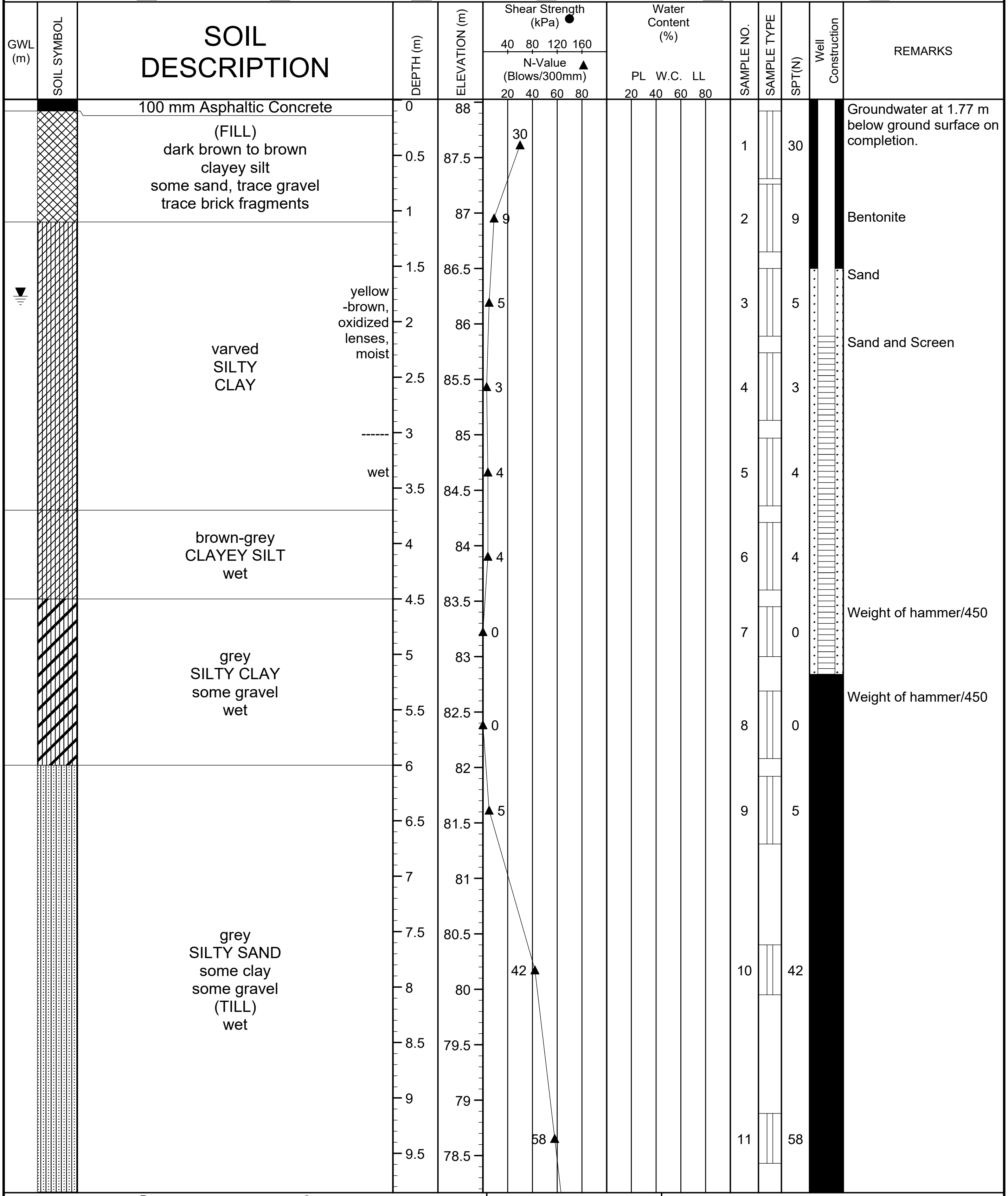
LOGGED BY: JA
REVIEWED BY: VN
DRILLING DATE: 2 February 2019
Page 2 of 2

CLIENT: Altona Group	METHOD: Hollow Stem Auger and Split Spoon	**BH No.: MW7**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN / ELEV. (m) 88.02	
LOCATION: 1294 Kingston Road, Pickering	NORTHING: / EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON



100 mm Asphaltic Concrete

(FILL)
dark brown to brown
clayey silt
some sand, trace gravel
trace brick fragments

varved
SILTY
CLAY
yellow
-brown,
oxidized
lenses,
moist
------
wet

brown-grey
CLAYEY SILT
wet

grey
SILTY CLAY
some gravel
wet

grey
SILTY SAND
some clay
some gravel
(TILL)
wet

SAMPLE NO.	SPT(N)
1	30
2	9
3	5
4	3
5	4
6	4
7	0
8	0
9	5
10	42
11	58

REMARKS:

Groundwater at 1.77 m below ground surface on completion.

