CHUNG & VANDER DOELEN
ENGINEERING LTD.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION
Eastridge Road, Walkerton, Ontario

SUBMITTED TO:
Seawaves Development Services Inc.
528 Upper Sherman Ave.
Hamilton, ON
L8V 2M1

ATTENTION:
Mr. Moe Bachi, Director

FILE NO /G22559**/** April 4, 2023

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April 4, 2023
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Seawaves Development Services Inc.
528 Upper Sherman Ave.
Hamilton, ON
L8V 2M1

Attention: Mr. Moe Bachi, Director

RE: Geotechnical Investigation
Proposed Residential Subdivision
Eastridge Road, Walkerton, 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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LIST OF ENCLOSURES

1.0 INTRODUCTION

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) has been retained by Seawaves Development Services Inc. to conduct a geotechnical investigation for a proposed residential subdivision to be located on Eastridge Road in Walkerton, Ontario.

It is proposed to develop the 9.8 acre site into a municipally serviced residential subdivision with a mix of single-detached houses, townhouses, and a 3-storey residential care facility. The finished floor levels of most of the proposed houses have been established at elevation between 293.8± and 295.5± m. The finished basement floor levels of those houses have been established at elevations between 289.1± and 292.0± m. The finished floor elevation of the proposed residential care facility was not available at the time of reporting. However, a basement is not anticipated underneath the building.

It is also understood that a slope exists in the southern portion of the site. Due to the substantial grade difference in the southwestern portion of the site, a retaining wall is proposed along the property line at this corner in order to raise grade for the proposed house construction.

The purpose of this investigation has been to determine the subsurface conditions and relevant soil properties at the subject site in order to provide geotechnical recommendations for the design and construction of site grading operations, municipal site servicing, roadway extensions, retaining wall and residential foundations. Estimates of infiltration rates of the insitu soil deposits are also provided.

2.0 FIELD WORK

Eighteen (18) boreholes were advanced to depths between 3.5 and 8.1 m below existing grade on January 12 to 17, 2023 in order to investigate the subsurface conditions at the site. The borehole locations are illustrated 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 specialist contractor. The drill rig was equipped with continuous flight hollow stem 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 deposit was determined on slightly disturbed SPT samples using a field pocket penetrometer. The compactness condition or consistency of the soil strata has been inferred from the various test results.

Ground surface elevations at the borehole locations were surveyed by CVD and were referenced to a temporary benchmark (TBM) described below:

TBM:	Top of manhole northeast of subject property in grass, along southern side of Eastridge Road, as shown in Drawing No. 1
Elevation:	295.88 m (Geodetic)

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, four (4) grain size distribution analyses were performed on the major soil deposits to confirm field classification and to provide information on soil hydraulic conductivity.

4.0 EXISTING SITE CONDITIONS

The site is currently vacant and appears to have previously existed as farmland. The site is bound to the north by a new extent of Eastridge Road, to the west and south by farmland, and to the east by a solar park.

The site is relatively flat lying with a significant slope located at the south boundary of the site. The southwest portion of the site has a significant decrease in grade in the southwestern direction.

5.0 SUBSURFACE CONDITIONS

The detailed subsurface conditions encountered at the boreholes are presented on the Borehole Log Sheets, Enclosures 1 to 18. The following notes are intended to amplify and comment on the subsurface data obtained. The borehole locations are indicated on the Borehole Location Plan, Drawing No. 1.

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 Topsoil

Topsoil was encountered at ground surface at Boreholes 1, 2, and 4 to 18 with measured thicknesses between 100 and 600 mm. The thickness of topsoil could vary between and beyond the borehole locations.

5.2 Fill and Reworked Native Soil

A layer of fill in composition of sandy clayey silt was encountered at ground surface at Borehole 3 and extended to a depth of 0.43 m below existing grade. The fill contained traces of gravel and topsoil. The bottom 125 mm layer consisted of mostly buried topsoil.

Reworked native sandy silt was encountered below the topsoil at Boreholes 12, 14, 16, 17 and 18, and extended to depths between 1.40 and 1.80 m below existing grades. The reworked sandy silt contained traces of gravel and clay. Traces of topsoil were encountered within the sandy silt at Boreholes 12, 16, and 17, and traces of topsoil/organics at Borehole 14 below 1.60 m below existing grade. Occasional clayey layers were observed within the reworked native at Borehole 16.

The SPT "N"-values measured within the fill, buried topsoil, and reworked native ranged from 3 to 22 blows per 300 mm of penetration, indicating a variable very loose to compact compactness condition. Natural moisture contents were measured between 10 and 23%, indicating a moist moisture condition. Elevated moisture contents are likely due to the presence of topsoil/organics.

5.3 Upper Fine Granular Deposits

Fine granular deposits were encountered underlying the topsoil at Boreholes 1, 2, 4 to 8, 10, 11, and 15, underlying the fill/reworked native soil at Boreholes 3, 12, 14, 16, and 18, and underlying the cohesive deposits at Boreholes 9, 13, and 17. These fine granular deposits extended to depths between 1.4 and 7.0 m below existing grades at Boreholes 1 to 3, 5, 6, 8, 11, 12, and 14 to 17. Boreholes 4, 7, 9, 10, 13, and 18 were terminated within these deposits at depths between 3.50 and 6.55 m below existing grades.

The fine granular deposits comprised of varying amounts of sand and silts in the range of sand with some silt to silt with trace sand. The silt-dominant deposits at Boreholes 1, 4 to 7, 11, 12, 14, 15, 17 and 18 are observed to have a till-like structure. Traces to some clay were observed within the deposit at all borehole locations, and trace gravel at all but 3 borehole locations. Occasional clayey seams and/or layers were observed at Boreholes 2, 3, 5, 6, 7, 16, and 18, occasional sand seams at Boreholes 5 and 13, and occasional silt seams and/or layer at Boreholes 13 and 14. Traces of topsoil and/or rootlets were observed within the deposit at Boreholes 5, 8, 11, and 15.

Results of three (3) grain size distribution analyses of the upper fine granular deposits from Boreholes 2, 7, and 13 are shown graphically on Enclosures 19, 20 and 22.

The SPT "N"-values measured within the deposits ranged from 2 to 30 blows per 300 mm of penetration, indicating a variable very loose to dense compactness condition. In general, the upper 2 to 3 m stratum exhibited loose to very loose compactness condition.

Natural moisture contents were measured between 12 and 28%, indicating a moist to saturated moisture condition.

5.4 Cohesive Deposits

A cohesive deposits in composition of clayey silt to clayey silt till was encountered at Boreholes 9 and 13 underlying the topsoil, underlying the reworked native soil at Borehole 17, and underlying the upper fine granular deposits at Boreholes 1 to 3, 5, 6, 8, 12, 15, and 16. The cohesive deposits at Boreholes 8, 9, 13, 15, 16, and 17 extended to depths between 1.40 and 7.00 m below existing grades. Boreholes 1 to 3, 5, 6, and 12 were terminated within the deposit at depths between 4.80 and 8.10 m below existing grades.

The deposit contained trace to some sand, and trace to some gravel at Boreholes 1 to 3, 5, 6, 8, 9, 12, 15, and 17. Occasional silt seams were encountered within the deposit at Boreholes 1, 5, and 6. Locally at Borehole 17, a 0.7 m thick layer of silt was encountered within the clayey silt till deposit. Occasional cobbles were observed within the deposit at Borehole 2, and occasional sand seams/layers at Borehole 15. The deposit at Borehole 9 contained trace topsoil/rootlets.

The SPT “N”-values measured within the cohesive deposits ranged from 4 to greater than 100 blows per 300 mm of penetration. The undrained shear strengths obtained on the retrieved samples ranged from 72 to over 250 kPa. Based on the above test results, the deposit is considered to have a firm to hard consistency. Natural moisture contents were measured between 14 and 25%, indicating a moist to wet condition.

5.5 Lower Fine Granular Deposits

A lower layer of fine granular deposits was encountered underlying the cohesive deposit at Boreholes 8, 15, and 16 and extended to at least the borehole termination depths between 6.55 and 8.10 m below existing grades.

The deposits are comprised of varying percents of sand and silt. The deposits at Boreholes 8 and 15 contained trace gravel. Trace clay and frequent clayey seams/layers were encountered within the deposit at Borehole 8. Results of one (1) grain size distribution analyses of the lower fine granular deposit from Borehole 8 are shown graphically on Enclosure 21.

The SPT “N”-values measured within the deposits ranged from 7 to 40 blows per 300 mm of penetration, indicating a loose to dense compactness condition. Natural moisture contents were measured between 9 and 11%, indicating a moist moisture condition.

5.6 Sandy Silt Till

A sandy silt till deposit underlaid the upper fine granular deposit at Boreholes 11, 14, and 17 and extended to at least the borehole termination depths between 6.55 and 8.10 m below existing grades.

The sandy silt till contained trace gravel and clay. Occasional clayey seams and lenses were observed within the sandy silt till at Boreholes 14 and 17. Locally at Borehole 17, a 1.0 m thick layer of clayey silt till was observed at the start of the sandy silt till deposit.

The SPT “N”-values measured within the deposits ranged from 20 to 24 blows per 300 mm of penetration, indicating a compact compactness condition. Natural moisture contents were measured between 14 and 18%, indicating a moist to saturated moisture condition.

5.7 Groundwater

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

Boreholes 1, 3, 5 and 12 remained open upon withdrawal of drilling augers with groundwater measured at depths between 2.4± and 5.0± m below existing grades. Boreholes 9, 14, 15, 16, and 17 experienced cave-ins at depths between 2.7± and 7.3± m below existing grades upon withdrawal of drilling augers with groundwater at depths between 1.2± and 3.7± m below existing grades. Boreholes 4, 10, and 11 experienced a dry cave-in at depths between 4.3± and 5.8± m below existing grades. Borehole 18 remained open and dry upon withdrawal of drilling augers.

In addition, four (4) monitoring wells were installed at Boreholes 2, 6, 8, and 13 to determine the groundwater level/elevation. The following table provides the water level readings taken on January 24, 2023.

Borehole No.	Existing Ground Elevation (m)	Water Level Below Existing Ground Surface (m)	Water Level Elevation (m)
2	293.54	0.88	292.67
6	291.75	1.03	290.72
8	293.70	0.76	292.94
13	293.22	1.52	291.71

Based on the measured/observed groundwater level results, the groundwater across the site is laterally discontinuous and the groundwater encountered is considered perched within the upper fine granular deposits.

It is noted that the groundwater table will fluctuate in response to major weather events. Seasonal fluctuations of the groundwater table are to be expected.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 General

It is proposed to develop the 9.8 acre site into a municipally serviced residential subdivision with a mix of single-detached houses, townhouses, and a 3-storey residential care facility. The finished floor levels of most of the proposed houses have been established at elevation between 293.8± and 295.5± m. The finished basement floor levels of those houses have been established at elevations between 289.1± and 292.0± m. The finished floor elevation of the proposed residential care facility was not available at the time of reporting. However, a basement is not anticipated underneath the building.

It is also understood that a slope exists in the southern portion of the site. Due to the substantial grade difference in the southwestern portion of the site, a retaining wall is proposed along the property line at this corner in order to raise grade for the proposed house construction.

In general, fill materials and/or reworked native sandy silt was encountered underneath the surficial topsoil at Boreholes 3, 12, 14, 16, 17 and 18 to depths between 0.43 and 1.80 m below existing grade. Native very loose to dense fine granular deposits, firm to hard cohesive deposit, and compact sandy silt till deposits were encountered underlain the above-described soils to depths between 3.50 and 8.10 m below existing grades, the maximum depths of exploration.

Groundwater levels measured in monitoring wells at Boreholes 2, 6, 8 and 13 were at depths between 0.76 and 1.52 m below existing grades, corresponding to elevations between 290.72 and 292.94 m. Based on the measured/observed groundwater level results, the groundwater across the site is laterally discontinuous and the groundwater encountered is considered perched within the upper fine granular deposits. It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

Given that the single-detached houses and townhouses have basement finished floor elevations between 289.1± and 292.0± m, the basement finished floor is expected to lie 0.6± to 2.2± m below the seasonal high groundwater table. However, due to the very low permeability of the native cohesive soils and native silt deposits, basements can still be constructed below the groundwater table with a conventional weeping tile and sump pump drainage system implemented at each single-detached house and townhouse block.

