



## Proposed Three-Storey Hotel

*2706499 Ontario Limited*

Attention: Mr. Charanjit Aneja

**Type of Document:**

Geotechnical Investigation

**Project Location:**

150 & 160 King Street East, Thornbury, Ontario

**Project Number:**

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## 1. Introduction

EXP Services Inc. (EXP) is pleased to present the findings of the geotechnical investigation conducted for the proposed three-storey hotel and three-storey commercial and apartment buildings at 150 & 160 King Street East in Thornbury, Ontario. The work was authorized by Mr. Charanjit Aneja of 2706499 Ontario Limited.

Sections 1 to 4 of this report will pertain to the entirety of the investigation at the site (150 and 160 King Street East), while Section 5 will pertain specifically to the focus of this report, the three-storey hotel at 160 King Street East. The three-storey apartment buildings at 150 King Street East will be reported under separate cover.

The project involves the development of a currently vacant site. Previously, the site plan included the development of 150 King Street East with a three-storey hotel in the southwest and a commercial building in the southeast, while the adjacent lot at 160 King Street East was to be developed as attainable housing. EXP provided a geotechnical report for the proposed site layout on April 13, 2020.

It is understood the design has since progressed and the new site plan includes the development of 150 King Street East with two (2) three-storey commercial & apartment buildings, while the three-storey hotel will be shifted to 160 King Street East. The new site configuration resulted in additional boreholes being required. No details regarding the proposed grading of the are available.

The purpose of this supplementary geotechnical investigation was to bridge gaps in site coverage with additional boreholes advanced based on the new site layout, so as to better define the subsurface soil and groundwater conditions at the site and based on this information, to provide geotechnical recommendations pertaining to the design and construction of the proposed development.

The comments and recommendations given in this report are based on the assumption the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these changes. The result of this review may be a modification of our recommendations or the requirement of additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint. Geo-environmental assessment of the site soils and groundwater was not a part of the terms of reference and no work has been carried out in this regard.

## 2. Site Description

The site is located along the north side of King Street East (Highway 26), between Eighth Street North to the west, and Grey Street North to the east, in Thornbury, Ontario. The Georgian Trail lies to the immediate north.

The site is currently undeveloped with light vegetation adjacent to the north property edge and some larger trees at the middle of the site.

The overall topography of the site is relatively flat, with about 2 m of relief observed across the property, being lowest at the west and east ends and highest in the middle of the site.

### 3. Fieldwork

The initial fieldwork was carried out on March 24, 2020, and consisted of Boreholes 1 to 8 advanced across the site for the proposed development to depths of 1.5 to 6.5 m.

The current fieldwork for this supplemental geotechnical investigation was carried out on April 11, 2022, and consisted of Boreholes 101 to 104, advanced to 7.9 to 8.1 m depth within the footprints of the newly proposed apartment and hotel buildings.

Current and previous boreholes were advanced at the approximate locations as shown on the attached Borehole Location Plan, Drawing 1, attached. The logs of the boreholes are also attached.

Prior to the commencement of drilling operations, underground services were cleared to minimize the risk of contacting any such services during the drilling operations.

The boreholes were advanced using continuous flight solid stem auger equipment owned and operated by a specialist drilling contractor. In each borehole, soil samples were recovered using conventional split spoon equipment and the Standard Penetration Test method.

Water levels were observed in the boreholes during the course of the fieldwork. In addition, 20 mm diameter PVC piezometers were installed in Boreholes 1, 3 and 5 to establish the short-term stabilized groundwater levels at the site. The piezometers were installed in accordance with the Ontario Water Resources Act, R.R.O. 1990, Ontario Regulation (O.Reg.) 903 – Amended to O.Reg. 128/03. Boreholes without piezometers were decommissioned as per O.Reg. 903.

The fieldwork was supervised throughout by a representative of EXP Services Inc. (EXP) geotechnical staff, who directed the drilling and sampling operations, prepared borehole logs, made groundwater observations during and upon completion of drilling, and processed the recovered samples. In the laboratory, the samples were classified as to their olfactory, visual and textural characteristics. Natural moisture content tests were carried out on all recovered samples, with results presented on the Log of Borehole sheets. In addition, grain size analyses were carried out on two samples of representative soil units.

Borehole locations and ground surface elevations were surveyed in the field by EXP. The ground surface elevation at each location was referenced to geodetic elevations.

## 4. Subsurface Conditions

### 4.1 Soil

The detailed soil profile encountered in each borehole and the results of laboratory moisture contents are indicated on the attached borehole logs. It should be noted the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The “Notes on Sample Descriptions” (Figure 1) preceding the borehole logs (Figures 2 to 13) form an integral part of, and should be read in conjunction with, this report.

The soil stratigraphy, as revealed in the boreholes, generally comprised surficial topsoil or fill, over native deposits of sandy silt, sand or silt, and a major till layer. A brief description of the stratigraphy in order of depth follows.

#### **Topsoil**

Surficial topsoil was encountered in Boreholes 1, 2, 4, 101, 103 and 104. The topsoil thickness was about 50 to 300 mm in thickness and comprised dark brown silty sand/sandy silt.

*It should be noted that topsoil measurements were carried out at the borehole location only. A much more detailed analysis (i.e. test pits) is required to accurately quantify the amount of topsoil to be removed for construction purposes. Consequently, topsoil quantities should not be established from the information provided at the borehole locations.*

#### **Fill**

Fill was encountered at the surface or below the topsoil in Boreholes 3 to 6, 8, or 102 to 104 extending to 0.6 to 1.8 m depth (elevation 185.6 to 187.2). The fill graded from sand and gravel to sand, some silt to silty. Moisture contents ranged from 6 to 17% (typically moist, locally wet).

#### **Sandy Silt**

A sandy silt layer was encountered below the topsoil in Boreholes 1 and 2, fill in Boreholes 6 and 8, and at the surface of Borehole 7. A sample of the material was submitted for gradation and the results are presented on Figure 14, appended. Accompanying Atterberg limits testing showed the material was slightly plastic. The sandy silt contained trace clay and gravel. The material extended to 0.7 m depth in Boreholes 1 and 2 and to the 1.5 m depth of drilling in Boreholes 6 to 8. The stratum existed in a loose state of compactness (N-Values of 6 to 8). Moisture contents ranged from 7 to 17%, with the material being typically moist, locally wet.

## **Silt**

A discontinuous silt deposit was encountered below the fill in Boreholes 4 and 103 extending to 1.5 to 1.6 m depth (elevation 185.1 to 186.0) and intercepting the till layer in Borehole 5 between 1.4 and 2.1 m depth (elevation 184.2 to 184.9). The silt deposit contained trace sand and gravel. The N-Values indicate the soil was compact in Boreholes 4 and 103 (N-Values of 14 to 26) and very dense in Borehole 5 (N-Value of 58). Moisture contents were 12 to 18%, indicating a moist condition.

## **Sand**

Sand was observed beneath the topsoil or fill in Boreholes 101 and 102, extending to 1.1 to 2.1 m depth (elevation 185.7 to 186.5). The layer contains some silt and variable gravel and organic content. Cobbles and boulders were noted locally. The sand was very loose to compact (N-Values of 3 to 18) and wet with a water content of 9 to 17%.

A second sand deposit with some silt was encountered at the base of Borehole 101, noted between 7.7 m depth and the 7.9 m depth of drilling (elevation 179.1 to 178.9). The layer was very dense and wet (moisture content of 19%).