Bentonite

Sand

Sand and Screen

Weight of hammer/450

Weight of hammer/450

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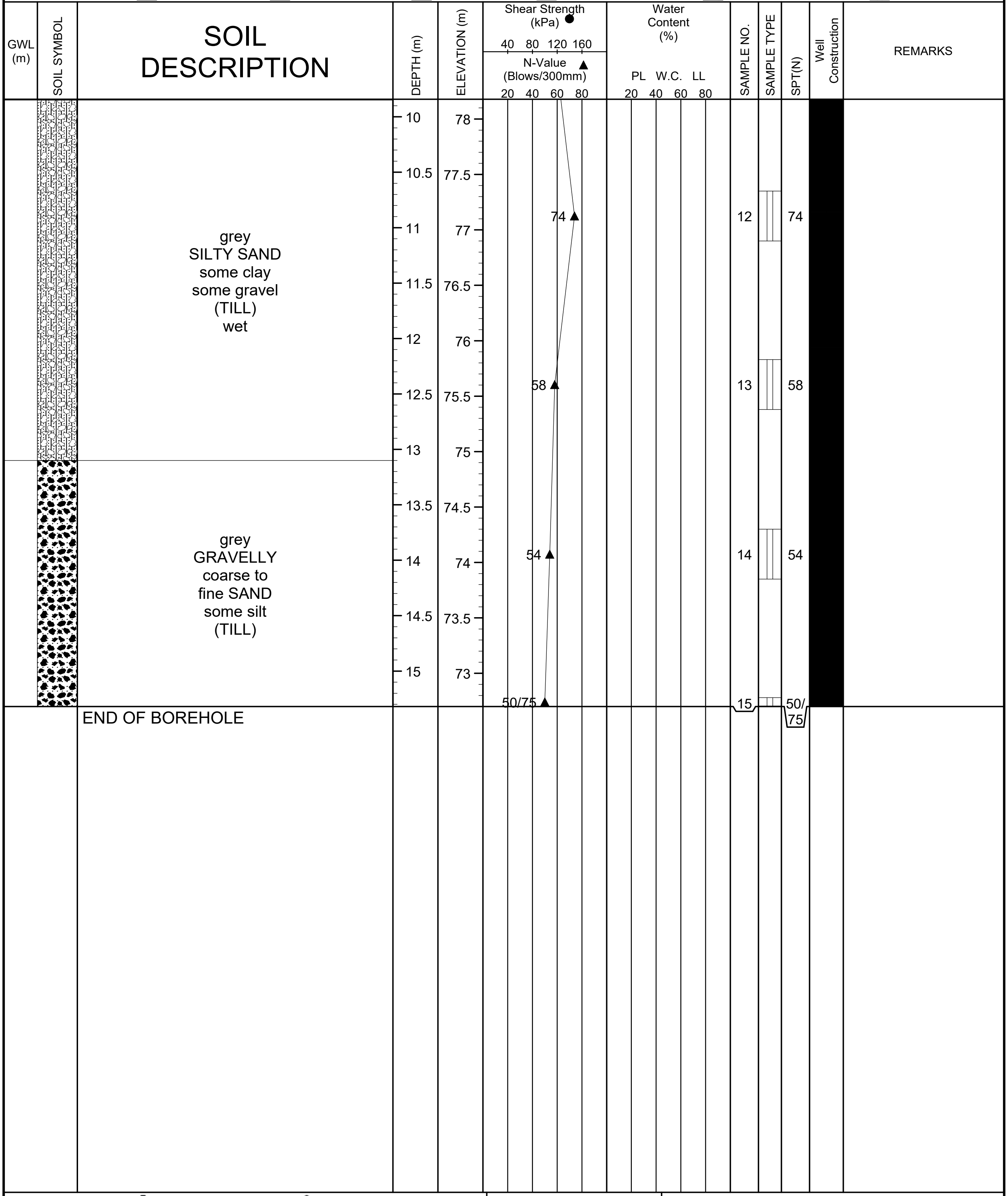
LOGGED BY: JA	DRILLING DATE: 7 February 2019
REVIEWED BY: VN	Page 1 of 2

CLIENT: Altona Group
PROJECT: Liverpool House Condos
LOCATION: 1294 Kingston Road, Pickering
METHOD: Hollow Stem Auger and Split Spoon
PROJECT ENGINEER: VN
ELEV. (m) 88.02
NORTHING:
EASTING:

BH No.: MW7

PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON



grey
SILTY SAND
some clay
some gravel
(TILL)
wet

grey
GRAVELLY
coarse to
fine SAND
some silt
(TILL)

END OF BOREHOLE

SAMPLE NO.	SPT(N)
12	74
13	58
14	54
15	50/75

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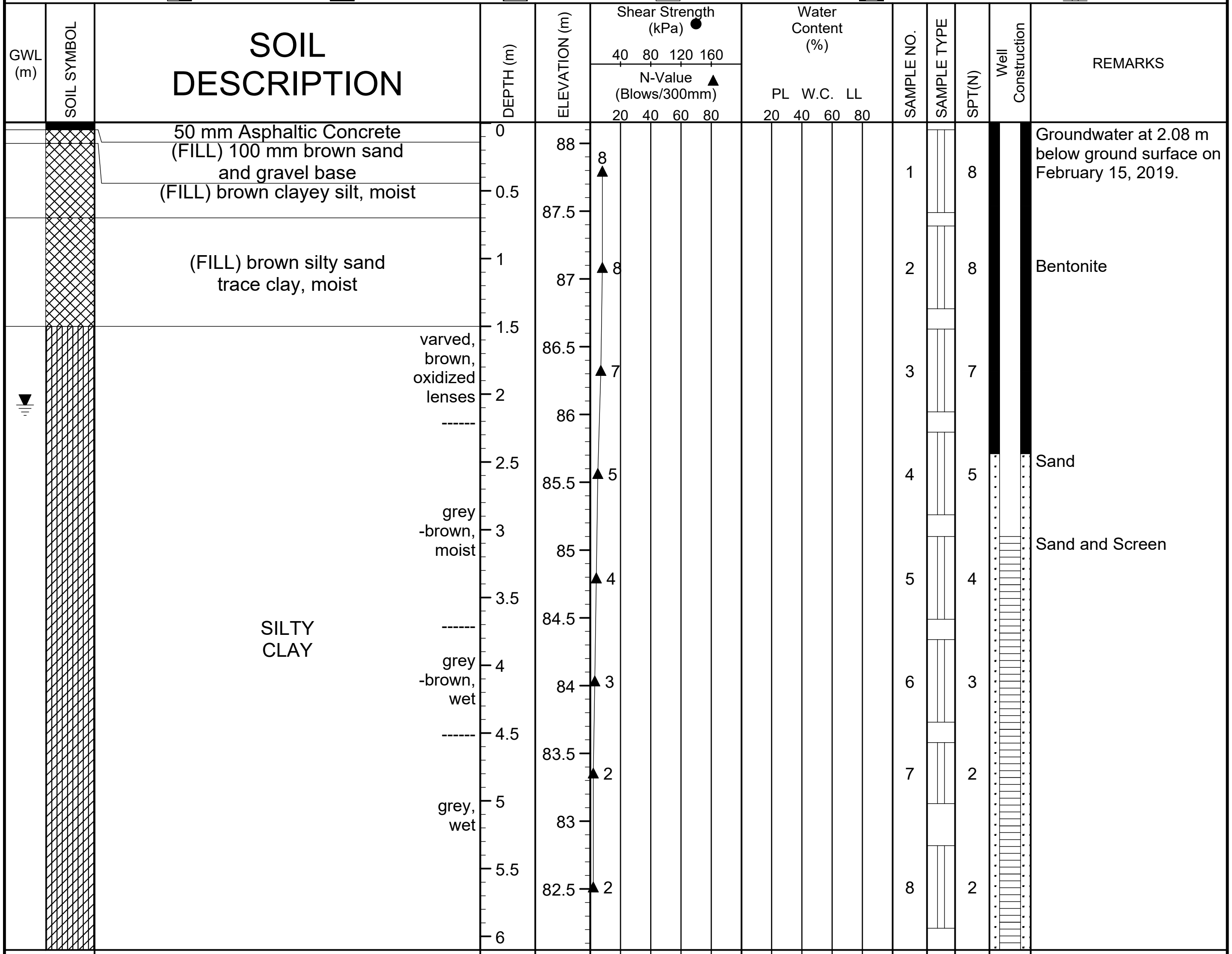
LOGGED BY: JA
REVIEWED BY: VN
DRILLING DATE: 7 February 2019