It is considered necessary to install an underfloor drainage system in the single-detached houses and townhouse blocks to efficiently convey the perched groundwater to the sumps. It is recommended that at least one (1) sump pit should be installed in every 3 units in the townhouse blocks and one (1) sump pit for each of the single-detached houses. Positive exterior grade adjacent to the building basement will direct surface water away from the building, preventing surface water infiltration.

6.2 Basement Construction

The basement finished floor for the single-detached houses and townhouses are proposed to have elevations between 289.1± and 292.0± m, approximately 1.0± to 3.5± m below existing grades. The basement finished floor is expected to lie 0.6± to 2.2± m below the seasonal high groundwater table.

Due to the very low permeability of the native cohesive soils and native silt deposits, basements can still be constructed below the groundwater table with a conventional weeping tile and sump pump drainage system implemented at each single-detached house and townhouse block. Positive exterior grade adjacent to the building basement will direct surface water away from the building, preventing surface water infiltration.

On the eastern portion of site, in the general area of Boreholes 13, 14, and 16, saturated fine granular deposits in composition of sand with some silt to silty sand were encountered at depths between 1.6± and 2.9± m below existing grades. It is recommended to raise the basements to be at least 0.6 m higher than the spring water table in the vicinity of Borehole 13. Alternatively, basements in the area of Borehole 13 could be eliminated altogether. Boreholes 14 and 16 exist within the footprint of the proposed 3-storey residential care facility where basements are not anticipated.

It is further recommended that the extent of the saturated fine granular material can be determined by test pits.

6.3 Foundations

6.3.1 Residential Subdivision

The compact and/or stiff native inorganic undisturbed soils encountered at the site are generally competent to support house foundations at the proposed basement elevations between 289.1± and 292.0± m.

Building foundations can be founded on native compact to dense fine granular deposits, stiff to very stiff cohesive deposits, and/or well-compacted, monitored engineered fill. The native soils and approved engineered fill (constructed in accordance with the procedures provided in Section 6.7) can be used to support footing foundations designed to a net soil bearing pressure of up to 100 kPa (2100 psf) at SLS.

Footing subgrade inspections are recommended to verify the bearing capacity of the soil prior to placement of the forms and concrete for the building foundations.

6.3.2 3-Storey Residential Care Facility

Conventional strip and spread footing foundations can be used to support the proposed 3-storey residential care facility. Footings cast on native compact and/or stiff native inorganic undisturbed soils and/or approved engineered fill (constructed in accordance with the procedures provided in Section 6.7) can be designed using a Geotechnical Reaction at SLS of 100 kPa. The SLS value given above is based on a maximum settlement of 25 mm under the footing foundations. The Factored Geotechnical Resistance at ULS is 150 kPa.

These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. The majority of the settlements will take place during construction and the first loading cycle of the building.

The following table summarizes the highest founding level and elevation for the footing at each borehole location in the area of the proposed 3-storey residential care facility:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
14	294.69	1.9±	292.8±
15	294.17	3.1±	291.1±
16	295.47	2.3±	293.2±
17	294.92	3.0±	291.9±

It is recommended that a lean concrete mat be placed over approved footing subgrade in wet or saturated areas to prevent further disturbance to the bearing soils resulting from construction activities.

In addition, the footings should be founded below any existing fill materials, on 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 12 mm, respectively, and these are considered tolerable for the structure being contemplated.

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 structures should be designed to resist earthquake load and effects as per OBC Subsection 4.1.8. Based on the anticipated condition of the engineered fill materials and the underlying soil condition encountered at the boreholes, the site can be classified as a **Site Class D** as per OBC Table 4.1.8.4.A (Page B4-24).

6.5 Floor Slab Construction

Given that the basement finished floor for the single-detached houses and townhouses is expected to lie 0.6± to 2.2± m below the seasonal high groundwater table, basements will be constructed with a conventional weeping tile and sump pump drainage system implemented at each single-detached house and townhouse block. Positive exterior grade adjacent to the building basement will direct surface water away from the building, preventing surface water infiltration.

In addition, it may be necessary to install an underfloor drainage system in the single-detached houses and townhouse blocks to efficiently convey the perched groundwater to the sumps. It is recommended that at least one (1) sump pit should be installed in every 3 units in the townhome blocks and one (1) sump pit for each of the detached homes.

Cognizant of the expected subgrade soil conditions at the finished basement floor levels, it is anticipated that a system of underfloor drains (at 6 m spacing) may be required and be connected to a positively drained sump(s) or permanently to the municipal sewer to locally control the groundwater table (and expected fluctuations) in order to keep the basement floors in a dry condition.

The exposed subgrade should be proof-rolled with a heavy roller in conjunction with an inspection by the geotechnical engineer at the time of floor slab construction. Excess moisture in the subgrade soil will render the material incompactable. Any soft and/or unstable areas detected should be replaced with imported Granular "B" Type I which should be compacted to 95% SPMDD.

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.

A modulus of subgrade reaction (k_s) of 30 MN/m^3 may be used for the design of the floor slabs, considering the floor subgrade will consist of predominantly fine granular and clayey silt soils.

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 to one-quarter of the slab thickness.

Moisture migration from the underlying soils through the concrete slab-on-grade will 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.

6.6 Lateral Earth Pressure

Basement walls and retaining walls should be designed to resist the lateral earth pressure acting against these walls. The following formula may be used for these calculations. 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.

$P = K (\gamma H + q)$

where:

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

The soils encountered during the investigation are not considered to be free-draining materials. A drainage core layer should be installed against basement walls in accordance with OBC requirements. The basement walls should be damp-proofed.

A perimeter drainage system is required to ensure hydrostatic pressure does not build up in the backfill against the foundation wall. The perimeter weeping tile system is to be installed at the base of the footing to direct the collected waters to sump pump installations or the storm sewer.

6.7 Site Grading and Engineered Fill Construction

Review of the proposed road grading and site servicing profile drawings indicates that there will be very minimal site grading operations. Locally at the southwest corner of the site, the grade will be raised by up to 3± m for the proposed single-detached houses and retaining wall. It is recommended to construct engineered fill in areas at the southwest corner in order to suitably support building foundations and the retaining wall.

The surficial topsoil layer varies in thickness between 100 and 600 mm at the borehole locations. It should be noted that the thickness of the organic soil layer could vary drastically across the site from those reported at the borehole locations.

It is noted that topsoil stripping operations should be conducted when the ground is not wet and will support suitably sized construction equipment. Over-stripping can result when the ground conditions are wet and unstable.

The inorganic onsite fine granular deposits and clayey silt deposits are deemed suitable for site regrading operations. The moisture content of these excavated soils should be within 3% below the optimum moisture content in order to achieve the specified degrees of compaction. The excavated inorganic fine granular soils can be reused to construct the engineered fill provided that this fill material is not overly wet or dry.

The grading work should be carried out during relatively dry weather as the predominant fine granular and clayey silt soils are sensitive to wetting and are difficult to handle when wet. Therefore, earthworks should be scheduled in the drier summer months. The native fine granular soils are susceptible to softening and deformation when exposed to excessive moisture and construction traffic. As a result, it is imperative that the grading/filling operations are planned and maintained to direct surface water run-off to low points and then be positively drained by suitable means. During periods of wet weather, construction traffic should be directed along the designated construction routes so as not to disturb and rut the exposed subgrade soil. Temporary construction roads consisting of clear crushed material (such as crushed stone or recycled concrete) may be required during poor weather conditions such as a wet Spring or Fall.

Should additional bulk fill require to be imported to the site for site grading purposes, it should be similar in gradation to the existing on-site granular soils or consist of OPSS Granular B Type I. It is recommended that any proposed borrow source materials be tested prior to importing, in order to ensure that the environmental quality of the fill meets all environmental approval standards and to ensure that the natural moisture content of the fill is suitable for compaction.

Backfilling local excavations (such as foundation walls, footings, and trenches inside the building footprint) should be performed using imported OPSS Granular B Type I or approved on-site soil.

The engineered fill should be constructed in accordance with the following procedures in order to support building foundations, floor slabs and pavement areas:

1. All existing topsoil, fill/reworked native and otherwise deleterious materials should be stripped from building and retaining wall areas;

2. The exposed inorganic subgrade surface is to be thoroughly recompacted by large heavy compaction equipment (10 tonne recommended) and inspected by qualified geotechnical personnel. Any loose or soft areas identified should be excavated to the level of competent soil. All prepared subgrade areas are to be inspected by qualified geotechnical personnel prior to placement of fill;

3. Should a wet/saturated subgrade condition be exposed in deeper excavation areas of the site, the initial lift of engineered fill may need to consist of coarse pit run sand and gravel (500± mm thick) statically rolled to stabilize and “bridge” the approved prepared subgrade;

4. The required grades can then be achieved by placing approved onsite granular-based fill and/or imported well-graded sand and gravel fill in maximum 300 mm thick lifts, compact to no less than 98% SPMDD to at leas the underside of the proposed footings.

   Salvaged inorganic silt to sandy silt fill may potentially be reused to build engineered fill (compacted to 98% SPMDD) between the footing level and the underside of floor slab level depending on its condition at the time of construction. Should this not be feasible at the time of construction, imported sand and gravel fill should be used.

The moisture content of the fill materials should be within 3% below their optimum moisture contents in order to achieve the specified degree of compaction;

5. Engineered fill used to support future buildings and retaining walls must be placed such that the fill pad extends horizontally outwards at least a distance equal to the depth of fill to be placed;

6. Overly wet and organic materials should be placed in non-structural areas where 90% SPMDD is adequate. Alternatively, wet inorganic soils can be mixed with drier soils to produce a suitable moisture content to allow appropriate compaction to occur if conditions dictate;

7. All fill placement and compaction operations must be supervised on a full-time basis by qualified geotechnical personnel to approve fill material and ensure the specified degrees of compaction have been achieved.

Vibration could be generated from various construction equipment, such as compactors and rollers which could be harmful to surrounding structures and buildings during construction. Peak particle velocity (PPV) of ground motion is widely accepted as the best descriptor of potential for vibration damage to structures. The safe vibration limit can be set to 10 to 20 mm/s PPV, depending on the sensitivity of surrounding structures to vibration.

Vibration monitoring can be carried out to measure the PPV of ground motion from vibration generated from typical compaction equipment at the beginning of the project in the potentially critical areas. This will set criteria and establish the type of equipment to be used for this project. It is also recommended that a pre-construction condition survey be conducted to document the condition of the existing structures within the possible zone of influence.

6.8 Site Servicing

The site will be serviced with municipal services and pipe invert depths are expected to be in the order of 1.5± to 3.0± m below finished grades.

6.8.1 Excavation Conditions

Trenching can be carried out using conventional open cut procedures. The excavations will generally intersect loose to compact fill, reworked native sandy silt, very loose to compact fine granular deposits, and/or firm to stiff clayey silt which will generally provide suitable subgrade support to sewer and watermain serving. Any loose/soft, unstable and/or organic soils encountered at the pipe invert should be sub-excavated and replaced with well compacted Granular "A" which should be placed in 150 mm thick layers and compacted to at least 95% Standard Proctor Maximum Dry Density (SPMDD). The support of pipes in these areas can also be achieved with non-shrinkable fill if poor soil is encountered at the subgrade level and fully removed.

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. 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.

6.8.2 Pipe Bedding

As noted in Section 6.8.1, any unsuitable soils exposed at the pipe subgrade should be sub-excavated and replaced with imported Granular "A", placed in thin layers, and compacted to at least 95% SPMDD, or can be removed and supported on non-shrinkable fill.

The bedding requirements for the services should be in accordance with Ontario Provincial Standard Drawings OPSD - 802 for flexible and rigid pipes. The bedding shall be a Class "B" and consist of at least 150 mm thick Granular "A" compacted to at least 95% SPMDD. Granular "A" should be used to backfill around the pipe to at least 150 mm above the top of the pipe.