## **Sandy Silt Till**

Glacial till was encountered at the base of Boreholes 1 to 5 and 101 to 104 extending to the 4.6 to 8.1 m depth of exploration in all boreholes with the exception of Borehole 101, where it was penetrated at 7.7 m depth. The till deposit was typically comprised of sandy silt, grading to silt till with depth, and contained some gravel and trace clay. Cobbles and boulders were noted. A sample of the material was submitted for gradation and the results are presented on Figure 14, appended. Based on the N-Values, the till typically existed in a very dense state (locally compact to dense), with N-Values of 44 or greater noted in all boreholes with the exception of Borehole 104, where it was compact to dense (N-Values of 19 to 44) until 3.5 m depth (elevation 183.3). Moisture contents ranged from 3 to 17%, with the till being typically moist. Wet pervious seams, noted to consist of sand with some gravel, were also observed throughout the till unit.

## **4.2 Groundwater**

Groundwater conditions were assessed in the open boreholes during the course of the fieldwork. As well, three (3) piezometers, installed in Boreholes 1, 3 and 5, allowed for stabilized water level readings. Short-term groundwater measurements are recorded in the attached borehole logs.

In general, groundwater is anticipated to exist in a perched condition within the near surface soils and reside in more pervious soil layers perched above the less pervious soil units. Groundwater also exists within pervious seams within the till layer. Stabilized groundwater levels, measured in the piezometers about one week after installation, are shown in the below table:

**Table 1: Groundwater Levels at Borehole Locations**

Borehole No.	Groundwater Level Upon Completion Depth (m) / Elevation	Groundwater Level in Piezometers on March 31, 2020 Depth (m) / Elevation
BH 1	5.8 / 180.8	2.6 / 184.0
BH 2	No Water	--
BH 3	No Water	2.7 / 185.8
BH 4	1.5 / 185.2	--
BH 5	No Water	0.0 / 186.3
BH 6	0.3 / 186.4	--
BH 7	1.2 / 186.1	--
BH 8	No Water	--
BH 101	2.1 / 184.7	--
BH 102	No Water	--
BH 103	2.1 / 185.3	--
BH 104	1.5 / 185.3	--

The stabilized water levels indicate that the groundwater regime is anticipated to be higher at the east end of the site in the hotel development area (elevation 185.8 to 186.3), trending in a downward gradient to the west end of the site near the proposed apartment buildings (elevation 184.0). The till layer that dominates the site was typically found in a moist condition, however wet seams in the till were observed and, based on the water level readings, appear to be under some degree of pressure.

The groundwater elevations reflect the conditions at the time of the investigation/water level reading site visit only. Seasonal fluctuation of the groundwater level should be anticipated at the site.

### 4.3 Estimated Soil Permeability

An estimate of the permeability of the site soils was requested based on laboratory gradation of two (2) retrieved soil samples.

The estimated permeability,  $k$ , and T-Times for the tested samples as based on OBC 2012 Supplementary Standards SB-6, and the grain size analyses (Figure 14) are summarized in the below table:

**Table 2: Estimated Permeability of Site Soils**

Sample ID	Depth (m)	Soil Description	Estimated Permeability, $k$ (cm/sec)	T-Time (min/cm)
BH1 SS3	1.5 to 1.7	Till: Sandy Silt, Some Gravel, Trace Clay	$10^{-5}$ to $10^{-6}$	20 to 50
BH7 SS1	0.0 to 0.6	Sandy Silt, Trace Clay	$10^{-5}$ to $10^{-6}$	20 to 50

The results indicate that in general the site soils have a relatively low permeability. Wet seams within the till layer would have a higher degree of permeability.

## 5. Engineering Discussion and Recommendations

### 5.1 General

The project involves the development of 160 King Street East in Thornbury, Ontario, as a three-storey hotel. The site is currently vacant. A parking area and entranceways will surround the building. No details regarding the grading of the site were provided, however the finished floor elevation (FFE) of the slab-on-grade building is anticipated to be at about Elevation 187.0, slightly above the existing grades in the area of majority of the building. It is noted the proposed west building line lies slightly higher (elevation 187.37 at Borehole 103) however it is anticipated this layer would be removed during site grading.

Based on the results of the limited boreholes drilled at the site, it is considered the site will be suitable for the proposed building.

The following subsections provide geotechnical engineering guidelines pertinent to the design and construction of the proposed development.

## 5.2 Site Grading

Considering the site is bounded by developed lands, it is anticipated that only minor cut and fill operations will be required across the site to facilitate construction of proposed structures. The following procedures are recommended for cut and fill operations for proposed pavement areas and building areas at the site, where required:

1. All existing topsoil, fill, upper loose disturbed soils and deleterious materials should be removed to approved native, inorganic soil in all directions. The depths to remove deleterious material, based on the boreholes and site layout, are shown in the below table:

**Table 3: Anticipated Deleterious Material Removal**

Site Feature	Borehole No.	Anticipated Depth (m) / Elevation to Remove Deleterious Materials	Anticipated Soil Layers to Be Removed
Hotel	BH 4	0.7 / 186.0	Topsoil, Fill
	BH 103	0.9 / 186.5	Topsoil, Fill
	BH 104	0.7 / 186.1	Topsoil, Fill
Parking Areas / Entranceway	BH 5	0.7 / 185.6	Fill

2. The exposed subgrade surface should be compacted and proof-rolled with a heavy vibratory roller and inspected by geotechnical personnel. Any soft areas detected during the proof-rolling process should be further sub-excavated and replaced with approved on-site or imported materials, compacted to 98% standard Proctor maximum dry density (SPMDD) within the proposed pavement areas. Within the proposed building areas, the material should be compacted to 100% SPMDD.
3. Low areas can then be brought up to final subgrade level with suitable on-site material or approved imported material placed in lifts not exceeding 300 mm thick and compacted to 98% SPMDD in proposed pavement areas and 100% SPMDD in proposed building areas ("engineered fill"). The moisture content of the fill to be placed should be at or near its optimum moisture content in order to assure the specified densities can be achieved with reasonable compactive effort.
4. All imported borrow fill material from local sources should be free from organic material and foreign objects (i.e. trees, roots, debris, etc.) and should be approved by EXP prior to transport to the site. In addition, the chemical quality of the borrow fill material should

be assessed in accordance with the current applicable Ministry of Environment, Conservation and Parks (MECP) regulations and guidelines.

5. All excavation, backfilling and compaction operations should be monitored on a full-time basis by geotechnical personnel from EXP to approve materials and verify the specified degree of compaction has been obtained.

### 5.3 Building Construction

The proposed hotel structure may be supported on conventional spread and strip footings founded on the compact to very dense native silt or till material below the existing topsoil, fill and loose native soils where they may be designed for a geotechnical resistance of 200 kPa at Serviceability Limit States (S.L.S.), subject to inspection during construction. The factored geotechnical reaction at Ultimate Limit States (U.L.S.) is 300 kPa. Higher bearing resistances are available at increased depths.

