Toronto Inspection LTD.
GEO-ENVIRONMENTAL CONSULTANTS

REPORT ON
GEOTECHNICAL INVESTIGATION
452 RAGLAN STREET
COLLINGWOOD, ONTARIO

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Table of Contents

1.0 INTRODUCTION

Toronto Inspection Ltd. (TIL) was retained by Eden Oak McNabb Inc. (the client) to conduct a geotechnical investigation at 452 Raglan Street, Collingwood, Ontario (hereafter described as "the Site"), within the area of the proposed residential development/sub-division. The field work for the geotechnical investigation was carried out in conjunction with a Hydrogeological study. The report of findings, relating to the Hydrogeological study, will be issued under in a separate cover.

A Geotechnical Investigation Report No.: 4688-17-GC, dated January 15, 2018 had been prepared and submitted to the client. Due to changes in the new site plan, ***TIL*** was requested to revise the geotechnical investigation report.

The Draft Plan of Subdivision, prepared by MHBC Planning, dated November 16, 2021, indicates that the redevelopment at the subject Site, on an area of 8.99 ha, will consist of the construction of single detached dwellings, Townhomes, Back To Back Stacked Townhomes, a SWM area, a Park, walkway, open space, right of way, driveways and roads etc.

It is understood that the proposed residential development will be slab-on-grade construction with and no basements, with the exception of few single family detached dwellings, which will have basements with finished basement floors at depths varying from 1.5m to 1.8m below existing grades.

The objectives of the geotechnical investigation were to:

- provide subsurface information with regards to the types, thicknesses and variability of the subsoils underlying the area of the proposed development
- establish groundwater conditions
- provide recommendations for the design and construction of foundations, slab-on-grade construction, excavation, provision for perimeter permanent drainage
- design and construction of roads and pavements within the proposed subdivision

This report is provided on the basis of the above terms of reference and on an assumption that the design of structures will be in accordance with the applicable building codes and standards. If there are any changes in the design features relevant to the geotechnical analysis, our office should be consulted to review the design and to confirm the recommendations and comments provided in the report.

This revised report supersedes the previous report and / or any written or verbal recommendations provided for the client.

2.0 SITE CONDITION

The Site is located approximately 250m west of Raglan Street, 320m north of Poplar Sideroad, east of a Train Trail, and just on the south end of Williams Street and Peel Street, in the Town of Collingwood. The Pretty River, approximately 100m to 250m west of Raglan Street, meandered from north to south along the east portion of the subject Site.

At the time of the investigation, the Site was occupied by a one storey dwelling located in the north westerly portion of the subject Site and the area beyond the extent of the house was a vacant, undeveloped land. The ground cover of the Site was observed to consist of a combination of grass and gravel surfaces. A conservation area, as shown on Borehole Location Plan, Drawing No. 1, lies between the west bank of Pretty River and the Site.

The topography of the subject Site was relatively flat, with a slight slope from south to north and west to east.

3.0 INVESTIGATION PROCEDURE

The field work for the investigation, carried on November 16 to 24, 2017, consisted of the drilling of twenty four (24) boreholes, BH-1 to BH-24, extending to depths of 5.0m to 10.7m (elevation 186.7m to 180.7m) from existing grades, in the area of proposed development, at the locations as shown on the Borehole Location Plan, Drawing Nos. 1 & 1A. Detailed descriptions of the subsoils encountered are presented on the borehole logs, Drawing Nos. 2 to 25.

The sampled Boreholes BH-1 to BH-24 were advanced to depths varying from 5.0m to 9.5m (elevations 186.4m to 183.6m) below existing grades, using a CME-55 track mounted drill rig, with continuous flight hollow stem augers. Soil samples were retrieved from the boreholes, at regular intervals of 0.8m to a depth of 3.0m from grade and generally 1.5m intervals thereafter, using a split spoon sampler, in conjunction with Standard Penetration Tests using a driving energy of 475 joules (350 ft-lbs), driven by a 140-lb hammer, falling 30" (760mm). The soil samples were identified and logged in the field and were carefully bagged for later visual identification.

The sampled boreholes BH-5, BH-6, BH-8 to BH-17, BH-19, BH-20, BH-23 and BH-24, extended to auger refusal into the bedrock at depths varying from 5.2m to 9.5m from existing grades. Following the auger refusal, coring of the bedrock was carried out at BH-5 (at depths of 7.9m to 10.9m), BH-9 (at depths of 7.9m to 10.7m) and BH-20 (at depths of 7.2m to 10.7m), using NXL core barrel, inside a continuous NW casing.

Following completion of the drilling and sampling operation, monitoring wells were installed at Boreholes BH-2, BH-5, BH-9, BH-18 and BH-20 to 22 locations to record the current static groundwater levels.

The surface elevations, at the borehole locations, are referenced to the slab-on-grade elevation of the garage of the existing house, located in the north westerly portion of the subject Site, as a temporary bench mark (TBM).

The geodetic elevation of 191.76m for the TBM was obtained from the topographic drawing, prepared by JoeTOPO Surveys and Cadd Inc., dated November, 2017, provided by the client to our office.

4.0 SUMMARIZED SITE AND SUBSURFACE CONDITIONS

Brief descriptions of the subsoils, encountered at the borehole locations, were as follows:

4.1 Ground Surface

The surficial materials, at Boreholes BH-1 to BH-24 locations, were observed to consist of topsoil, varying in thickness ranging from 250mm to 310mm.

4.2 Fill

Fill materials, consisting of silty sand/sandy silt were encountered directly below the surficial topsoil at BH Nos. 1 to 24 and extended to approximate depth of 0.8m (192.2m) to 1.4m (Elevation 189.1m) blow existing grades. The fill materials contained inclusion of occasional organic stained soils. The fill materials were in very loose to compact state, based on Standard Penetration resistance (“N” values) of 2 to 20 blows per 300mm. The in-situ moisture contents of the recovered samples, from the fill materials, indicated the fill to be in a moist to very moist state, with some wet pockets.

4.3 Silty Sand and Sandy Silt

Natural, loose to compact, silty sand and sandy silt deposits were encountered underlying the fill materials at all borehole locations, with the exception of Borehole BH-21, and extended to approximate depths of 2m (i.e. elevation 190.9m) to 2.9m (i.e. elevation 187.0m) below existing grades. The results of Standard Penetration Tests (SPT) in the silty sand and sandy silt deposit, with N-values varying from 7 to 22 blows per 300mm penetration, indicated that the silty sand and sandy silt deposits were in loose to compact state.

A grain size analysis was conducted on a selected soil sample, obtained from BH-22 (SS2, at a depth of 0.8m), using both mechanical sieved and hydrometer. The grain size distribution, shown on the attached Figure No. 1, indicated 0.2% gravels, 72.1% sand, 27.7% silt.

4.4 Clayey Silt / Silty Clay

Clayey silt / silty clay deposits was encountered below the upper fill materials at Borehole BH-21 and below the natural silty sand deposits at Boreholes BH-1 to BH-20, BH-23 and BH-24. A layer of silty clay was encountered at a depth of 3.0m at Borehole BH-24 location.

Based on the Standard Penetration Test (SPT) “N” values of 0 to 18 blows per 300mm penetration, the consistency of the clayey silt / silty clay deposits was very soft to very stiff. The clayey silt deposits extended to depths varying from 3m to 6.1m (elevation 188.7m to 184.0m) below the existing grades.

Based on the in-situ Shear Vane Tests, conducted in the clayey silt / silty clay deposits, at Boreholes BH-1, BH-6, BH-8, BH-11 to BH-13 to BH-17, BH-19, BH-20 and BH-24 locations, at depths ranging from 2.3m to 4.9m from existing grades, the estimated undrained shear strength (cu) and remodelled Vane shear strength of the deposits was in the range of 12 kPa to 51 kPa and 5kPa to 22 kPa, respectively, indicating sensitivity of the deposits in the range of 2 to 6 if the deposits are in a disturbed condition.

Grain size analyses were carried out on selected soil samples, obtained from Boreholes BH-17, BH-23 and BH-24 (SS5, at depths of 3m to 3.5m), using both mechanical sieve and hydrometer. The gradation size distributions shown on attached Figure No. 1A, indicated 0% to 1.4%

gravels, 2.4% To 6.6% sand, 46.3% to 55.1% silt, and 40.9% to 50.1% clay . Atterberg Limits test results, carried out on representative samples, obtained from Boreholes BH-17, BH-23 and BH-24 (SS5, at depths of 3.0m to 3.5m), indicated that this deposit was of low to medium plasticity. The test results were shown in the appended Figure No. 2.

Based on the grain size distributions and Atterberg Limits test results, it is our opinion that the deposits will behave as clay silt and silty clay deposits.

4.5 Silt Till

Underlying the natural clayey silt deposits at Boreholes BH-1 to BH-21, BH-23, BH-24 and the natural silty sand deposit at Borehole BH-22, natural silt till deposits were encountered. The silt till deposits extended to explored depths of 5.0m to 7.3m (elevation 186.7m to 182.80m) below existing grades at Boreholes BH-1, BH-3, BH-4, BH-18, BH-21 and BH-22 locations and to depths varying from 5m to 9.2m (elevation 186.6m to 182.5m) ,below the existing grades at Boreholes BH-2, BH-5 to BH-17, BH-19, BH-20, BH-23 and BH-24 locations.

The silt till deposits consisted of heterogeneous mixture of sand and silt, with some gravel, trace clay. Based on the Standard Penetration Tests (SPT) N-values in the range of 7 to over 100 blows per 300mm penetration, the relative density of the silt till deposits was compact to very dense.

4.6 Sand and Gravel

A natural sand and gravel deposit was observed to underlay silt till deposit at BH-19 location, at a depth of 7.3m below the existing grade and extended to explored depth of 7.9m (elevation 183.7m) below existing grade.

Based on the Standard Penetration Tests (SPT) N-value of over 100 blows per 300mm penetration, the relative density of the sand and gravel deposit was very dense.

4.7 Silty Gravelly Sand

A natural silty gravelly sand with some clay deposit was observed to underlay silt till deposit at BH-2 location at a depth of 6m (elevation

185.66m) below existing grade and extended down to the explored depth of 6.5m (elevation 185.1m) below existing grade.

Based on the Standard Penetration Tests (SPT) N-value of over 100 blows per 300mm penetration, the relative density of the silty gravelly sand deposit was very dense.

A grain size analysis was conducted on a selected soil sample, obtained from BH-2 (SS7, at a depth of 6.1m), using both mechanical sieved and hydrometer. The grain size distribution, shown on the attached Figure No. 1, indicated 22.5% gravel, 35.5% sand, 28.3% silt and 13.6% clay.

4.8 Bedrock

The surface of bedrock was encountered at depths ranging from 5.0m (elevation 186.6m) to 9.2m (elevation 182.5m) below existing grades at Boreholes BH-5, BH-6, BH-8 to BH-17, BH-19, BH-20, BH-23 and BH-24 locations. The bedrock was observed to consist of limestone, grey in colour. The upper portion of the limestone bedrock, varying in thickness from 0.1m to 0.9m, was found to be in a weathered condition, as evidence by relatively easy advancement of the augers. Refusal to further penetration by the auger equipment, occurred at depths ranging from 5.2m to 9.5m (elevation 186.5m to 184.1m) below existing grades.

Coring of the bedrock was carried out at BH-5 (at depths of 7.9m to 10.9m), BH-9 (at depths of 7.9m to 10.7m) and BH-20 (at depths of 7.3m to 10.7m). Recoveries of the rock samples at BH-5, BH-9 and BH-20 were found to range from 89% to 100% and RQD (Rock Quality Designation) measurements were observed to range from 83% to 92%, indicating a good rock condition, below the upper weathered zone. No noticeable fractures and weathered zones were observed in the rock cores.

4.9 Groundwater

Following completion of drilling, Boreholes BH-1, BH-3, BH-4, BH-6 to BH-8, BH-10 to BH-17, BH-23 and BH-24 caved in at depths ranging from 1.5m to 4.6m below existing grades and Boreholes BH-2, BH-5, BH-9, BH-18 to BH-22 remained open to full explored depths. Free ground water levels in the caved and open Boreholes were documented at depths of 1.5m to 4.6m (191.51m to 186.14m) below existing grades upon completion of Boreholes with the exception of Boreholes BH-5 and BH-14,

which were observed to be dry down to the full explored depths upon completion.

The groundwater levels in the open boreholes are documented in Table 4.9-1 below.

Table 4.9-1 Depths and Elevations of Free Groundwater Upon Completion of Boreholes

BH No.	Existing Grade Elevation, ±m	Free Groundwater Depth, ±m	Free Groundwater Elevation, ±m
1	191.30	4.00	187.30
2	191.61	4.60	187.00
3	192.87	4.20	188.67
4	191.42	3.00	188.42
5	192.13	Dry	Dry
6	192.59	3.70	188.89
7	193.01	1.50	191.51
8	193.59	3.10	190.49
9	192.99	3.70	189.29
10	192.31	3.00	189.31
11	192.70	2.30	190.40
12	191.63	2.40	189.23
13	191.46	1.80	189.66
14	190.08	Dry	Dry
15	191.78	2.40	189.38
16	191.99	3.00	188.99
17	192.30	3.00	189.30
18	190.14	4.00	186.14
19	191.64	3.00	188.64
20	191.45	3.00	188.45
21	192.42	3.00	189.42
22	191.31	2.30	189.01
23	191.31	3.00	188.1
24	191.95	3.00	188.95

Following completion of drilling, monitoring wells were installed at Boreholes BH-2, BH-5, BH-9, BH-18, BH-20, BH-21 and BH-22 locations for determination of static water levels.

On the groundwater monitoring rounds between January 2018 and April 2019, and between March and September 2021, the static ground water levels, at Monitoring Well locations, varied in depths from 0.26m to 6.47m (elevation 186.47m to 191.35m) across the area of the subject Site. Table 4.9-2, below, presents a summary of measurements of the elevations of static ground water levels at each of the Monitoring Well location.

Table 4.9-2 Elevations of Groundwater at Monitoring Well Locations Measurements On The Groundwater Monitoring Rounds

Monitoring Well (BH) No.	Existing Grade Elevation, ±m	Jan 2018 to Sept 2021, Groundwater Depth, ±m	Jan 2018 to Sept 2021, Groundwater Elev., ±m
2	191.61	0.26 to 1.68	189.93 to 191.35
5	192.13	4.48 to 5.66	186.47 to 187.65
9	192.99	5.27 to 6.47	186.52 to 187.72
18	190.14	2.91 to 4.09	186.05 to 187.23
20	191.45	3.67 to 4.92	186.53 to 187.78
21	192.42	1.72 to 3.28	189.14 to 190.70
22	191.31	0.05 to 1.35	189.96 to 191.26

The higher static ground water levels in the monitoring wells and free ground water levels in the boreholes upon completion of drilling may be attributed to the perched water in the upper permeable silty sand deposits overlying less permeable clayey silt / silty clay deposits and wet condition of the natural clayey silt / silty clay deposits.

For the groundwater conditions across the Site, we recommend that the Hydrogeological study, issued under a separate cover, should reviewed for temporary and permanent ground water control.

5.0 DISCUSSIONS AND RECOMMENDATIONS

The Draft Plan of Subdivision, prepared by MHBC Planning, dated November 16, 2021, indicates that the redevelopment at the subject Site, on an area of 8.99 ha, will consist of the construction of single detached dwellings, Townhomes, Back To Back Stacked Townhomes, a SWM area, a Park, walkway, open space, right of way, driveways and roads etc.

5.1 Site Preparation

The upper fill materials, consisting of silty sand and sandy silt with occasional organic stains, encountered at BH locations 1 to 24 are in a very loose to compact and very moist to wet condition and will provide satisfactory subgrade for support of the exterior pavement after removal of soft and unstable soils and after application of satisfactory mechanical compaction.

The soil description and depth of fill shown on the Borehole Logs are at the borehole locations only. The thickness of topsoil and the depth of the fill materials at locations beyond the boreholes may be deeper. We recommend that the contractor bidding for the job should determine the depths of deleterious material in several test pits and remove any deleterious fill and material, with high moisture and/or organic content, during the site grading.

Depending on the final grades, the Site might have to be regraded for the residential development. If cut and fill operation is proposed, the on-site excavated native silty sand and sandy silt soils, to be used for site grading, should be organic free and maintained at or close to its optimum moisture content during placement and compaction. The natural,clayey silt soils excavated from the area of the Site are not suitable for backfilling due to their very moist to wet condition. Alternatively, imported materials conforming to OPSS Select Subgrade designation may also be used and should be compacted in lifts of 200mm to at least 98% of its Standard Proctor maximum dry density (SPMDD).

Compressible topsoil and the fill material, containing relatively high organic content, will not be suitable for reuse in areas where future settlement cannot be tolerated. This material will have to be disposed off-site or reused in landscaped areas, subject to approval by the landscape architect.

5.2 Foundation Design

It is understood that the proposed residential development will be slab-on-grade construction, with no basements, with the exception of few single family detached dwellings, with finished basement floors at depths varying from 1.5m to 1.8m below existing grades.

In the light of above, the undersides of the conventional spread foundations of the proposed buildings, with and without basement levels, will be at depths varying from 1.8m to 2.1m in order to accommodate thickness of granular basecourses and slab-on-grade and 1.5m below existing grades in order to protect the foundation from the action of frost, respectively at BH-1 to BH-24 locations. This will place undersides of the conventional spread foundations on silty sand, sandy silt and clayey silt deposits.

The upper fill materials, consisting of silty sand and sandy silt with occasional organic stains, encountered at BH-1 to BH-24 locations are in a very loose to compact and very moist to wet condition and are not suitable to support the foundations of the permanent structures but will provide satisfactory subgrade for support of the exterior pavement after removal of soft and unstable soils and after application of satisfactory mechanical compaction.

The upper natural silty sand and sandy silt subsoils encountered at approximate depths of 1.2m to 2.9m below existing grades, at BH-1 to BH-24 locations, are generally in a loose to compact state, based on the Standard Penetration resistance (“N” values) of 7 to 22 blows per 300mm, and only the static groundwater table encountered at approximate depths of 0.26m to 1.68m and 0.05m to 1.35m in monitoring wells installed at BH-2 and BH-22 locations, respectively, considered as perched water, may be higher than the footing levels, therefore, most of the footings will be above the current water table, as encountered the remaining monitoring wells.

Based on these conditions, encountered at the borehole locations, foundation design bearing pressures, at the Serviceability Limit State (SLS) in the silty sand subsoils, will be limited due to the presence of underlying very soft to very stiff clayey silt layer.

The foundations will have to be taken through the very soft to very stiff clayey silt layer and placed on the natural undisturbed very stiff, clayey silt

or medium dense to very dense silt till deposits, at depths varying from 3m to 6.1m below existing grades at the Borehole locations. Spread / strip foundations, placed on these undisturbed soils, can be designed for a bearing pressures of 150 kPa at the Serviceability Limit State and 250 kPa at the factored Ultimate Limit State, for a total and differential settlements of less than 25mm and 15mm, respectively.

The deep excavations in the range of 3.0m to 6.1m below existing grades, to place the footings on the competent subsoils, might require that the faces of excavations to be temporarily braced or shored, if adequate space is not available for an open cut excavation, in addition to intensive dewatering of the subject Site. In light of the above conditions, we recommend that consideration should be given to using deep foundation, such as drilled piles consisting of cast in place drilled concrete piles (CFAs) or drilled caissons.

5.2.1 Cast-in-Place Concrete Piles

The cast-in-place continuous flight augering concrete piles (CFAs) installed by advancing a continuous flight, hollow-stem augers into the good limestone bedrock encountered at approximate depths of 5.2m to 9.5m (elevation 186.5m to 184.1m) below existing grades at BH locations BH-5 to BH-17, BH-19, BH-20, BH-23 and BH-24 may be designed for a end-bearing pressure of 5000 kPa at the Factored Ultimate Limit State, for piles socketed a minimum of 500±mm into the bedrock. The bearing capacity at the Serviceability Limit State need not be considered.

For preliminary design estimation, 600mm diameter auger cast piles, socketed into the bedrock by at least 500±mm, can be designed for an axial load of 1500 kN. The minimum spacing of the piles should be 3 times the diameter of piles, centre to centre. If higher bearing pressures are to be used for the CFA piles, it will be necessary to determine the load using a full scale load test, to at least twice the design load.

5.2.2 Drilled Caisson Foundations

Drilled caisson foundations established on the good limestone bedrock encountered at approximate depths of 5.2m to 9.5m (elevation 186.5m to 184.1m) below existing grades at BH locations BH-5 to BH-17, BH-19, BH-20, BH-23 and BH-24 may be considered for the proposed residential development. Caissons established below the surface of the good bedrock, as described above, may be designed for a end-bearing pressure of 5000 kPa at the Factored Ultimate Limit State, for piles socketed a

minimum of 500±mm into the bedrock. The bearing capacity at the Serviceability Limit State need not be considered.

Due to the presence of very moist to wet condition of upper fill materials, consisting of silty sand to sandy silt, and very moist condition of underlying natural clayey silt deposits above the founding depth, it will be necessary to install a temporary steel liner, in order to support the sides of the drilled hole, and to minimize the ingress of water seepage from the wet layers above. It is essential that the specialist contractor performing the drilling operations for caisson foundations is fully aware of the subsurface conditions, and must make every effort to use appropriate technique and equipment in order to accomplish this task.