Particular attention should be given to ensure material placed beneath the haunches of the pipe is adequately compacted. Recycled asphalt will not be allowed to be used in Granular “A” bedding material.

6.8.3 Trench Backfill

Excavated inorganic materials are considered suitable for reuse as trench backfill. If necessary, potential mixing of drier and wetter excavated soils in proper ratios can be done to produce a suitable mixture near the material’s optimum moisture content in order to achieve the required compaction specification. Conversely, judicious addition of water may be required if the soils are significantly drier than their optimum moisture content in order to facilitate suitable compaction.

The backfill should be placed in thin layers, 300 mm thick or less dependant on the demonstrated success of compaction based on in-situ density test results. Other types of materials such as organic soils, overly wet soils, boulders, and frozen materials (if work is carried out in the winter months) should not be used for backfilling. All trench backfill should be compacted to at least 95% SPMDD.

Backfilling operations should follow closely after excavation so that only a minimal length of trench slope is exposed at any one time so as to minimize potential problems. This will potentially minimize over-wetting of the subgrade material. Particular attention should be given to make sure frozen material is not used as backfill should construction extend into the winter season.

It has been our experience that excavated cohesive soils should be broken into smaller pieces (less than 150 mm diameter) before returning into the trench as backfill. This will eliminate “wedging” problems and reduce long term settlement. Particular attention must be made to backfilling the laterals where the trenches are narrow and against the manholes and catch-basins. Thinner lifts and additional compaction must be applied.

Frequent inspection by experienced geotechnical personnel should be carried out to examine and approve backfill material, to carefully inspect placement, and to verify that the specified degree of compaction has been obtained by in situ density testing.

6.8.4 Groundwater Control

Uncontrollable groundwater flows are not expected to be encountered within the anticipated servicing installation excavations. Subsurface seepage and surface water runoff into the excavations may be handled by conventional sump pumping techniques, as and where required. The sump pits should be filtered.

6.9 Pavement Design and Construction

The earth subgrade soil is generally expected to consist of fine granular soils and/or cohesive soils. The following flexible pavement structure is recommended for the local residential roadway based on the results of the gradational analyses, assumed CBR values, groundwater table, frost susceptibility of subgrade soils and anticipated traffic volume.

Pavement Component	Component Thickness
HL3 Surface Asphaltic Concrete HL8 Binder Asphaltic Concrete	40 mm 60 mm
Granular "A" Base Course	150 mm
Granular "B" Type II Sub-base Course	450 mm
Granular Base Equivalency (GBE)	650 mm

Note: GBE denotes Granular Base Equivalency which is calculated using factors of 2 for asphaltic concrete, 1 for Granular “A” base and 0.67 for Granular “B” sub-base.

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.

The subgrade should be prepared in accordance with the recommendations provided in Section 6.7 and Section 6.8.3 prior to placement of the granular base layers.

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 so as 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. The roadway subgrade should be free of depressions and should have a 2% slope from the crown to the edge of the pavement.

Longitudinal sub-drains with positive drainage outlets are recommended to be installed at the subgrade level along the periphery and in low areas of the pavement construction to enhance the performance of the pavement. Systematic drainage of the granular base materials will promote the longevity of the pavement structure.

6.10 Retaining Wall

It is understood that a retaining wall will be constructed at the southwest corner of site. The top of the retaining wall is proposed to lie at elevations between 287.50 and 290.50 m. The type of retaining wall and the elevation of the base of the wall was not available at the time of reporting.

It is assumed that the retaining wall will be a segmental concrete retaining wall. The following sections provide suggested design parameters; however, it is the responsibility of the retaining wall designer to verify the given values. In addition to the retaining wall design itself, a global stability check will be required and can be performed once the retaining wall design is available.

6.10.1 Retaining Wall Foundation

The upper loose to compact fill and loose native soils are not considered reliable and consistent for support of the retaining wall foundation. The footing extending past all fill and loose native soils and constructed on or within the underlying competent native soil deposits and/or approved engineered fill (constructed in accordance with the procedures provided in Section 6.7) may be designed using a Geotechnical Reaction at SLS of 100 kPa. The Factored Geotechnical Resistance at ULS is 150 kPa.

The following table summarizes the highest founding level and elevation for the retaining wall:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
9	284.18	3.0±	281.2±

These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. The total and differential settlement of footing foundations designed to the recommended soil bearing pressures will be less than 25 and 12 mm, respectively, and these are considered tolerable for the structure being contemplated.

The proposed segmental retaining wall is a "flexible" structure and, therefore, the retaining wall footing does not require a soil cover of 1.2 m for frost protection.

6.10.2 Retaining Wall Design Parameters

The following soil parameters may be used in the design of the segmental retaining wall:

Soil Type	Soil Unit Weight	Friction Angle
Fill/reworked native, compact sandy silt	19 kN/m^3	28^0
Native compact fine granular deposits	20 kN/m^3	30^0
Native firm to very stiff cohesive deposits	21 kN/m^3	29^0
Granular B backfill, compacted to 95% SPMDD	21 kN/m^3	32^0

A surcharge load of 12 kPa should be considered in the design for supporting the traffic loading adjacent to the retaining wall.

The backfill for retaining wall 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 at least 95% SPMDD. Weeping tiles or weep holes should be installed to effect drainage behind the retaining wall.

Periodic field reviews of the installation of the retaining wall procedure and compaction testing of the granular footing and backfill are to be carried out by the geotechnical engineer for as-built certification.

6.11 Infiltration Rates of Onsite Soils

Grain size distribution analyses were conducted on samples of the fine granular deposit and the results are graphically presented on Enclosures 19 to 22.

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:

Material	Hydraulic Conductivity (K) (cm/sec)	Infiltration Rate (mm/hr)
Silt (Enclosures 19 to 21)	1×10^{-6} to 4×10^{-6}	1 to 2
Silty Sand to Sand (Enclosure 22)	9×10^{-4}	25
Cohesive Deposits	1×10^{-6}	1

6.12 Handling of Excess Soil

Excess soil may be generated due to the proposed site works. The management of excess soil is now governed by Ontario Regulation 406/19. In accordance with the regulation, the Project Leader is responsible for the handling, storage, reuse, transportation, and removal of all soil. To support off-site removal, the following is required:

- Planning Documentation
  - Assessment of Past Use
  - Sampling and Analysis Plan
  - Excess Soil Characterization Report
  - Excess Soil Destination Report
- Tracking
- Registry
- Record Keeping

CVD can provide further assistance on this matter as the project develops.

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.

LICENSED PROFESSIONAL ENGINEER
E.Y. CHUNG
8345506
May 2, 2023
PROVINCE OF ONTARIO

Brianna Cobbe, E.I.T.
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

Soil Abbreviations and Terms Used on Record of Borehole Sheets

TERMINOLOGY DESCRIBING COMMON SOIL TYPES:

Topsoil	-	mixture of soil and humus capable of supporting vegetation
Peat	-	mixture of visible and invisible fragments of decayed organic matter
Till	-	unstratified glacial deposit which may range from clay to boulders
Fill	-	soil materials identified as being placed anthropologically

CLASSIFICATION (UNIFIED SYSTEM)

Clay	<0.002mm		
Silt	0.002 to .075mm		
Sand	0.075 to 4.75mm		
		Fine	0.075 to 0.425 mm
		Medium	0.425 to 2.0 mm
		Coarse	2.0 to 4.75 mm
Gravel	4.75 to 75mm		
		Fine	4.75 to 19 mm
		Coarse	19 to 75 mm
Cobbles	75 to 300mm		
Boulders	>300mm		

TERMINOLOGY

Soil Composition	**% by Weight**
"traces"	<10%
"some"(eg. some silt)	10-20%
Adjective (eg. sandy)	20-35%
"and"(eg. sand and gravel)	35-50%

Standard Penetration Resistance (SPT): Standard Penetration Resistance ('N' Values) refers to the number of blows required to advance a standard (ASTM D1586) 51 mm Ø (2 inch) split-spoon sampler by the use of a free falling, 63.5 Kg (140lbs) hammer. The number of blows from the drop weight is recorded for every 15 cm (6 inches). The hammer is dropped from a distance of 0.76m (30 inches) providing 474.5 Joules per blow. When the sampler is driven a total of 45 cm (18 inches) into the soil, the standard penetration index ('N' Value) is the total number of blows for the last 30 cm (12 inches).

Dynamic Cone Penetration Resistance (DCPT): Dynamic Cone Penetration Resistance is similar to a SPT with the 474.5 Joule/blow impulse provided by the free falling hammer where the split-spoon sampler is replaced by a 51 mm Ø, 60˚ conical point and the number of blows is recorded continuously for every 30 cm (12 inches).

COHESIVE SOILS CONSISTENCY

	(kPa)	**(P.S.F.)**	**Nominal 'N' Value**
Very Soft	<12	<250	0-2
Soft	12-25	250-500	2-4
Firm	25-50	500-1000	4-8
Stiff	50-100	1000-2000	8-15
Very Stiff	100-200	2000-4000	15-30
Hard	>200	>4000	>30

RELATIVE DENSITY OF COHESIONLESS SOIL

	'N' Value
Very Loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

MOISTURE CONDITIONS:

Cohesive Soil	**Cohesionless Soil**
DTPL- Drier than plastic limit	Damp
APL- About plastic limit	Moist
WTPL- Wetter than plastic limit	Wet
MWTPL- Much wetter than plastic limit	Saturated

SAMPLE TYPES AND ADDITIONAL FIELD TESTS

SS	Split Spoon Sample (obtained from SPT)	**GS**	Grab Sample	**PP**	Pocket Penetrometer
		BS	Bulk Sample	**VANE**	Peak & Remolded shear
AS	Auger Sample	**TW**	Thin Wall Sample or Shelby Tube	**DMT**	Flat Plate Dilatometer

LABORATORY TESTS

SG	Specific Gravity	**S**	Sieve Analysis	**W**	Water Content
H	Hydrometer	**P**	Field Permeability	**K**	Lab Permeability
W_p	Plastic Limit	**W_l**	Liquid Limit	**I_p**	Plasticity Index
GSA	Grain Size Analysis	**C**	Consolidation	**UNC**	Unconfined compression

