CHUNG & VANDER DOELEN
ENGINEERING LTD.

GEOTECHNICAL INVESTIGATION
PROPOSED HOUSING DEVELOPMENT

130 Cornwall Road

Oakville, Ontario

SUBMITTED TO:
Support & Housing Halton
165 Cross Avenue, Suite 201
Oakville, Ontario
L6J 0A9

ATTENTION:
Mr. Paul Gregory

FILE NO /G20080/August 5, 2020

CHUNG & VANDER DOELEN
ENGINEERING LTD.

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KITCHENER / ONTARIO / N2H 5E1
519-742-8979

August 5, 2020
File No.: G20080

Support & Housing Halton
165 Cross Avenue, Suite 201
Oakville, Ontario
L6J 0A9

Attention: Mr. Paul Gregory

RE: Geotechnical Investigation
Proposed Housing Development
130 Cornwall Road, Oakville, Ontario

We take pleasure in enclosing one (1) copy of our Geotechnical Investigation Report carried out at the above-referenced Site. Soil samples will be retained for a period of three (3) months and will thereafter be disposed of unless we are otherwise instructed.

If you have any questions or clarifications are required, please contact the undersigned at your convenience.

We thank you for giving us this opportunity to be of service to you.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

Eric Y. Chung, M. Eng., P.Eng.
Principal Engineer

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1.0 INTRODUCTION

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) has been retained by Support and Housing Halton to carry out a geotechnical investigation for the proposed housing development to be located at 130 Cornwall Road in Oakville, Ontario.

It is understood that the existing 2-storey residential building with basement is to be demolished and a 5-storey apartment building with a basement is the proposed at the site. The proposed building is to have a total floor area of 25,260 ft^2 (5 floors), comprised of 37 units, common spaces, and an office area. An asphalt paved access driveway and parking lot with twelve (12) spaces are proposed to the east of the building. The finished floor elevation and site grading plan were not available at the time of reporting.

The purpose of this investigation was to determine the subsurface conditions at the site and, based on the findings, to make geotechnical recommendations for:

- Foundation design recommendations;
- Excavation condition;
- Groundwater control during and after construction;
- Backfilling recommendations;
- Slab-on-grade floor construction;
- Foundation soil classification for seismic design per OBC 2012;
- Foundation walls and retaining wall design;
- Shoring design; and
- Pavement design construction

Infiltration rates of the various soil deposits encountered during the investigation will also be provided for a potential storm water management feature.

2.0 FIELD WORK

The field work, consisting of advancing three (3) boreholes to depths between 4.10 and 5.50 m, was carried out on July 14, 2020. The borehole locations are indicated on the Borehole Location Plan, Drawing No. 1.

The field work was carried out under the supervision of a member of our engineering team, who logged the boreholes in the field, effected the subsurface sampling, and monitored the groundwater conditions. The boreholes were advanced using a track-mounted drilling rig, supplied and operated by a specialized contractor. The drill rig was equipped with continuous flight augers and standard soil sampling equipment. Standard penetration tests (SPTs) in accordance with ASTM Specification D1586, were carried out at frequent intervals of depth, and the results are shown on the Borehole Logs as Penetration Resistance or “N”-values. The undrained shear strength of the cohesive soil deposits was determined on the slightly disturbed SPT samples using a field penetrometer. The consistency or compactness condition of the soil strata has been inferred from these test results.

The location and ground surface elevation of the boreholes were surveyed by CVD for the purpose of this report. The ground surface elevations were referenced to a temporary benchmark (TBM) which is shown on Drawing No. 1 and described below:

TBM: Top of catch basin in parking lot east of existing building, as shown on Drawing No. 1

Elevation: 100.00 m (Metric, Assumed)

3.0 LABORATORY TESTING

Soil samples obtained from the in-situ tests were examined in the field and subsequently brought to our laboratory for visual and tactile examination to confirm field classification. Moisture content determination of all retrieved samples occurred.

In addition, two (2) grain size distribution analyses were performed on the major soil deposits to confirm field identification and provide information on soil hydraulic conductivity for design of infiltration gallery.

4.0 EXISTING SITE CONDITIONS

The site is bound to the east by an apartment building complex, to the south by a public trail and ravine (bordering Sixteen Mile Creek), to the west by a public park and to the north by Cornwall Road. The site is currently occupied by one (1) 2-storey residential building with a basement. The building is centrally located on the site. An access driveway and parking lot is located to the north of the building. Scattered mature trees and manicured gardens are located throughout the site, and the remainder of the site is grass-covered.

The ground surface of the site is generally relatively level in grade. Ground surface elevations at the borehole locations ranged between 100.08 and 100.29 m.

5.0 SUBSURFACE CONDITIONS

The detailed subsurface conditions encountered in the three (3) boreholes advanced as part of this investigation are shown on the Borehole Log Sheets, Enclosures 1 to 3. The following sections provide descriptions of the major soil deposits encountered in the boreholes.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling conducted during advancement of the borehole drilling procedures and, therefore, represent transitions between soil types rather than exact planes of geologic change. The subsurface conditions will vary between and beyond the borehole locations.

5.1 Pavement and Topsoil

Asphalt pavement was encountered at ground surface at Boreholes 1 and 2 with measured asphalt thicknesses of 100 and 90 mm and granular base thicknesses of 480 and 460 mm, respectively

Topsoil was encountered at ground surface at Borehole 3 with a measured thicknesses 150 mm.

5.2 Fill

Fill materials were encountered underlying the pavement structure at Boreholes 1 and 2 and underlying the topsoil at Borehole 3 and extended to depths between 2.15 and 2.35 m below ground surface. It is noted that fill materials could be deeper in the vicinity of former/existing building foundations and utility trenches. The fill materials comprised of sandy silt with trace gravel and trace clay. Traces of topsoil/organics were observed throughout the fill materials. Brick, asphalt, coal, and steel mesh fragments were observed throughout the fill materials.