5.3 Pipe Bedding

Based on the borehole information, the subsoil at service trench inverts may consist of native silty sand, clayey silt and silt till subsoils.

The pipe bedding for underground services, including catch basins and manholes, should consist of OPSS Granular A, 20mm crusher run limestone, or equivalent, compacted to 95% of its Standard Proctor maximum dry density (SPMDD). If free water is encountered in the trenches, from saturated sand layers, the bedding in the service trenches may consist of HL6 stone or equivalent, provided that a geotextile filter fabric (Terrafix 270R or equivalent) is used to separate the stone bedding from the base and the sides of the excavation. The geotextile filter fabric must surround the clear stone bedding completely.

5.4 Floor Slab Construction

Slab-on-grade type of floor construction may be considered for the lowest level of the proposed structure.

In the light of the lowest basement floor levels of the few single family dwellings, 1.5m to 1.8m blow existing grades, and undersides of the granular basecourses below the slab, 1.8m to 2.1m below existing grades, the subgrade materials will be silty sand, sandy silt overlying natural, very moist to wet, soft to very soft clayey silt, which may be in an unstable condition. The silty sand and sandy silt overlying unstable clayey silt subsoils should be examined by an engineer from ***Toronto Inspection Ltd.*** in order to determine that the soils are suitable to support the slab-on-grade.

The slab-on-grade, on stable subgrade, examined by an engineer of ***Toronto Inspection Ltd.***, may be constructed over a minimum thickness of 150mm (6"), Granular "A" compacted in lifts not exceeding 200mm to a minimum of 98% of its Standard Proctor maximum dry density (SPMDD). If 19mm ($^3/_4$") crushed stone is to be used, it might have to be separated from the underlying wet sands by a geotextile filter fabric.

The slab-on-grade should be constructed independently of any structural members (i.e. walls, columns, etc.) by means of fibre board or an equivalent isolation compound. Saw cuts should be provided along column lines, with "diamond" cuts around columns, to minimize uncontrolled cracking of floor slab.

5.5 Earthquake Consideration

For purpose of design of the proposed structure to resist earthquake forces and effects as per Table 4.1.8.4A, in the Ontario Building Code:

- the Site Classification for Seismic Site Response of Site Class C (soft rock) may be assumed for deep foundations established on the limestone bedrock, encountered at the subject Site at depths of 5.2m to 9.5m (elevation 186.5m to 184.1m) below existing grades at BH-5 to BH-17, BH-19, BH-20, BH-23 and BH-24 locations.

The acceleration and velocity based site coefficients, Fa and Fv, should conform to Tables 4.1.8.4.B and 4.1.8.4.C. These values should be reviewed by the Structural Engineer.

5.6 Excavation and Groundwater Control

In general, the excavation of the upper fill materials and natural subsoils down to the approximate depths of the undersides of the grade beams (1.5m to 2.5m below existing grades of the Site) should be relatively straightforward with no major groundwater problems anticipated. Perched water encountered at Boreholes BH-2, BH-13 and BH-22 locations and minor seepage emanating from the upper fill materials and underlying natural soils at rest of the Borehole locations can be controlled by local pumping. A hydrogeological study should be referred for source of the groundwater, the groundwater table and the temporary / permanent groundwater control.

In the permanent condition, where finished floor levels of the proposed buildings are below groundwater table, installation of permanent dewatering system, with underfloor drainage grid, as shown on Figure No. 3, leading to sump pits will be required. A source of emergency power consisting of battery pack or generator will be required to ensure continuous operation of pumps to keep the groundwater from exerting hydrostatic pressure on the basement slab-on-grade and ingress of water into the underground level.

Excavations must be conducted in conformance with regulation 213/91 (construction projects) under the Ontario Construction Health and Safety Act. The upper fill materials and the natural, soft, clayey silt subsoils may be classified as Type 3 soils, and the natural, very stiff, clayey silt and natural, medium dense to very dense, silt till and natural, very dense, sand and gravels subsoils as Type 2 soils, above groundwater table, and limestone bedrock as Type 1 soils, as per the Ontario Ministry of Labour Occupational Health and Safety Act.

Within the confines of the project area, the sides of excavations in the upper fill and natural silty sand, clayey silt, silt till and sand and gravel subsoils, above groundwater table, may be safely cut back to 1 vertical to 1 horizontal above a maximum vertical cut of 1.2m in very dense silt till subsoils.

Where the above-noted safe cut side of excavation cannot be accomplished within the limits of the subject property or the excavation is below ground water table, the installation of temporary shoring will be required.

5.7 Lateral Earth Pressure

A triangular pressure distribution envelope is assumed for the design of all supporting elements. It is assumed that the lagging does not extend below the base of excavation. The lateral pressure, p, in kPa, acting on a unit element at any depth h, in metres, below the surface of the retained soil, may be estimated from the following expression:

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

where p =	lateral earth pressure	(kPa)
	K = lateral earth pressure coefficient	0.4
	γ = bulk unit weight of backfill	21.0 kN/m^3
	H= depth of wall below the finished grade	(m)
	q = surcharge loads adjacent to the walls	(kPa)

This expression assumes that a permanent free drainage system is provided to prevent a build up of hydrostatic pressure next to the wall.

5.8 Permanent Perimeter and Underfloor Drainage

For an open cut excavation at the locations of full or partial basements, the recommended permanent perimeter drainage system is shown on Figure No. 3. Where the lowest interior floor level is at least 300mm above the exterior, perimeter grade, the perimeter weeping tile are not required. Exterior grades should be sloped away from the buildings.

The perimeter and underfloor drainage, shown on Figure No. 3, should be led to a positive frost-free sump from which the water can be pumped to the municipal or storm sewers. It is recommended that cleanouts are placed at strategic locations to allow for periodic cleaning and washing of the weeping tile of the perimeter drainage to inhibit the clogging of the interior of the pipes. The amount and quality of water, anticipated from the perimeter drainage and subfloor drainage system, if encountered, should be addressed by the hydrogeologist.

In additional to above, we also recommend that cleanouts are placed at strategic locations to allow for periodic cleaning and washing of the weeping tile of the perimeter drainage and below slab-on-grade to inhibit the clogging of the interior of the pipes.

5.9 Pavement Construction

The fill materials, at Boreholes BH-1 to BH-24 locations, consisting of silty sand to sandy silt, were encountered with inclusion of occasional organic stains, in a very loose to compact and moist to very moist state and will provide satisfactory subgrade for support of interior slab-on-grade and exterior pavement. However, proof-rolling and or re-compaction of the subgrade will be required prior to placement of subbase and basecourse below asphalt pavement on stable and competent subgrade.

Prior to filling and/or backfilling, the exposed subgrade should be thoroughly cleaned to remove all loose, disturbed and organic materials prior to filling. Any regrading carried out up to the underside of basecourses below exterior pavement should be carried out using only approved, free draining materials, placed in shallow lifts not exceeding 150mm and compacted to at least 98% Standard Proctor maximum dry density.

The following minimum pavement design thicknesses are recommended based on the assumption that perforated sub-drains will be installed to prevent build-up of water in the granular bases of the pavement:

		Light Duty Parking	Heavy Duty Fire Routes
Asphaltic Concrete	OPSS HL3 or equivalent	65mm	40mm
	OPSS HL8 or equivalent	-	60mm
Base:	OPSS Granular A or 20mm crusher-run	150mm	150mm
Sub-base:	OPSS Granular B or 50mm crusher-run	200mm	350mm

Roads and driveways to be assumed by the local municipality should be constructed to the municipal standards.

The above pavement thicknesses are based on the favourable site conditions and the construction being carried out during the drier time of the year and that the subgrade is stable, not heaving under construction traffic. If the subgrade is wet and unstable, additional thickness of sub-base material may be required.

Following site grading, the subgrade of the entire pavement should be proof-rolled using a heavy vibratory roller. Any soft spots revealed by the proof-rolling should be sub-excavated and replaced with an approved dry

material and compacted to at least 98% of its SPMDD. If the subgrade is wet and unstable, the wet material should be removed from the subgrade and additional thickness of subbase be used for road construction.

Provision should be made for the water to drain out and not to cause granular base courses saturated in order to function pavement properly.

Perforated subdrains should be provided, extending to a distance of 3m in all directions of catch basins, (see Figure No. 4) and continuously at locations where a drop in the subgrade elevation is relevant, such as beside the ramp or concrete sidewalks. The invert of subdrains should be at least 800mm below the road pavement level, and installed on a positive gradient led to catch basins to allow for a free flow of water. The backfill above the drains should comprise of free draining Granular B or its equivalent and should be continuous with the granular subbase of the pavement.

The catch basins should be perforated just above the drain invert level and the weep holes should be screened with a filtered fabric.

6.0 GENERAL STATEMENT OF LIMITATION

The comments and recommendations presented in this report are based on the subsoil and ground water conditions encountered at the borehole locations, indicated in the borehole location plan, and are intended for the guidance of the design engineer. Although we consider this report to be representative of the subsurface conditions at the subject property, the soil and the ground water conditions between and beyond the borehole locations may differ from those encountered at the time of our investigation and may become apparent during construction. Any contractor bidding on, or undertaking the works, should decide on their own investigation and interpretations of the groundwater and the soil conditions between the borehole locations.

Any use and/or the interpretation of the data presented in this report, and any decisions made on it by the third party are responsibility of the third parties. The responsibility of ***Toronto Inspection Ltd.*** is limited to the accurate interpretation of the soil and ground water conditions prevailing in the locations investigated and accepts no responsibility for the loss of time and damages, if any, suffered by the third party as a result of decisions or actions based on this report.

Any legal actions arising directly or indirectly from this work and/or ***Toronto Inspection Ltd.'s*** performance of the services shall be filed no longer than two years from the date of ***Toronto Inspection Ltd.'s*** substantial completion of the services. ***Toronto Inspection Ltd.*** shall not be responsible to the client for lost revenues, loss of profits, cost of content, claims of customers, or other special indirect, consequential, or punitive damages.

To the fullest extent permitted by law, the client's maximum aggregate recovery against ***Toronto Inspection Ltd.***, its directors, employees, sub-contractors, and representatives, for any and all claims by clients for all causes including, but not limited to, claims of breach of contract, breach of warranty and/or negligence, shall be the amount of the fee paid to ***Toronto Inspection Ltd.*** for its professional services rendered under the agreement with respect to the particular site which is the subject of the claim by the client.

Yours sincerely,
TORONTO INSPECTION LTD.

LICENSED PROFESSIONAL ENGINEER
M. MAQSOOD
PROVINCE OF ONTARIO
Dec 7, 2021

LICENSED PROFESSIONAL ENGINEER
S. WANG
100131918
Dec 7, 2021
PROVINCE OF ONTARIO

Muhammad Maqsood, P. Eng.
Senior Engineer

David S. Wang, P. Eng.
Senior Engineer

Drawings

Borehole Location Plan
Logs of Boreholes (BH-1 to BH-24)
Stratigraphic Sections Through Boreholes (Section Nos. 1 to 5)

LEGEND

Borehole and Monitoring Well Location

Site Boundary

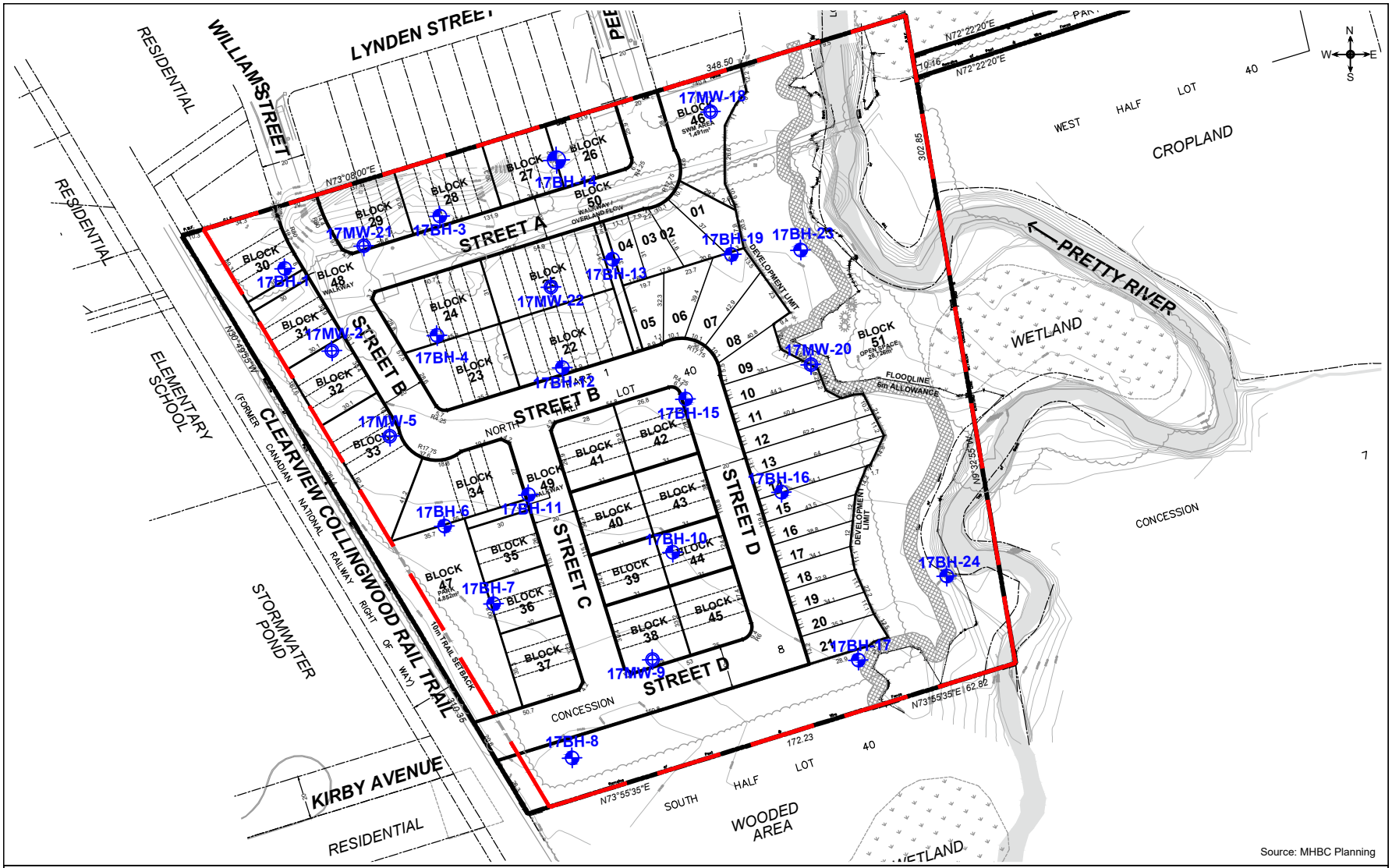
NOT TO SCALE

TorontoInspection LTD.
GEO-ENVIRONMENTAL CONSULTANTS

110 Konrad Crescent,
Unit 16
Markham, Ontario
L3R 9X2

Tel: 905-940 8509 Fax: 905-940 8192 Email : til@torontoinspection.com

TITLE:	Borehole and Monitoring Well Location Plan
LOCATION:	452 Raglan Street, Collingwood, Ontario
PROJECT NO.	4688-17-GD
DATE :	December 2021
FIGURE NO.	1



LEGEND

Borehole and Monitoring Well Location

Site Boundary

NOT TO SCALE

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GEO-ENVIRONMENTAL CONSULTANTS

110 Konrad Crescent,
Unit 16
Markham, Ontario
L3R 9X2

Tel: 905-940 8509 Fax: 905-940 8192 Email : til@torontoinspection.com

TITLE:	Borehole and Monitoring Well Location Plan		
LOCATION:	452 Raglan Street, Collingwood, Ontario		
PROJECT NO. 4688-17-GC	DATE : November 2021	DRAWING NO. 1A	

Project No. 4688-17-GC

Log of Borehole 1

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

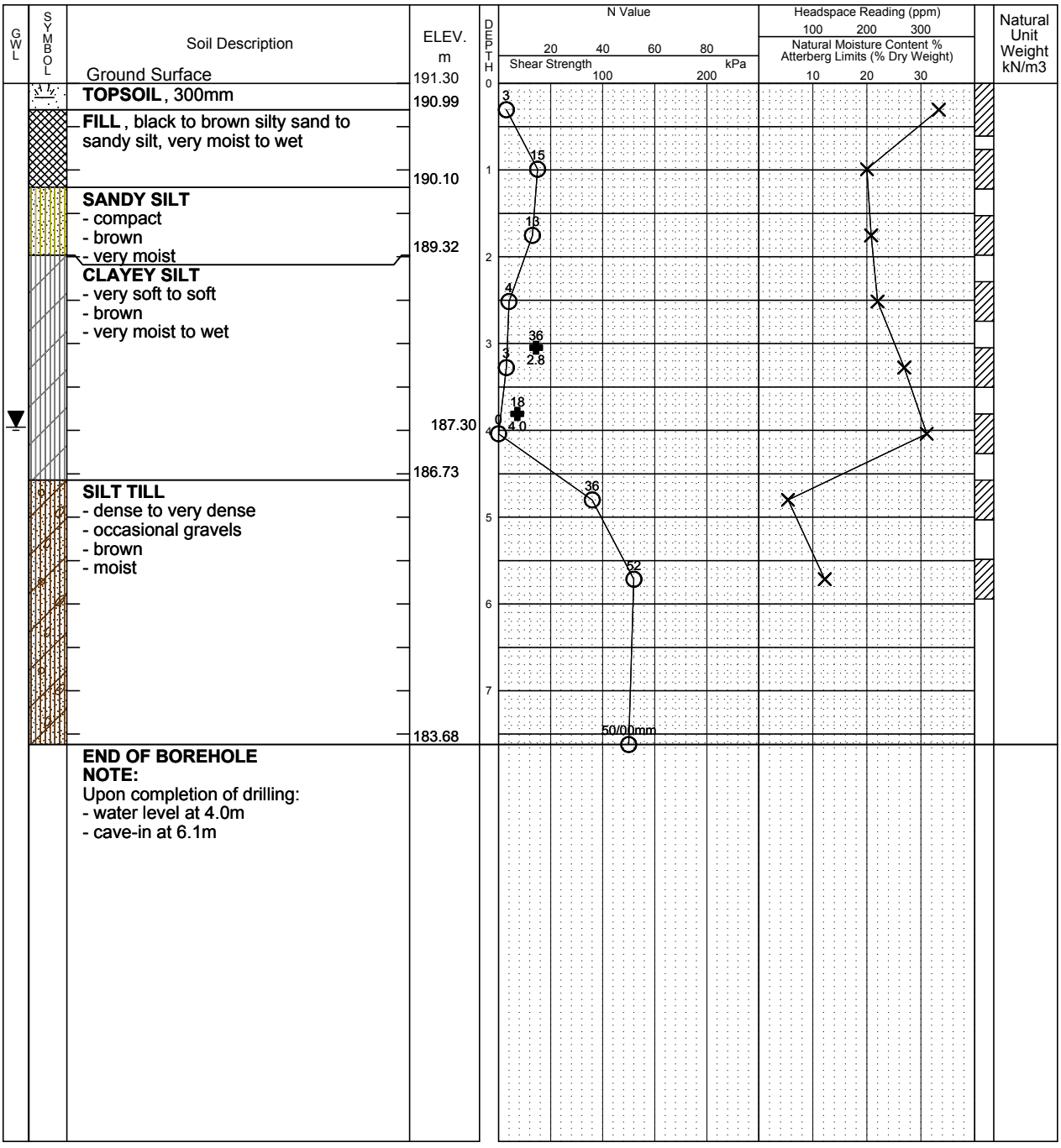
Date Drilled: 11/20/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 2