The anticipated minimum depths for footings at the building locations to achieve the above noted bearing resistances is shown in the below table and should be verified during construction:

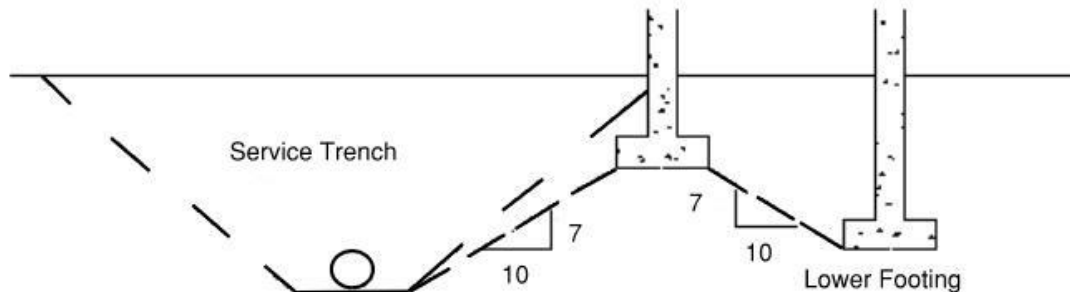
**Table 4: Highest Founding Elevations/Excavation Depths for Foundations**

Building	Borehole No.	Highest Founding Depth (m) / Elevation	Anticipated Founding Stratum
Hotel	BH 4	1.6 / 185.1	Till
	BH 103	0.9 / 186.5	Silt
	BH 104	0.7 / 186.1	Till

The excavated footing trench should be at least 100 mm wider than the footing on either side. A plate should be installed on the end of the excavator bucket to remove all loose/disturbed soils in order to produce a clean surface at the base of the excavation. The excavation operation must be monitored on a full-time basis by geotechnical personnel from EXP.

### 5.3.1 Foundations General

Footings which are to be placed at different elevations should be located such that the higher footing is set below a line drawn up at 10 horizontal to 7 vertical from the near edge of the lower footing, as indicated on the following sketch:



FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

All footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m of soil cover or equivalent insulation, depending on the final design requirements.

The on-site soils are susceptible to disturbance. It is therefore recommended that a concrete skim coat be placed over the founding surface as soon as possible after approval to protect it from disturbance from construction traffic and inclement weather.

The total and differential settlements of well designed and constructed footings placed in accordance with the above recommendations are expected to be less than 25 mm and 20 mm, respectively.

It should be noted the recommended geotechnical resistance value has been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily ongoing as new information on underground conditions becomes available. For example, it should be appreciated modification to bearing levels may be required if unforeseen subsurface conditions are encountered or if final design decisions differ from those assumed in this report. For this reason, this office should be retained to review final foundation drawings and to provide field inspections during the construction stage.

## 5.4 Site Servicing

The servicing invert levels have not yet been determined at the time of investigation, but an assumption of 3.0 m depth was provided by Capes Engineering Limited on behalf of the Client. Details for excavation and groundwater control for site servicing are provided in section 5.5.

### 5.4.1 Pipe Bedding/Cover

It is anticipated that the servicing pipes will be founded on competent native soils or on engineered fill. Provided adequate groundwater control measures are implemented, no bearing capacity problems are envisioned.

In general, the pipe bedding may consist of a minimum thickness of 150 mm of compacted OPSS Granular A material. Where wet conditions are encountered, the pipe bedding may comprise 150 mm of 19 mm clear stone, High Performance Bedding (HPB) or HL-6 stone material. However, these types of bedding must be completely wrapped in a geotextile filter fabric to prevent the migration of fines from the surrounding soils, which may result in settlement of the pipes. The chosen geotextile should be compatible with the existing soils on site.

The base of the excavations in the competent compact to very dense soils should remain stable provided excavations are not left open for extended periods of time and the work is done in accordance with good construction practice.

The Granular A type bedding material should be placed in 150 mm lifts and compacted to at least 98% SPMDD. Particular attention should be given to ensure material placed beneath the bottom quadrants of the pipe is adequately compacted. Compaction is not required for clear stone, HPB or HL-6 stone bedding.

Pipe cover material should consist of fine sand which can be more readily compacted with light equipment to avoid damaging the pipes. The cover material should be placed in 150 mm lifts, compacted to 98% SPMDD and extend to 300 mm above the top of the pipe.

## 5.5 Excavation and Groundwater Control

Grading has not yet been established at the site, however excavation for the slab-on-grade buildings is anticipated to extend as much as 1.6 m below existing grades (locally deeper for any elevator shafts or to remove loose native soils), with excavation for the site servicing anticipated as deep as 3.0 m below existing grades. Excavation will be carried through the topsoil, fill and into native soils. It should be noted boulders frequently occur in till deposits and their presence may influence the progress of excavation. Consequently, provisions should be made in the contract documents to cover any delays caused by the presence of boulders.

Subject to effective groundwater control measures as discussed below, excavation may be carried out in open cuts using conventional equipment. Side slopes of temporary excavation must conform to the Occupational Health and Safety Act (OHSA) and local regulations. Site soils can be classified as Type 3 soils requiring excavation of side slopes to be completed at 1 horizontal to 1 vertical (1H:1V) from the base of the excavation. Where loose soil is encountered or within zones of persistent seepage, it may be necessary to locally flatten the side slopes.

Stabilized groundwater levels are anticipated to reflect pervious seams within the till layer that are under some degree of pressure and are not representative of the overall groundwater levels. No major groundwater control requirements are expected for foundation construction/site servicing, however seepage from surface runoff, water perched within fill and within pervious seams and layers within the native till deposit should be anticipated during construction.

Considering the relatively low permeability of the site soils, it should be possible to control and remove the seepage water using conventional construction dewatering techniques (i.e. pumping from sumps) for the foundation excavations. Deeper servicing areas may require a higher degree of groundwater control. In general, the groundwater table should be lowered at least 0.5 m below the deepest excavation, prior to excavation.

A test dig is recommended to allow prospective contractors an opportunity to evaluate the conditions likely to be encountered during construction, such that they can assess excavation and groundwater control requirements based on their own experiences.

## **5.6 Backfill Considerations**

Backfill used to satisfy underfloor slab requirements, in footing and service trenches, etc., should be compactible fill, i.e., inorganic soil with its moisture content close to its optimum value determined in the standard Proctor maximum dry density test. The excavated materials will consist of topsoil, fill, and native sandy silt, sand, and sandy silt till. Topsoil and fill containing organics and otherwise deleterious materials are not suitable for backfilling purposes. The native soils are considered suitable for reuse as backfill, however, some moisture conditioning may be required for proper compaction.

Any organic or excessively wet or deleterious material should not be used for backfilling purposes. Any shortfall of suitable on-site excavated material can be made up with imported granular material, OPSS Granular B or equivalent. The backfill should be placed in lifts not more than 300 mm thick in the loose state with each lift being compacted to 100% standard Proctor maximum dry density (SPMDD) within the building footprint and 98% elsewhere before subsequent lifts are placed. The degree of compaction achieved in the field should be checked by in-place density tests.

The overburden soils are not free draining and, therefore, should not be used where this characteristic is required or in confined areas where smaller compaction equipment is required. Imported granular material conforming to OPSS Granular 'B' would be suitable for these purposes.

## **5.7 Floor Slab Construction and Permanent Drainage**

The floor slab of the proposed structure may be constructed as a slab-on-grade construction at the site. Prior to slab-on-grade construction, all existing topsoil, fill, and disturbed/reworked native soils within the floor slab areas must be removed. Following rough grading, the exposed subgrade surface should be proofrolled and inspected by a geotechnical technician. Any soft areas identified during the proof-rolling operation should be sub-excavated and replaced with approved material compacted in the manner described in the "Backfill Considerations" subsection of the report.

A moisture barrier, consisting of a 200 mm thick layer of 19 mm clear crushed stone should be placed directly under the floor slab. Within unheated areas (if any), Styrofoam insulation of minimum 50 mm thick should be provided below the floor slab to protect against frost heave.

If the interior floor slab is placed 150 mm or higher above the exterior grade, perimeter drains are not required. Around the perimeter of the building, the ground surface should be sloped on a positive grade away from the structure to promote surface water run-off and to reduce groundwater infiltration adjacent to the foundations.

Since the elevator pit will be the lowest point within the buildings, pit walls should be designed to withstand hydrostatic pressure and waterproofed.

## **5.8 Earthquake Consideration**

The recommendations for the geotechnical aspects to determine the earthquake loading are presented below.