CLIENT: Altona Group	METHOD: Hollow Stem Auger and Split Spoon		**BH No.: MW8**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN	ELEV. (m) 88.15	
LOCATION: 1294 Kingston Road, Pickering	NORTHING:	EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◩ DRIVEN ⧗ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON



END OF BOREHOLE

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LOGGED BY: ALPK	DRILLING DATE: 7 February 2019
REVIEWED BY: VN	Page 1 of 1

CLIENT: Altona Group	METHOD: Manual Split Spoon Sampling	**BH No.: MW9**
PROJECT: Liverpool House Condos	PROJECT ENGINEER: VN ELEV. (m) 86.7	
LOCATION: 1294 Kingston Road, Pickering	NORTHING: EASTING:	PROJECT NO.: 18-204

SAMPLE TYPE ▮ AUGER ◩ DRIVEN ⧓ CORING ▀ DYNAMIC CONE ▯ SHELBY ⌶ SPLIT SPOON

GWL (m)	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) ● 40 80 120 160 N-Value (Blows/300mm) ▲ 20 40 60 80	Water Content (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
	150 mm Concrete	0								Interior borehole advanced in basement of Liverpool John's Pub. Samples were collected using direct push technology. No SPT's were performed. Groundwater measured at 0.55 m below basement floor slab on February 22, 2019.
			86.5							
▼	SILTY CLAY varved, brown, oxidized lenses	0.5	86	▲		1	⌶	-		
		1	85.5	▲ -		2	⌶	-		
		1.5	85							Sand
	brown	2		▲ -		3	⌶	-		
	------		84.5							Sand and Screen
		2.5	84	▲ -		4	⌶	-		
	grey	3	83.5							
		3.5	83	▲ -		5	⌶	-		

END OF BOREHOLE

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geotechnical division of TERRAPEX

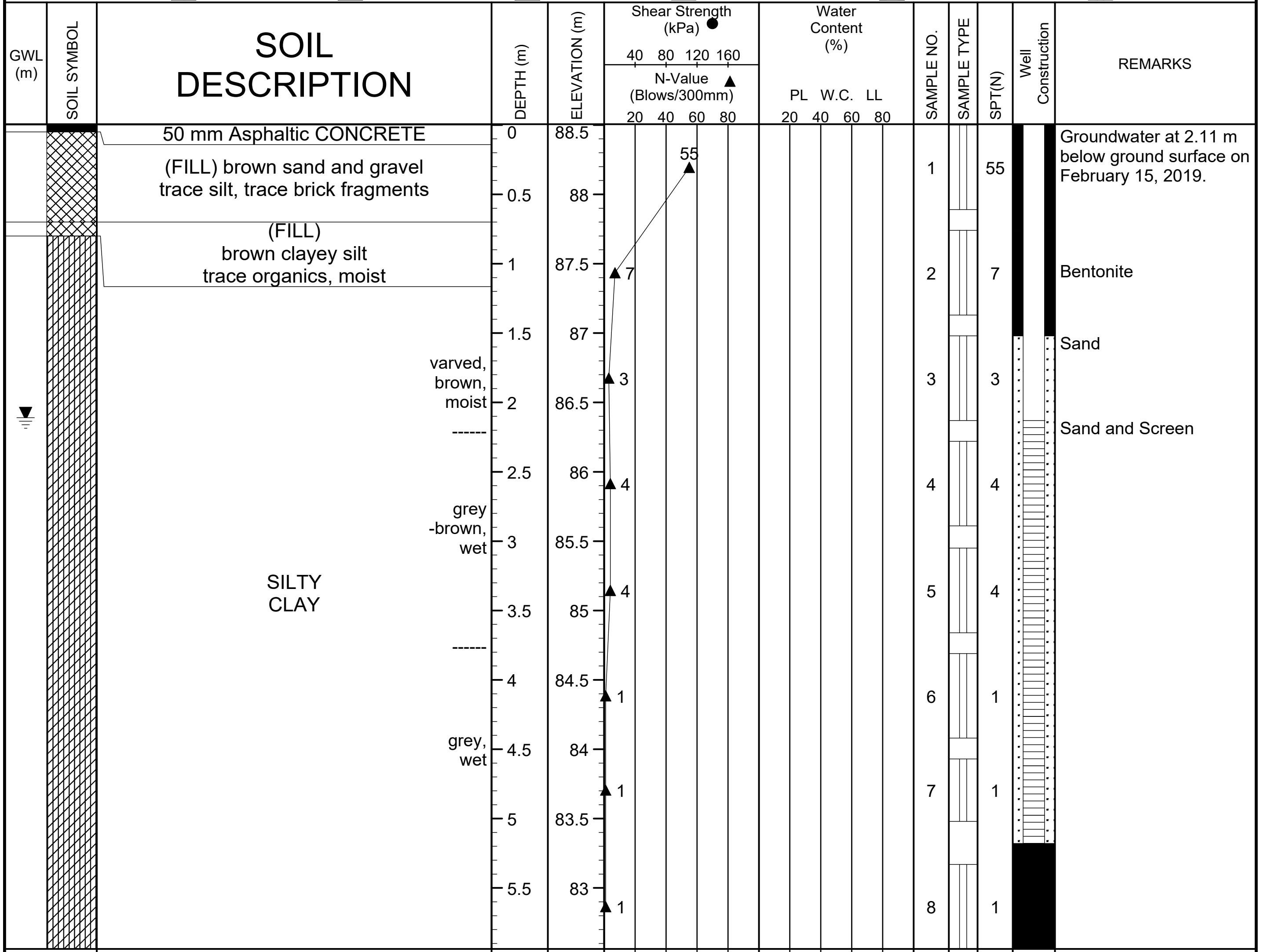
LOGGED BY: ALPK	DRILLING DATE: 31 January 2019
REVIEWED BY: VN	Page 1 of 1