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

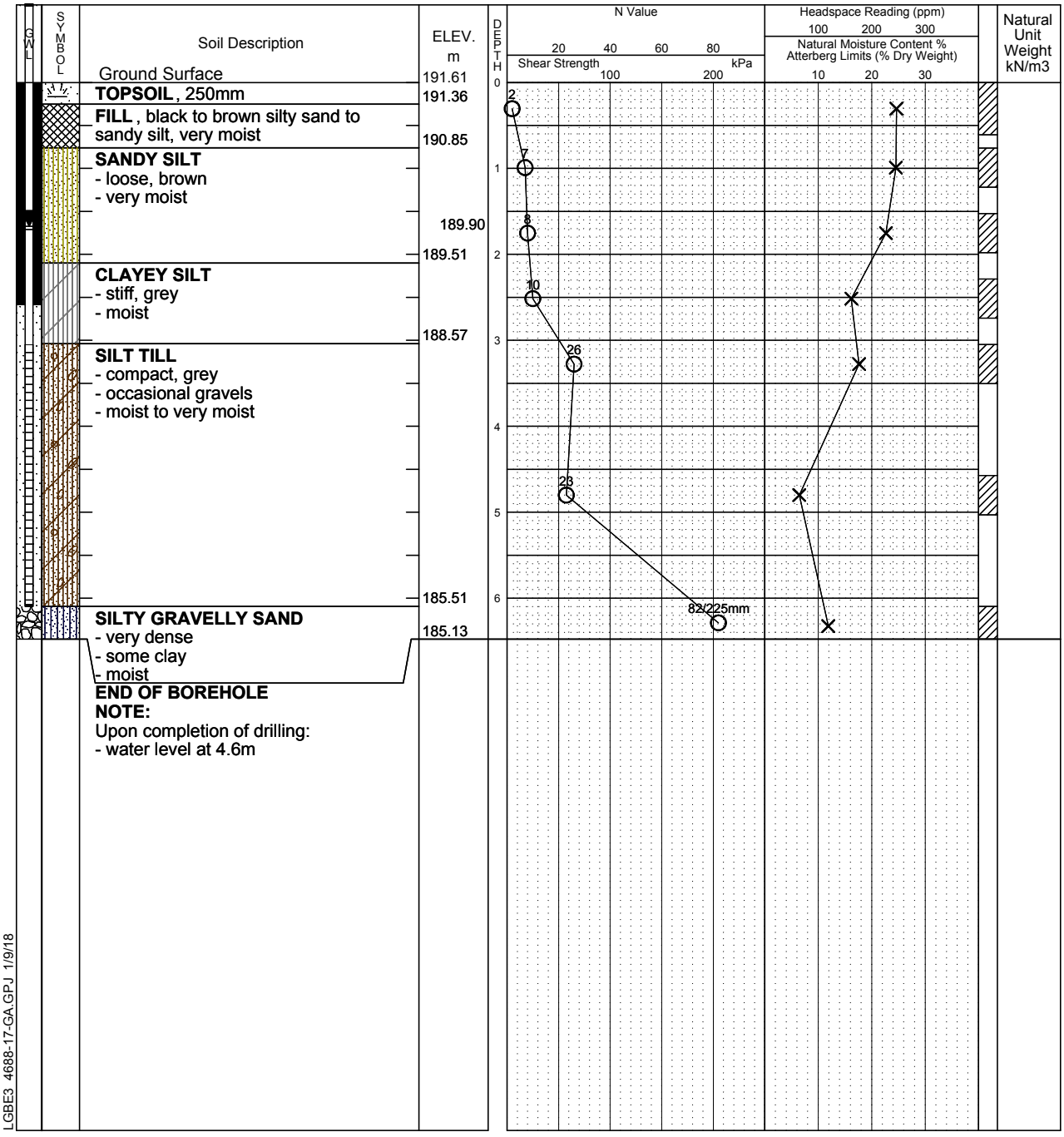
Date Drilled: 11/20/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Nov. 29, 2017	1.71m	

Project No. 4688-17-GC

Log of Borehole 3

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

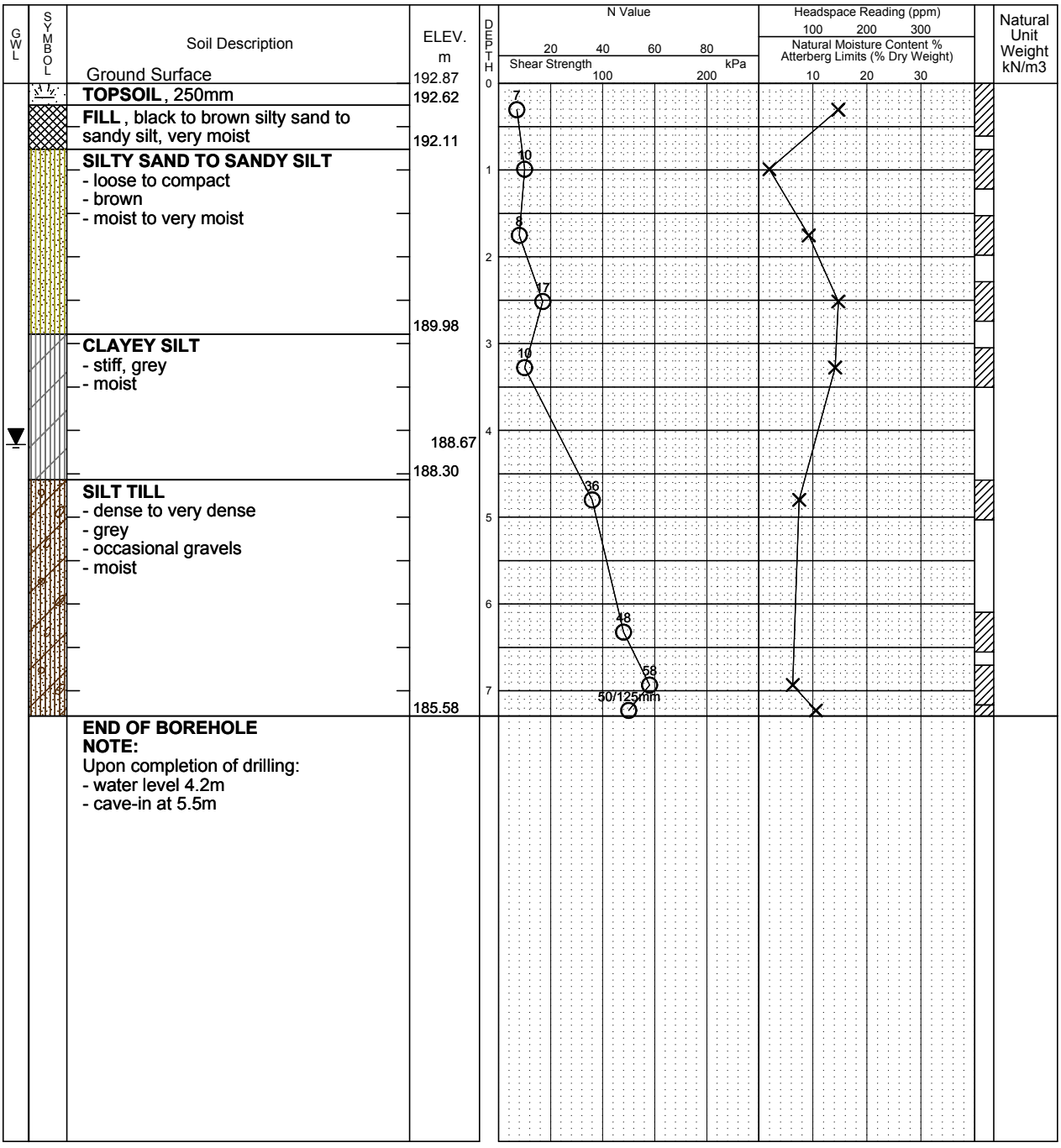
Date Drilled: 11/20/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 4

Dwg No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

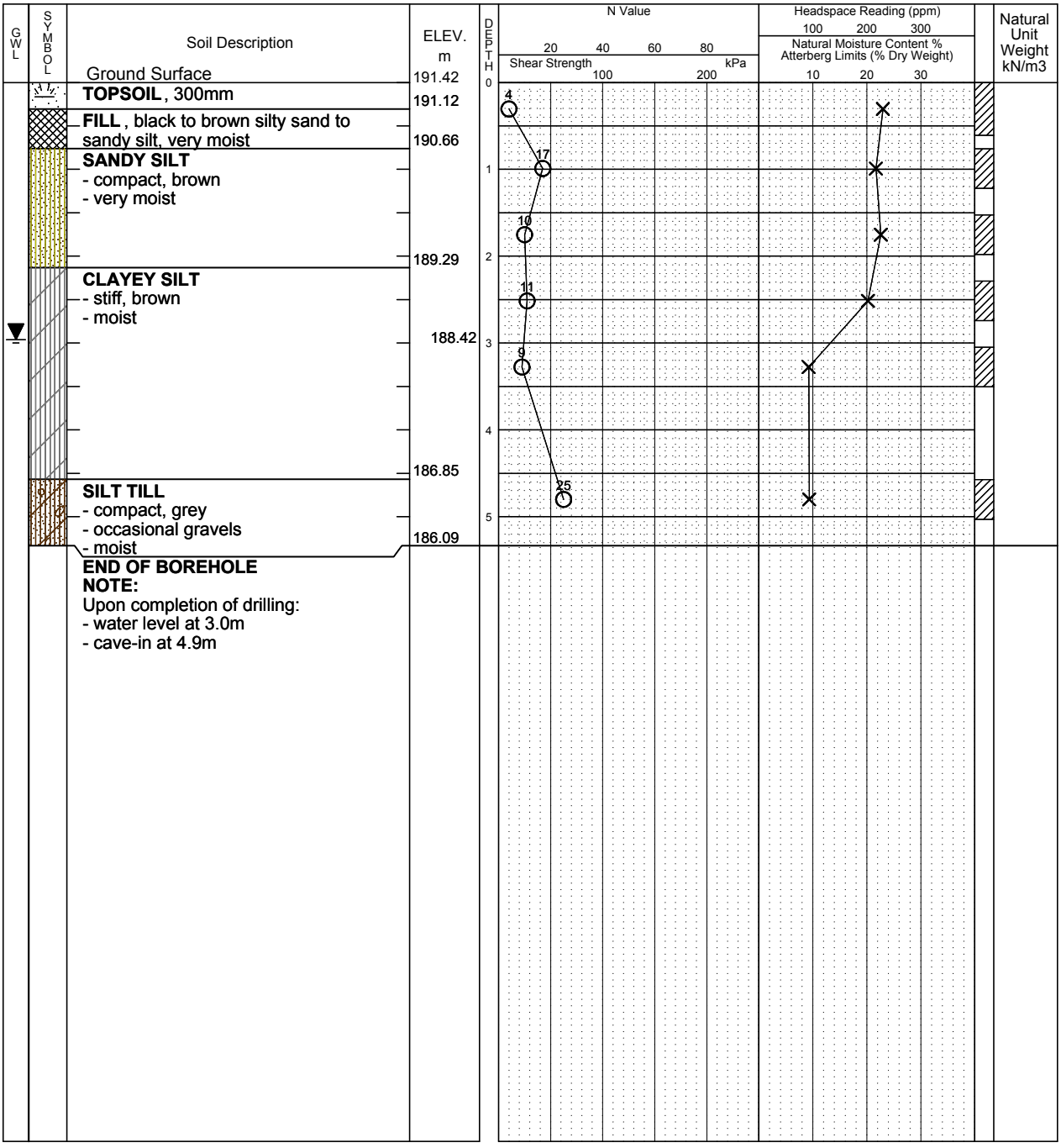
Date Drilled: 11/20/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 5

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

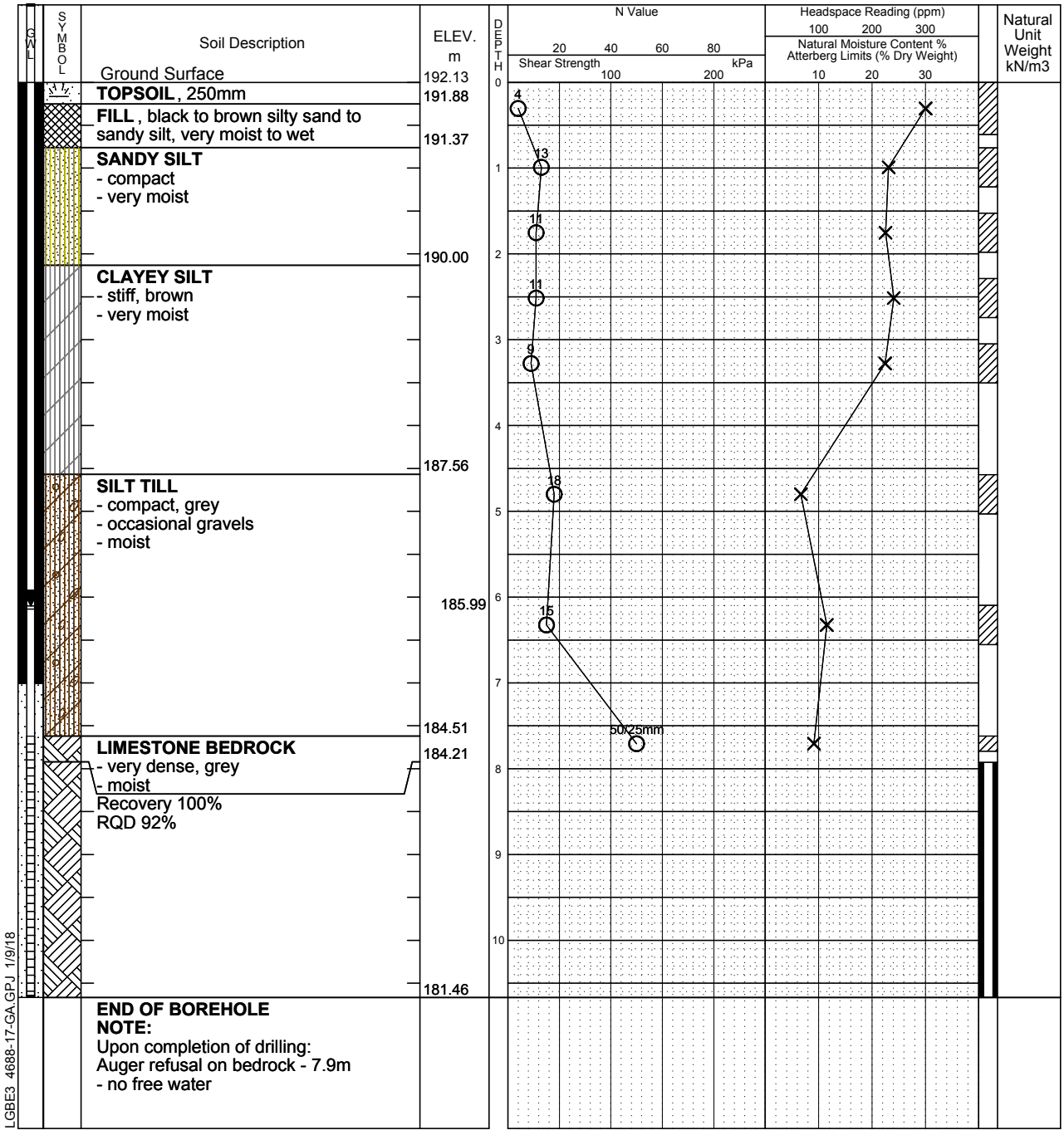
Date Drilled: 11/23/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Nov. 29, 2017	6.14m	

Project No. 4688-17-GC

Log of Borehole 6

Dwg No. 7

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

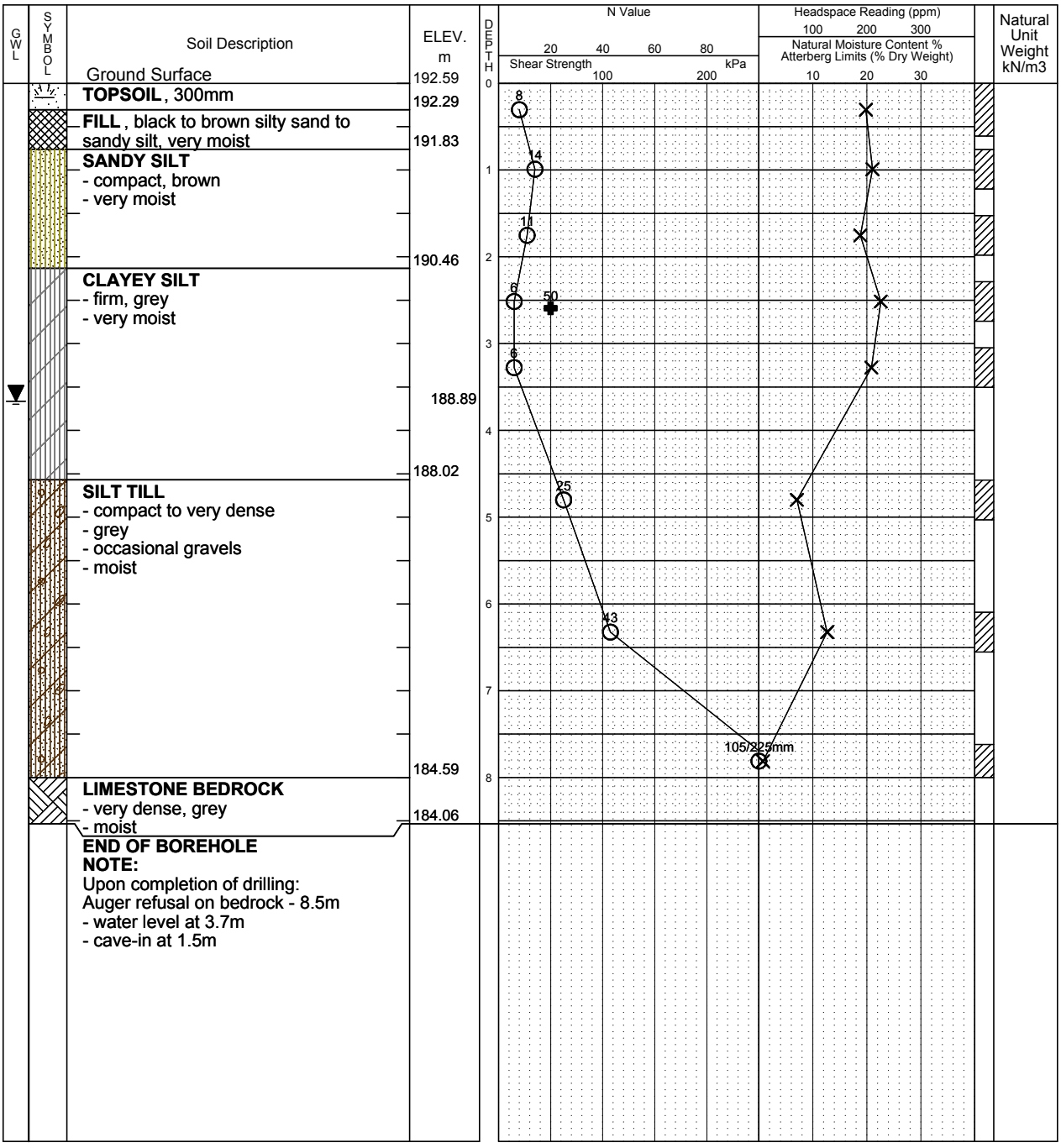
Date Drilled: 11/14/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 7

Dwg No. 8

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

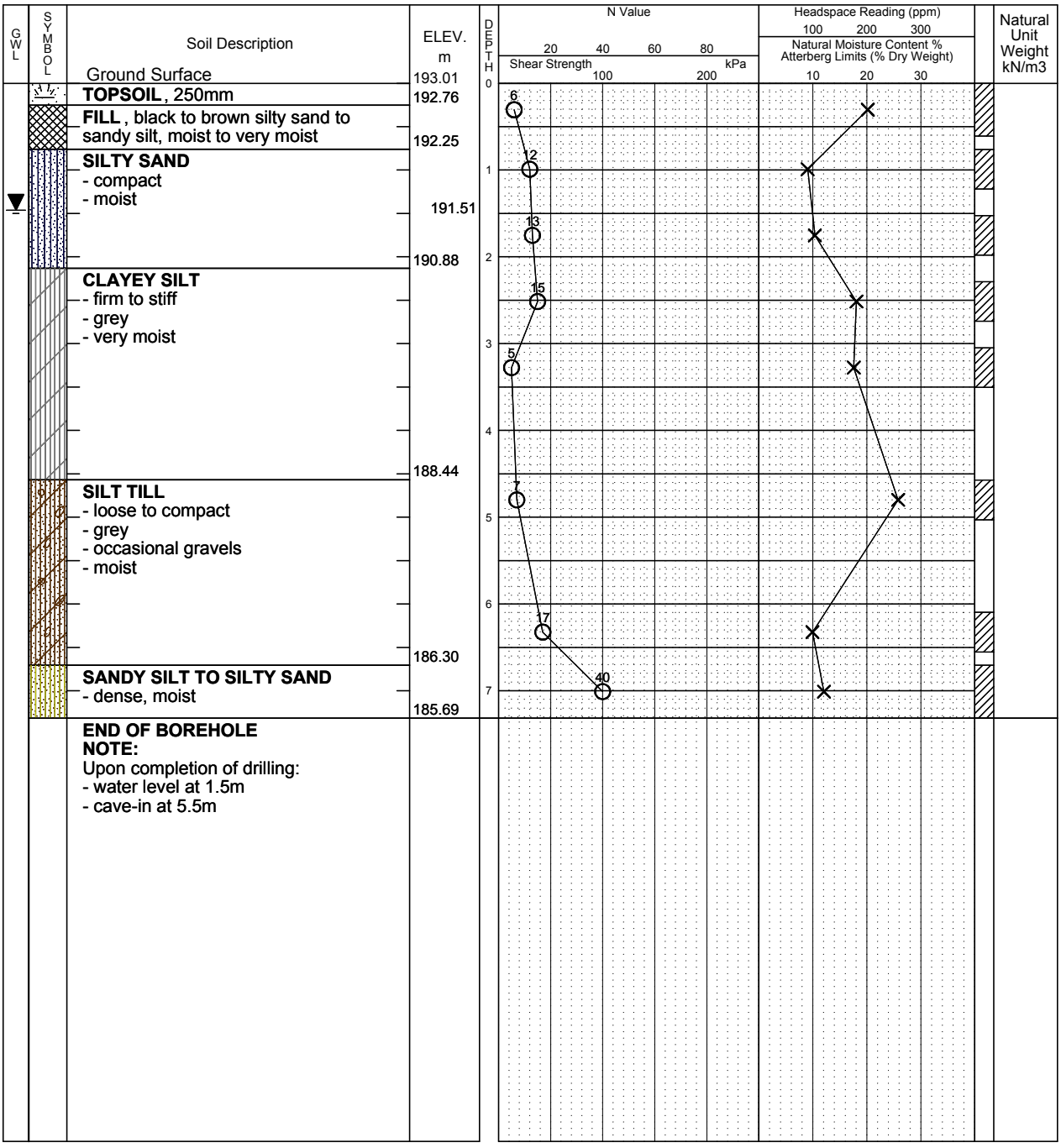
Date Drilled: 11/14/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 8