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Enclosure A

FILE No: G22559

BOREHOLE No. 1

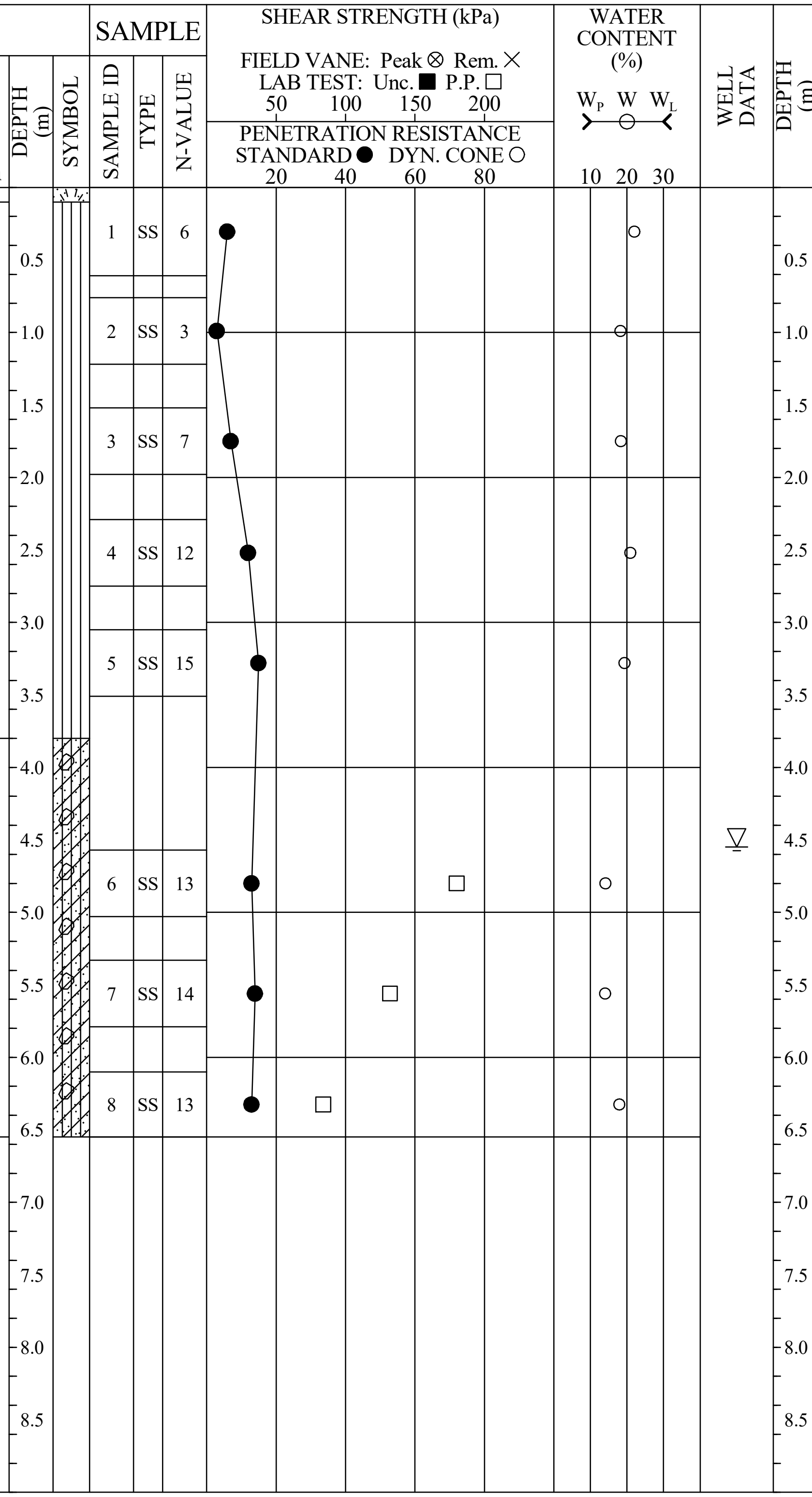
Client:	**Seawaves Development Services Inc.**
Project:	**Proposed Residential Subdivision**
Location:	**Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine:	**Diedrich D50T**
Method:	**Hollow Stem Auger**
Size:	**83 mm I.D.**
Date:	**Jan 12 - 23** TO **Jan 12 - 23**

SOIL LITHOLOGY — Ground Elevation: **293.74 m**

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
293.64 / 0.10	100 mm TOPSOIL				upper 0.10 +/- m frozen
	clayey layer, trace topsoil ------ very loose to compact, brown SILT (till-like), trace gravel, trace sand, trace clay, moist to wet	1	SS	6	
		2	SS	3	
		3	SS	7	
		4	SS	12	
		5	SS	15	
289.94 / 3.80	stiff, grey CLAYEY SILT TILL, trace gravel, trace sand, occ. silt seams, moist to wet				water level at depth of 4.6 m bgs upon withdrawal of drilling augers
		6	SS	13	
		7	SS	14	
		8	SS	13	
287.19 / 6.55	End of Borehole				borehole open upon withdrawal of drilling augers



PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 2

Client:	**Seawaves Development Services Inc.**
Project:	**Proposed Residential Subdivision**
Location:	**Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine:	**Diedrich D50T**
Method:	**Hollow Stem Auger**
Size:	**83 mm I.D.**
Date:	**Jan 12 - 23** TO **Jan 12 - 23**

SOIL LITHOLOGY

Ground Elevation: **293.54 m**

ELEV./ DEPTH (m)	DESCRIPTION
293.44 / 0.10	100 mm TOPSOIL
	clayey layer trace topsoil ------ loose to compact brown SILT trace sand, trace clay occ. clayey seams wet to moist
291.39 / 2.15	brown ------ stiff to hard, grey CLAYEY SILT TILL trace gravel, trace sand occ. cobbles moist to wet
288.74 / 4.80	End of Borehole on Inferred Boulder

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	5
2	SS	9
3	SS	8
4	SS	18
5	SS	14
6	SS	12
7	SS	50/ 75 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, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5

REMARKS

- above-grade protective casing set in concrete
- upper 0.10 +/- m frozen
- bentonite seal/50 mm I.D. PVC riser
- water level at 0.88 m depth on January 24, 2023
- 3.05 m long, 50 mm I.D. PVC screen with sandpack
- monitoring well installed in separate borehole approximately 1.8 m east of Borehole 2

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 3

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

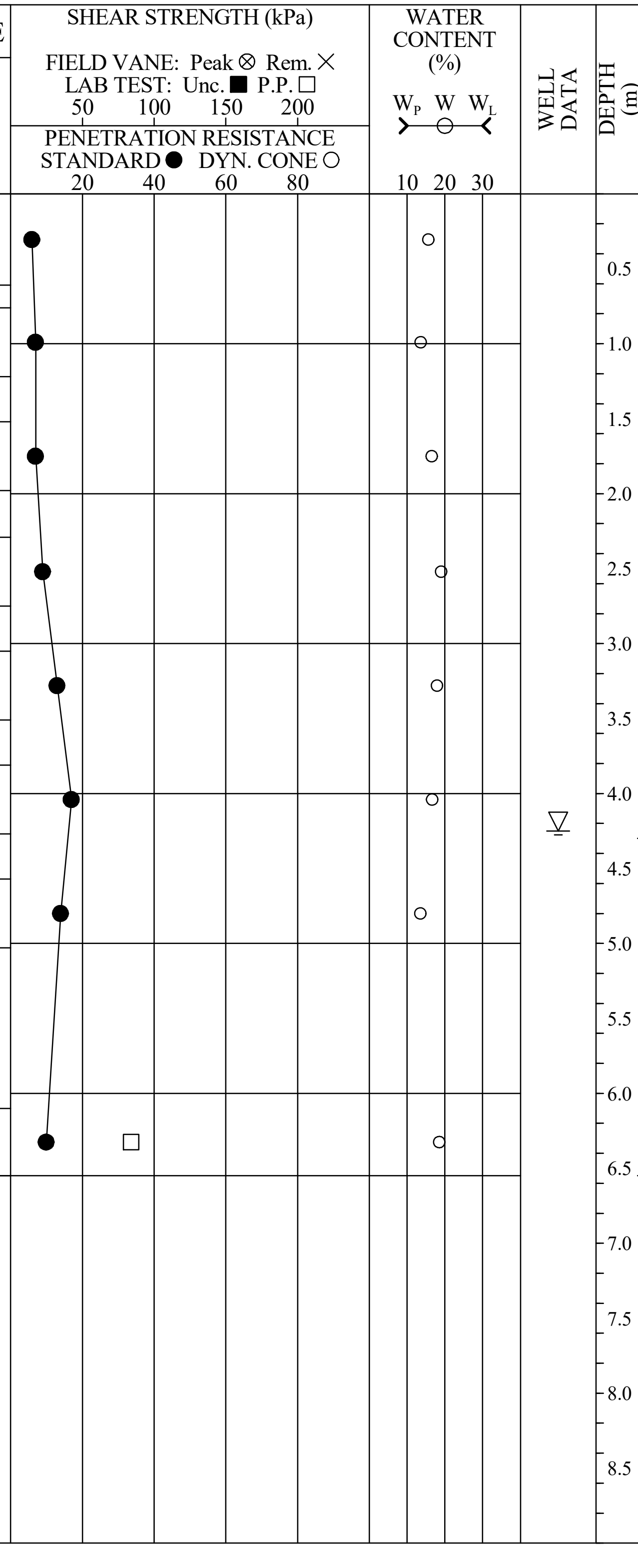
Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 12 - 23** TO **Jan 12 - 23**

Ground Elevation: **293.35 m**

ELEV./DEPTH (m)	SOIL LITHOLOGY DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	WATER CONTENT (%)	REMARKS
292.92 / 0.43	loose, brown, FILL, sandy clayey silt, trace gravel, trace clay, trace topsoil, moist	1	SS	6		
292.25 / 1.10	------ buried topsoil; loose, brown SANDY SILT, trace gravel, trace clay, moist	2	SS	7		
	loose to compact brown SILT some sand, trace gravel trace clay occ. clayey seams moist	3	SS	7		
		4	SS	9		
		5	SS	13		
		6	SS	17		water level at depth of 4.3 m bgs upon withdrawal of drilling augers
287.85 / 5.50	------ grey	7	SS	14		
286.80 / 6.55	stiff, grey CLAYEY SILT TILL trace gravel, trace sand moist to wet	8	SS	10		borehole open upon withdrawal of drilling augers
	End of Borehole					



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FILE No: G22559

BOREHOLE No. 4

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 16 - 23** TO **Jan 16 - 23**

SOIL LITHOLOGY

Ground Elevation: **293.53 m**

ELEV./DEPTH (m)	DESCRIPTION	REMARKS
293.33 / 0.20	200 mm TOPSOIL	upper 0.20 +/- m frozen
291.33 / 2.20	trace topsoil ------ loose to compact brown SANDY SILT trace gravel, trace clay moist	
288.48 / 5.05	compact, brown SILT (till-like) trace gravel, trace sand trace clay moist ------ clayey layer	dry cave-in at 4.3 m bgs upon withdrawal of drilling augers
	End of Borehole	

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	6
2	SS	10
3	SS	5
4	SS	11
5	SS	22
6	SS	16
7	SS	12

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 6.0 6.5 7.0 7.5 8.0 8.5

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 5

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 16 - 23** TO **Jan 16 - 23**

Ground Elevation: **293.55 m**

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	Lab Test P.P. (kPa, approx.)	WATER CONTENT	WELL DATA	REMARKS
293.45 / 0.10	100 mm TOPSOIL							upper 0.05 +/- m frozen
	very loose to loose; some sand, trace topsoil and rootlets; ------ ; loose to compact; brown; SILT (till-like); trace gravel, trace sand, trace clay; occ. sand seams; occ. clayey seams/layers; moist	1	SS	3				
		2	SS	4				
		3	SS	8				
		4	SS	11				
		5	SS	14				
		6	SS	12				
289.15 / 4.40	stiff, grey; CLAYEY SILT TILL; some sand, trace gravel; occ. silt seams; moist to wet	7	SS	9				
							▽	water level at depth of 5.0 m bgs upon withdrawal of drilling augers
		8	SS	13				
		9	SS	13				
287.00 / 6.55	End of Borehole							borehole open upon withdrawal of drilling augers

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 6

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 17 - 23** TO **Jan 17 - 23**

SOIL LITHOLOGY

Ground Elevation: **291.75 m**

ELEV./DEPTH (m)	DESCRIPTION
291.35 / 0.40	400 mm TOPSOIL
284.75 / 7.00	loose to compact, brown SILT (till-like), trace gravel, trace sand, trace clay, occ. clayey seams, moist to wet; ------ occ. sand seams
283.65 / 8.10	very stiff, grey CLAYEY SILT TILL, trace gravel, trace sand, occ. silt seams, moist to wet
	End of Borehole