The SPT “N”-values measured within the fill materials ranged from 5 to 18 blows per 300 mm of penetration, indicating a loose to compact compactness condition. Elevated “N”-values are due to the presence of non-soil materials within the fill. Natural moisture contents were measured between 10 and 21%, indicating a moist moisture condition. Elevated moisture contents are likely due to the presence of organics.

5.3 Clayey Silt Till

A deposit of clayey silt till was encountered at Boreholes 1 and 2 underlying the fill materials and extended to a depth of 3.35 m below ground surface. The deposit contained sand in the range of some to sandy and trace to some gravel. Occasional cobbles were observed within the deposit at Borehole 1. Results of one (1) grain size distribution analysis from Borehole 1 are shown graphically on Enclosures 4.

The SPT “N”-values measured within the till deposit ranged from 17 blows per 300 mm to 50 blows per 125 mm of penetration. The undrained shear strength of the till obtained on the retrieved samples ranged from 168 kPa to over 250 kPa. Based on the above test results and tactile examination, the clayey silt till deposit is considered to have a very stiff to hard consistency. The measured moisture content of the collected samples ranged between 10 and 26%, thus indicating a moist moisture condition.

5.4 Silt

A silt deposit was encountered at Borehole 3 underlying the fill materials and extended to a depth of 3.20 m below ground surface. The deposit contained trace to some sand and trace clay. Results of one (1) grain size distribution analysis from Borehole 3 are shown graphically on Enclosures 5.

The SPT "N"-values measured within the deposit ranged from 16 blows per 300 mm to 50 blows per 100 mm of penetration, indicating a compact to very dense compactness condition. Natural moisture contents were measured between 10 and 23%, indicating moist to wet moisture condition.

5.5 Shale

The clayey silt till deposit at Boreholes 1 and 2 and the silt deposit at Borehole 3 were underlain by grey shale of the Georgian Bay Formation. All three (3) boreholes were terminated within the weathered shale bedrock at depths between 4.10 and 5.50 m below existing grade. Limestone interbeds were encountered within the shale deposit.

The SPT "N"-values measured within the weathered shale ranged from 25 blows per 300 mm to 50 blows per 125 mm of penetration, indicating a very stiff to hard consistency . Natural moisture contents were measured between 5 and 6%, indicating damp moisture condition.

5.6 Groundwater

Groundwater conditions were monitored during sampling and upon removal of the drilling augers at all borehole locations.

Upon withdrawal of the drilling augers, all three (3) boreholes were open and dry to their maximum explored depths between 4.10 and 5.50 m below ground surface. However, during sampling, wet condition was observed at Borehole 3 within the silt deposit above the shale and this is considered to be a perched condition. During favourable/wet weather condition, water may be perched within the upper fill materials.

It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 General

It is understood that the existing 2-storey residential building with basement is to be demolished and a 5-storey apartment building with a basement is the proposed at the site. The proposed building is to have a total floor area of 25,260 ft^2 (5 floors), comprised of 37 units, common spaces, and an office area. An asphalt paved access driveway and parking lot with twelve (12) spaces are proposed to the east of the building. The finished floor elevation and site grading plan were not available at the time of reporting.

CVD should be retained to review final design information to determine if additional geotechnical investigation is warranted or required.

6.2 One Level Basement

The finished floor elevation of the basement level was not provided at the time of reporting. It is recommended that, due to the low permeability of the soils, a perimeter weeping tile and a system of under-floor drains should be installed to guard against future seasonal fluctuation of the groundwater table.

6.3 Footing Foundations

Conventional strip and spread footing foundations can be used to support the proposed 5-storey apartment building with basement. Footings cast on the native compact silt, very stiff to hard clayey silt till deposits can be designed using a Geotechnical Reaction at SLS of 200 kPa and a Factored Geotechnical Resistance at ULS of 300 kPa.

The following table summarizes the highest founding level and elevation for the footings founded on the clayey silt till or silt deposit at each borehole location:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
1	100.29	2.29	98.00
2	100.08	2.18	97.90
3	100.25	2.45	97.80

However, if the basement for the proposed building is to have a full basement, footings could be cast on the weathered shale and can be designed using a Geotechnical Reaction at SLS of 500 kPa and a Factored Geotechnical Resistance at ULS of 800 kPa.

The following table summarizes the highest founding level and elevation for the footings founded onto the shale bedrock at each borehole location:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
1	100.29	3.39	36.90
2	100.08	3.58	96.50
3	100.25	3.25	97.00

In addition, the footings should be founded below any existing fill materials and former basements/foundations, on competent native undisturbed soils. Spacing between adjacent footing steps should not be steeper than 10H to 7V.

The maximum total and differential settlements of footings designed to the above recommended soil bearing pressure are expected to be less than 25 and 20 mm, respectively, and these are considered tolerable for the structure being contemplated. The majority of the settlements will take place during construction and the first loading cycle of the building.

Exterior footings and footings in unheated portions of the building should be provided with a soil cover of not less than 1.2 m or equivalent synthetic thermal insulation for adequate frost protection. The founding subgrade soils must be protected from frost penetration during winter construction.

It is recommended that the footing excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation.

6.4 Earthquake Considerations

In accordance with The Ontario Building Code 2012 (OBC), the proposed structure should be designed to resist earthquake load and effects as per OBC Subsection 4.1.8.

The anticipated footing founding depth will be within 3 m of the shale bedrock as encountered at the boreholes. Therefore, the site can be classified as a Site Class B as per OBC Table 4.1.8.4.A (Page B4-24).