Dwg No. 9

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

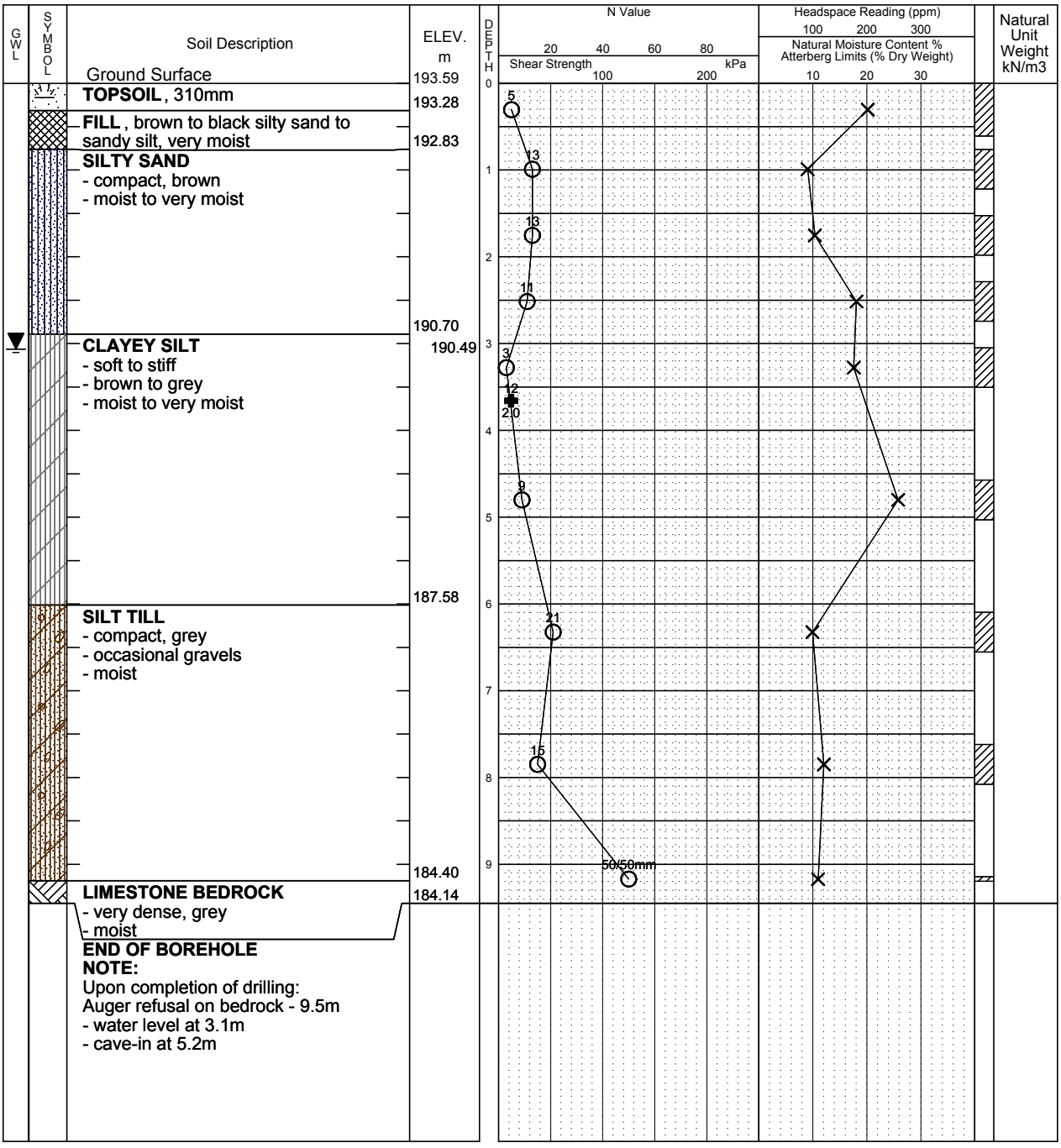
Date Drilled: 11/14/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 9

Dwg No. 10

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

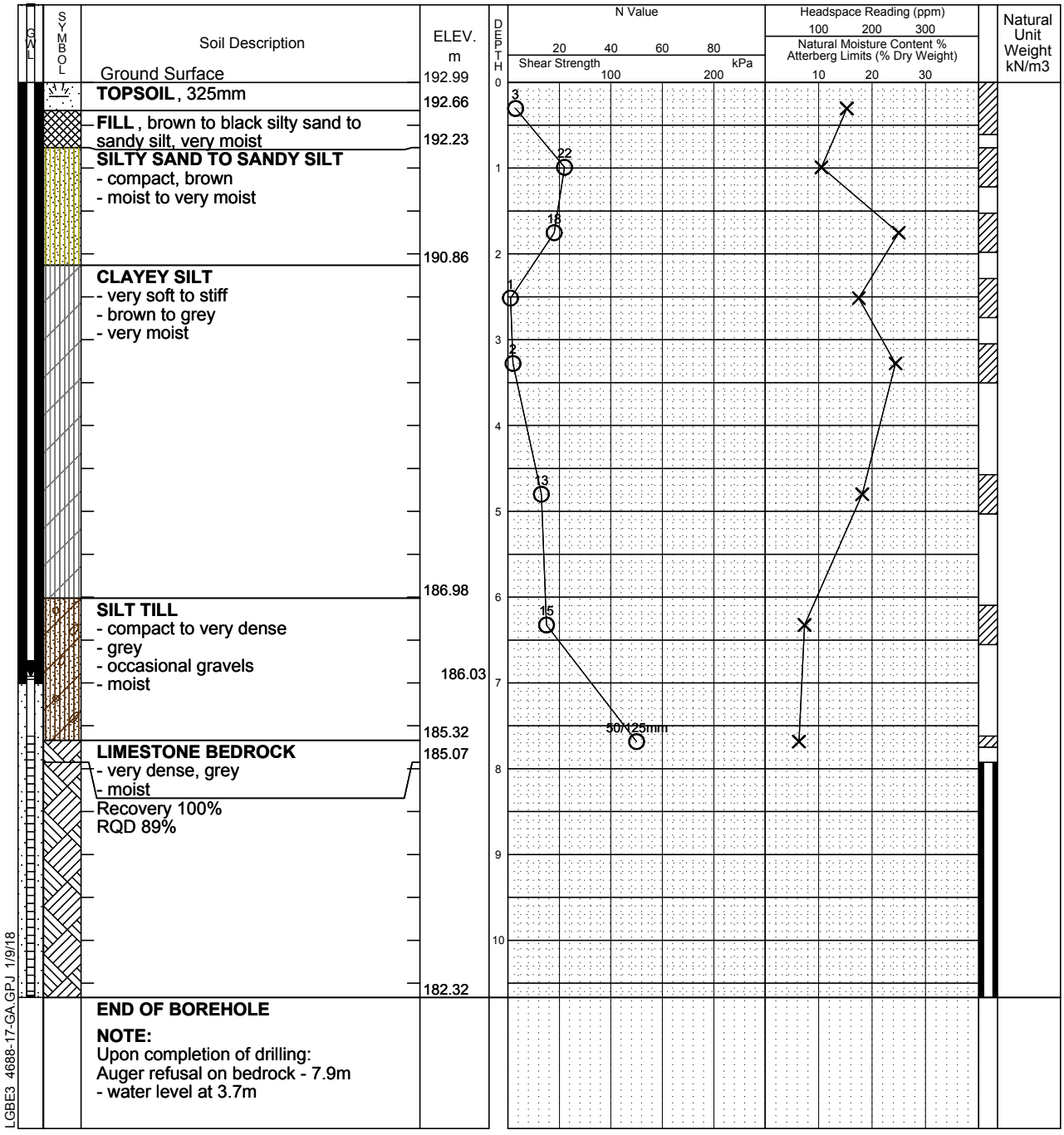
Date Drilled: 11/24/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Nov. 29, 2017	6.96m	

Project No. 4688-17-GC

Log of Borehole 10

Dwg No. 11

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

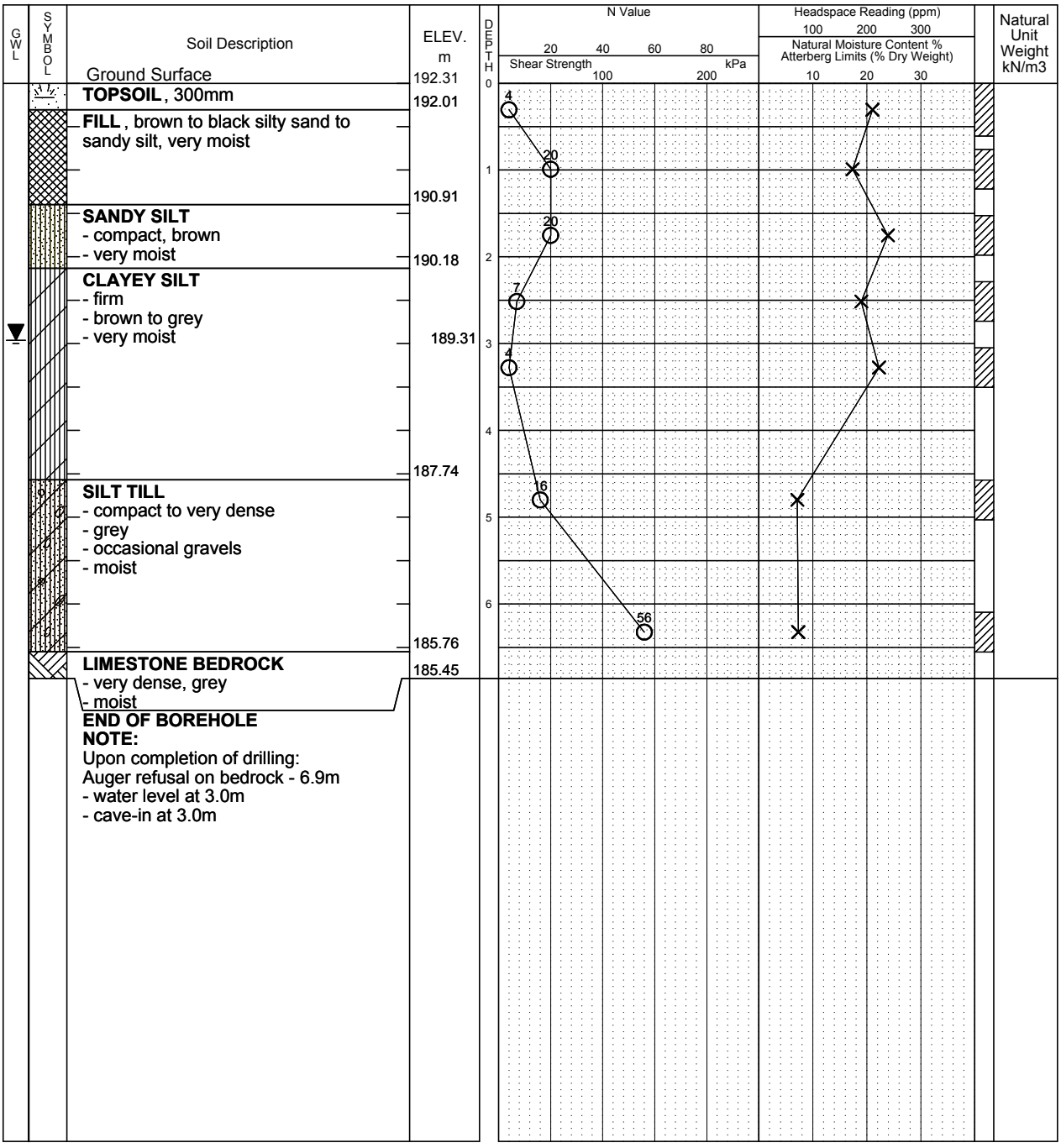
Date Drilled: 11/16/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 11

Dwg No. 12

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/18/17

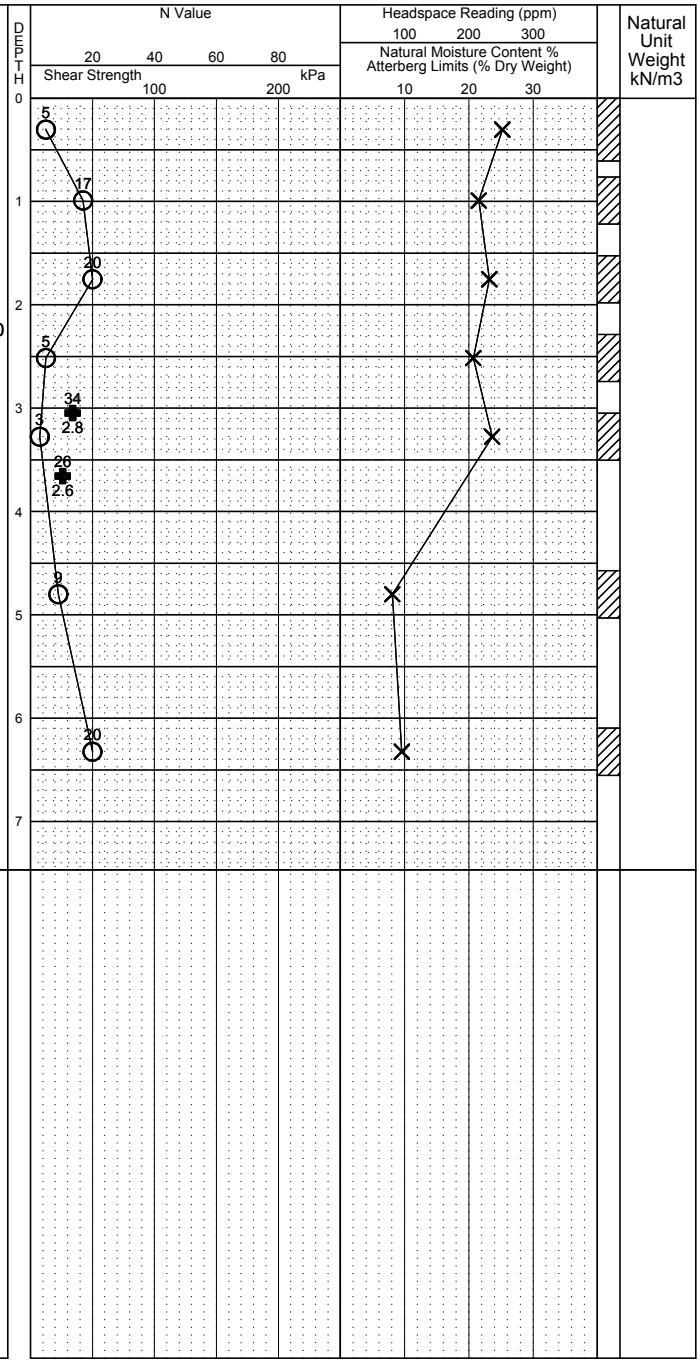
Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m
		Ground Surface	192.70
		TOPSOIL, 250mm	192.45
		FILL, brown to black silty sand to sandy silt, very moist	191.33
		SANDY SILT - compact, brown - very moist	190.57
▼		**CLAYEY SILT** - soft to firm - brown to grey - very moist	190.40
		SILT TILL - loose to compact - grey - occasional gravels - moist	188.13
		LIMESTONE BEDROCK - very dense, grey - moist	186.15
		END OF BOREHOLE **NOTE:** Upon completion of drilling: Auger refusal on bedrock - 7.5m - water level at 2.3m - cave-in at 2.3m	185.23



Natural Unit Weight kN/m3

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NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 12

Dwg No. 13

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

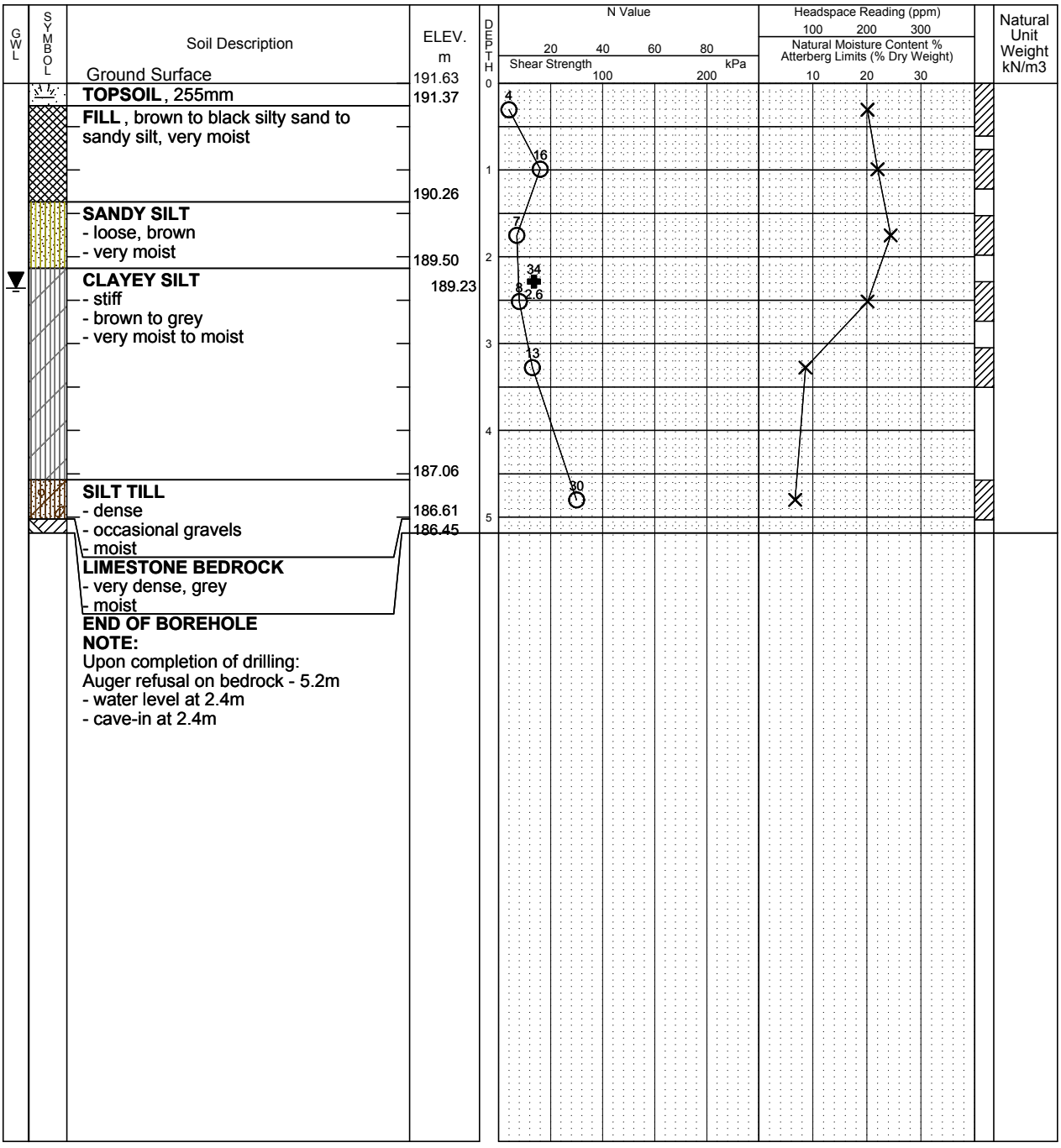
Date Drilled: 11/17/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



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NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 13