### **5.8.1 Subsoil Conditions**

The subsoil information at this site has been examined in relation to Section 4.1.8.4 of OBC 2012.

The subsoil consisted of native sandy silt, sand, and sandy silt till. The proposed structures will be supported on conventional footings founded on the native sandy silt till.

There have been no shear wave velocity measurements carried out at this site. Therefore, N-Values will be used to determine the site classification.

### 5.8.2 Depth of Boreholes

Table 4.1.8.4.A Site Classification for Seismic Site Response in OBC 2012 indicated that to determine the site classification, the average properties in the top 30 m are to be used. The building boreholes were advanced to depths of 4.7 to 8.1 m below existing grade.

### 5.8.3 Site Classification

Based on the known soil conditions, the Site Class for this site should be "C" as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012.

## 5.9 Parking Area and Driveway

The recommended pavement structure provided in the below table is based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples. A functional design life of ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

**Table 5: Recommended Pavement Structure Thicknesses**

Pavement Layer	Compaction Requirements	Light-Duty Asphalt	Heavy-Duty Asphalt
Asphaltic Concrete	OPSS 310	40 mm HL3 50 mm HL8	40 mm HL3 80 mm HL8
Granular A Base (OPSS 1010)	100% SPMDD*	150 mm	150 mm
Granular B Subbase (OPSS 1010)	100% SPMDD*	300 mm	400 mm

\* Denotes standard Proctor maximum dry density, MTO LS-706

The foregoing design assumes construction is carried out during dry periods and the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather and heaving or rolling of the subgrade is experienced, additional thickness of subbase course material may be required.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved.

In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped to provide

effective surface drainage. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas.

Additional comments on the construction of the parking area and driveway are as follows:

1. The proposed parking area and driveway should be stripped of vegetation, topsoil/organics, fill and weak native subgrade material.
2. The exposed subgrade should be proof-rolled in the presence of a representative of this office. Soft or spongy subgrade areas should be further sub-excavated and replaced with suitable approved backfill compacted to 98% SPMDD for pavement areas. Fill required to raise the grades to design elevations should be organic-free and at a moisture content which will permit compaction to 98% SPMDD. The final subgrade surface should be properly shaped and crowned.
3. Perimeter subdrains should be provided around the parking area and along the driveway.
4. The most severe loading conditions on pavement areas and the subgrade may occur during construction. Consequently, special provisions such as half-loads during paving may be required, especially if construction is carried out during unfavorable weather.

## 6. General Comments

A geotechnical engineer should be retained for a general review of the final design and specifications to verify the recommendations in this report address all the relevant geotechnical parameters regarding the design and construction of the proposed development.

The comments given in this report are intended only for the guidance of design and structural engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations as well as their own interpretations of the factual borehole results so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The information contained in this report in no way reflects on the environmental aspects of the soils, which has not been addressed as this is beyond our terms of reference. Should specific information be required, additional drilling and/or testing may be required. More specific information with respect to the conditions between samples or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, a geotechnical engineer should be contacted to assess the situation and additional testing and reporting may be required. EXP has qualified personnel to provide assistance in regard to future geotechnical issues related to this property.

We trust this report is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact this office.

Yours truly,  
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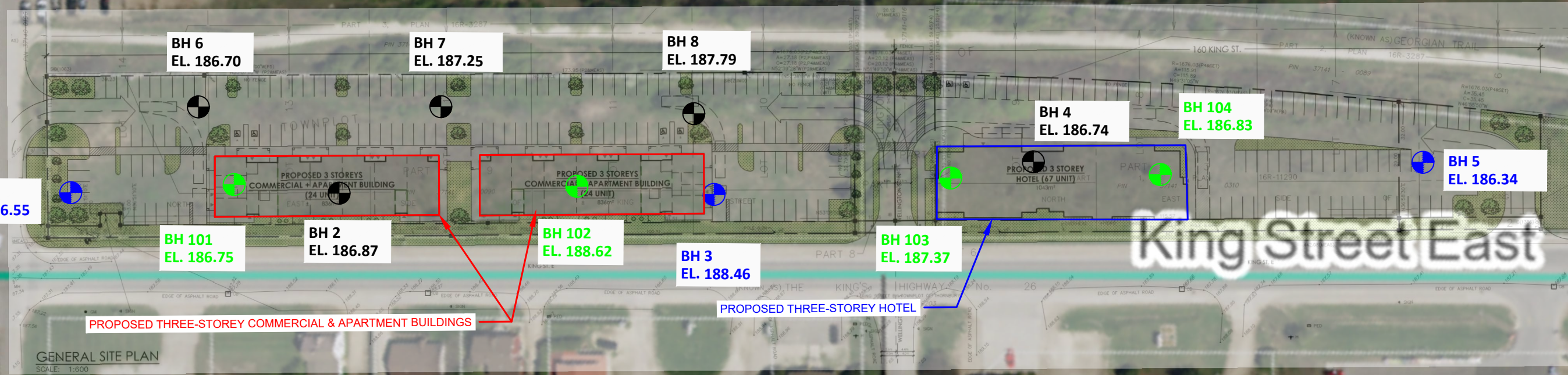
Elgin Street North

Grey Street North

st

South

South



**LEGEND:**

- CURRENT BOREHOLE LOCATION
- PREVIOUS BOREHOLE LOCATION
- PREVIOUS BOREHOLE LOCATION (WITH PIEZOMETER)

**NOTES:**

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES WILL BE RETAINED IN STORAGE FOR 1 MONTH AND THEN DESTROYED UNLESS CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. GROUND SURFACE ELEVATIONS AT THE BOREHOLE LOCATIONS WERE DERIVED FROM CAN-NET ELEVATIONS WITH THE USE OF A TRIMBLE TSC3 CONTROLLER.
4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO ESTABLISH GRADES.
5. THIS DRAWING SHOULD BE REPRODUCED IN COLOUR.

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Canada  
www.exp.com



**PROJECT TITLE AND LOCATION:**  
GEOTECHNICAL INVESTIGATION  
PROPOSED THREE-STOREY HOTEL &  
APARTMENT BUILDINGS  
150 & 160 KING STREET EAST,  
THORNBURY, ONTARIO

**DRAWING TITLE:**  
BOREHOLE LOCATION PLAN

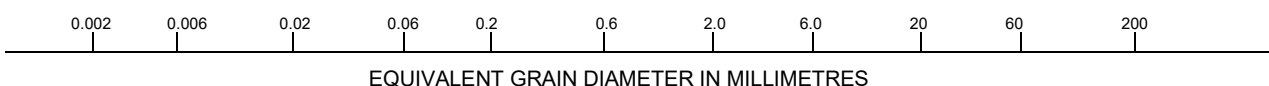
<b>PROJECT#:</b> BAR-00258217-A1	<b>DWN.:</b> RB
<b>SCALE:</b> NOT TO SCALE	<b>CHKD.:</b> LK
<b>DATE:</b> APRIL 2022	<b>DWG. No.:</b> 1

**Notes On Sample Descriptions**

1. All sample descriptions included in this report follow the Unified Soil Classification System (USCS) as outlined by the Ministry of Transportation. Different classification systems may be used by others; one such system is the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

**UNIFIED SOIL CLASSIFICATION**

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



**ISSMFE SOIL CLASSIFICATION**

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

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.
3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

**Figure 1**

### Notes On Sample Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.075 mm		
Sand	0.075 to 4.75 mm	"trace" (e.g. Trace sand)	0% to 10%
Gravel	4.75 to 75 mm	"some" (e.g. Some sand)	10% to 20%
Cobbles	75 to 200 mm	with (e.g. with sand)	20% to 35%
Boulders	>200 mm	and (e.g. and sand)	35% to 50%

For a given material listed as an adjective (e.g. silty sand) means the predominant grain size is sand sized with 30 to 40% silt sized particles.