6.5 Open Cut Excavation and Groundwater Control

Excavations are expected to be in the order of 2± to 4± m deep for footing foundations, elevator pits, and site servicing. The excavations will penetrate loose to compact fill and native very stiff to hard clayey silt till, compact to very dense silt and very stiff to hard shale deposits. The upper soil layers are considered to be Type 3 Soils in accordance with the latest Occupational Health and Safety Act.

Above the groundwater table, excavations in the Type 3 Soils are expected to remain stable during the construction period provided that side slopes are cut to 1H : 1V from the bottom of the excavation. Near vertical side slope can be made in the sound shale bedrock. Where seepage or perched groundwater is encountered, side slopes should be cut to more stable angles of 3H : 1V. The side slopes should be suitably protected from erosion processes.

Uncontrollable groundwater flows are not expected to be encountered within the anticipated construction excavations. Subsurface seepage, perched groundwater from the fill and silt deposit, and surface water runoff into the excavations may be handled by conventional filtered sump pumping techniques, as and where required.

In wet to saturated subgrade condition, it will be necessary to excavate below founding level and pour a 75 mm thick mud slab of lean concrete to protect the founding soil from disturbance during the installation of reinforcing steel bars and form work.

6.6 Shored Excavation

As excavations for the basement and footings are expected to be in the order of 3± to 4± m, a shoring system may be required for temporary excavation support during construction where sufficient space is not available for open cut excavations and to support the adjacent roadway, park and infrastructure. Possible shoring supports include soldier pile and timber lagging system, caisson wall or steel sheet piles.

The shoring system is generally designed and built by a specialized shoring contractor. The shoring system should be designed in accordance with the guidelines provided in the Canadian foundation Engineering Manual (CFEM) 4th Edition.

The shoring system will have to withstand the lateral earth pressure, the adjacent roadways, buried services, and the traffic loads as well as the adjacent parking lots and building structures. Frost pressures on the shoring system should be considered if the system is exposed to winter freezing condition. The shoring system should be monitored to ensure deflection and lateral movements are acceptable, and modifications made to the shoring system if deflection and lateral movements become a problem.

The following soil parameters may be used in the design of shoring. K_o (at rest condition) should be used where the shoring will need to support any existing building/structure.

Soil	Unit Weight (kN/m^3)	Friction Angle (ϕ^0)	K_o	Ka	Kp
Fill Materials	19	28	0.53	0.36	2.77
Native Clayey Silt Till	20	30	0.50	0.33	3.00
Native Silt	20	30	0.50	0.33	3.00

The shoring system can be supported by soil anchor tie-backs and/or raker footings. Soil anchors will provide an unobstructed open space for construction whereas raker supports will obstruct the forming and construction of footings and foundation walls.

If a soldier pile and timber lagging system is adopted, the augering/installation of the soldier piles and timber laggings, especially where they are located adjacent existing structures, should be carried out with caution such that the installation process will not cause future settlements to the adjacent existing structures. The geotechnical engineer should be retained to perform inspection during the installation.

6.7 Floor Slab Construction

The floor slab for the proposed building can be constructed as conventional slab-on-grade on the approved native clayey silt till, silt and shale deposits. At the time of floor slab construction, the exposed subgrade should be proof-rolled with a heavy roller in conjunction with an inspection by the geotechnical engineer. Any soft and/or unstable areas detected should be replaced with imported granular fill which should be compacted to at least 95% SPMDD.

In addition to the perimeter weeping tile, a system of under-floor drains is recommended to guard against future seasonal fluctuation of the groundwater table. The under-floor drain should be installed below the Granular “A” base course (i.e., keyed into the native soil subgrade). It shall consist of a 150 mm diameter perforated tile surrounded by 150 mm of OPSS Granular “B” Type I (and with less than 5% silt), all wrapped around by filter cloth to prevent “silt” from migrating into the perforated tile. It should be installed at typical spacing of 6 m at a 0.5% gradient.

Following the proof-rolling of the subgrade, it is recommended that a minimum 150 mm thick layer of OPSS Granular “A” be placed and compacted to at least 100% SPMDD beneath the concrete floor slabs to provide uniform support.

The floor slab should be separated structurally from the columns and foundation walls. Sawcut control joints should be provided at regular spacing (less than 30 times the concrete slab thickness) and to depths between one-third and one-quarter of the slab thickness.

Care should be taken to ensure that the backfill against foundation walls, interior piers/columns and concrete pits are placed in thin layers and each layer compacted to at least 95% SPMDD. These types of confined areas should be backfilled with excavated granular materials or imported granular soils such as OPSS Granular B Type I.

Moisture migration from the underlying soils through the concrete slab-on-grade may take place via "capillary action" and "diffusion" (due to vapour pressure differential). Although, the Granular "A" layer will provide a capillary break, the low permeance of the concrete slab and floor coverings will result in 100% humidity under the concrete slab and, consequently, the moisture in the concrete will increase over time. The potential effect of the soil moisture should be considered in selecting the floor coverings. A vapour retarder material (such as a 15 mil poly, ASTM E-1745) can be placed to reduce soil moisture migration. Reference is made to ACI 302.

6.8 Lateral Earth Pressure

The unbalanced foundation walls and any other soil retaining structures should be designed to resist the lateral earth pressure acting against these walls. The following formula may be used to calculate the unfactored earth pressure distribution. The factored resistance can be calculated by using a factor of 0.8.

$$\mathbf{P = K(\gamma H + q)}$$

where:

P =	Lateral earth pressure	kPa
K =	earth pressure coefficient, 0.5 for non-yielding foundation wall earth pressure coefficient, 0.3 for yielding retaining wall	
γ =	unit weight of granular backfill, compacted to 95% SPMDD	21 kN/m^3
H =	unbalanced height of wall	m
q =	surcharge load at ground surface	kPa

The backfill for the foundation walls and retaining walls should be free-draining granular materials which should have less than 8% silt particles (OPSS Granular "B" Type I). The backfill should be placed in thin layers and compacted to 95% SPMDD. Over-compaction adjacent to the foundation/retaining walls should be avoided. Weeping tiles leading to a frost-free outlet or weep holes should be installed to effect drainage behind the retaining wall.