Dwg No. 14

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

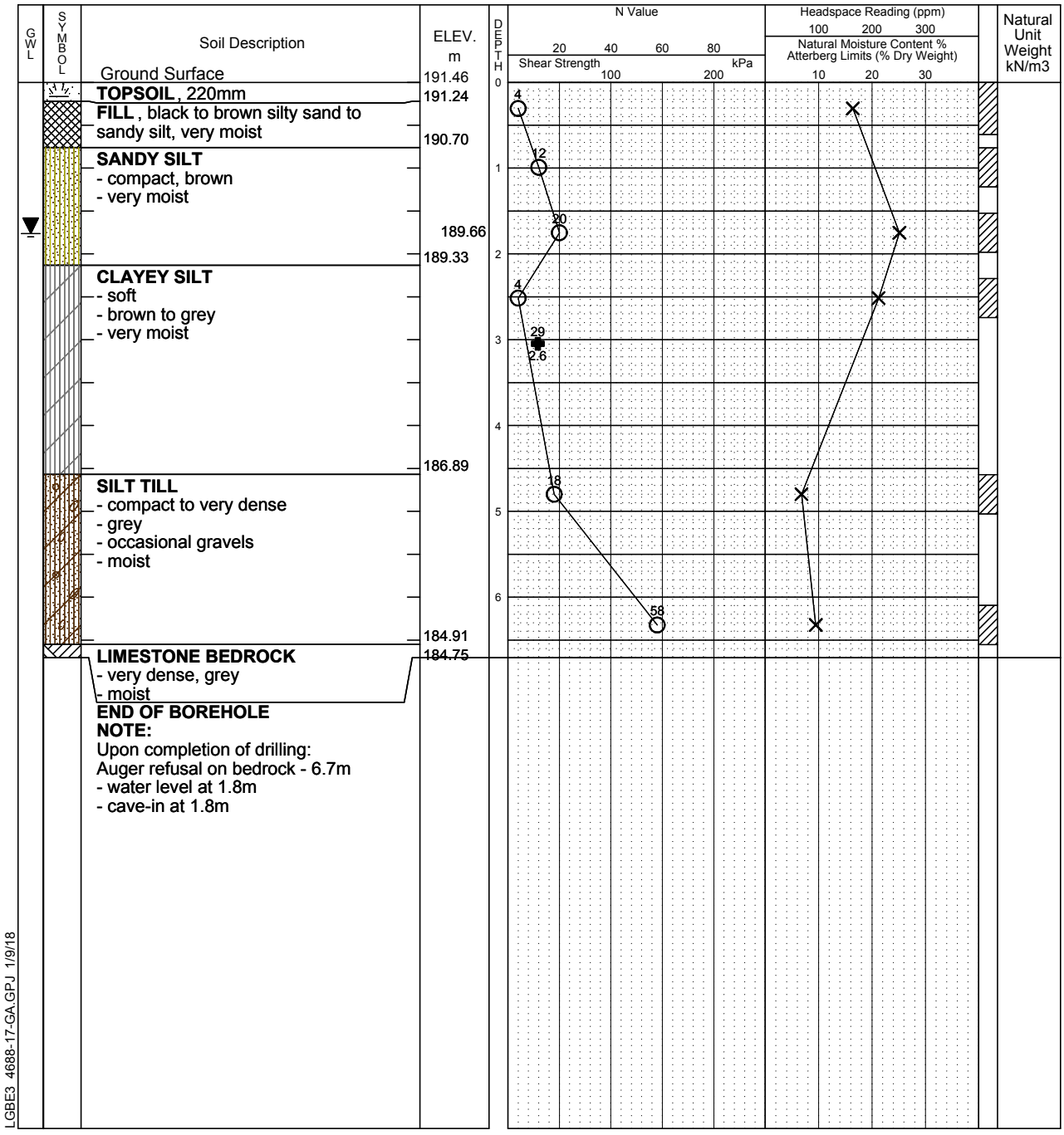
Date Drilled: 11/17/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 14

Dwg No. 15

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

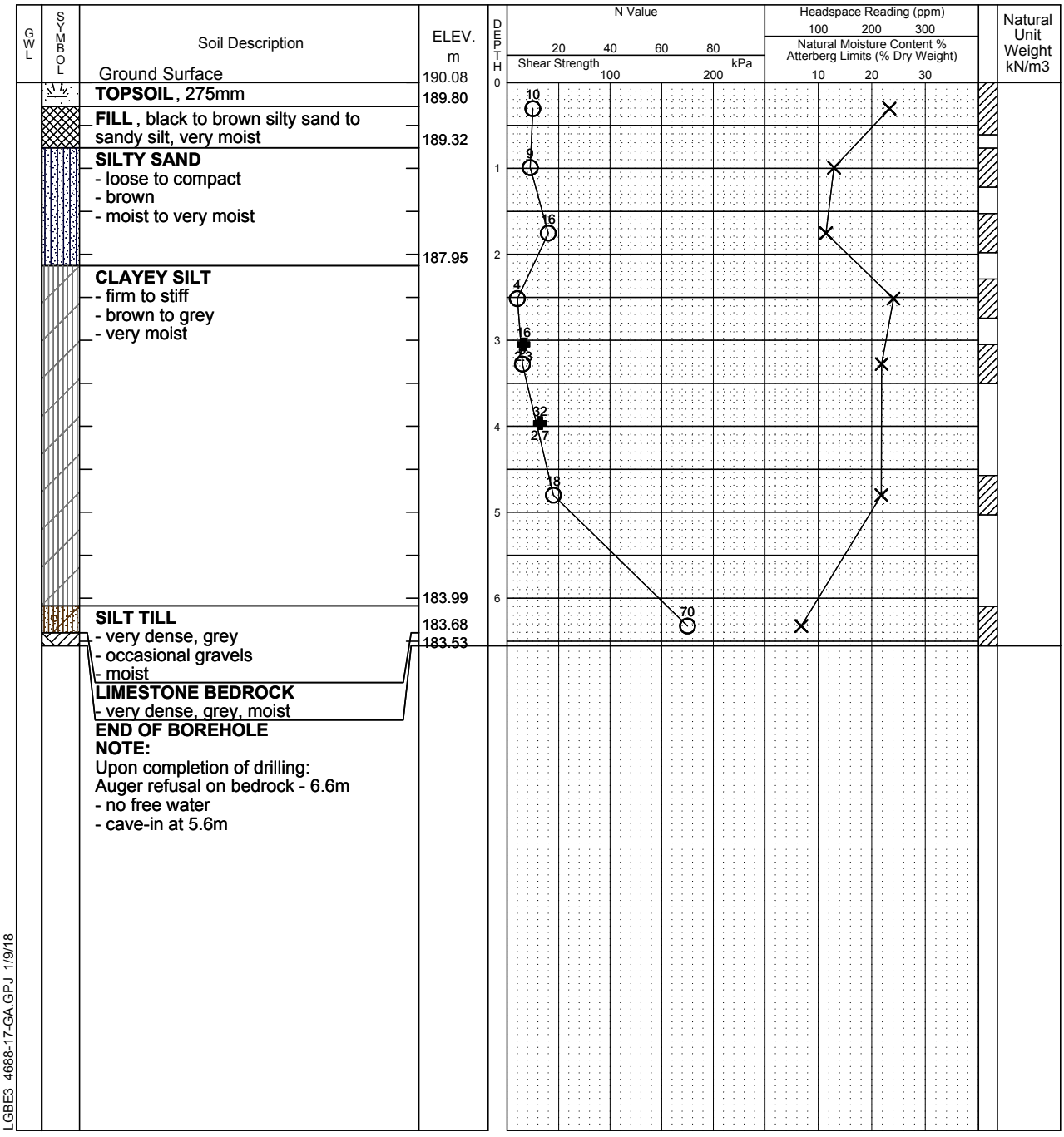
Date Drilled: 11/19/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 15

Dwg No. 16

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

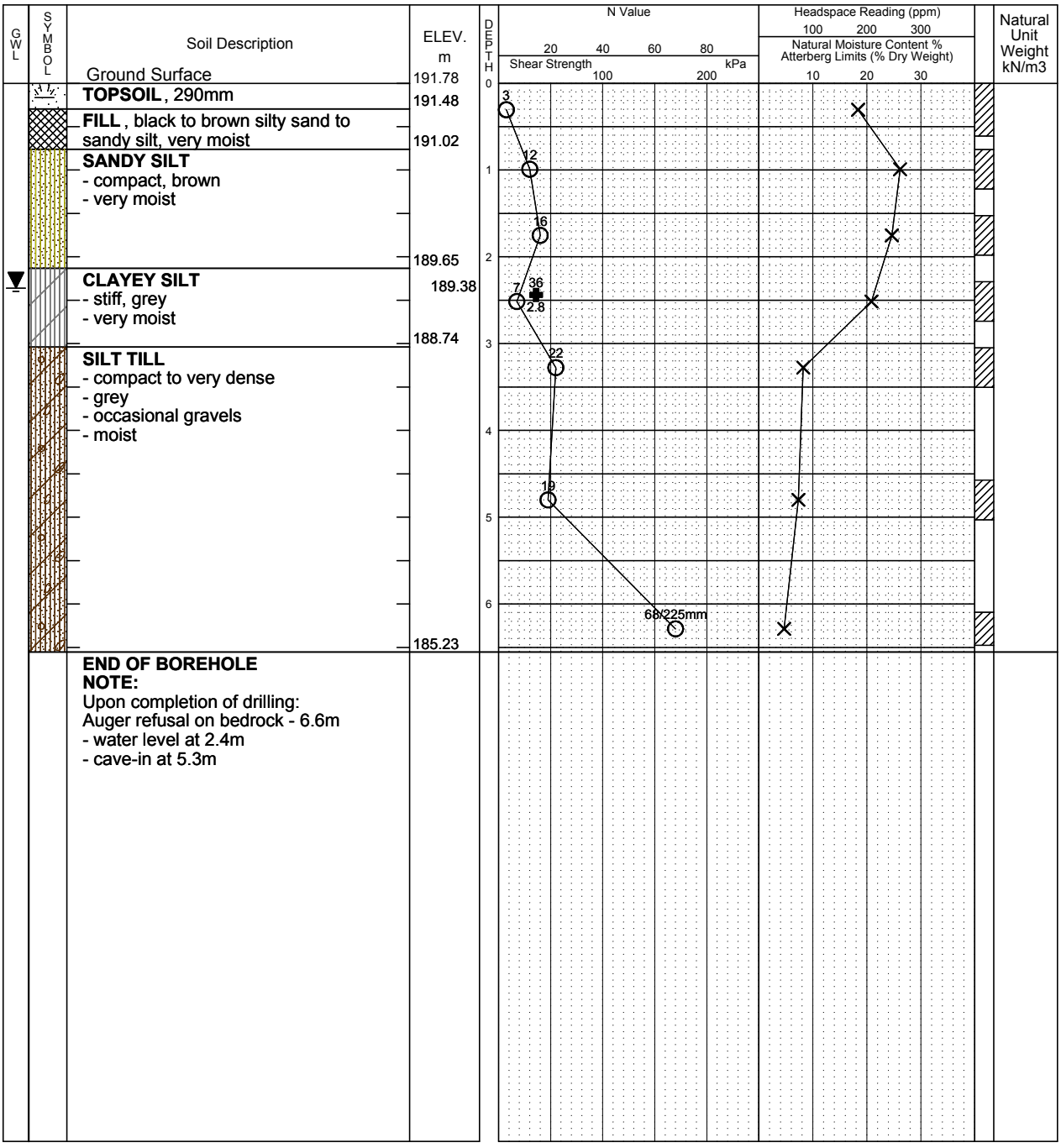
Date Drilled: 11/17/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 16

Dwg No. 17

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

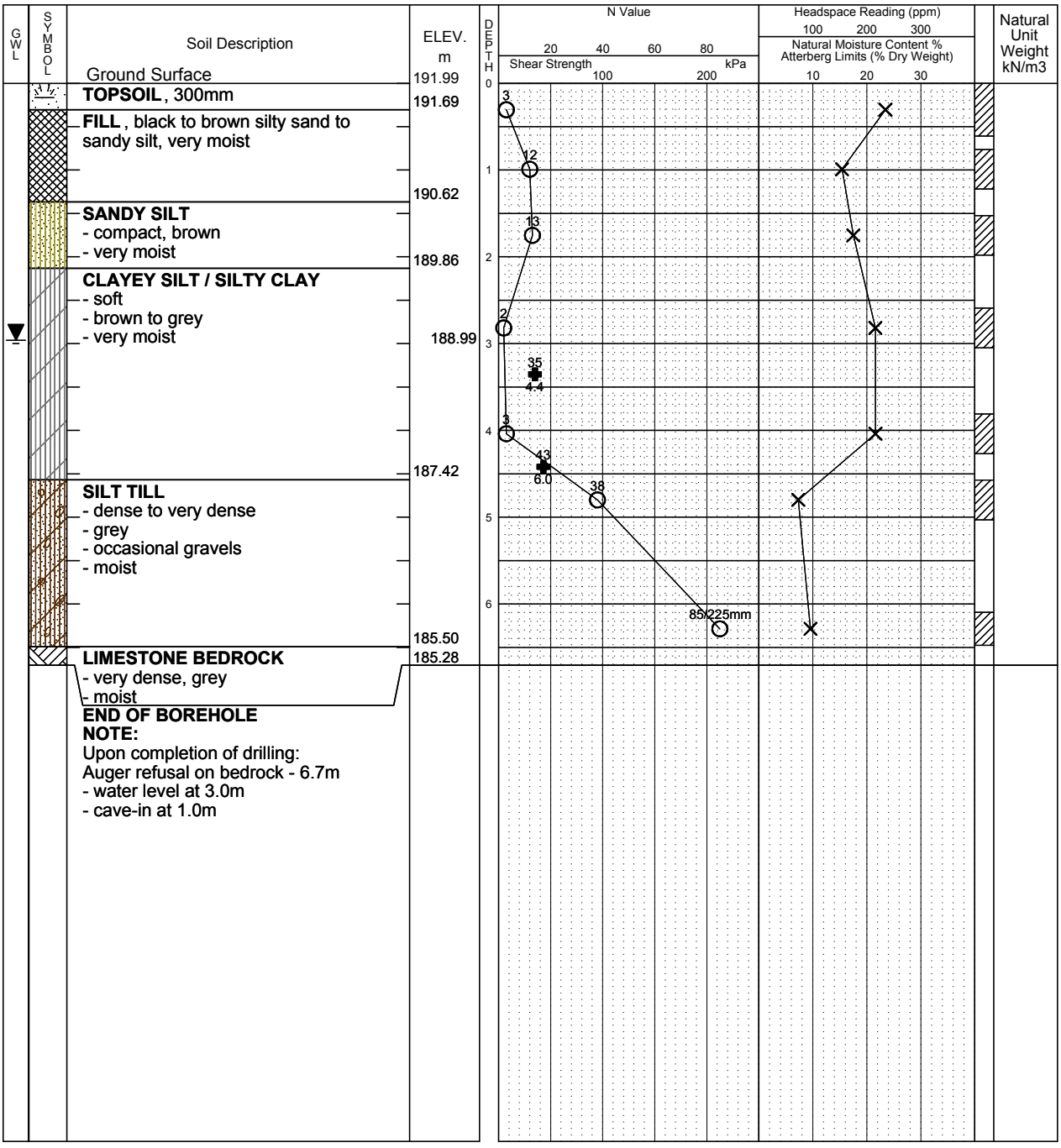
Date Drilled: 11/18/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 17

Dwg No. 18

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

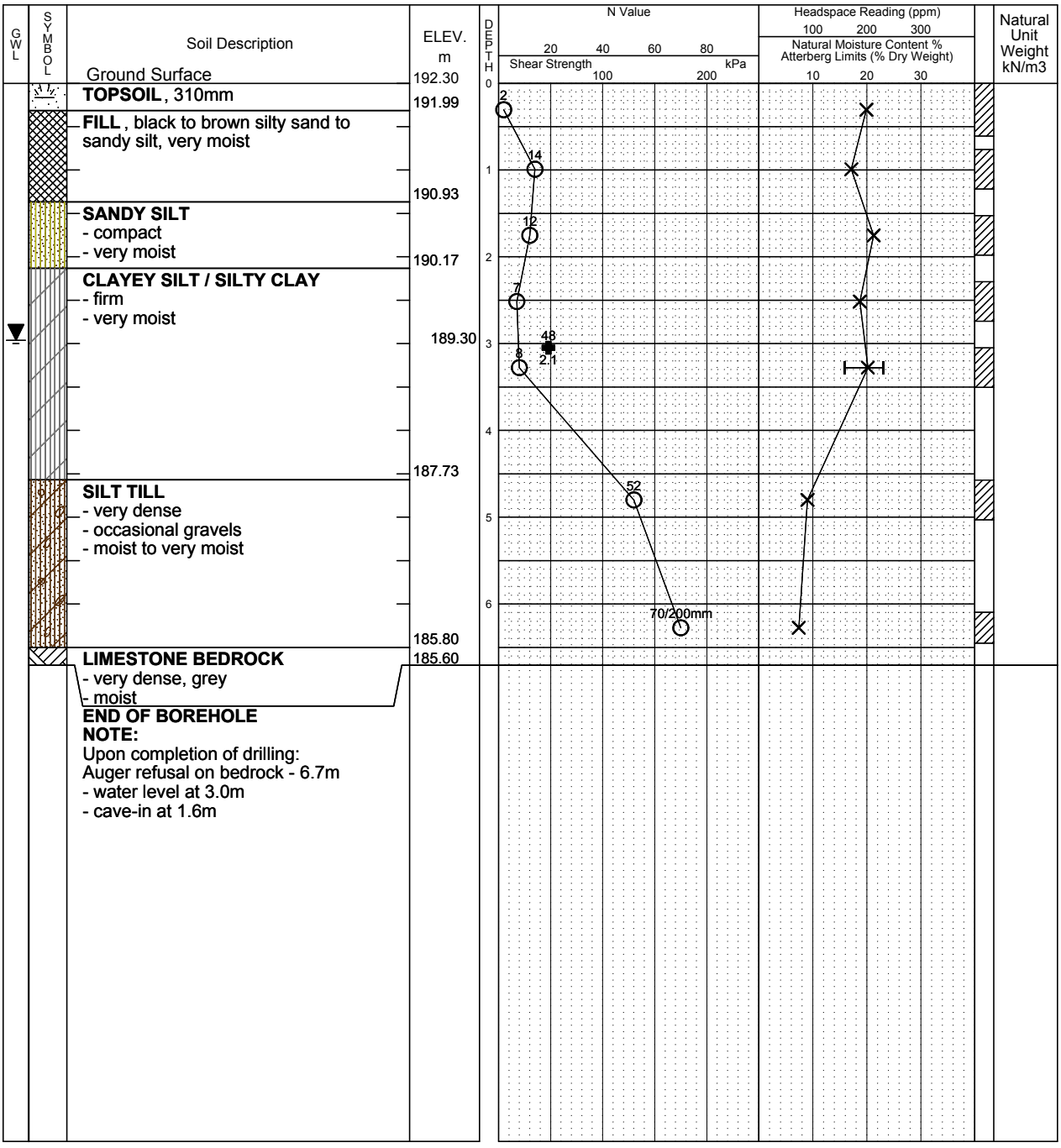
Date Drilled: 11/18/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 18

Dwg No. 19

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/19/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

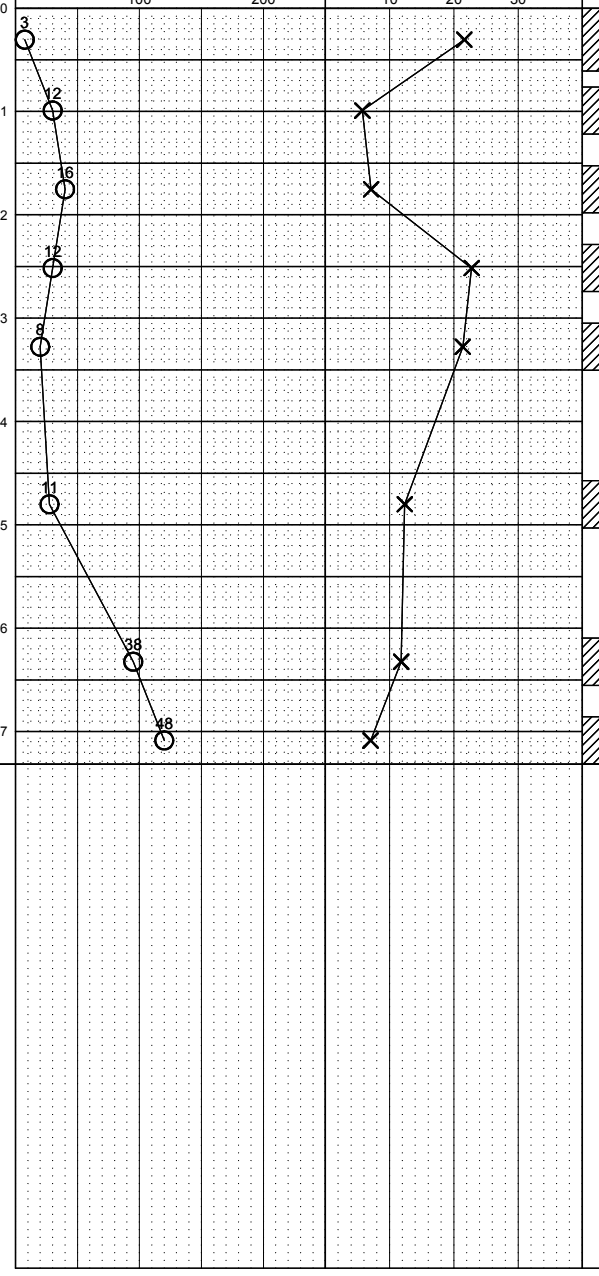
Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	190.10	0
		TOPSOIL, 285mm	189.81	
		FILL, black to brown silty sand to sandy silt, very moist	189.34	
		SILTY SAND - compact, brown - very moist	187.97	1
		CLAYEY SILT - stiff - brown to grey - moist to very moist	184.98	2
			184.00	3
		SILT TILL - dense - grey - occasional gravels - moist	182.79	4
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 4.0m		5
				6
				7