CLIENT: Altona Group
PROJECT: Liverpool House Condos
LOCATION: 1294 Kingston Road, Pickering
METHOD: Hollow Stem Auger and Split Spoon
PROJECT ENGINEER: VN
ELEV. (m) 88.50
NORTHING:
EASTING:

BH No.: MW10

PROJECT NO.: 18-204

SAMPLE TYPE: AUGER, DRIVEN, CORING, DYNAMIC CONE, SHELBY, SPLIT SPOON



SOIL DESCRIPTION	
50 mm Asphaltic CONCRETE	
(FILL) brown sand and gravel trace silt, trace brick fragments	
(FILL) brown clayey silt trace organics, moist	
SILTY CLAY	varved, brown, moist
	------
	grey -brown, wet
	------
	grey, wet
END OF BOREHOLE	

SAMPLE NO.	SPT(N)
1	55
2	7
3	3
4	4
5	4
6	1
7	1
8	1

REMARKS

Groundwater at 2.11 m below ground surface on February 15, 2019.

Bentonite

Sand

Sand and Screen

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LOGGED BY: ALPK
REVIEWED BY: VN
DRILLING DATE: 7 February 2019
Page 1 of 1

APPENDIX D

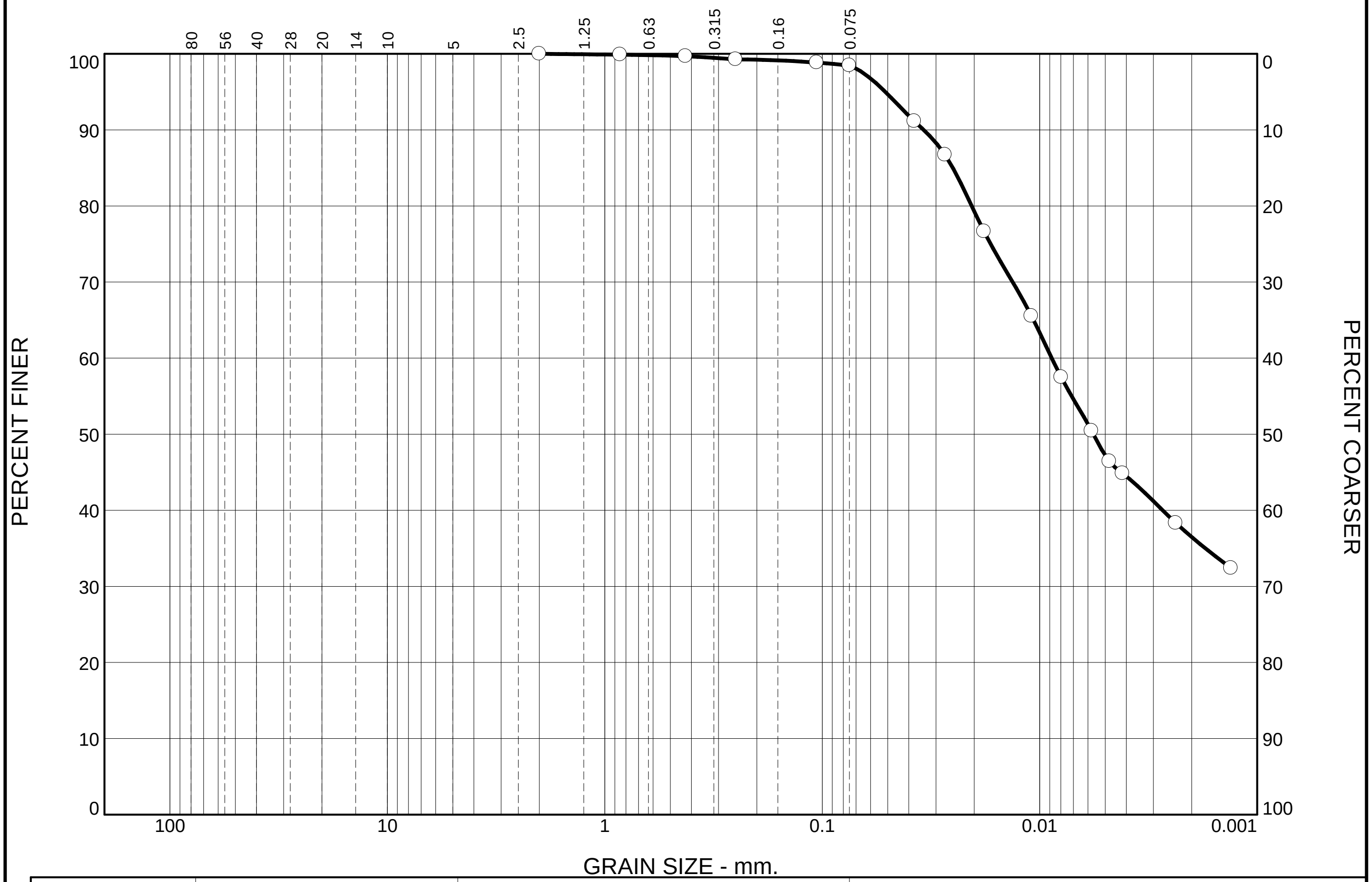
LABORATORY TEST RESULTS

WATER CONTENT RECORD

Project: 18-204	Client: Altona Group	By: VP
Ref. No.:	Location: 1294 Kingston Road, Pickering	Date: 15 Jan 2019