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	Standard Penetration Resistance "N" value Blows/ 0.3 m	Consistency	Undrained Shear Strength (kPa)	'N' Values
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

#### 5. ROCK CORING

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundness of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation: } \quad \% \text{ Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

# Log of Borehole 1

Project No. BAR-00258217-A0

Figure No. 2

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

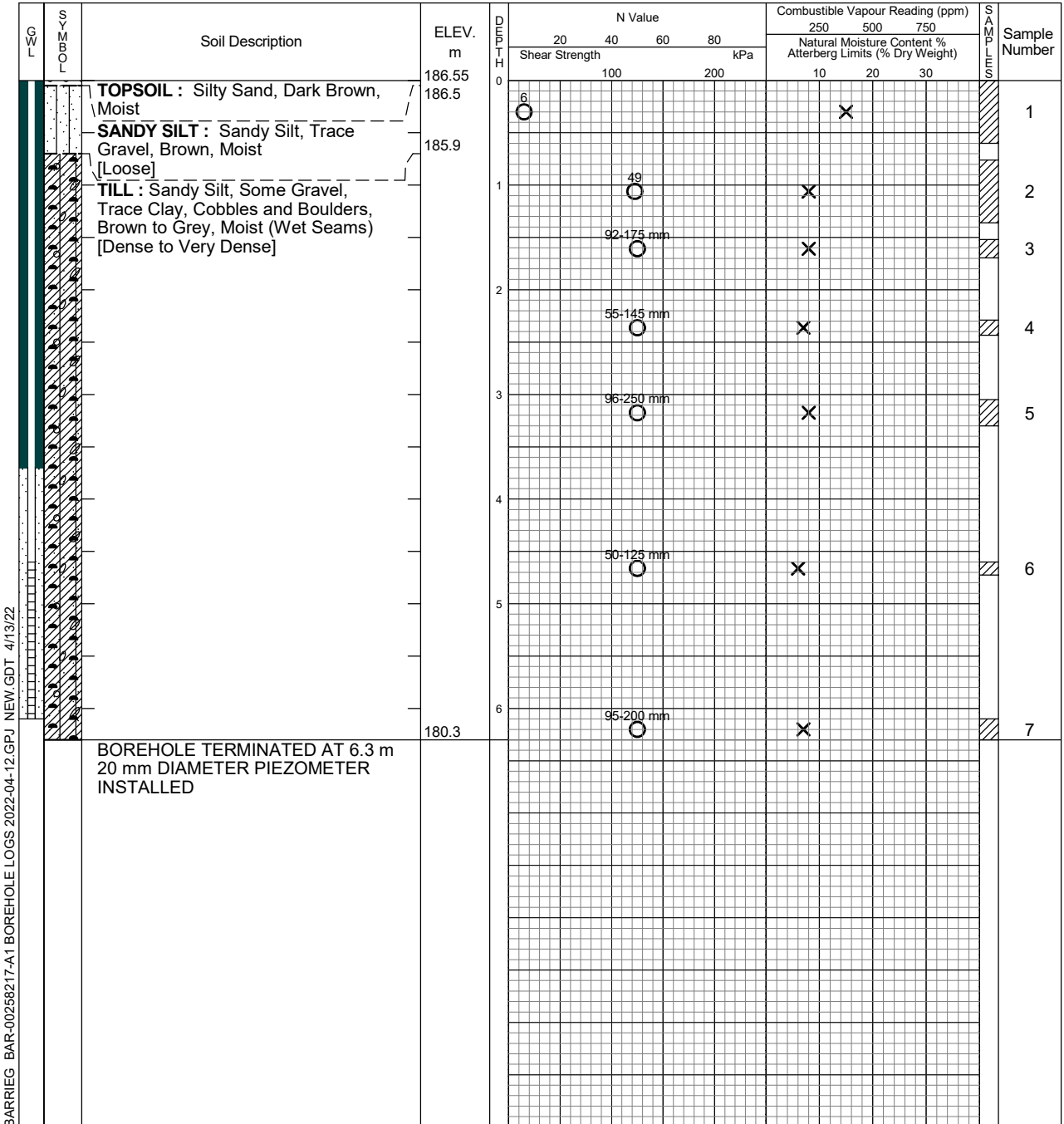
Location: 17T 4934130 544071

Date Drilled: March 24, 2020

Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample	☒	Combustible Vapour Reading	☐
SPT (N) Value	○	Natural Moisture	✕
Dynamic Cone Test	—	Plastic and Liquid Limit	—○
Shelby Tube	■	Undrained Triaxial at % Strain at Failure	⊕
Field Vane Test	⊕	Penetrometer	▲



BARRIEG BAR-00258217-A1 BOREHOLE LOGS 2022-04-12.GPJ NEW.GDT 4/13/22



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Borehole data requires interpretation assistance from EXP before use by others.  
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion March 31, 2020	5.8 2.6	Open -