N Value: 20 40 60 80
Shear Strength: 100 200 kPa

Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Nov. 29, 2017	5.12m	

Project No. 4688-17-GC

Log of Borehole 19

Dwg No. 20

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

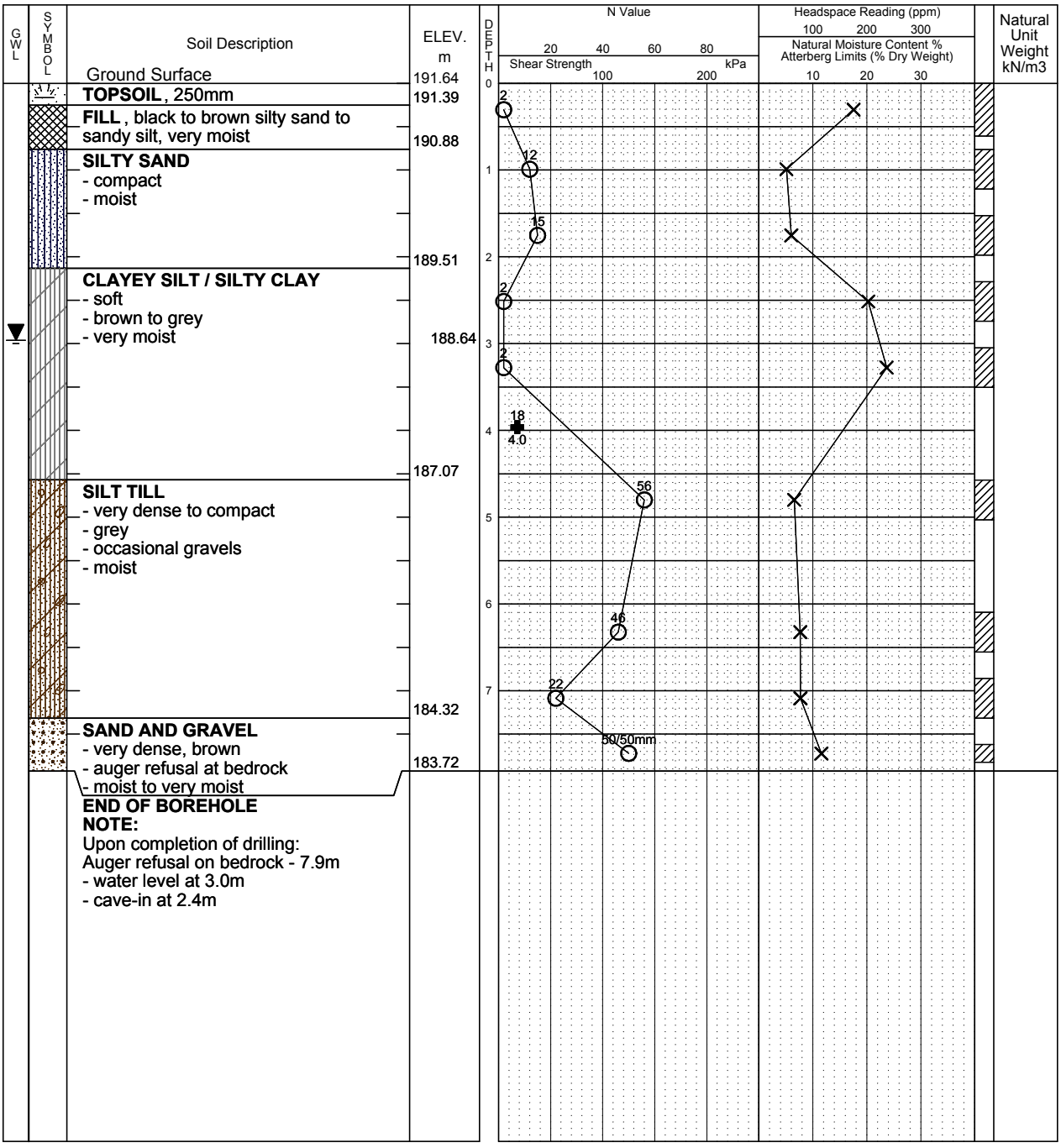
Date Drilled: 11/17/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 20

Dwg No. 21

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

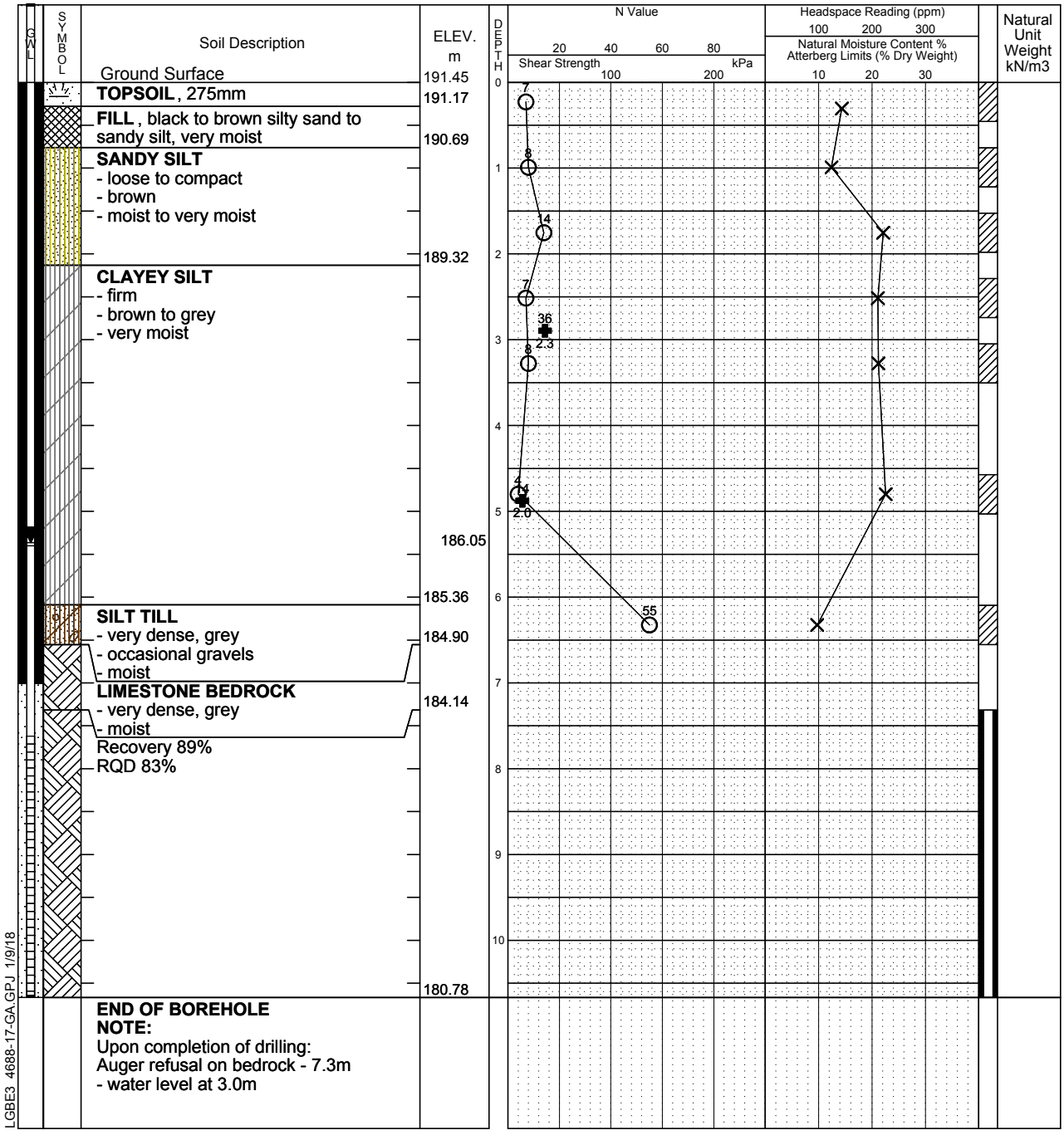
Date Drilled: 11/24/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Nov. 29, 2017	5.40m	

Project No. 4688-17-GC

Log of Borehole 21

Dwg No. 22

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

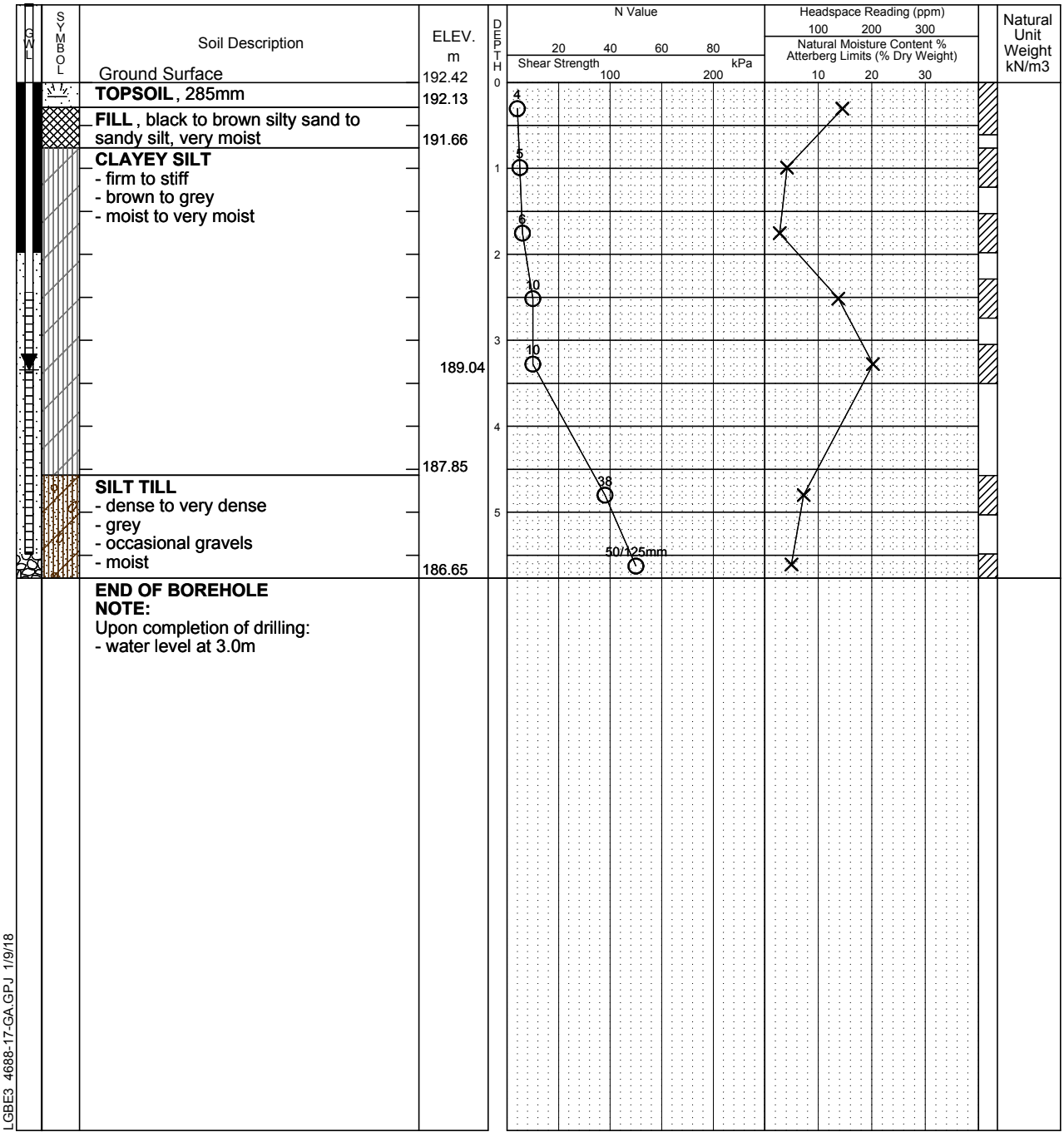
Date Drilled: 11/23/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Nov. 29, 2017	3.38m	

Project No. 4688-17-GC

Log of Borehole 22

Dwg No. 23

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/19/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test S

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	191.31	0
		TOPSOIL, 290mm	191.02	
		FILL, black to brown silty sand to sandy silt, very moist to wet	190.55	
		SANDY SILT - loose to compact - brown - very moist	189.57	1
		SILT TILL - loose to dense - grey - occasional gravels - moist	189.03	2
			186.28	3
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 2.3m		4
				5

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Natural Unit Weight kN/m3

LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Nov. 29, 2017	1.74m	

Project No. 4688-17-GC

Log of Borehole 23

Dwg No. 24

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

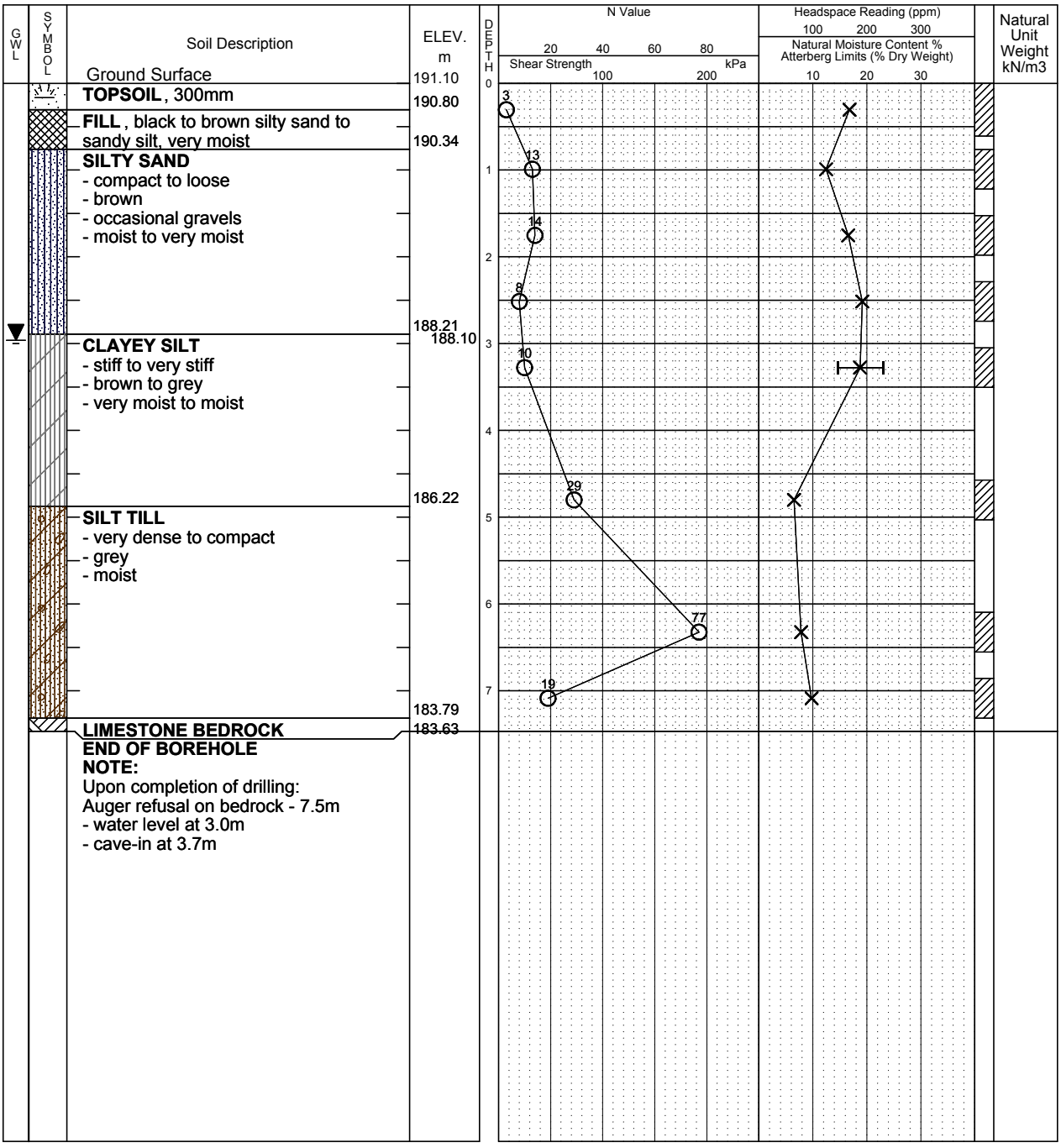
Date Drilled: 11/24/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4688-17-GC

Log of Borehole 24

Dwg No. 25

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

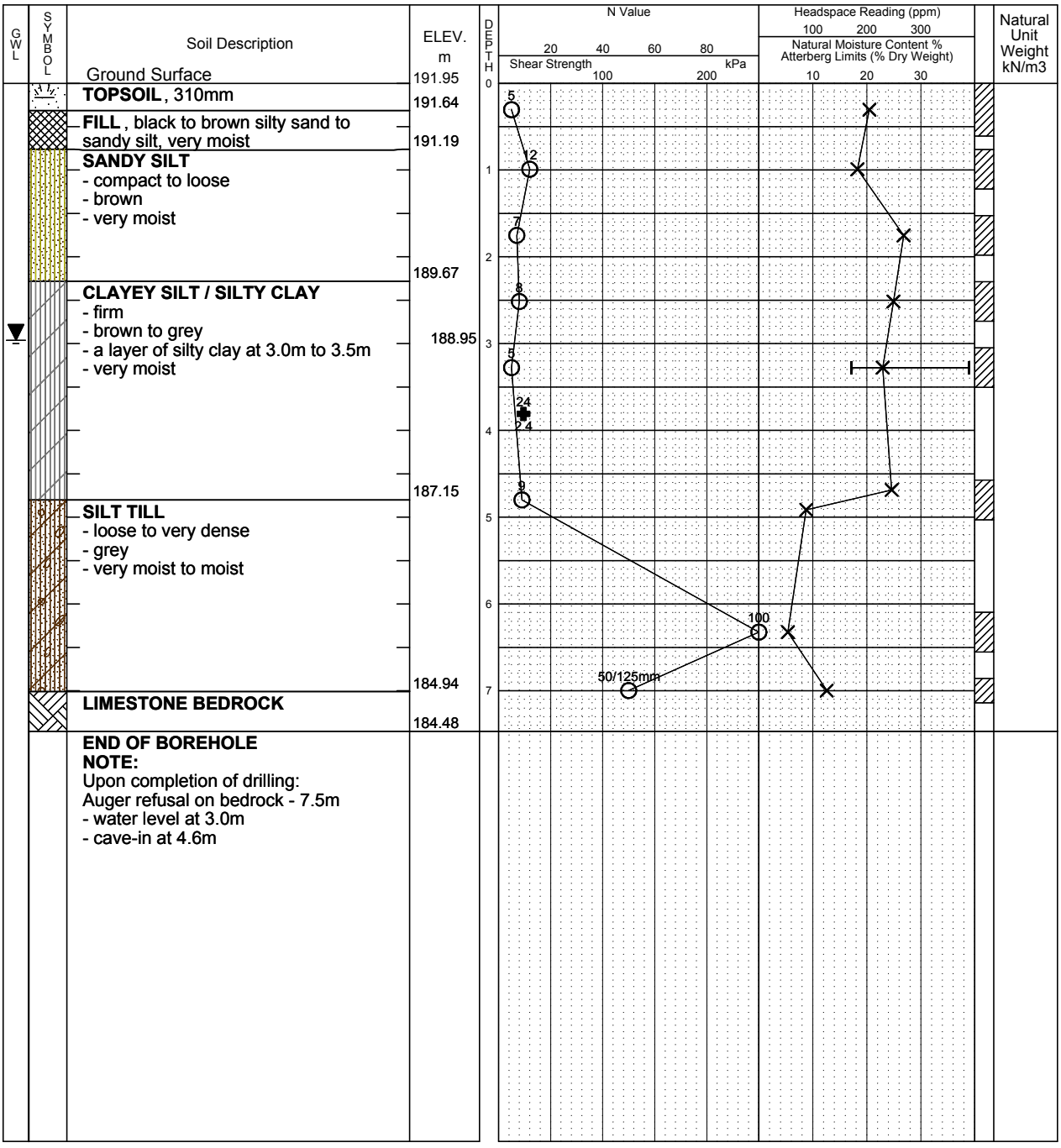
Date Drilled: 11/24/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

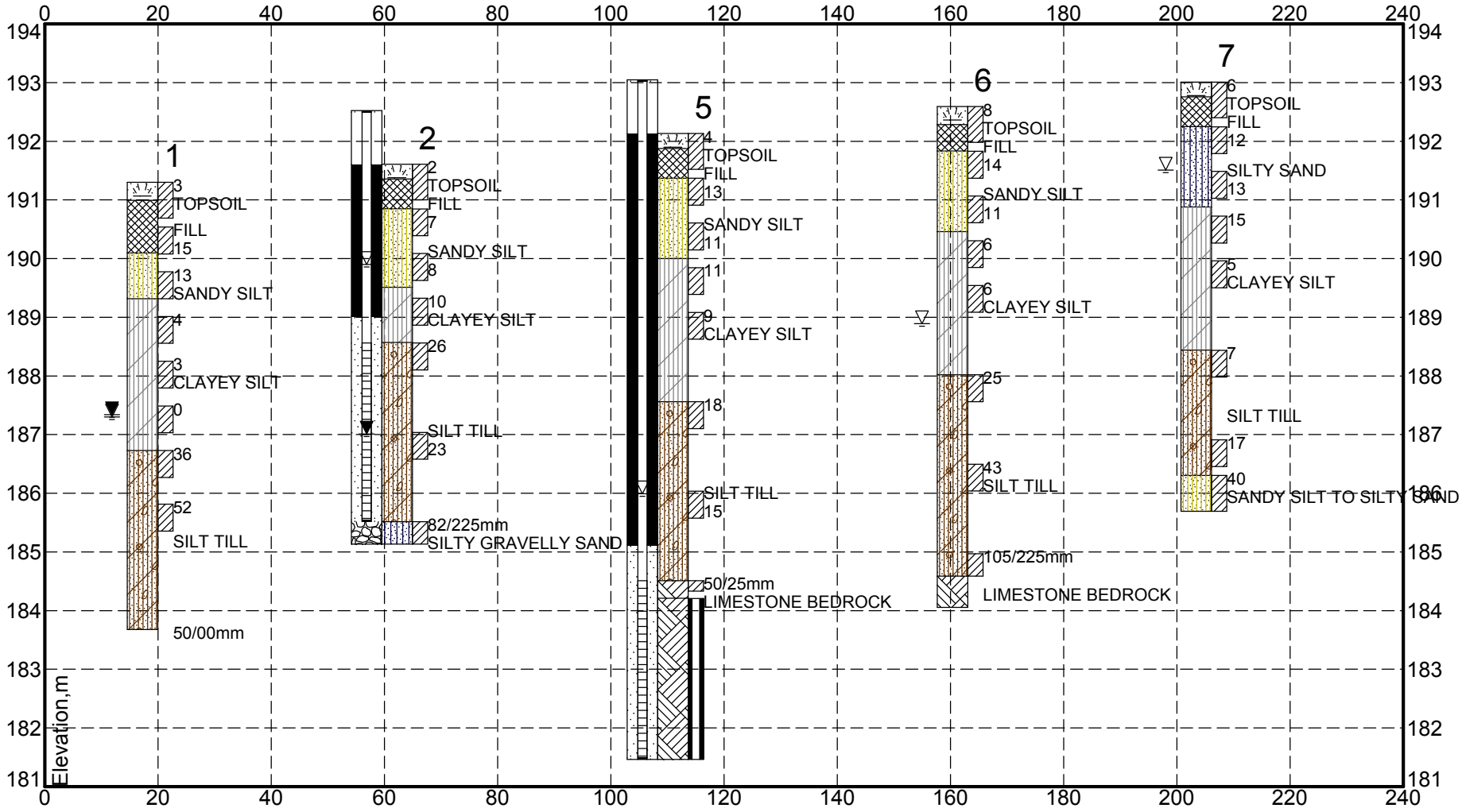


LGBE3 4688-17-GA.GPJ 1/9/18

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)



Borehole No	Elev.	Depth
1	191.3	7.6
2	191.6	6.5
5	192.1	10.7
6	192.6	8.5
7	193.0	7.3

Toronto Inspection Ltd.