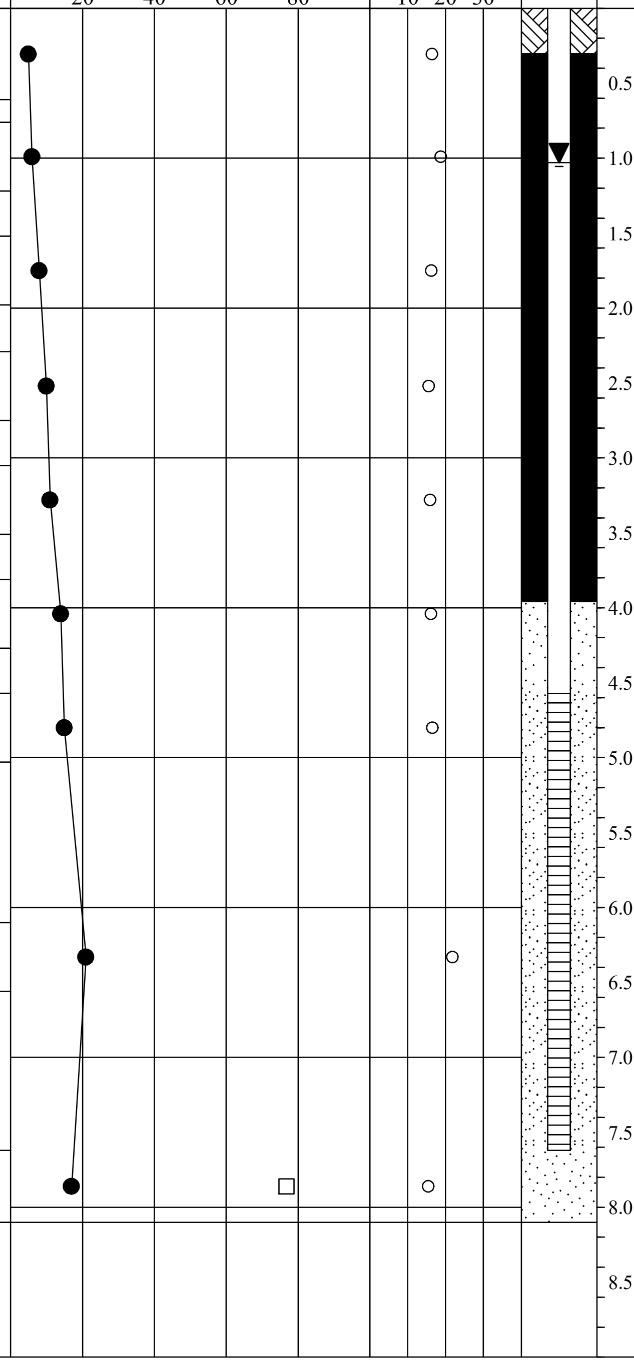
SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	5
2	SS	6
3	SS	8
4	SS	10
5	SS	11
6	SS	14
7	SS	15
8	SS	21
9	SS	17

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



REMARKS

- above-grade protective casing set in concrete
- bentonite seal/50 mm I.D. PVC riser
- water level at 1.03 m depth on January 24, 2023
- 3.05 m long, 50 mm I.D. PVC screen with sandpack

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 7

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 16 - 23** TO **Jan 16 - 23**

Ground Elevation: **293.70 m**

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	230 mm TOPSOIL				
293.47 / 0.23	dark brown, some sand, trace topsoil ------ loose to compact, brown SILT (till-like), trace to some sand, trace gravel, trace clay, occ. clayey seams, moist	1	SS	5	upper 0.23 +/- m frozen
		2	SS	8	
		3	SS	7	
		4	SS	11	
		5	SS	11	
		6	SS	15	dry cave-in at 4.3 m bgs upon withdrawal of drilling augers
		7	SS	11	
288.65 / 5.05	End of Borehole				

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, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 8

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 16 - 23** TO **Jan 16 - 23**

SOIL LITHOLOGY

Ground Elevation: **293.70 m**

ELEV./DEPTH (m)	DESCRIPTION
293.55 / 0.15	150 mm TOPSOIL
292.30 / 1.40	loose, dark brown to brown SANDY SILT trace gravel, trace clay trace topsoil and rootlets moist to wet
290.80 / 2.90	firm to stiff, brown CLAYEY SILT TILL trace gravel, trace sand moist
287.15 / 6.55	loose to compact, brown SILT (till-like) trace to some sand trace gravel, trace clay freq. clayey seams/layers moist ------ grey below 4.1 m
	End of Borehole

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	5
2	SS	4
3	SS	5
4	SS	9
5	SS	11
6	SS	11
7	SS	7
8	SS	8
9	SS	11

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

- upper 0.08 +/- m frozen
- above-grade protective casing set in concrete
- water level at 0.76 m depth on January 24, 2023
- bentonite seal/50 mm I.D. PVC riser
- 3.05 m long, 50 mm I.D. PVC screen with sandpack

PROJECT MANAGER: **NZ**

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FILE No: G22559 BOREHOLE No. 9

Client: **Seawaves Development Services Inc.**
Project: **Proposed Residential Subdivision**
Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA
Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 17 - 23** TO **Jan 17 - 23**

SOIL LITHOLOGY — Ground Elevation: **284.18 m**

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	600 mm TOPSOIL	1	SS	4	
283.58 / 0.60	firm, dark brown CLAYEY SILT trace gravel, trace sand trace topsoil/rootlets moist	2	SS	7	
282.78 / 1.40	loose to very loose dark brown ------ compact, brown SILT trace sand, trace clay saturated to moist ------ grey below 5.9 m	3	SS	6	water level at depth of 1.5 m bgs one hour upon withdrawal of drilling augers
		4	SS	2	
		5	SS	13	
		6	SS	16	cave-in at 3.7 m one hour upon withdrawal of drilling augers
		7	SS	27	
		8	SS	17	
277.63 / 6.55	End of Borehole				

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 6.0 6.5 7.0 7.5 8.0 8.5

PROJECT MANAGER: **NZ**

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Enclosure No.: 10
Sheet 1 of 1

FILE No: G22559

BOREHOLE No. 10

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 16 - 23** TO **Jan 16 - 23**

SOIL LITHOLOGY — Ground Elevation: **294.03 m**

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
293.88 / 0.15	150 mm TOPSOIL				upper 0.15 +/- m frozen
	trace topsoil ------ loose, dark brown to brown SANDY SILT trace clay, moist	1	SS	4	
		2	SS	4	
292.63 / 1.40	loose to compact brown SILT trace sand, trace clay moist	3	SS	8	
		4	SS	13	
		5	SS	14	
	------ grey below 4 m	6	SS	14	
		7	SS	9	
		8	SS	12	dry cave-in at 5.8 m bgs upon withdrawal of drilling augers
	------ some sand, trace gravel (till-like)	9	SS	12	
287.48 / 6.55	End of Borehole				

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

CVD BOREHOLE (2017) G22559 EASTRIDGE ROAD, WALKERTON.GPJ CVD_ENG.GDT 23-2-21

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 11

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 16 - 23** TO **Jan 16 - 23**

SOIL LITHOLOGY

Ground Elevation: **294.54 m**

ELEV./ DEPTH (m)	DESCRIPTION
294.34 / 0.20	200 mm TOPSOIL
293.54 / 1.00	loose, dark brown to brown SILTY SAND trace gravel, trace topsoil moist
289.04 / 5.50	some sand to sandy ------ loose to compact brown SILT trace to some sand trace gravel, trace clay moist till-like above ------ grey below 3.3 m
287.99 / 6.55	compact, grey SANDY SILT TILL trace gravel, trace clay moist
	End of Borehole

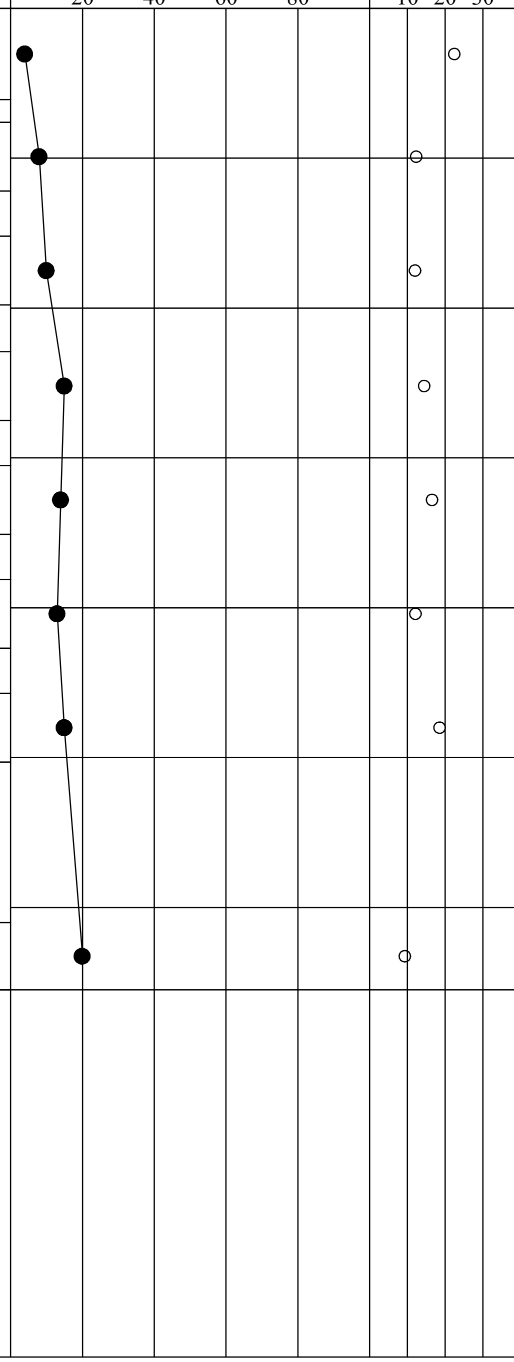
SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	4
2	SS	8
3	SS	10
4	SS	15
5	SS	14
6	SS	13
7	SS	15
8	SS	20

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

- upper 0.13 +/- m frozen
- dry cave-in at 5.8 m bgs upon withdrawal of drilling augers

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 12

Client: **Seawaves Development Services Inc.**
Project: **Proposed Residential Subdivision**
Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA
Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 13 - 23** TO **Jan 13 - 23**

SOIL LITHOLOGY — Ground Elevation: **293.35 m**

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	Depth (m)	Lab test P.P. (kPa)	Water content W (%) (approx.)	REMARKS
293.15 / 0.20	200 mm TOPSOIL							
291.95 / 1.40	loose to very loose dark brown to brown sandy silt (reworked native) trace gravel, trace clay trace topsoil moist	1	SS	5	0.3		~21	
		2	SS	3	1.0		~21	
289.65 / 3.70	loose to compact brown SILT (till-like) trace to some sand trace gravel, trace clay moist	3	SS	6	1.75		~20	
		4	SS	11	2.5		~15	water level at depth of 2.4 m bgs upon withdrawal of drilling augers
		5	SS	27	3.25			
288.30 / 5.05	very stiff to stiff grey CLAYEY SILT TILL trace gravel, trace sand moist to wet	6	SS	18	4.0	~160	~15	
		7	SS	12	4.75	~115	~16	
	End of Borehole							borehole open upon withdrawal of drilling augers

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

PROJECT MANAGER: **NZ**

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Enclosure No.: 13
Sheet 1 of 1

FILE No: G22559 BOREHOLE No. 13

Client: **Seawaves Development Services Inc.**
Project: **Proposed Residential Subdivision**
Location: **Eastridge Road, Walkerton, Ontario**

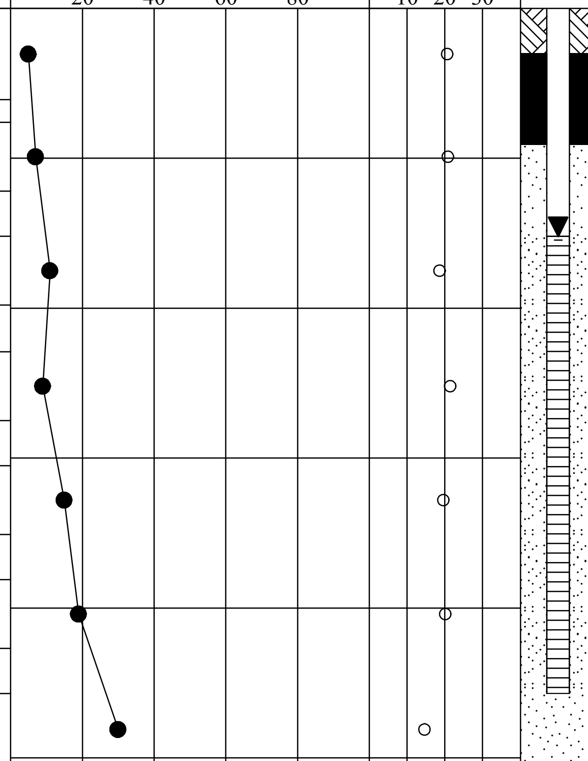
EQUIPMENT DATA
Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 13 - 23** TO **Jan 13 - 23**