# Log of Borehole 2

Project No. BAR-00258217-A0

Figure No. 3

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

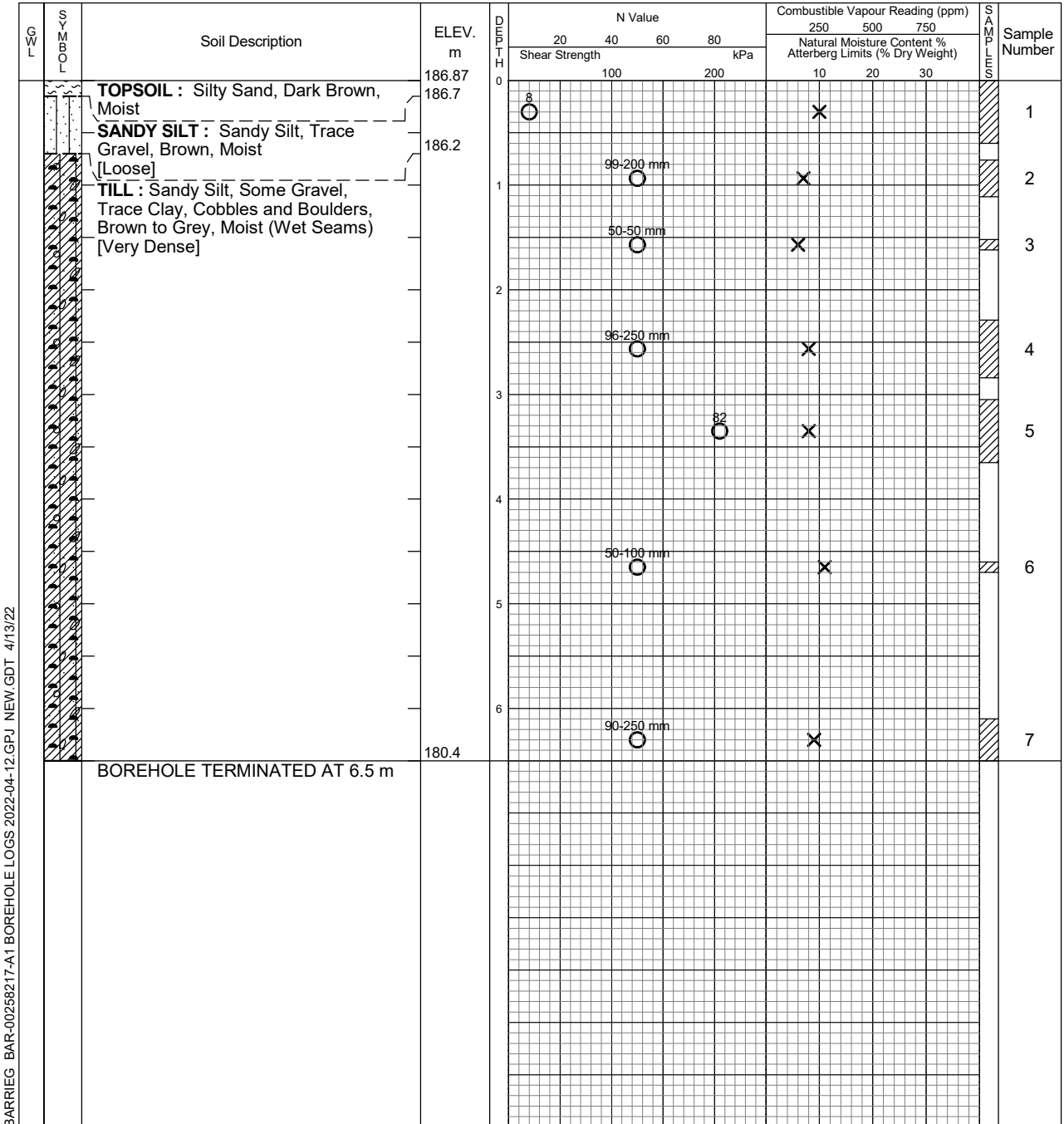
Location: 17T 4934090 544124

Date Drilled: March 24, 2020

Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample	<input checked="" type="checkbox"/>	Combustible Vapour Reading	<input type="checkbox"/>
SPT (N) Value	<input checked="" type="checkbox"/>	Natural Moisture	<input checked="" type="checkbox"/>
Dynamic Cone Test	<input type="checkbox"/>	Plastic and Liquid Limit	<input type="checkbox"/>
Shelby Tube	<input type="checkbox"/>	Undrained Triaxial at % Strain at Failure	<input type="checkbox"/>
Field Vane Test	<input type="checkbox"/>	Penetrometer	<input type="checkbox"/>



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See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	No Water	Open

# Log of Borehole 3

Project No. BAR-00258217-A0

Figure No. 4

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

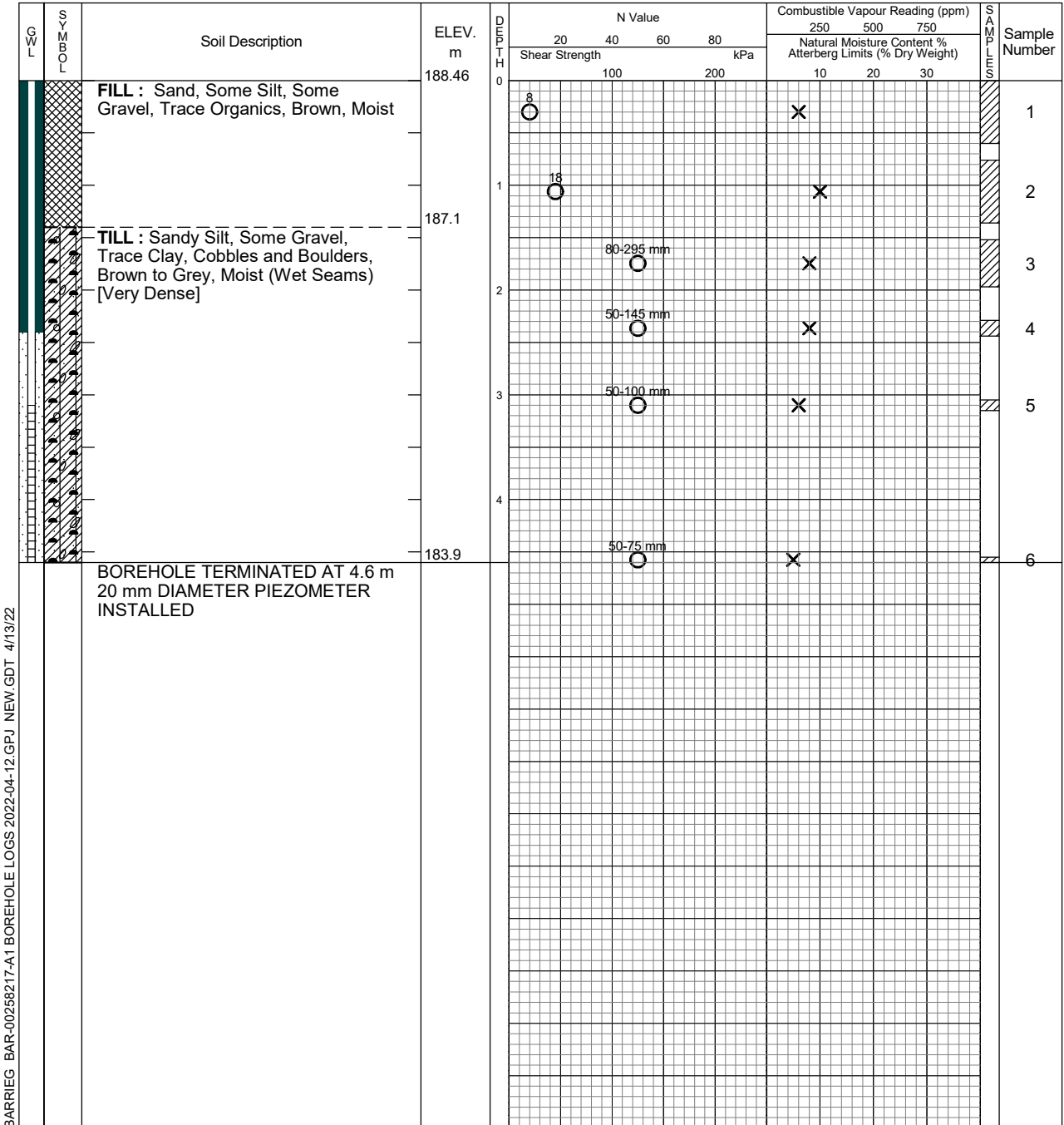
Location: 17T 4934034 544198

Date Drilled: March 24, 2020

Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample	<input checked="" type="checkbox"/>	Combustible Vapour Reading	<input type="checkbox"/>
SPT (N) Value	<input checked="" type="checkbox"/>	Natural Moisture	<input checked="" type="checkbox"/>
Dynamic Cone Test	<input type="checkbox"/>	Plastic and Liquid Limit	<input type="checkbox"/>
Shelby Tube	<input type="checkbox"/>	Undrained Triaxial at % Strain at Failure	<input type="checkbox"/>
Field Vane Test	<input type="checkbox"/>	Penetrometer	<input type="checkbox"/>



BARRIEG BAR-00258217-A1 BOREHOLE LOGS 2022-04-12.GPJ NEW.GDT 4/13/22



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See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion March 31, 2020	No Water 2.7	Open -