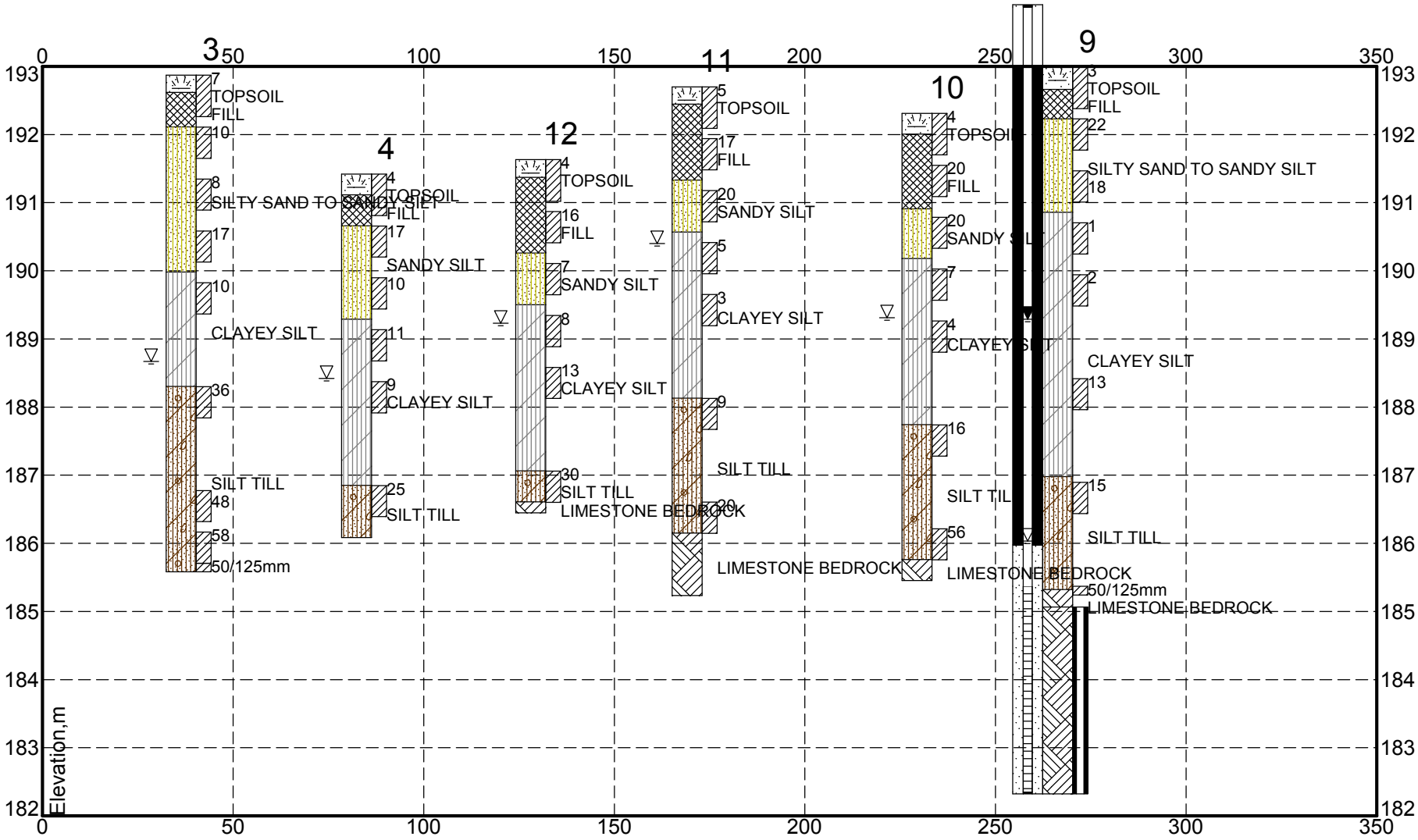
SUBSURFACE STRATIGRAPHY

Section 1

Geotechnical Investigation

452 Raglan Street, Collingwood, Ontario

PROJECT #	DATE	DRAWING
4688-17-GC	Dec 17	26



Borehole No	Elev.	Depth
3	192.9	7.3
4	191.4	5.3
9	193.0	10.7
10	192.3	6.9
11	192.7	7.5
12	191.6	5.2

Toronto Inspection Ltd.

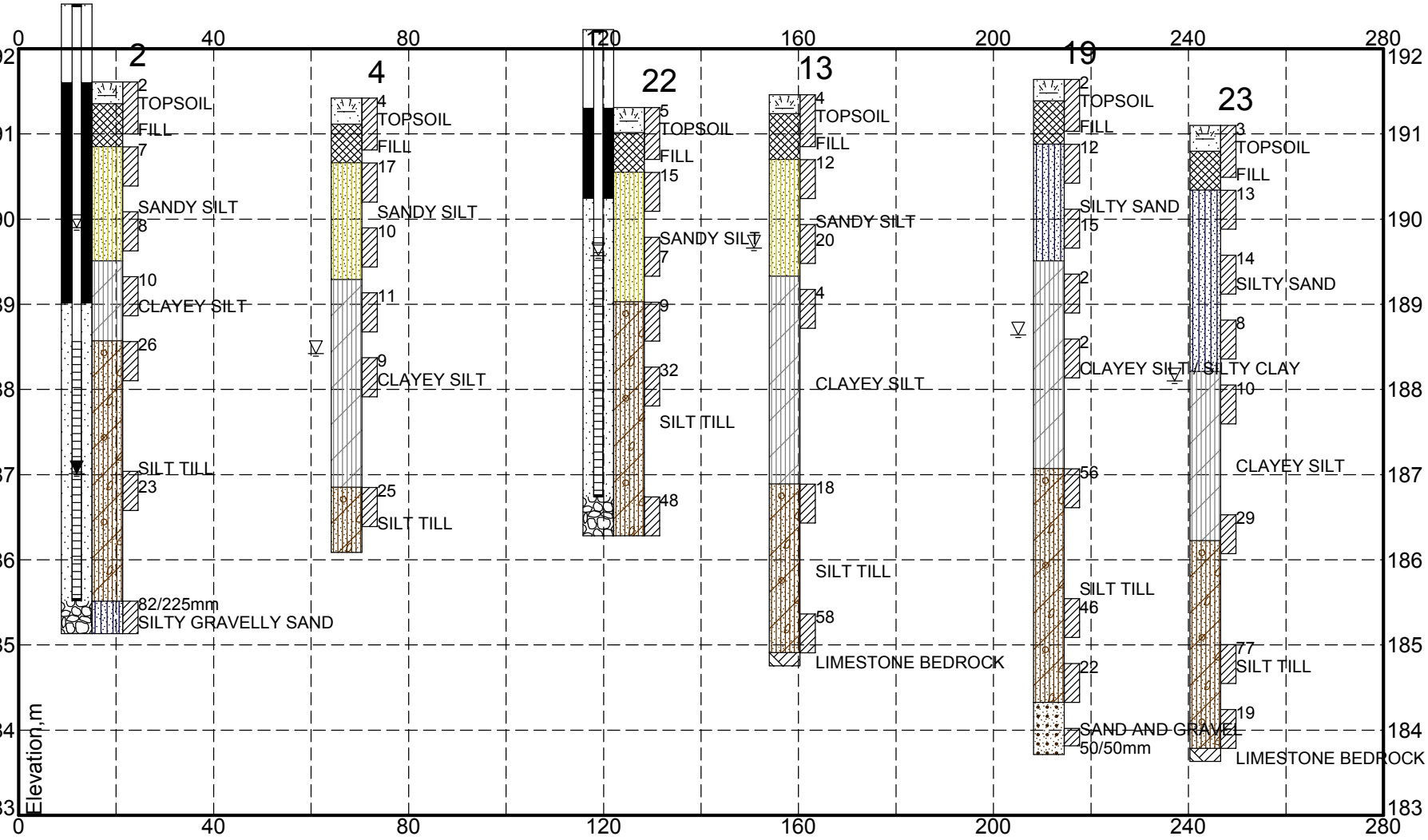
SUBSURFACE STRATIGRAPHY

Section 2

Geotechnical Investigation

452 Raglan Street, Collingwood, Ontario

PROJECT #	DATE	DRAWING
4688-17-GC	Dec 17	27



Borehole No	Elev.	Depth
2	191.6	6.5
4	191.4	5.3
13	191.5	6.7
19	191.6	7.9
22	191.3	5.0
23	191.1	7.5

Toronto Inspection Ltd.

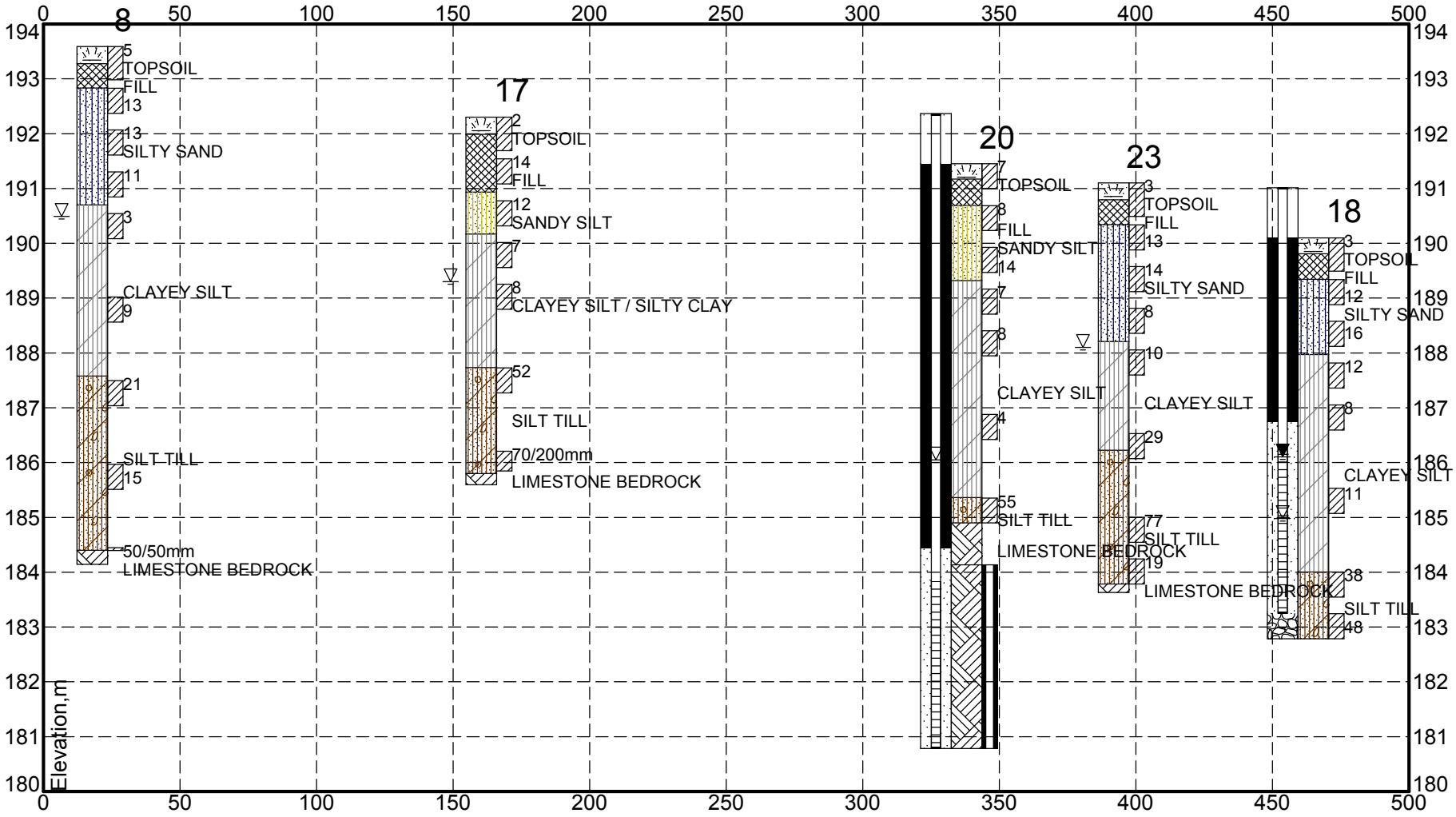
SUBSURFACE STRATIGRAPHY

Section 3

Geotechnical Investigation

452 Raglan Street, Collingwood, Ontario

PROJECT #	DATE	DRAWING
4688-17-GC	Dec 17	28



Borehole No	Elev.	Depth
8	193.6	9.4
17	192.3	6.7
18	190.1	7.3
20	191.5	10.7
23	191.1	7.5

Toronto Inspection Ltd.

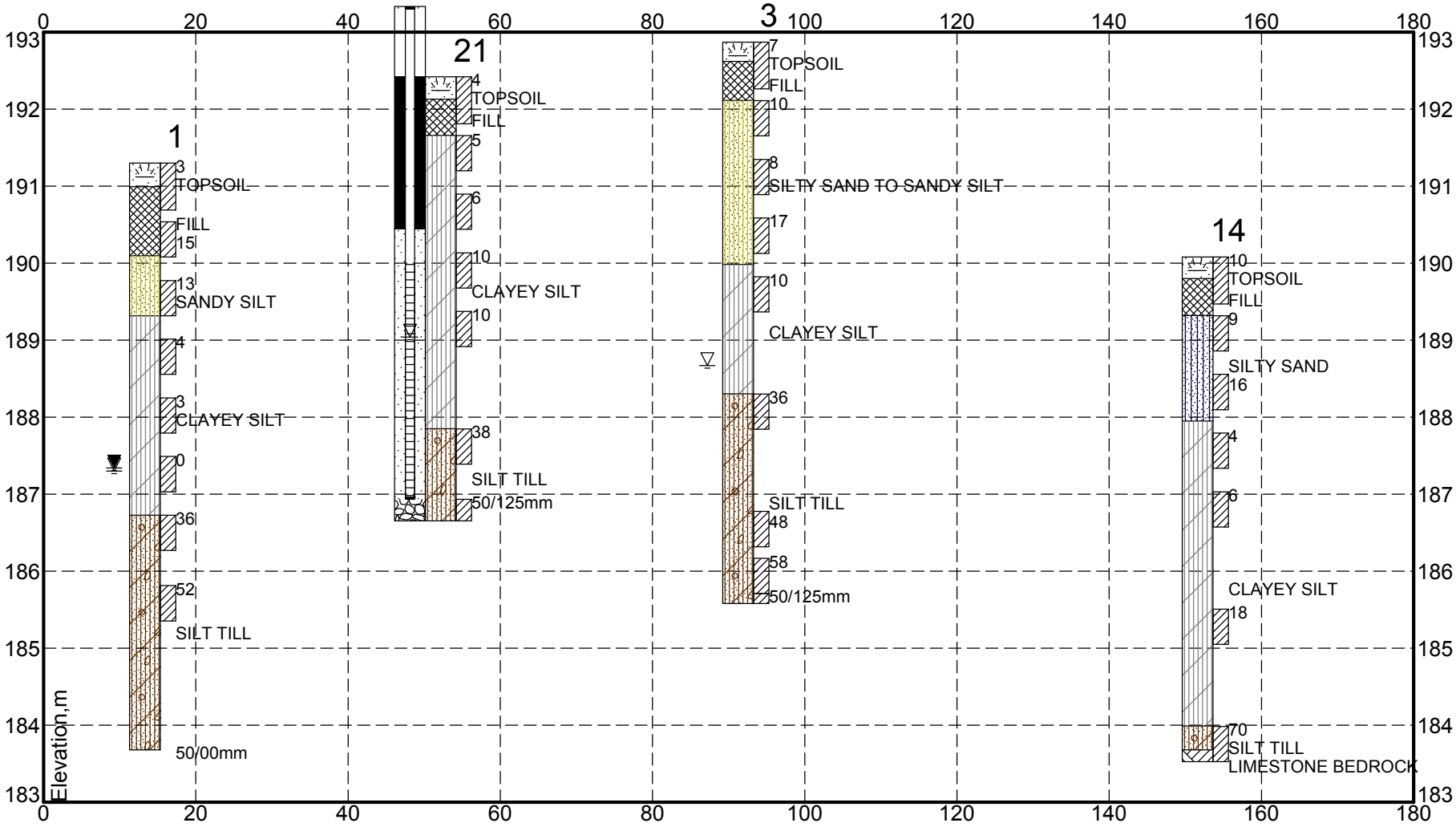
SUBSURFACE STRATIGRAPHY

Section 4

Geotechnical Investigation

452 Raglan Street, Collingwood, Ontario

PROJECT #	DATE	DRAWING
4688-17-GC	Dec 17	29



Borehole No	Elev.	Depth
1	191.3	7.6
3	192.9	7.3
14	190.1	6.6
21	192.4	5.8

Toronto Inspection Ltd.