The sliding resistance of the retaining wall footings should be checked. The unfactored horizontal resistance against sliding between cast-in-place concrete and the various soils can be calculated using a friction coefficient as follows:

- Very stiff to hard clayey silt till: 0.40
- Compact to very dense silt: 0.30
- Very stiff to hard shale: 0.50

The unit weight of the native clayey silt till and silt deposits is 20 kN/m^3, and the unit weight of the granular backfill compacted to 95% SPMDD and shale is 21 kN/m^3.

6.9 Access Driveway and Paved Parking Areas

The existing topsoil, pavement structure and any deleterious materials should be excavated from the pavement area. The excavated inorganic site materials can be reused to raise grades to the proposed subgrade level, if required. Based on the results of the field work, the predominant subgrade materials at the site will consist of sandy silt soil.

The following flexible pavement structures are recommended based on the results of grain size distribution, assumed CBR values, groundwater conditions, frost susceptibility of subgrade soils and traffic volume.

Component	Light Duty Pavement (mm)	Heavy Duty Pavement (mm)
Asphaltic Concrete HL3 HL8	 40 40	 40 50
Granular "A" Base	150	150
Granular "B" Sub-base	300	400

The pavement design considers that pavement construction will be carried out during the drier time of the year and that the subgrade is stable, not heaving under construction equipment traffic. If the subgrade is wet or unstable, additional granular sub-base may be required.

Prior to the placement of the granular base, the subgrade will be stripped of existing pavements, topsoil, and deleterious materials. The exposed subgrade should be thoroughly recompacted with a heavy vibratory compactor and inspected by a qualified geotechnical inspector. Any soft spots encountered during the process should be excavated to the level of competent soil. The required grades can then be achieved by placing approved on-site soils in maximum 200 to 300 thick lifts which should be compacted to 95% SPMDD.

The base and sub-base materials should be produced in accordance with the current OPSS specifications and placed and uniformly compacted to at least 100% SPMDD. The asphaltic concrete should be placed and compacted in accordance with OPSS Form 310 and to at least 92% of the Marshall Density (MRD). Frequent in situ density testing by this office should be carried out to verify that the specified degree of compaction is being achieved and maintained.

It should be noted that even well compacted trench backfill could settle for a period of time after construction. In this regard, the surface course of the asphaltic concrete should be placed at least one (1) year after trench backfill is completed to allow any minor settlements to occur within the trench backfill. The incomplete pavement structure may not be capable of supporting construction traffic. Consequently, minor repairs of the sub-base, base and asphaltic concrete may be required prior to paving with the base course and/or the surface course asphaltic concrete.

The prepared earth subgrade and final pavement surfaces should be graded to direct water runoff away from buildings, sidewalks, and other similar pertinent structures. Positive drainage outlets should be provided at all low points of the prepared earth subgrade, such as stub drains extended from the catch-

6.10 On Site infiltration

It is understood that the potential for a storm water management feature is to be considered at the site.

The top of the infiltration feature should be located below the footing drain/weeper and at least 5 m away from the proposed building footprints. It is noted that infiltration features should have the base located at least 1.0 m above the groundwater table and that a minimum infiltration rate of 15 mm/hr is required.

Grain size distribution analyses were conducted on samples of the native clayey silt till and silt deposits and the results are graphically presented on in the Enclosures 4 and 5. Based on the results of grain size analyses and our past experience, the hydraulic conductivity and infiltration rate of the native inorganic soil types encountered at the boreholes are estimated and provided in the following table and may be used for storm water management purposes:

MATERIAL	PERMEABILITY (K) (cm/sec)	INFILTRATION RATE (mm/hr)
Shale	1×10^{-9}	<1
Silt, trace clay (Enclosure 5)	4×10^{-6}	2
Clayey Silt Till (Enclosure 4)	1×10^{-3}	1

Due to the low infiltration rate of the native soil deposits, infiltration of storm water is not considered feasible.

7.0 CLOSURE

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

We trust that the information presented in this report is complete within our terms of reference. If there are any further questions concerning this report, please do not hesitate to contact our office.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

Joe van der Zalm
Geotechnical Engineering Intern

Eric Y. Chung, M. Eng., P.Eng.
Principal Engineer

APPENDIX A

LIMITATIONS OF REPORT

APPENDIX “A”

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

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 testholes and their respective depths 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 conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

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. CHUNG & VANDER DOELEN ENGINEERING LIMITED accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this 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. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.

ENCLOSURES

FILE No: G20080 — BOREHOLE No. 1

Client: **Support & Housing Halton**
Project: **Proposed Housing Development**
Location: **130 Cornwall Road, Oakville, Ontario**

EQUIPMENT DATA
Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jul 14 - 20** TO **Jul 14 - 20**