# Log of Borehole 4

Project No. BAR-00258217-A0

Figure No. 5

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

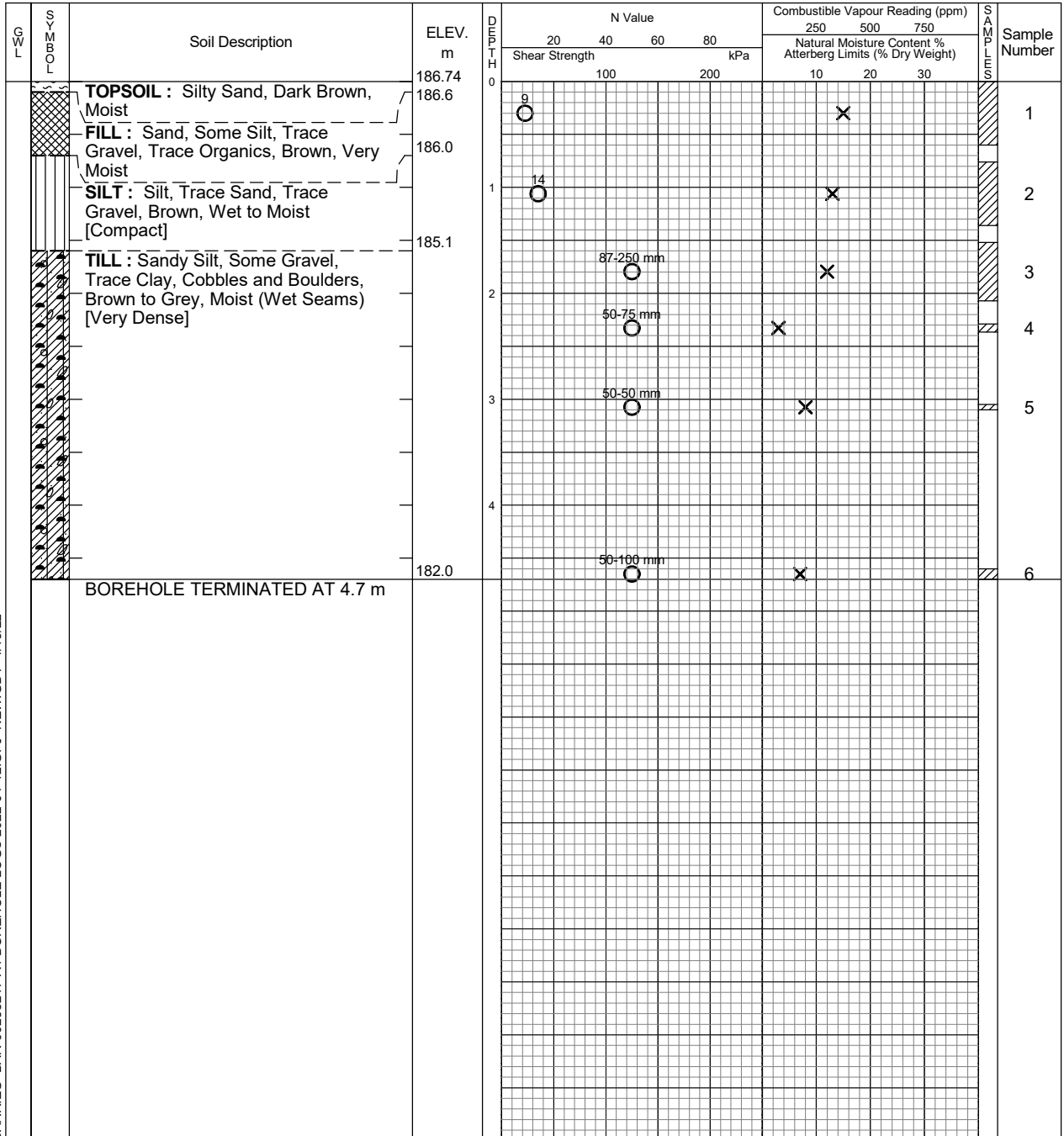
Location: 17T 4933993 544266

Date Drilled: March 24, 2020

Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample	<input checked="" type="checkbox"/>	Combustible Vapour Reading	<input type="checkbox"/>
SPT (N) Value	<input checked="" type="checkbox"/>	Natural Moisture	<input checked="" type="checkbox"/>
Dynamic Cone Test	<input type="checkbox"/>	Plastic and Liquid Limit	<input type="checkbox"/>
Shelby Tube	<input type="checkbox"/>	Undrained Triaxial at % Strain at Failure	<input type="checkbox"/>
Field Vane Test	<input type="checkbox"/>	Penetrometer	<input type="checkbox"/>



BARRIEG BAR-00258217-A1 BOREHOLE LOGS 2022-04-12.GPJ NEW.GDT 4/13/22



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Borehole data requires interpretation assistance from EXP before use by others.  
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	1.5	4.0

# Log of Borehole 5

Project No. BAR-00258217-A0

Figure No. 6

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

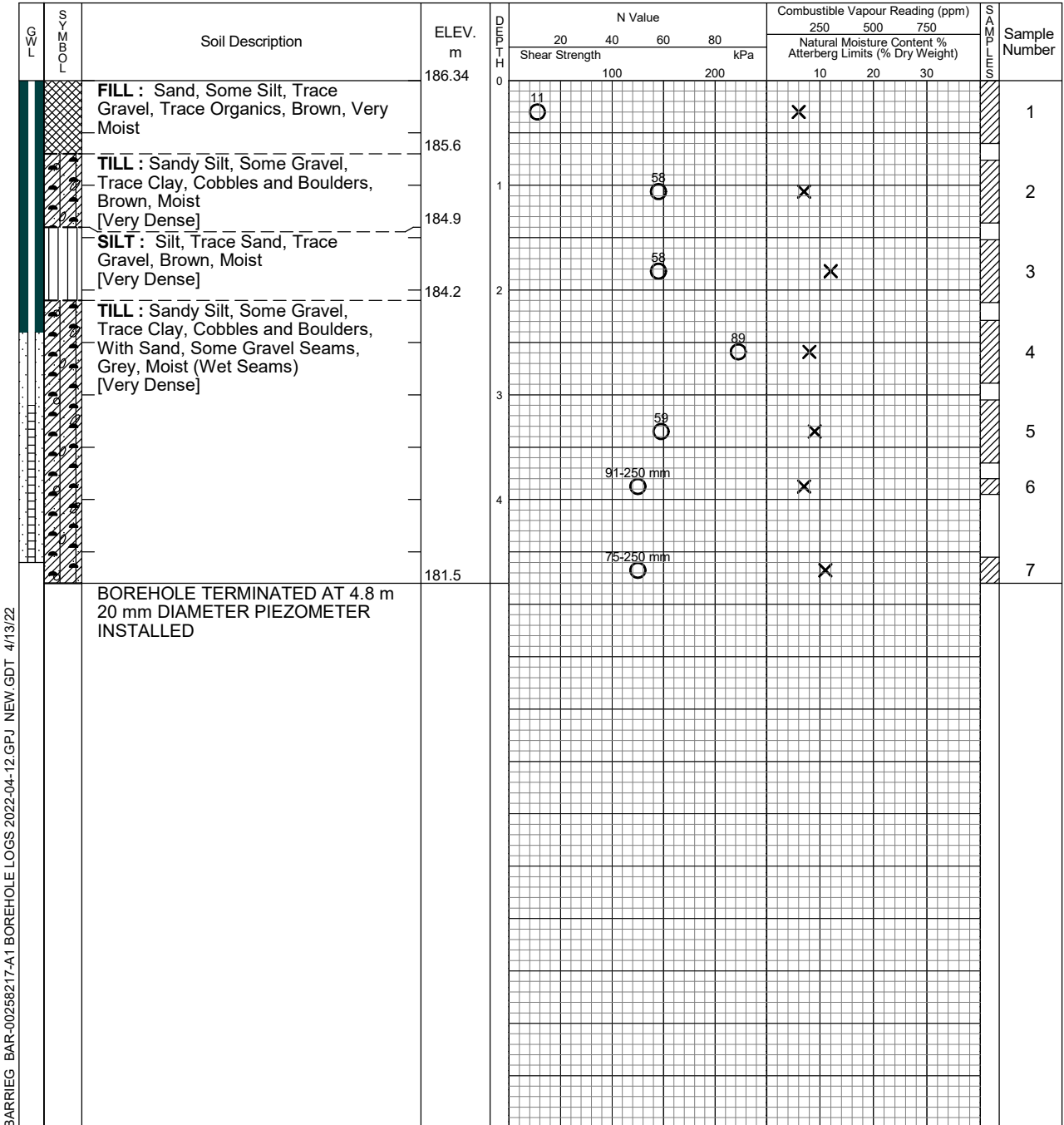
Location: 17T 4933935 544343

Date Drilled: March 24, 2020

Drill Type: Solid Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Combustible Vapour Reading
- Natural Moisture X
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure ⊕
- Penetrometer