SOIL LITHOLOGY

Ground Elevation: **293.22 m**

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE
	300 mm TOPSOIL			
292.92 / 0.30	firm, brown CLAYEY SILT trace sand moist	1	SS	5
		2	SS	7
291.62 / 1.60	sandy silt layer ------ loose to compact, brown SILTY SAND occ. silt seams saturated	3	SS	11
		4	SS	9
289.92 / 3.30	compact to dense brown SANDY SILT trace gravel, trace clay occ. silt layers occ. sand seams saturated to moist	5	SS	15
		6	SS	19
		7	SS	30
288.17 / 5.05	End of Borehole			

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

DEPTH (m)	REMARKS
0.0	upper 0.03 +/- m frozen
0.0	above-grade protective casing set in concrete
0.8	bentonite seal/50 mm I.D. PVC riser
1.5	water level at 1.52 m depth on January 24, 2023
3.0	3.05 m long, 50 mm I.D. PVC screen with sandpack

PROJECT MANAGER: **NZ**

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Enclosure No.: 14
Sheet 1 of 1

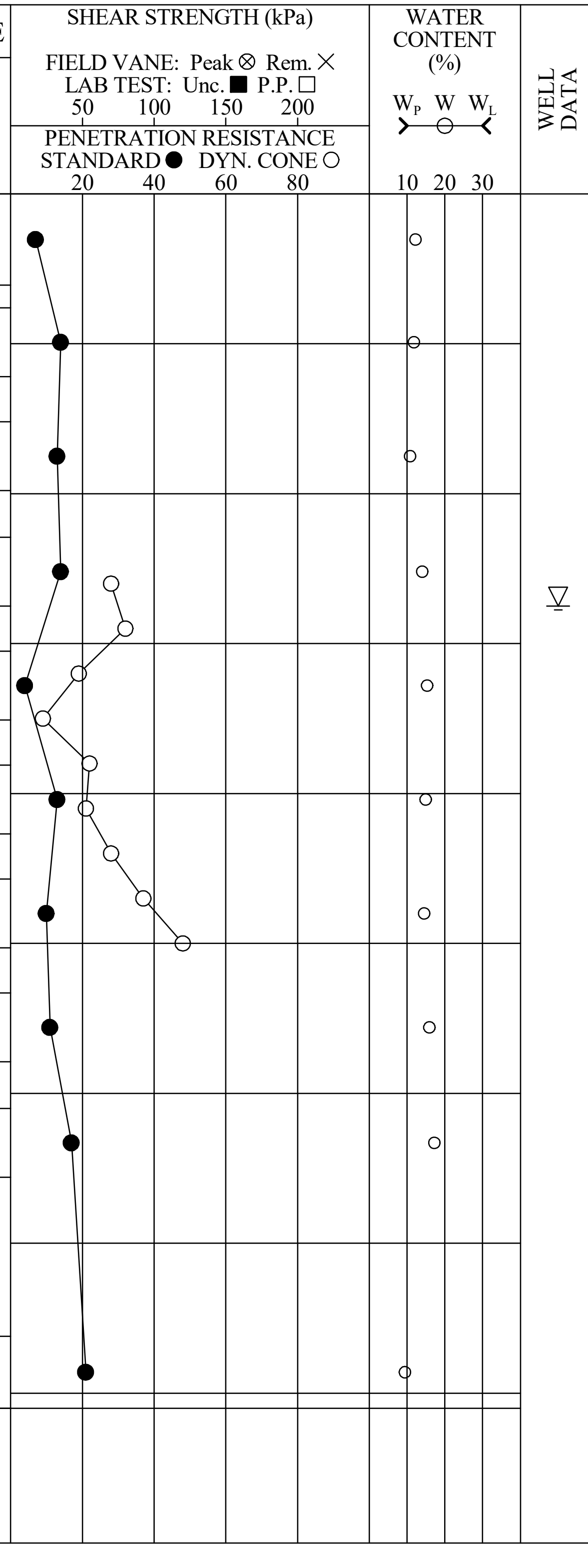
FILE No: G22559 BOREHOLE No. 14

Client: **Seawaves Development Services Inc.**
Project: **Proposed Residential Subdivision**
Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA
Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 12 - 23** TO **Jan 12 - 23**

Ground Elevation: **294.69 m**

ELEV./DEPTH (m)	SOIL LITHOLOGY – DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
294.49 / 0.20	200 mm TOPSOIL				
292.89 / 1.80	loose to compact dark brown to brown sandy silt (reworked native) trace gravel, trace clay moist ------ trace topsoil/organics	1	SS	7	
		2	SS	14	
		3	SS	13	
291.39 / 3.30	compact to loose brown SILTY SAND trace gravel occ. silt seams moist to saturated	4	SS	14	dynamic cone penetration testing (DCPT) conducted between 2.60 and 5.05 m depth; cave-in and water level at depth of 2.7 m bgs upon withdrawal of drilling augers
287.69 / 7.00	sandy clayey layer ------ loose to compact, brown SILT (till-like) trace gravel, trace sand trace clay wet to moist ------ grey below 4.8 m	5	SS	4	
		6	SS	13	
		7	SS	10	
		8	SS	11	
		9	SS	17	
286.59 / 8.10	compact, grey SANDY SILT TILL trace gravel, trace clay occ. clayey seams moist	10	SS	21	
	End of Borehole				



PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 15

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 13 - 23** TO **Jan 13 - 23**

SOIL LITHOLOGY

Ground Elevation: **294.17 m**

ELEV./ DEPTH (m)	DESCRIPTION
	600 mm TOPSOIL
293.57 0.60	trace topsoil and rootlets ------ loose, brown SILT (till-like) trace gravel, trace sand trace clay trace clay, trace topsoil/rootlets moist
291.77 2.40	brown occ. sand seams/layers ------ sandy layer trace to some gravel ------ firm to stiff grey CLAYEY SILT TILL some sand, trace gravel moist to wet
287.17 7.00	dense, brown Fine SAND some silt, trace gravel saturated
286.07 8.10	End of Borehole

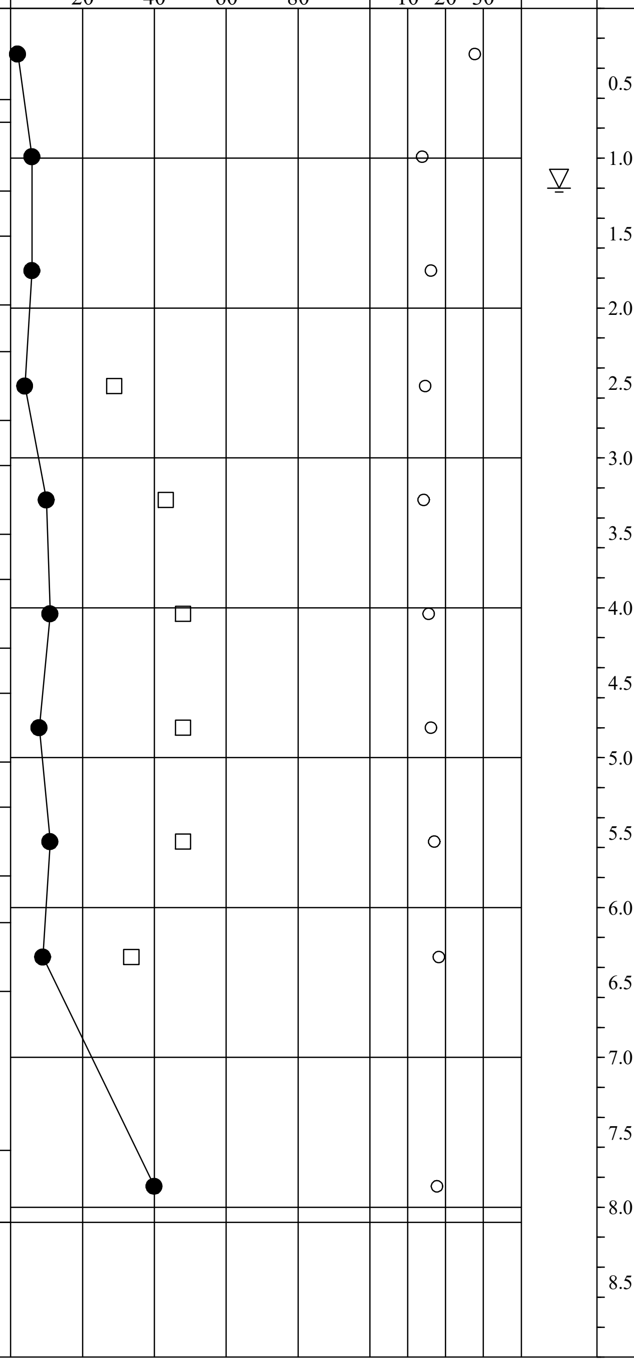
SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	2
2	SS	6
3	SS	6
4	SS	4
5	SS	10
6	SS	11
7	SS	8
8	SS	11
9	SS	9
10	SS	40

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

- water level at depth of 1.2 m bgs upon withdrawal of drilling augers
- cave-in at depth of 7.3 m bgs upon withdrawal of drilling augers

PROJECT MANAGER: **NZ**

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Enclosure No.: 16
Sheet 1 of 1

FILE No: G22559

BOREHOLE No. 16

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 13 - 23** TO **Jan 13 - 23**

Ground Elevation: **295.47 m**

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
295.37 / 0.10	100 mm TOPSOIL				upper 0.12 +/- m frozen
294.07 / 1.40	loose, dark brown sandy silt (reworked native) trace gravel, trace clay trace topsoil occ. clayey layers moist	1	SS	7	
		2	SS	4	
292.57 / 2.90	loose to compact brown SILT some sand, trace clay wet	3	SS	7	
		4	SS	10	
290.67 / 4.80	compact, brown Fine SAND some silt to silty occ. clayey silt seams saturated	5	SS	13	cave-in and water level at depth of 3.4 m bgs upon withdrawal of drilling augers
		6	SS	18	
289.97 / 5.50	compact, brown SILT trace sand saturated	7	SS	24	
288.47 / 7.00	stiff, grey CLAYEY SILT TILL trace sand wet	8	SS	8	
287.37 / 8.10	compact, brown SANDY SILT saturated	9	SS	25	
	End of Borehole				

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

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 17

Client:	**Seawaves Development Services Inc.**
Project:	**Proposed Residential Subdivision**
Location:	**Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine:	**Diedrich D50T**
Method:	**Hollow Stem Auger**
Size:	**83 mm I.D.**
Date:	**Jan 13 - 23** TO **Jan 13 - 23**

SOIL LITHOLOGY

Ground Elevation: **294.92 m**

ELEV./ DEPTH (m)	DESCRIPTION
294.82 / 0.10	100 mm TOPSOIL
	compact to loose brown to dark brown sandy silt (reworked native) trace gravel, trace clay moist
293.52 / 1.40	silt layer some sand trace gravel and clay ------ firm to stiff brown CLAYEY SILT TILL trace to some sand, trace gravel moist to wet
291.22 / 3.70	compact, brown SILT (till-like) trace gravel, trace sand trace clay wet to moist
289.32 / 5.60	hard, grey CLAYEY SILT TILL trace sand occ. cobbles moist to wet
288.32 / 6.60	compact, brown SANDY SILT TILL trace gravel, trace clay occ. clayey lenses moist
286.82 / 8.10	End of Borehole

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	SS	22
2	SS	9
3	SS	8
4	SS	7
5	SS	9
6	SS	14
7	SS	21
8	SS	50/ 75 mm
9	SS	24

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, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5

REMARKS

- upper 0.10 +/- m frozen
- water level at depth of 3.7 m bgs upon withdrawal of drilling augers
- cave-in at depth of 7.3 m bgs upon withdrawal of drilling augers

CVD BOREHOLE (2017) G22559 EASTRIDGE ROAD, WALKERTON.GPJ CVD_ENG.GDT 23-2-21

PROJECT MANAGER: **NZ**

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FILE No: G22559

BOREHOLE No. 18

Client: **Seawaves Development Services Inc.**

Project: **Proposed Residential Subdivision**

Location: **Eastridge Road, Walkerton, Ontario**

EQUIPMENT DATA

Machine: **Diedrich D50T**
Method: **Hollow Stem Auger**
Size: **83 mm I.D.**
Date: **Jan 12 - 23** TO **Jan 12 - 23**