SOIL LITHOLOGY

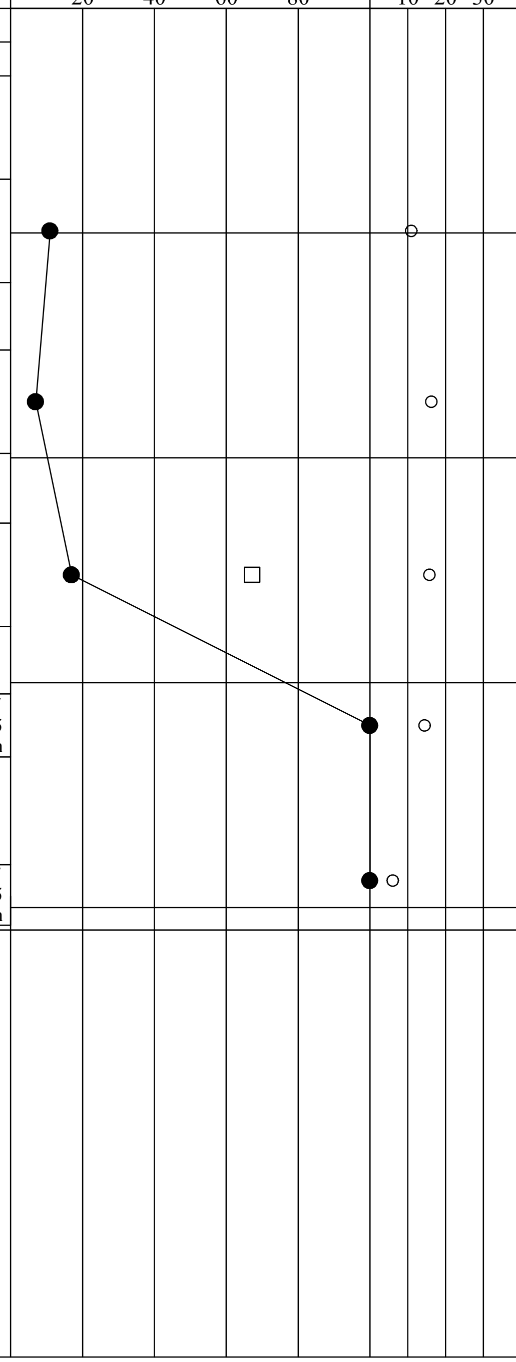
Ground Elevation: **100.29 m**

ELEV./DEPTH (m)	DESCRIPTION
	100 mm APSPHALT 480 mm GRANULAR BASE
99.71 0.58	loose to compact dark brown to reddish brown FILL, sandy silt trace gravel, trace clay, trace topsoil/organics contains brick/asphlat/coal/steel mesh fragments moist
98.14 2.15	very stiff to hard grey CLAYEY SILT TILL some sand to sandy, trace gravel occ. cobbles moist
96.94 3.35	hard, grey SHALE with limestone interbedding (Georgian Bay Formation) damp
96.19 4.10	Auger Refusal on Inferred Bedrock

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	AS	
2	SS	11
3	SS	7
4	SS	17
5	SS	50/125 mm
6	SS	50/125 mm

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □ (50, 100, 150, 200)
PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ (20, 40, 60, 80)
WATER CONTENT (%): W_P W W_L (10, 20, 30)
WELL DATA
DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5



REMARKS: borehole open and dry to 4.10 m bgs upon withdrawal of the drilling augers

PROJECT MANAGER: **EYC**

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FILE No: G20080

BOREHOLE No. 2

Client: **Support & Housing Halton**

Project: **Proposed Housing Development**

Location: **130 Cornwall Road, Oakville, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jul 14 - 20** TO **Jul 14 - 20**

SOIL LITHOLOGY

Ground Elevation: **100.08 m**

ELEV./DEPTH (m)	DESCRIPTION
	90 mm APSPHALT 460 mm GRANULAR BASE
99.53 0.55	loose to compact dark brown to reddish brown FILL, sandy silt trace gravel, trace clay, trace topsoil/organics contains brick/asphlat/coal fragments moist
97.93 2.15	very stiff grey CLAYEY SILT TILL some sand to sandy, trace to some gravel moist
96.73 3.35	very stiff to hard grey SHALE with limestone interbedding (Georgian Bay Formation) damp
94.58 5.50	Auger Refusal on Inferred Bedrock

SAMPLE

SAMPLE ID	TYPE	N-VALUE	Approx. depth (m)
1	AS		
2	SS	10	1.0
3	SS	6	
4	SS	20	2.5
5	SS	25	
6	SS	50/ 100 mm	
7	SS	50/ 125 mm	
8	SS	50/ 0 mm	5.5

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □
50 100 150 200

PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○
20 40 60 80

WATER CONTENT (%)
W_P W W_L
10 20 30

WELL DATA

DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5

REMARKS

5.5 – borehole open and dry to 5.50 m bgs upon withdrawal of the drilling augers

PROJECT MANAGER: **EYC**

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FILE No: G20080

BOREHOLE No. 3

Client: **Support & Housing Halton**

Project: **Proposed Housing Development**

Location: **130 Cornwall Road, Oakville, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jul 14 - 20** TO **Jul 14 - 20**