Borehole	Sample No.	Container No.	Wet Soil +Tare (g)	Dry Soil + Tare (g)	Tare (g)	Water Content (%)
MW3	1A	618	83.5	77.9	14.6	9%
MW3	1B	628	74.7	65.2	14.8	19%
MW3	2	613	81.1	69.6	15.0	21%
MW3	4	616	83.2	69.0	14.6	26%
MW3	5	620	88.5	73.0	14.5	27%
MW3	6	606	74.2	60.1	14.7	31%
MW3	7	637	96.5	84.2	14.9	18%
MW3	8	633	79.3	71.2	15.0	14%
MW3	9	601	89.8	85.6	15.1	6%
MW3	10	617	80.4	76.3	15.1	7%
MW3	11	624	92.5	86.7	15.4	8%
MW3	12A	640	83.0	78.0	15.1	8%
MW3	12B	645	86.4	78.5	15.3	13%
MW3	13	602	88.9	84.2	15.3	7%
MW3	14	625	69.1	65.5	15.0	7%
MW3	15	630	79.5	73.7	15.0	10%
MW4	1A	635	70.4	69.6	15.2	
MW4	1B	603	73.5	64.8	14.8	17%
MW4	2A	608	87.2	74.3	14.7	22%
MW4	2B	619	66.2	56.5	15.0	23%
MW4	3	648	89.6	77.0	14.2	20%
MW4	4	604	75.7	65.1	15.0	21%
MW4	5A	615	98.4	87.6	15.0	15%
MW4	5B	622	60.7	56.7	14.5	9%
MW4	6	627	92.2	87.2	15.6	7%
MW4	7	611	74.0	69.9	15.6	8%
MW4	8	623	79.2	73.3	14.3	10%
MW4	9	643	108.1	94.1	14.7	18%
MW4	10	612	75.6	67.7	14.9	15%
MW4	11	629	82.4	74.0	15.6	14%
MW4	12	609	86.1	77.2	14.6	14%
MW4	13	614	79.9	75.7	14.5	7%
MW4	14	636	88.4	82.5	14.6	9%
MW4	15	642	75.0	67.0	15.2	15%

Grain Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	0	0	0	0	2	62	36

☒	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○				0.0251	0.0088	0.0057					

Material Description	USCS	AASHTO
○ SILT and CLAY trace sand		

Project No. 18-204 **Client:** Altona Group

Project: 1294 Kingston Road, Pickering

○ **Location:** Borehole 6 **Sample Number:** Sample 3

Date: ○ February 6, 2019

Remarks:

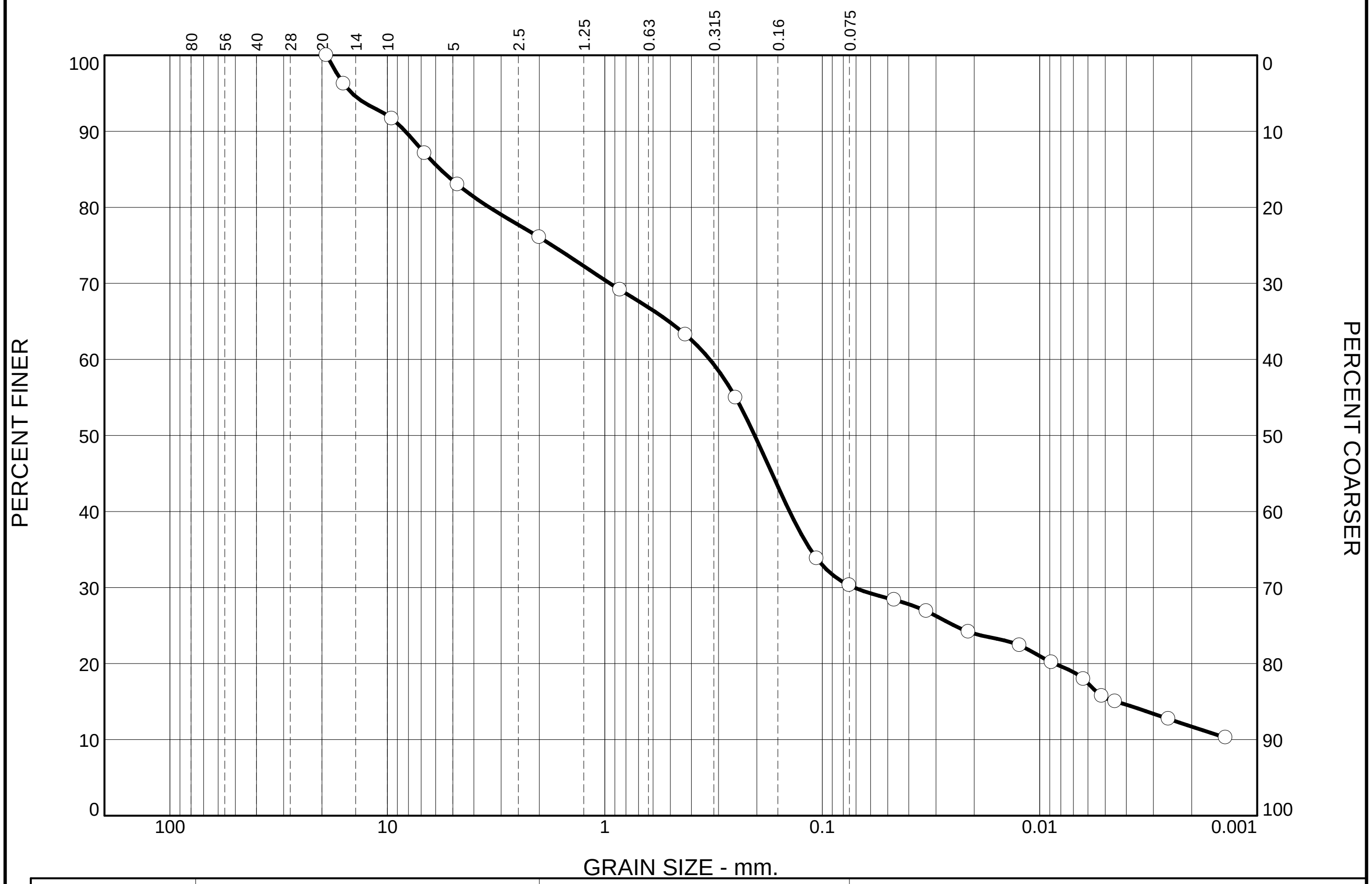
Alston Associates

Geotechnical Division of Terrapex

Figure 1

Tested By: VP **Checked By:** DM

Grain Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	24	13	33	18	12

☒	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○				5.7075	0.3292	0.2045	0.0712	0.0045			

Material Description	USCS	AASHTO
○ GRAVELLY SAND, some silt, some clay		

Project No. 18-204 **Client:** Altona Group

Project: 1294 Kingston Road, Pickering

○ **Location:** Borehole 5 **Sample Number:** Sample 9

Date: ○ Feb 6, 2019

Remarks:

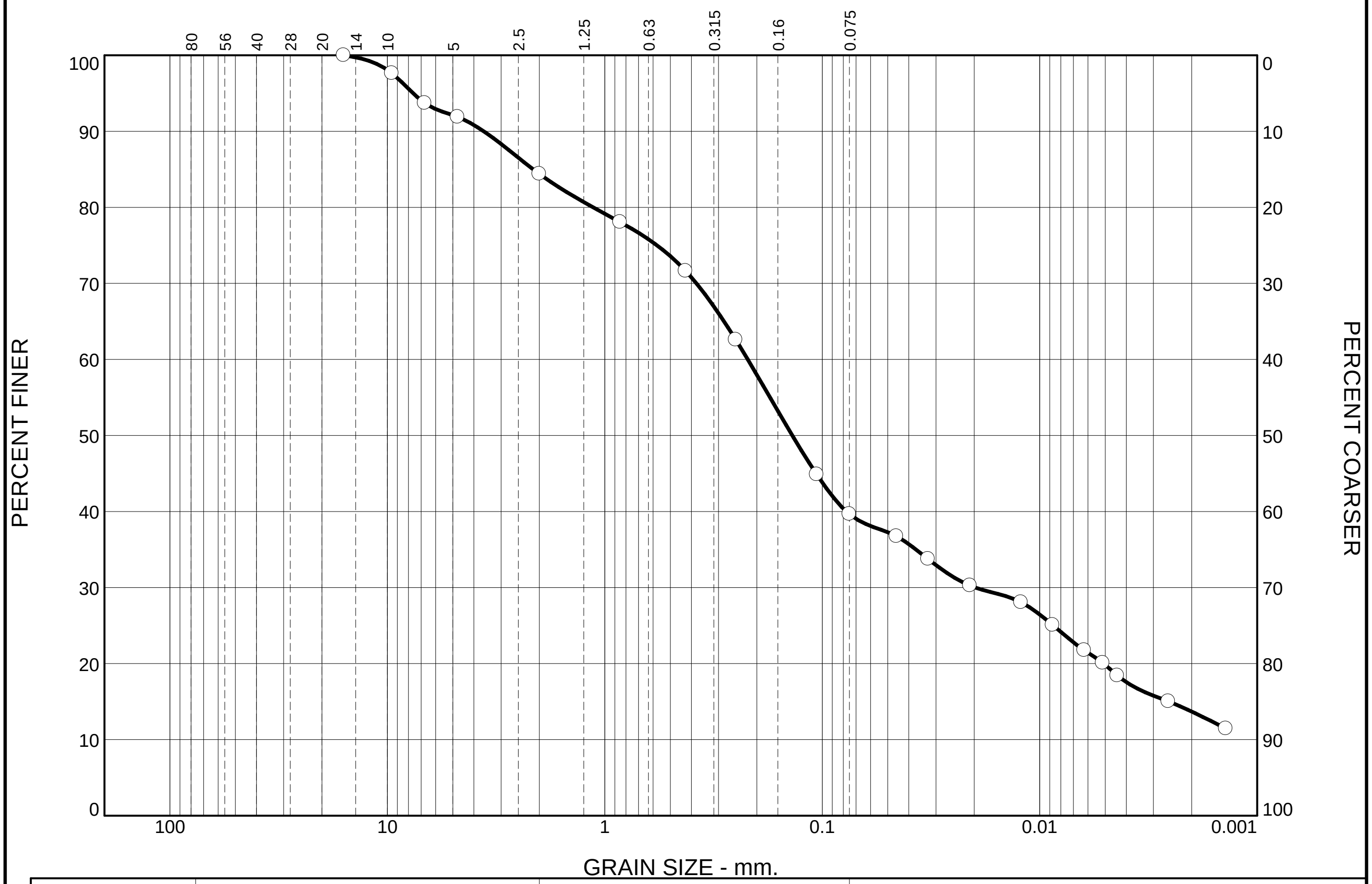
Alston Associates

Geotechnical Division of Terrapex

Figure 2

Tested By: ND/VP

Grain Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	16	12	32	26	14

☒	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○				2.1356	0.2202	0.1374	0.0198	0.0025			

Material Description	USCS	AASHTO
○ SILTY SAND, some gravel, some clay		

Project No. 18-204 **Client:** Altona Group
Project: 1294 Kingston Road, Pickering
○ **Location:** Borehole 3 **Sample Number:** Sample 9

Date: ○ Feb 6, 2019

Remarks:

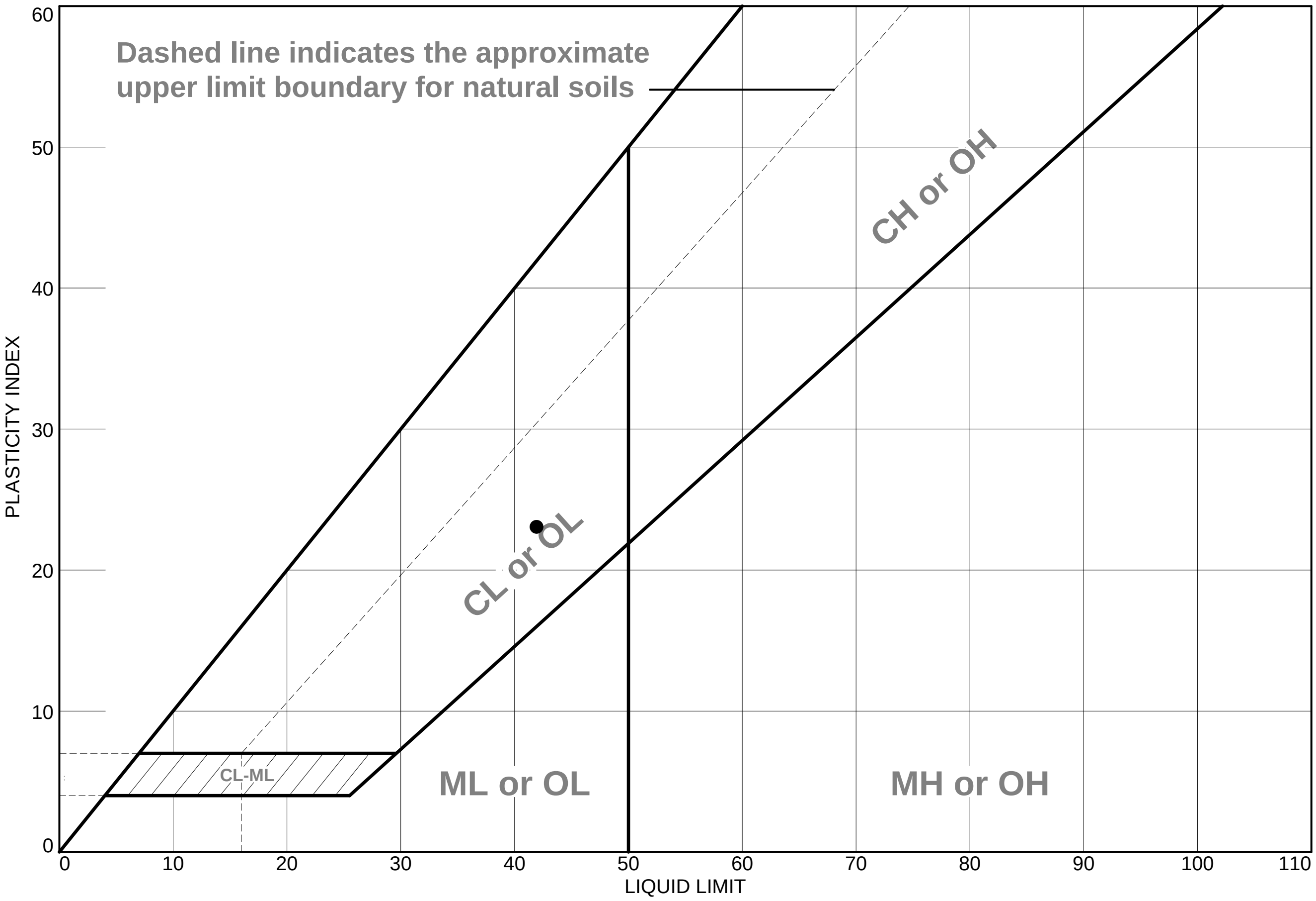
Alston Associates

Geotechnical Division of Terrapex

Figure 3

Tested By: ND/VP

LIQUID AND PLASTIC LIMITS TEST REPORT



	Material Description	Sampled	Tested	Technician	LL	PL	PI	%<#40	USCS
●	SILT and CLAY trace sand	February 6, 2019		VP	42	19	23	100	CL

Project No. 18-204 **Client:** Altona Group

Project: 1294 Kingston Road, Pickering

○**Location:** Borehole 6 **Sample Number:** Sample 3

Alston Associates

Geotechnical Division of Terrapex

Checked by:

Title:

Figure 4

Tested By: VP

APPENDIX E

CERTIFICATE OF CHEMICAL ANALYSES

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED
90 SCARSDALE RD
TORONTO, ON M3B2R7
(905) 474-5265

ATTENTION TO: Jeff Au

PROJECT: 1294 Kingston Rd

AGAT WORK ORDER: 19T435198

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Supervisor

DATE REPORTED: Feb 11, 2019

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Certificate of Analysis

AGAT WORK ORDER: 19T435198

PROJECT: 1294 Kingston Rd

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED

ATTENTION TO: Jeff Au

SAMPLING SITE:

SAMPLED BY:

pH & SO4 (Soil)

DATE RECEIVED: 2019-02-06

DATE REPORTED: 2019-02-11

			SAMPLE DESCRIPTION:	BH3 S-11	BH4 S-10
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2019-01-07	2019-01-02
Parameter	Unit	G / S	RDL	9884979	9884980
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.83	7.78
Sulphate (2:1)	µg/g		2	409	270

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9884979-9884980 pH was determined on the 0.01M CaCl2 extract obtained from 2:1 leaching procedure (2 parts extraction fluid:1 part wet soil). Sulphate was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil).
Samples were received and analyzed beyond recommended hold times.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Amanjot Bhela

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
AMANJOT BHELA
CHEMIST

Quality Assurance

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED
PROJECT: 1294 Kingston Rd
SAMPLING SITE:

AGAT WORK ORDER: 19T435198
ATTENTION TO: Jeff Au
SAMPLED BY:

Soil Analysis

RPT Date: Feb 11, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
pH & SO4 (Soil)															
pH, 2:1 CaCl2 Extraction	9884979	9884979	7.83	7.84	0.1%	NA	100%	90%	110%	NA			NA		
Sulphate (2:1)	9885004		51	46	10.3%	< 2	107%	70%	130%	99%	70%	130%	83%	70%	130%