Ground Elevation: **294.55 m**

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	WATER CONTENT (%)	REMARKS
294.40 / 0.15	150 mm TOPSOIL					
293.15 / 1.40	loose to compact, brown sandy silt (reworked native) trace gravel, trace clay trace topsoil/rootlets moist	1	SS	4		
		2	SS	13		
291.05 / 3.50	loose to compact, brown SILT (till-like) trace gravel, trace sand trace clay occ. clayey layers moist	3	SS	9		
		4	SS	7		
		5	SS	11		
	End of Borehole					borehole open and dry upon withdrawal of drilling augers

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

PROJECT MANAGER: **NZ**

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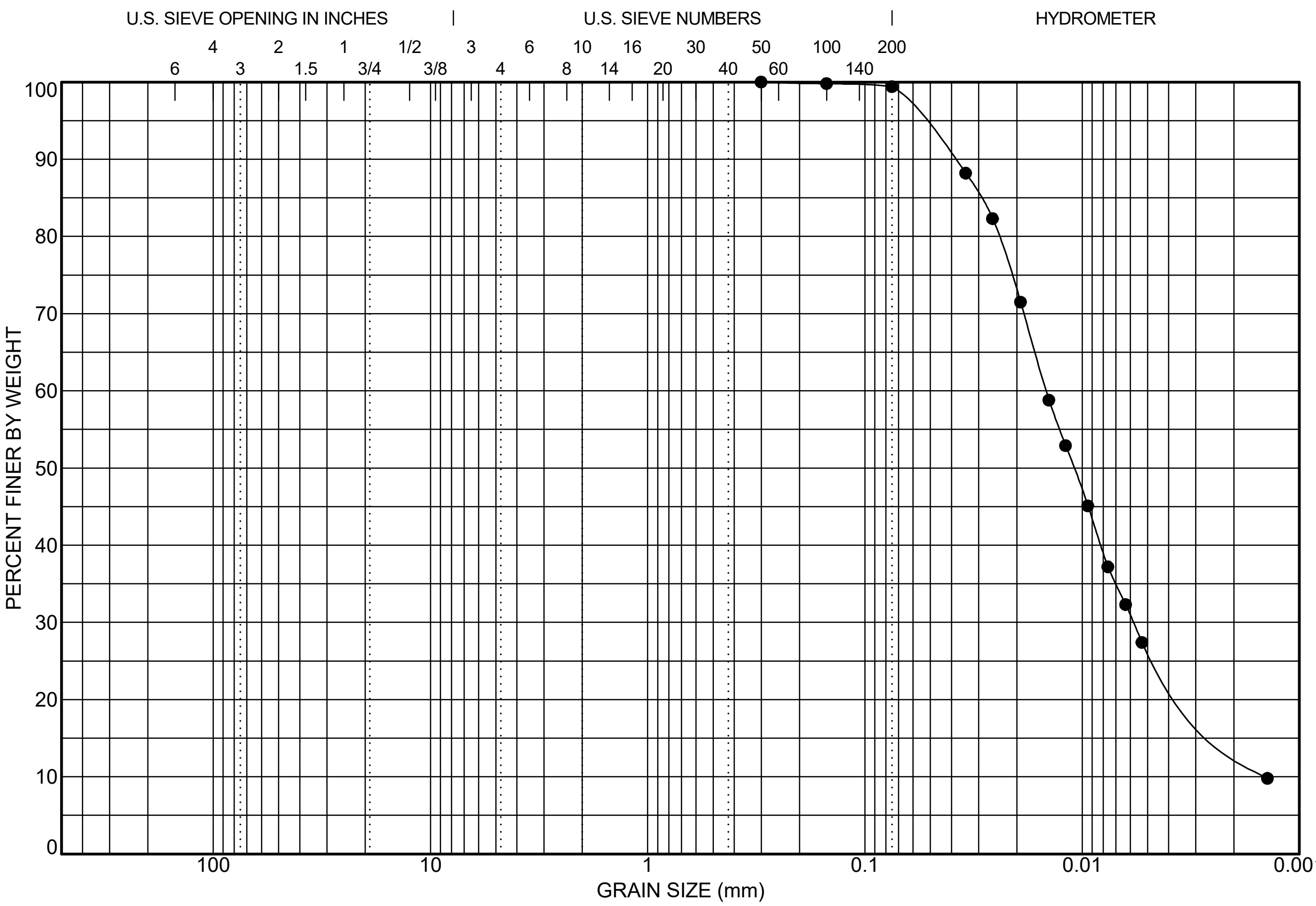

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.62	10.28	0.3	0.015	0.006	0.001	0.0	0.6	99.4	

Date: Feb. 09 - 2023
Client: Seawaves Development Services Inc.
Contractor:
Source:
Sampled From: BH 2 - SA 3; 1.50 to 1.95 m depth
Sample No.: 2-3
Date Sampled: Jan. 12 - 2023
Sampled By: DO
Lab No.: 0140
Date Tested: Feb. 06 - 2023
Type of Material: Silt, some clay

Sieve Size (mm)	Percent Passing	No Specifications

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e-mail: info@cvdengineering.com

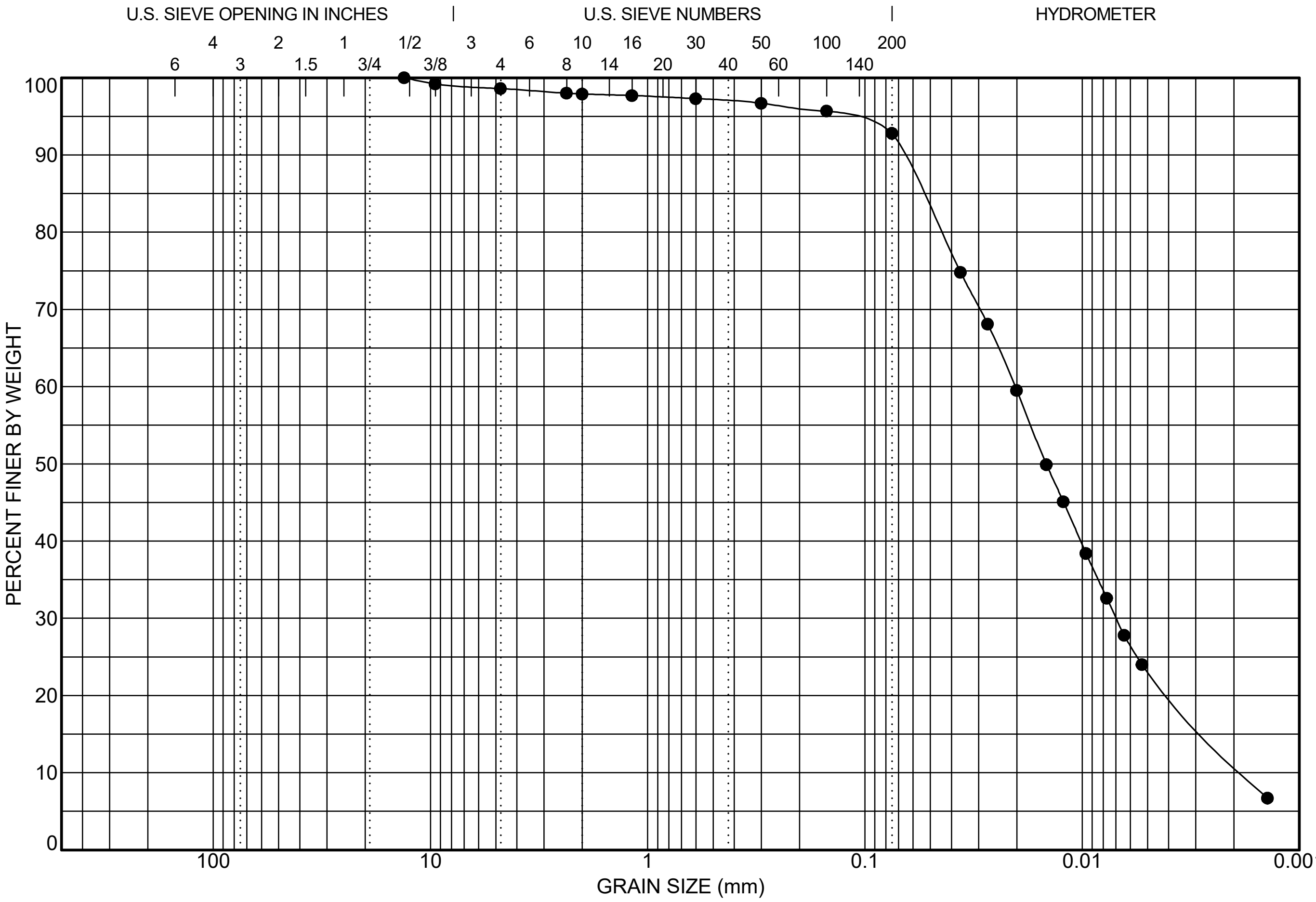
GRAIN SIZE DISTRIBUTION

Project: Proposed Residential Subdivision

Location: Eastridge Road, Walkerton, Ontario

File No.: G22559

Enclosure No.: 19



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.32	11.28	13.2	0.02	0.007	0.002	1.4	5.8	92.8	

Date: Feb. 09 - 2023
Client: Seawaves Development Services Inc.
Contractor:
Source:
Sampled From: BH 7 - SA 4; 2.30 to 2.75 m depth
Sample No.: 7-4
Date Sampled: Jan. 16 - 2023
Sampled By: DO
Lab No.: 0141
Date Tested: Feb. 06 - 2023
Type of Material: Silt, some clay, trace gravel, trace sand

Sieve Size (mm)	Percent Passing	No Specifications

DM - NO SPECIFICATIONS G22559 EASTRIDGE ROAD, WALKERTON.GPJ LAW LNDN.GDT 23-4-4

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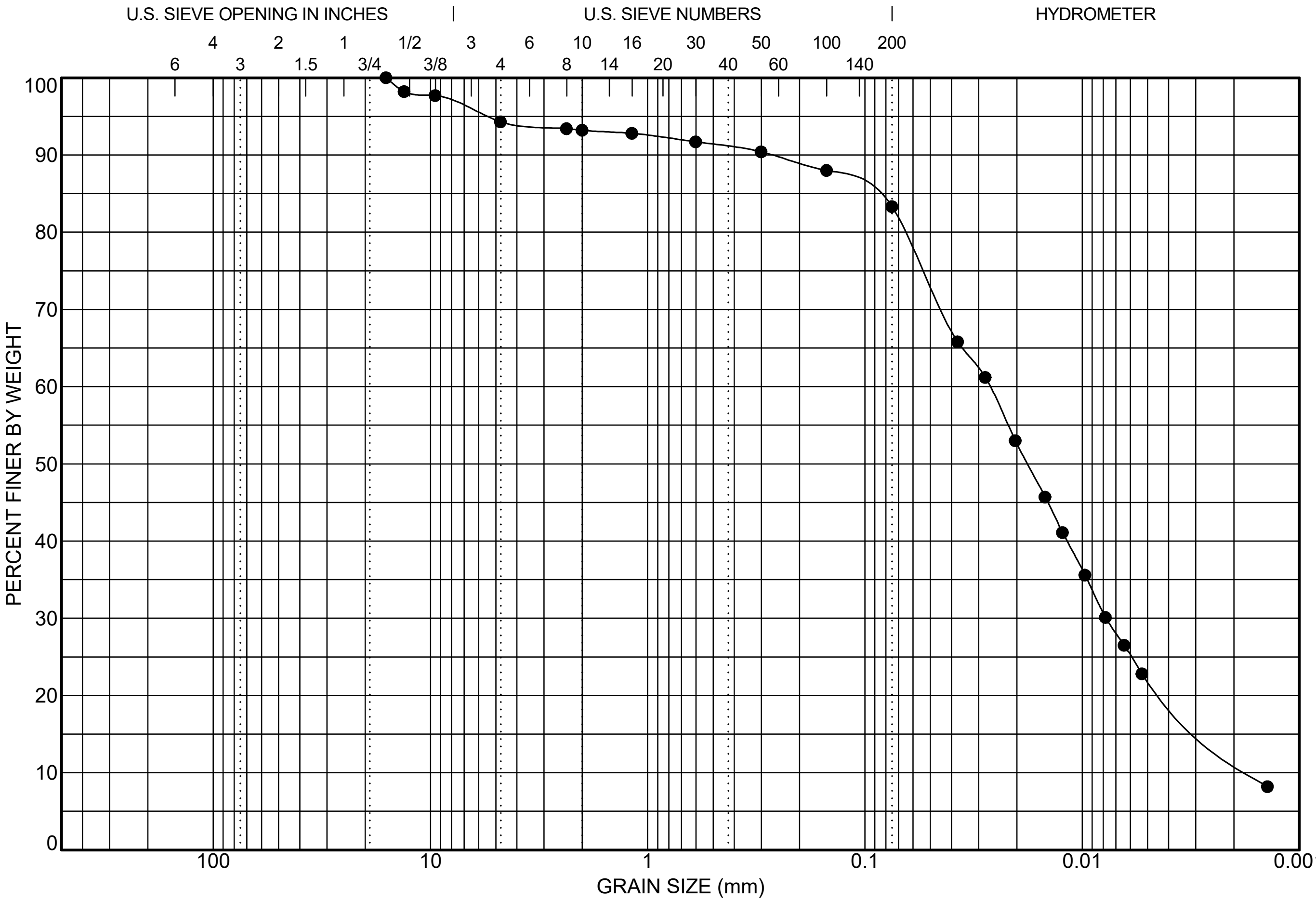
GRAIN SIZE DISTRIBUTION