SOIL LITHOLOGY

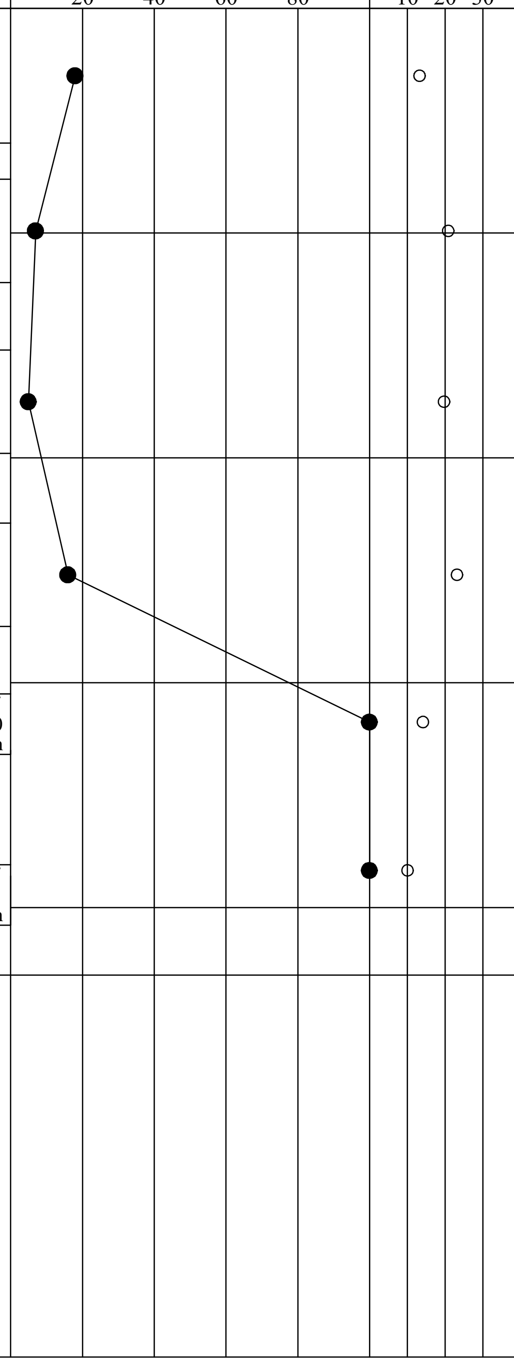
Ground Elevation: **100.25 m**

ELEV./ DEPTH (m)	DESCRIPTION
100.10 / 0.15	150 mm TOPSOIL
97.90 / 2.35	loose to compact dark brown to reddish brown FILL, sandy silt trace gravel, trace clay, trace topsoil/organics; contains brick/asphlat/coal fragments; moist
97.05 / 3.20	compact to very dense reddish brown SILT trace to some sand, trace clay; moist to wet
95.95 / 4.30	hard, grey SHALE with limestone interbedding (Georgian Bay Formation); damp
	Auger Refusal on Inferred Bedrock

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	18
2	SS	7
3	SS	5
4	SS	16
5	SS	50/ 100 mm
6	SS	50/ 50 mm

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. × ; LAB TEST: Unc. ■ P.P. □ ; 50 100 150 200
PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ ; 20 40 60 80
WATER CONTENT (%): W_P W W_L ; 10 20 30

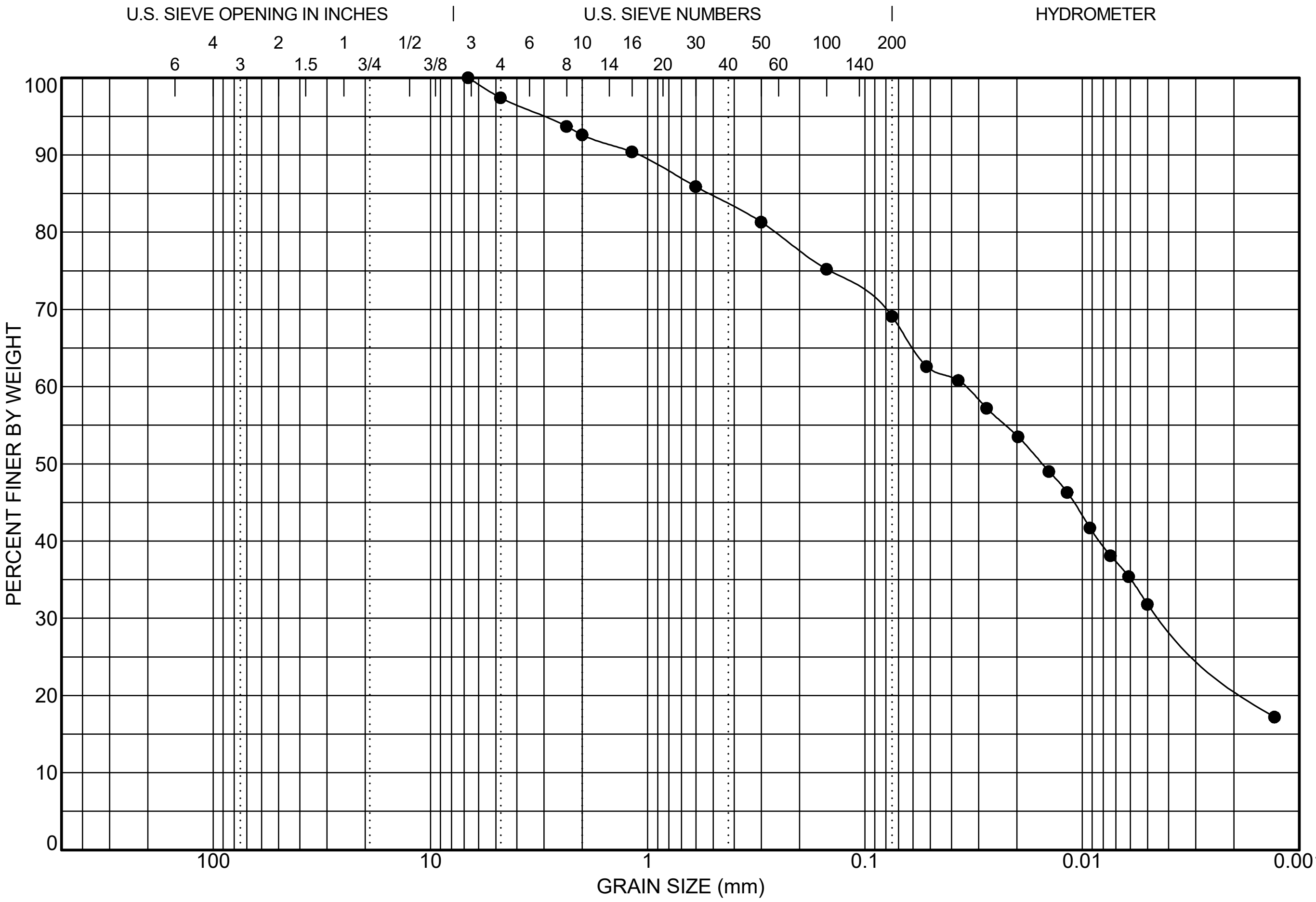


WELL DATA

REMARKS: borehole open and dry to 4.30 m bgs upon withdrawal of the drilling augers