SUBSURFACE STRATIGRAPHY

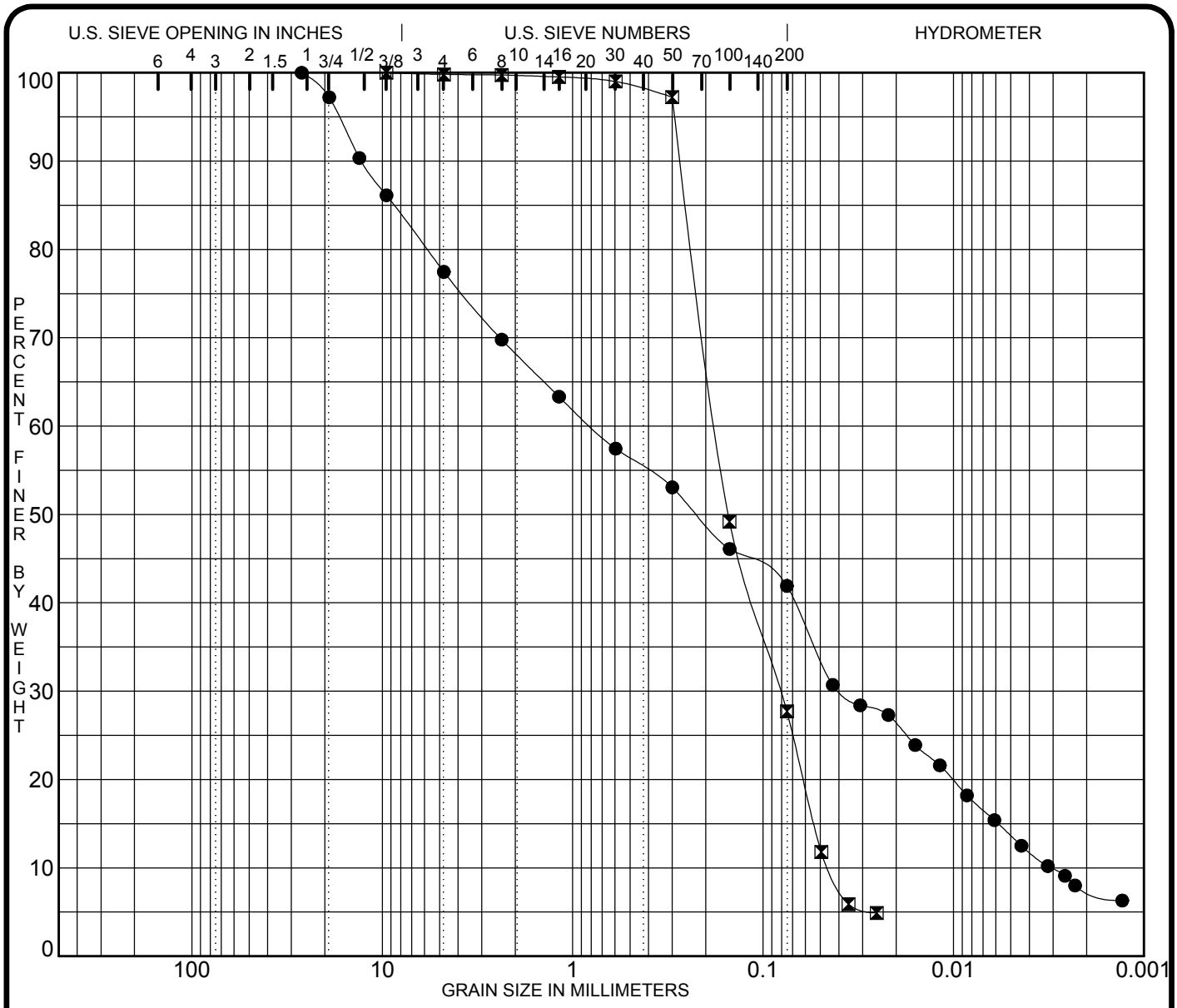
Section 5

Geotechnical Investigation

452 Raglan Street, Collingwood, Ontario

PROJECT #	DATE	DRAWING
4688-17-GC	Dec 17	30

Figures



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH-2**	**6.1**						**0.61**	**259.9**
⧓	**BH-22**	**0.8**						**0.83**	**3.9**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-2**	**6.1**	**26.50**	**0.80**	**0.039**	**0.0031**	**22.5**	**35.5**	**28.3**	**13.6**
⧓	**BH-22**	**0.8**	**9.50**	**0.18**	**0.081**	**0.0448**	**0.2**	**72.1**	**27.7**	

PROJECT **Geotechnical Investigation - 452 Raglan Street, Collingwood, Ontario**

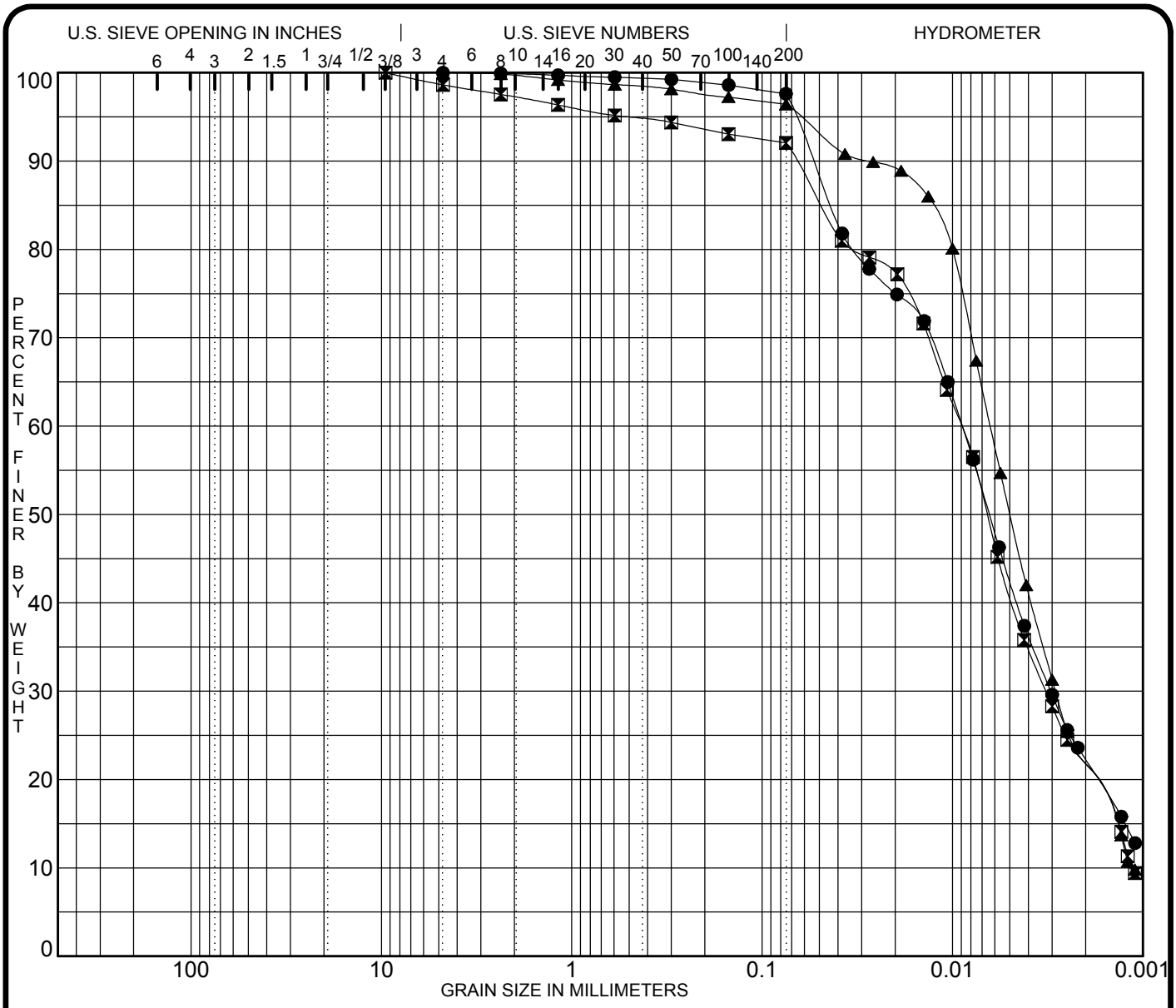
JOB NO. **4688-17-GC**

DATE **1/4/18**

GRADATION CURVES

FIGURE NO. 1

Toronto Inspection Ltd.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH-17**	**3.0**	**SILTY CLAY CL-ML**		**23**	**16**	**7**		
⧓	**BH-23**	**3.0**	**LEAN CLAY CL**		**23**	**15**	**8**	**1.03**	**8.0**
▲	**BH-24**	**3.0**	**LEAN CLAY CL**		**39**	**17**	**22**	**1.17**	**5.6**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-17**	**3.0**	**4.75**	**0.01**	**0.003**		**0.0**	**2.4**	**55.1**	**42.5**
⧓	**BH-23**	**3.0**	**9.50**	**0.01**	**0.003**	**0.0011**	**1.4**	**6.6**	**51.2**	**40.9**
▲	**BH-24**	**3.0**	**4.75**	**0.01**	**0.003**	**0.0011**	**0.0**	**3.6**	**46.3**	**50.1**

PROJECT **Geotechnical Investigation - 452 Raglan Street, Collingwood, Ontario**

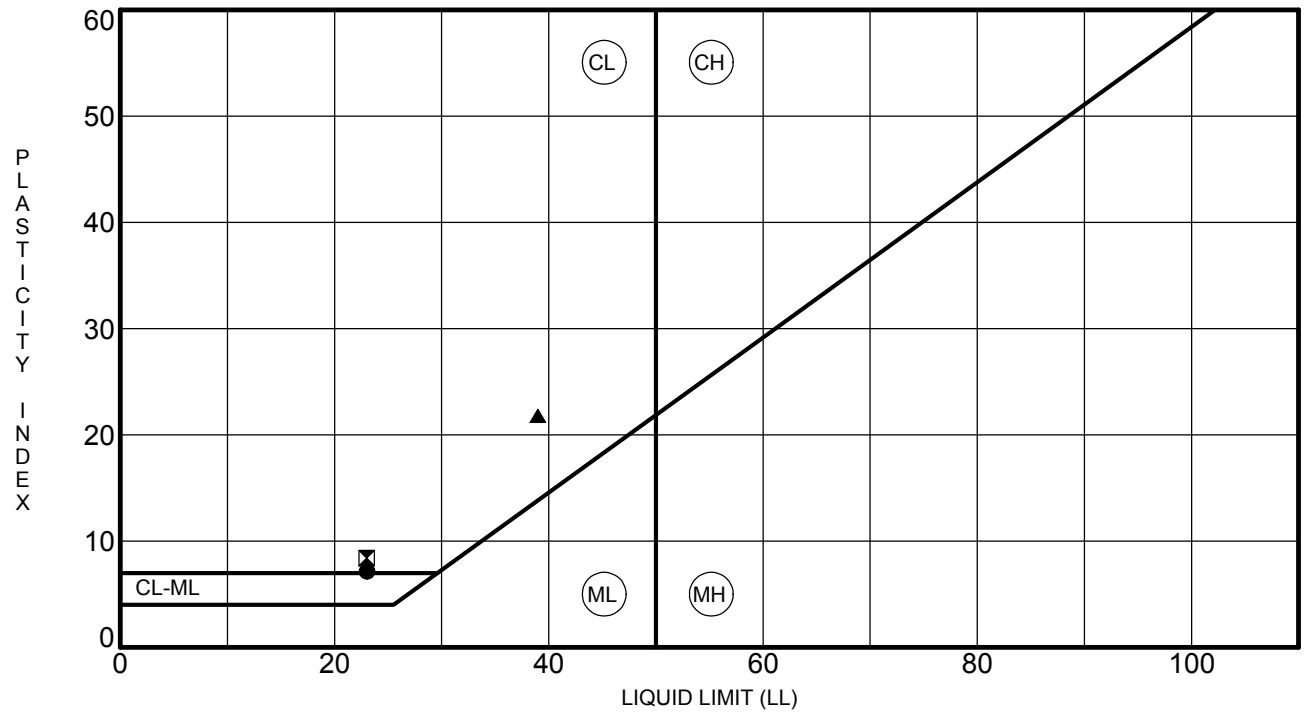
JOB NO. **4688-17-GC**

DATE **1/4/18**

GRADATION CURVES

Toronto Inspection Ltd.

FIGURE NO. 1A



Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH-17**	**3.0**	**23**	**16**	**7**	**97.6**	**SILTY CLAY CL-ML**
⊠	**BH-23**	**3.0**	**23**	**15**	**8**	**92.0**	**LEAN CLAY CL**
▲	**BH-24**	**3.0**	**39**	**17**	**22**	**96.4**	**LEAN CLAY CL**

PROJECT **Geotechnical Investigation - 452 Raglan Street, Collingwood, Ontario**

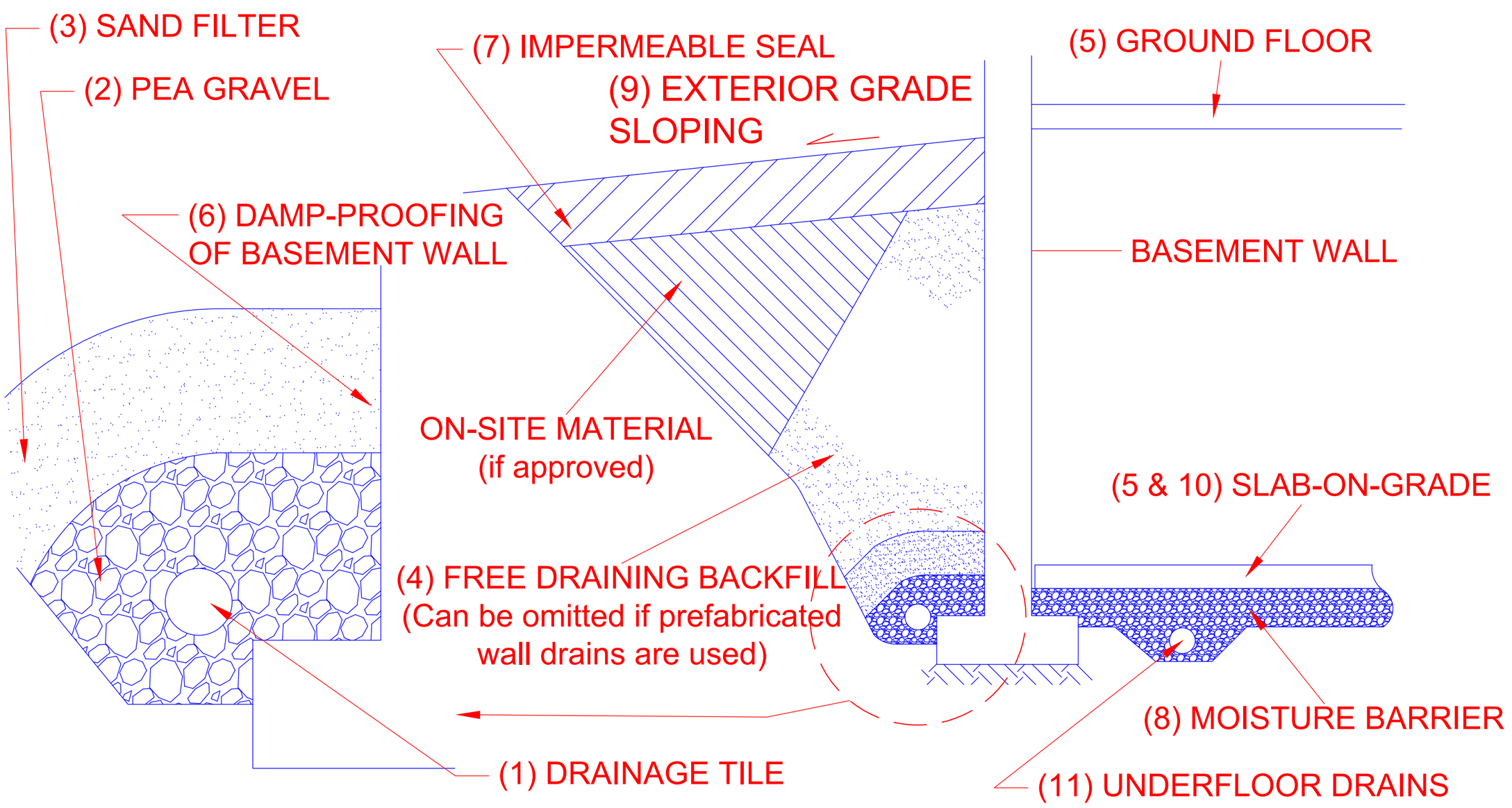
JOB NO. **4688-17-GC**

DATE **1/3/18**

ATTERBERG LIMITS' RESULTS

Toronto Inspection Ltd.

FIGURE NO. 2



Notes:

1. **Drainage tile**: consist of 100mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. invert to be at minimum of 150mm (6") below underside of basement floor level.
2. **Pea gravel**: at 150mm (6") on the top and sides of drain. If drain is not placed on footing, provide 100mm (4") of pea gravel below drain. The pea gravel may be replaced by 20mm clear stone provided that the drain is covered by a porous geotextile membrane of Terrafix 270 R or equivalent.
3. **Filter material**: consists of C.S.A. fine concrete aggregate. A minimum of 300mm (12") on the top and sides of gravel. This may be replaced by an approved porous geotextile membrane of Terrafix 270R or equivalent.
4. **Free-draining backfill**: OPSS Granular B or equivalent, compacted to 93 to 95% (maximum) Standard Proctor Density. Do not ocmpact closer than 1.8m (6ft.) from wall with heavy equipment. This may be replaced by on site material if prefabicated wall drains (Miradrain) extending from the finished grade to the bottom of the basement wall are used.
5. **Do not backfill** until the wall is supported by the basement floor slab and ground floor framing, or adequate bracing.
6. **Damp-proofing** of the basement wall is requred before backfilling.
7. **Impermeable backfill seal** of compacted clay, clayey silt or equivalent. If the original soil in the vicinity is a free draining sand, the seal may be omitted.
8. **Moisture barrier**: consists of 20mm clear stone or compacted OPSS Granular A, or equivalent. The thickness of this layer to be 150mm (6") minimum.
9. **Exterior Grade**: slope away from basement wall on all the sides of the building.
10. **Slab-on-grade** should not be structurally connected to walls or foundations.
11. **Underfloor drains *** should be placed in parallel rows at 6-8m (20-25 ft.) centre, on 100mm (4") of pea gravel with 150mm (6") of pea gravel on top and sides. The invert should be at least 300mm (12") below the underside of the floor slab. The drains should be connected to positive sumps or outlets. Do not connect the underfloor drains to the perimeter drains.

* Underfloor drains can be deleted where not required.

NOT TO SCALE

TIL Toronto Inspection LTD. GEO-ENVIRONMENTAL CONSULTANTS
110 Konrad Cresent, Unit 16, Markham, Ontario L3R 9X2
Tel: 905-940 8509 Fax: 905-940 8192

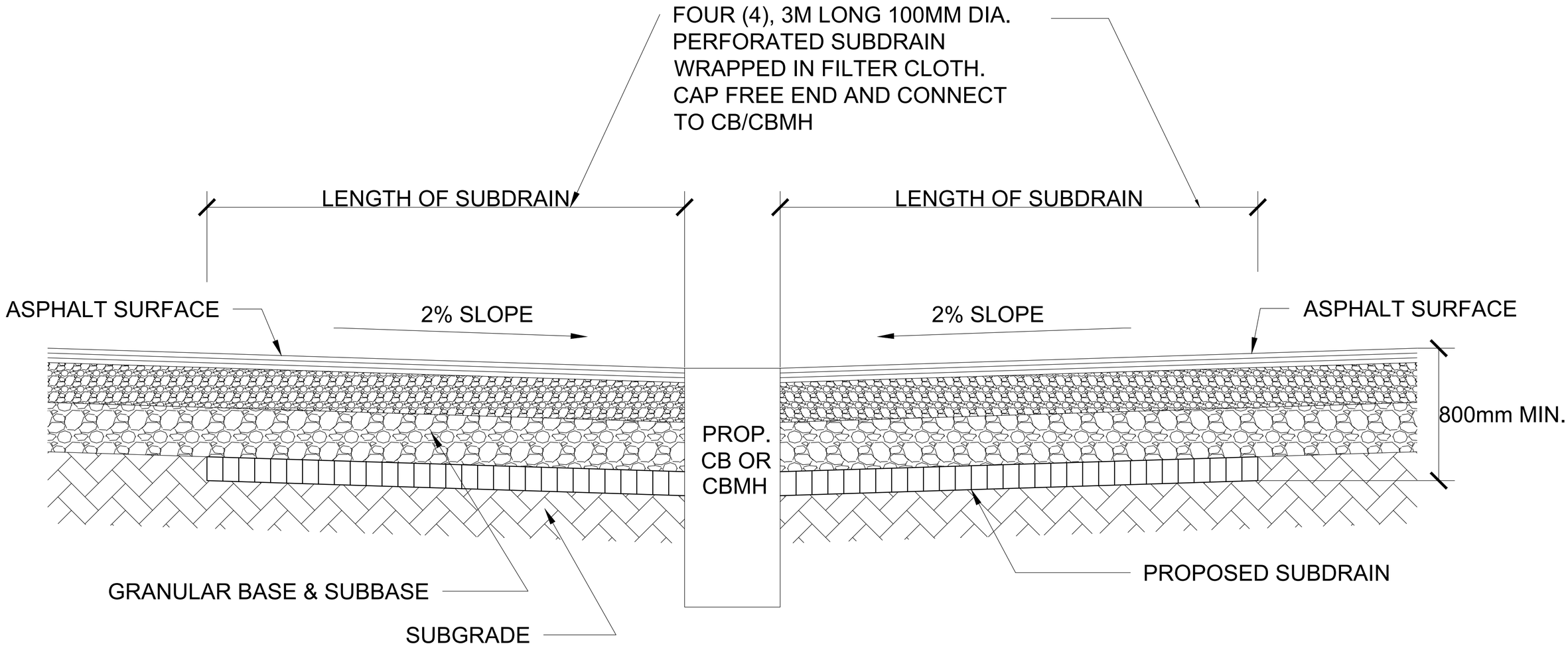
TITLE: Details of Perimeter Subdrain and Basement Backfill

LOCATION: 7647 Kennedy Road, Markham, Ontario

PROJECT NO. 4689-17-GC

DATE: December, 2017

FIGURE NO. 3



NOT TO SCALE

TorontoInspection LTD. GEO-ENVIRONMENTAL CONSULTANTS	TITLE: Detail For Subdrain At CB's	PROJECT NO: 4688-17-GC
110 Konrad Cresent, Unit 16, Markham, On L3R 9X2 Tel: 905-940 8509 Fax: 905-940 8192	LOCATION: 452 Raglan Street, Collingwood, Ontario DATE: December, 2017	FIGURE NO: 4