Project: Proposed Residential Subdivision

Location: Eastridge Road, Walkerton, Ontario

File No.: G22559

Enclosure No.: 20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.37	16.14	16	0.027	0.008	0.002	5.7	11.0	83.3	

Date: Feb. 09 - 2023
Client: Seawaves Development Services Inc.
Contractor:
Source:
Sampled From: BH 8 - SA 7; 4.55 to 5.00 m depth
Sample No.: 8-7
Date Sampled: Jan. 16 - 2023
Sampled By: DO
Lab No.: 0142
Date Tested: Feb. 06 - 2023
Type of Material: Silt, some sand, some clay, trace gravel

Sieve Size (mm)	Percent Passing	No Specifications

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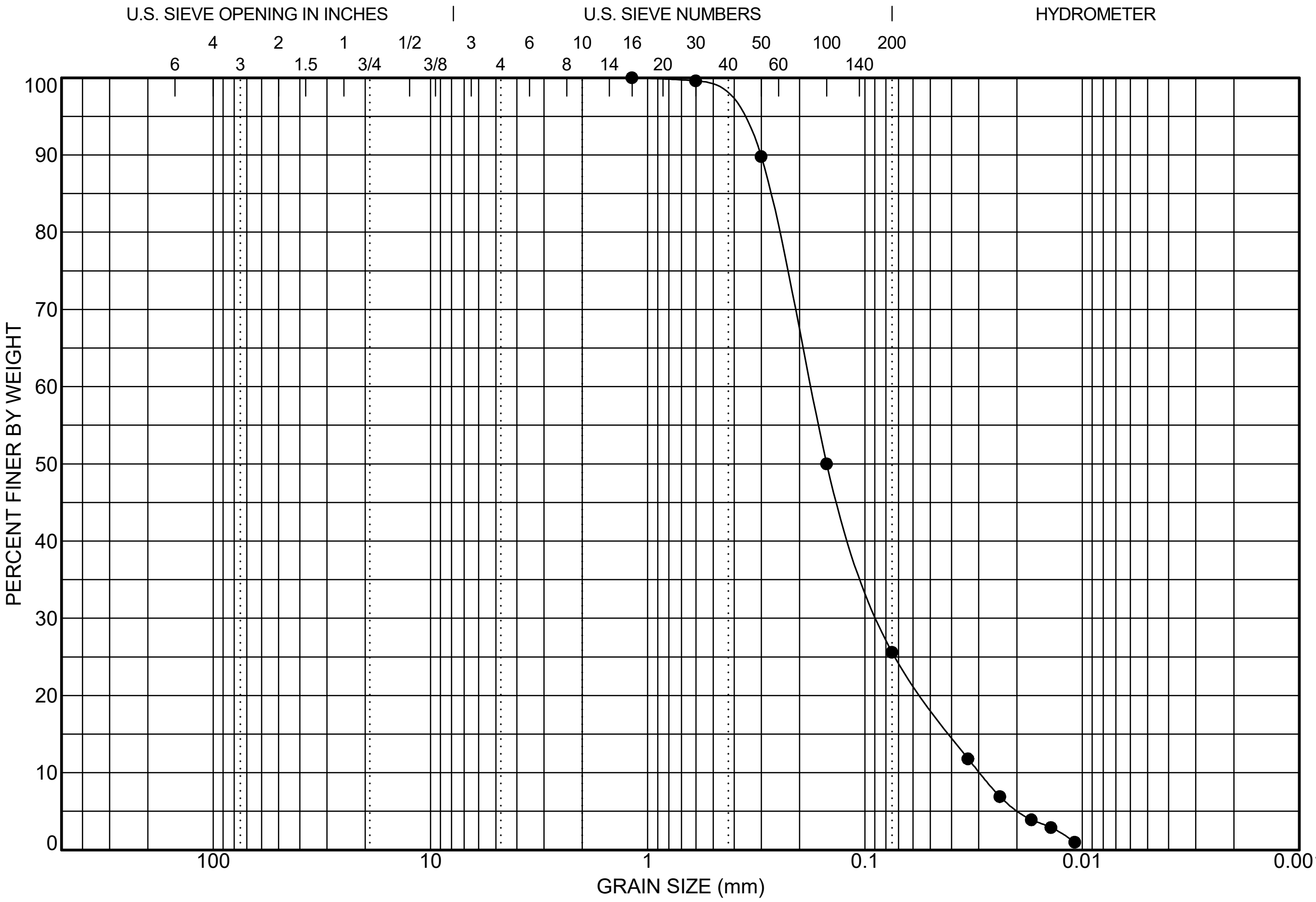
GRAIN SIZE DISTRIBUTION

Project: Proposed Residential Subdivision

Location: Eastridge Road, Walkerton, Ontario

File No.: G22559

Enclosure No.: 21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
			1.37	6.03	1.18	0.179	0.085	0.03	0.0	74.4	25.6	

Date: Feb. 09 - 2023
Client: Seawaves Development Services Inc.
Contractor:
Source:
Sampled From: BH 13 - SA 4; 2.30 to 2.75 m depth
Sample No.: 13-4
Date Sampled: Jan. 13 - 2023
Sampled By: DO
Lab No.: 0143
Date Tested: Feb. 06 - 2023
Type of Material: Silty Sand

Sieve Size (mm)	Percent Passing	No Specifications

CHUNG & VANDER DOELEN ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

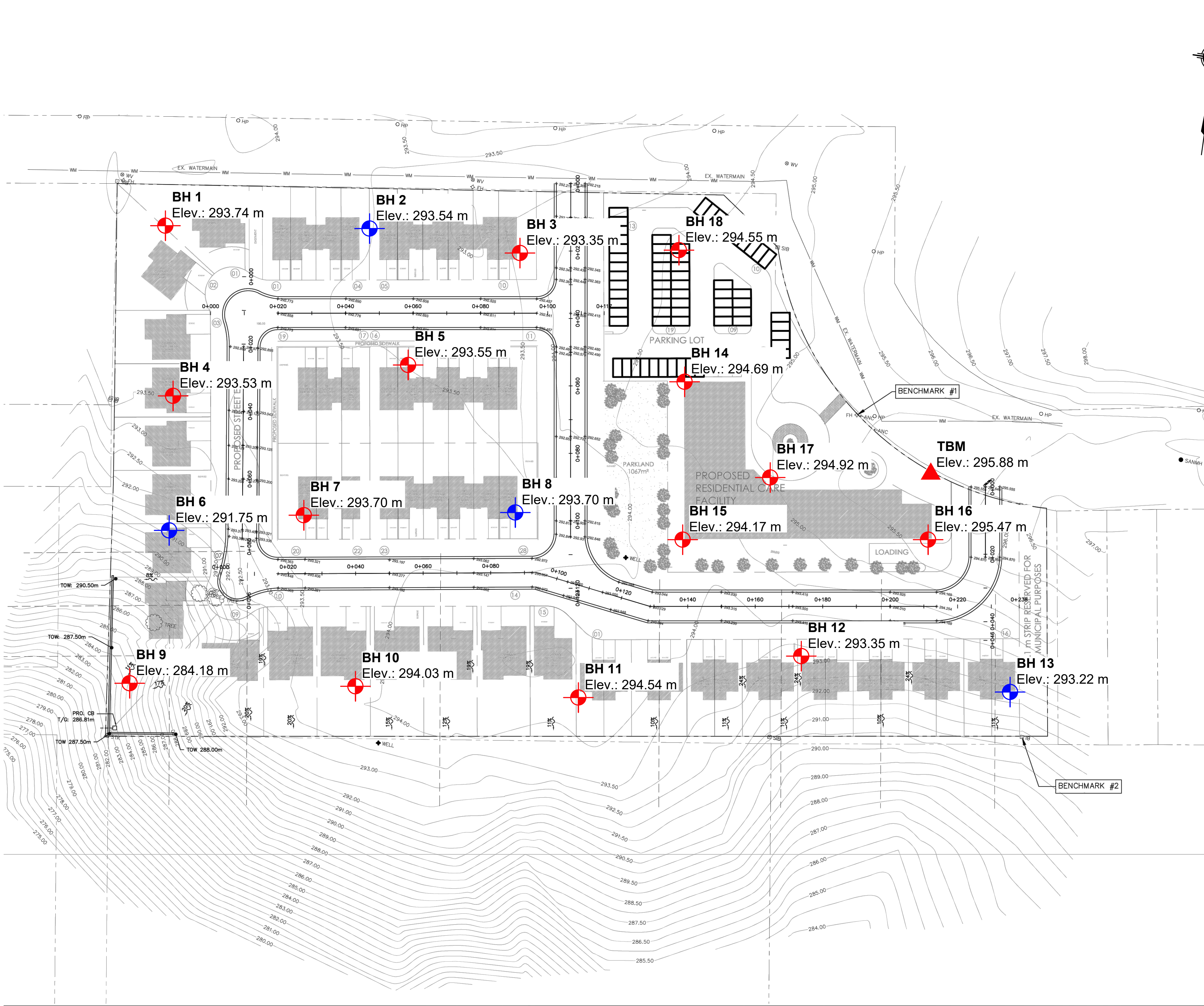
GRAIN SIZE DISTRIBUTION

Project: Proposed Residential Subdivision

Location: Eastridge Road, Walkerton, Ontario

File No.: G22559

Enclosure No.: 22



KEY PLAN **SOURCE:** Bruce County GIS Map

LEGEND

TBM: Top of manhole in grass located northeast of subject property, along southern side of Eastridge Road.
Elev.: 295.88 m (Geodetic)

Borehole Location

Borehole and Monitoring Well Location

Elev. Ref.: The borehole locations and associated ground surface elevations were surveyed using a Network RTK Global Navigation Satellite System (GNSS) Receiver. The survey data was collected using UTM Zone 17N Projection, NAD83(CSRS)v7-2010 datum and Canada Geoid Model HT2_2010v70 (CGVD28).

DWG. Ref.: GSS Engineering Consultants Ltd. Drawing No. 21-090-01 (REVISED), *"Existing Conditions Hilltop Meadows, Walkerton"* dated 19/05/22.

BOREHOLE LOCATION PLAN

Proposed Residential Subdivision

Eastridge Road
Walkerton, Ontario

CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1 / 519-742-8979

Drawn By: DO	Date: March, 2022	File No.: G22559
Checked By: NZ	Scale: N.T.S.	Drawing No.: 1