PROJECT MANAGER: **EYC**

CHUNG & VANDER DOELEN ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
					6.7	0.035	0.004		2.6	28.3	69.1	

Date: Aug. 04 - 2020
Client: Support & Housing Halton
Contractor:
Source:
Sampled From: BH 1 - SA 4, 2.30 to 2.75 m depth
Sample No.: 1-4
Date Sampled: Jul. 14 - 2020
Sampled By: JV
Lab No.: 0683
Date Tested: Jul. 21 - 2020
Type of Material: Sandy Clayey Silt Till, trace gravel

Sieve Size (mm)	Percent Passing	No Specifications

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Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

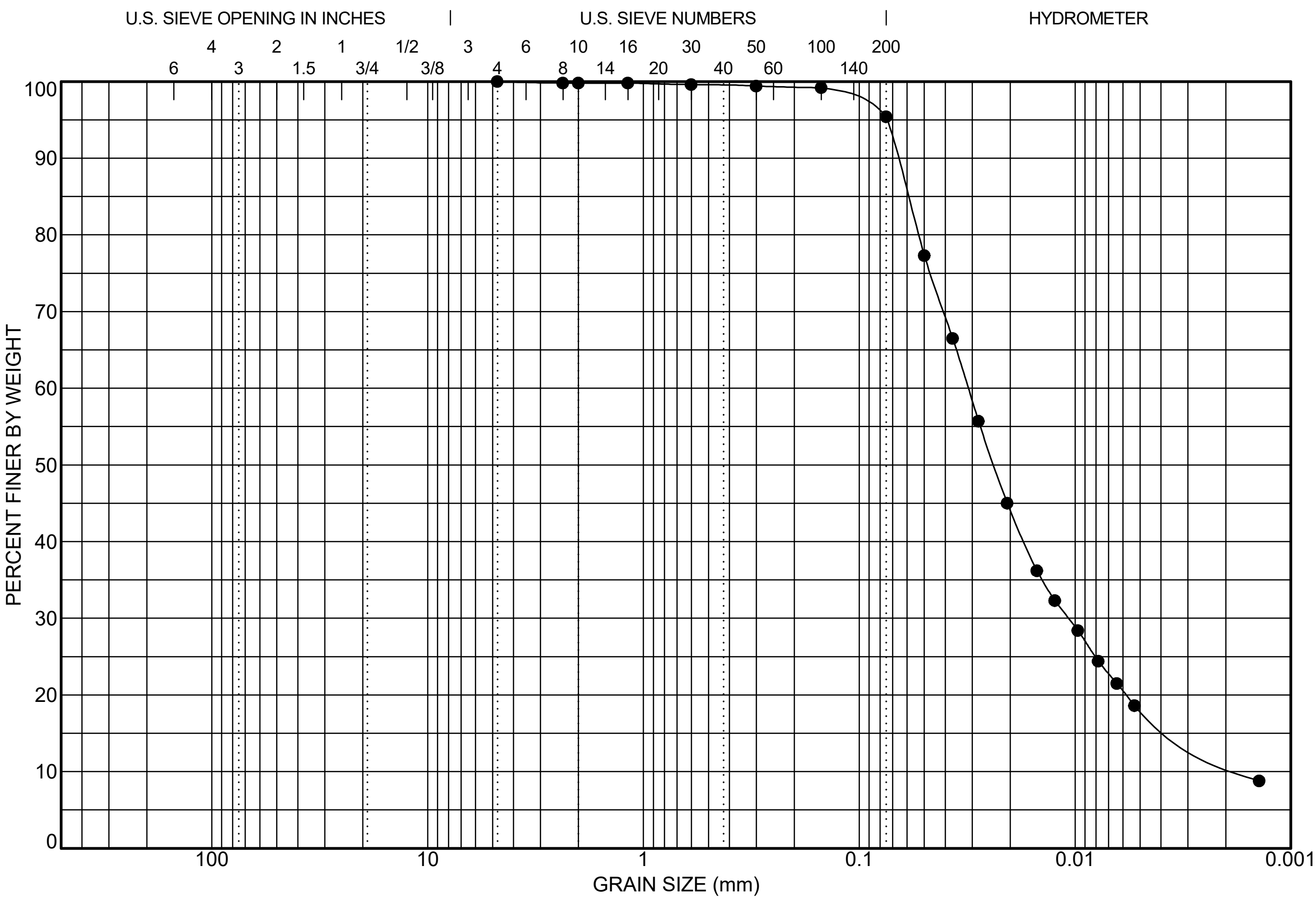
Project: Proposed Housing Development

Location: 130 Cornwall Road, Oakville, Ontario

File No.: G20080

Enclosure No.: 4

DM - NO SPECIFICATIONS G20080 130 CORNWALL RD OAKVILLE.GPJ LAW LNDN.GDT 20-8-5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			2.23	18.97	4.75	0.031	0.011	0.002	0.0	4.6	95.4	

Date: Aug. 04 - 2020
Client: Support & Housing Halton
Contractor:
Source:
Sampled From: BH 3 - SA 4 , 2.30 to 2.75 m depth
Sample No.: 3-4
Date Sampled: Jul. 14 - 2020
Sampled By: JV
Lab No.: 0684
Date Tested: Jul. 21 - 2020
Type of Material: Silt, trace sand, trace clay

Sieve Size (mm)	Percent Passing	No Specifications

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Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