Comments: NA signifies Not Applicable

Certified By: Amanjot Bhela

CHARTERED
AMANJOT BHELA
CHEMIST

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED

AGAT WORK ORDER: 19T435198

PROJECT: 1294 Kingston Rd

ATTENTION TO: Jeff Au

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	pH METER
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH

19T435198

AGAT Laboratories

Small cooler

5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com
P: 905.712.5100 · F: 905.712.5122

Chain of Custody Record

Laboratory Use Only

Arrival Temperature: 4.3 3.8. 3.6
AGAT WO #:
Lab Temperature: 3.5 . 3.2 3
Notes:

Client Information

Company: Alston terrapex
Contact: Jeff Au
Address: 90 Scarsdale Rd, → Pickering
Phone: 416 528 5070
Fax:
Project: 1294 Kingston Rd
PO: CA18-204
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements

☐ Regulation 153/04 (reg. 511 Amend.)
Table ______ Indicate one
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (check one)
☐ Coarse ☐ Fine

☐ Sewer Use
Region ______ Indicate one
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☒ None

Turnaround Time Required (TAT) Required*

Regular TAT
☐ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day

OR

Date Required (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Invoice To

Same: Yes ☐ No ☐
Company: Terrapex
Contact: Jeff Au
Address:

Is this a drinking water sample?
(potable water intended for human consumption)
☐ Yes ☒ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition?**
☐ Yes ☐ No

Legend Matrix

GW	Ground Water	**O**	Oil
SW	Surface Water	**P**	Paint
SD	Sediment	**S**	Soil

Report Information – reports to be sent to:

1. Name: Jeff Au
Email: j.au@alston.ca
2. Name:
Email:

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	**ORPs:** ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ NO_3/NO_2 ☐ N- Total ☐ Hg ☐ pH	**Nutrients:** ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	**VOC:** ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	pH + SO4								
BH3 S-11	Jan 7, 19		S																		X								
BH4 S-10	Jan 2, 19		S																		X								

Samples Relinquished By (Print Name and Sign): VERONIKA PETRIKOVA
Date/Time: 5 FEB 19, 12:55

Samples Received By (Print Name and Sign): Ray
Feb 6/19
Date/Time: 12:49

Samples Relinquished By (Print Name and Sign): Ray
Feb 6/19
Date/Time: 2:37

Samples Received By (Print Name and Sign):
Date/Time:

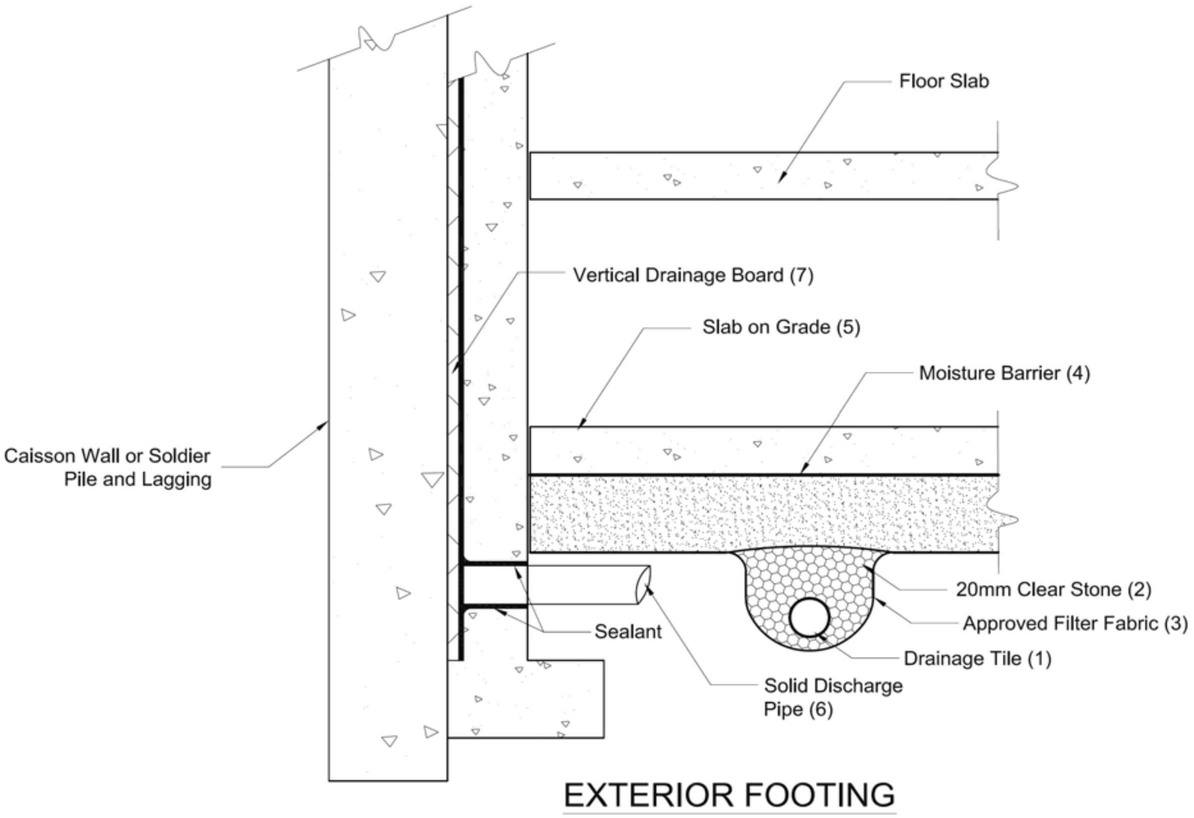
Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page ______ of ______

Nº: 25268

APPENDIX F

RECOMMENDED DRAINAGE SYSTEM



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 – 150mm (6”) top and side of drain, 100 mm (4”) 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 special floors.
5. Do not connect the underfloor drains to the perimeter drains.
6. Solid discharge pipe outletting into a solid pipe leading to a sump.
7. Vertical drainage board Terradrain 600 or equivalent with filter cloth should be continuous from bottom to 1.2 m below exterior finished grade.
8. 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)

alston associates inc.
consulting engineers