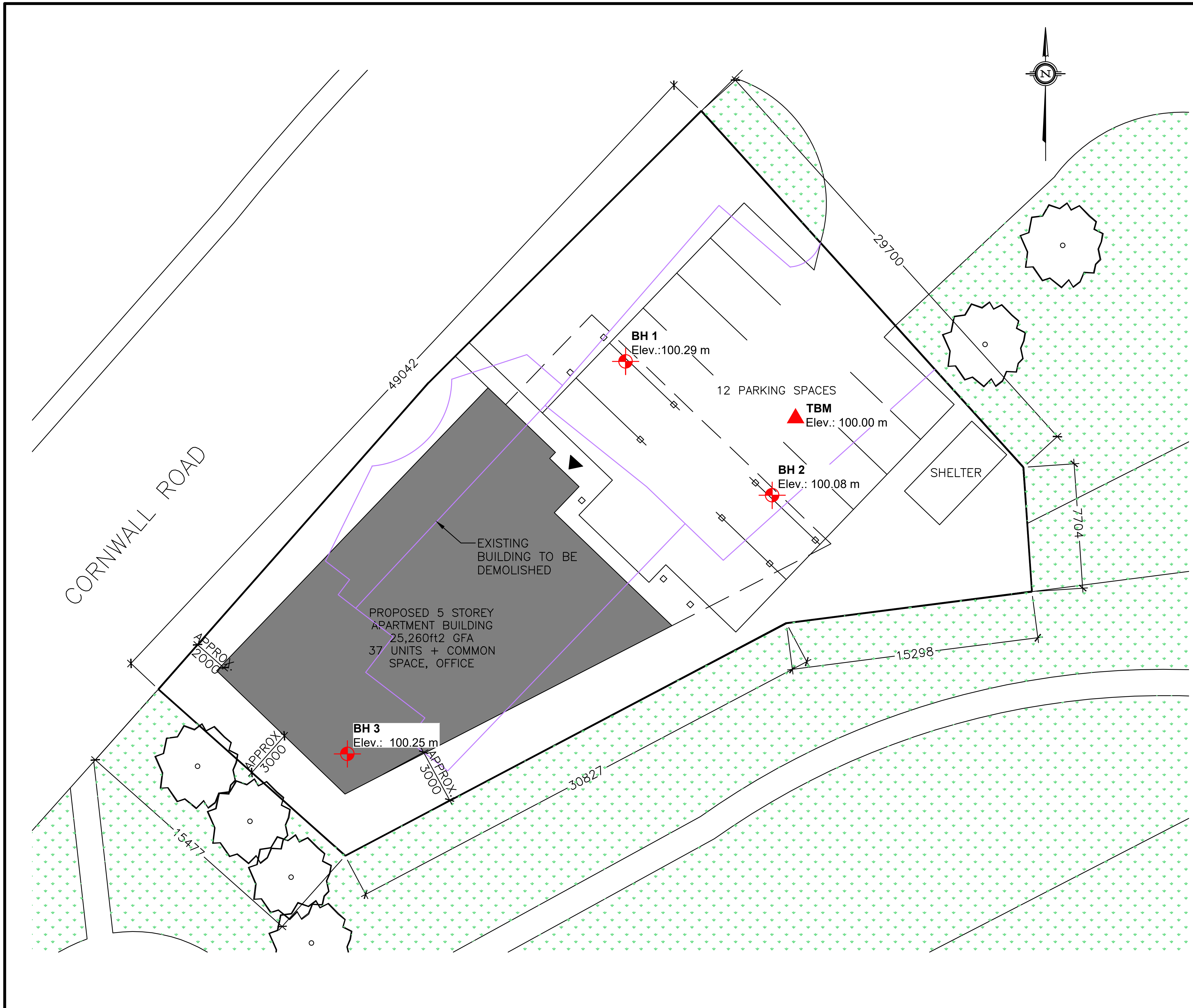
GRAIN SIZE DISTRIBUTION

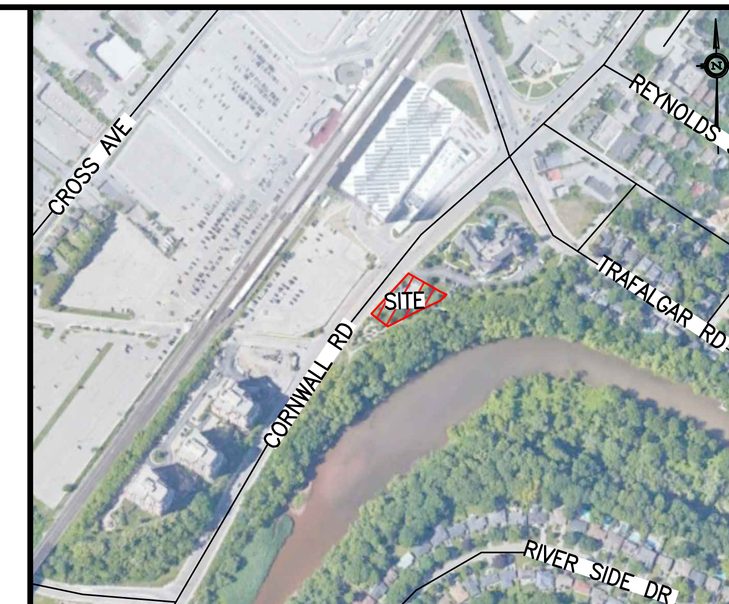
Project: Proposed Housing Development

Location: 130 Cornwall Road, Oakville, Ontario

File No.: G20080

Enclosure No.: 5





KEY PLAN **SOURCE:** Google Earth

LEGEND

TBM: Top of catch basin in parking lot east of existing building
Elev.: 100.00 m (Assumed)

Borehole Location

DWG./Elev. Ref.: *Invizij Architects Inc.; "Proposed New Development - Option D"; Proposed Site Plan; May 29, 2020*

BOREHOLE LOCATION PLAN

Proposed Housing Development

130 Cornwall Road
Oakville, Ontario

CHUNG & VANDER DOELEN
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311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1 / 519-742-8979

Drawn By: JV	Date: August, 2020	File No.: G20080
Checked By: EYC	Scale: N.T.S	Drawing No.: 1