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See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion March 31, 2020	No Water 0.0	Open -

# Log of Borehole 6

Project No. BAR-00258217-A0

Figure No. 7

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

Location: 17T 4934128 544109

Date Drilled: March 24, 2020

Drill Type: Solid Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH 0 1	N Value				Combustible Vapour Reading (ppm)			SOIL SAMPLE	Sample Number	
					20	40	60	80	250	500	750			
		<b>FILL</b> : Sand and Gravel, Trace Silt, Brown, Wet	186.70											
		<b>SANDY SILT</b> : Trace Gravel, Trace Clay, Brown, Wet	186.1											1
		<b>SANDY SILT</b> : Trace Gravel, Trace Clay, Brown, Wet	185.2											2
		BOREHOLE TERMINATED AT 1.5 m												

BARRIEG BAR-00258217-A1 BOREHOLE LOGS 2022-04-12.GPJ NEW.GDT 4/13/22



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Borehole data requires interpretation assistance from EXP before use by others.  
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	0.3	0.3

# Log of Borehole 7

Project No. BAR-00258217-A0

Figure No. 8

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

Location: 17T 4934092 544157

Date Drilled: March 24, 2020

Drill Type: Solid Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH 0	N Value				Combustible Vapour Reading (ppm)			SOIL SAMPLE	Sample Number	
					20	40	60	80	250	500	750			
		<b>SANDY SILT</b> : Trace Clay, Brown, Wet	187.25											
				1										1
														2
		<b>BOREHOLE TERMINATED AT 1.5 m</b>	185.8											

BARRIEG BAR-00258217-A1 BOREHOLE LOGS 2022-04-12.GPJ NEW.GDT 4/13/22



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See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	1.2	Open

# Log of Borehole 8

Project No. BAR-00258217-A0

Figure No. 9

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

Location: 17T 4934053 544206

Date Drilled: March 24, 2020

Drill Type: Solid Stem Augers

Datum: Geodetic

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH 0 1	N Value				Combustible Vapour Reading (ppm)			SOIL SAMPLE	Sample Number	
					20	40	60	80	250	500	750			
		<b>FILL</b> : Sand and Gravel, Trace Silt, Brown, Moist	187.79											
		<b>SANDY SILT</b> : Trace Gravel, Trace Clay, Brown to Grey, Moist	187.2											1
														2
			186.3											3
		BOREHOLE TERMINATED AT 1.5 m												

BARRIEG BAR-00258217-A1 BOREHOLE LOGS 2022-04-12.GPJ NEW.GDT 4/13/22



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Borehole data requires interpretation assistance from EXP before use by others.  
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	No Water	Open

# Log of Borehole 101

Project No. BAR-00258217-A0

Figure No. 10

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

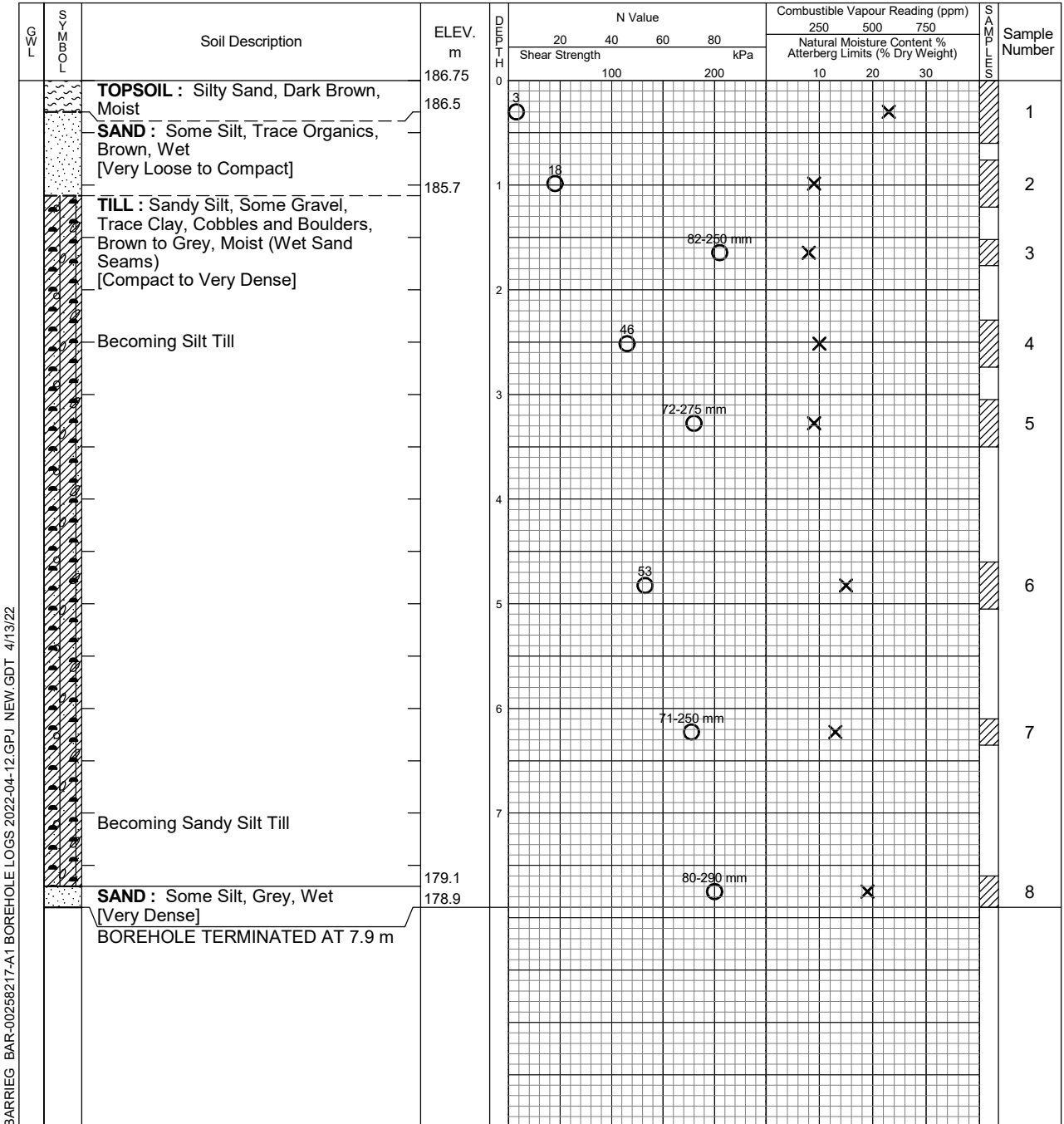
Location: 17T 4934108 544099

Date Drilled: April 11, 2022

Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample		Combustible Vapour Reading	<input type="checkbox"/>
SPT (N) Value		Natural Moisture	
Dynamic Cone Test		Plastic and Liquid Limit	
Shelby Tube		Undrained Triaxial at % Strain at Failure	
Field Vane Test		Penetrometer	



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Borehole data requires interpretation assistance from EXP before use by others.  
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.1	Open

# Log of Borehole 102

Project No. BAR-00258217-A0

Figure No. 11

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

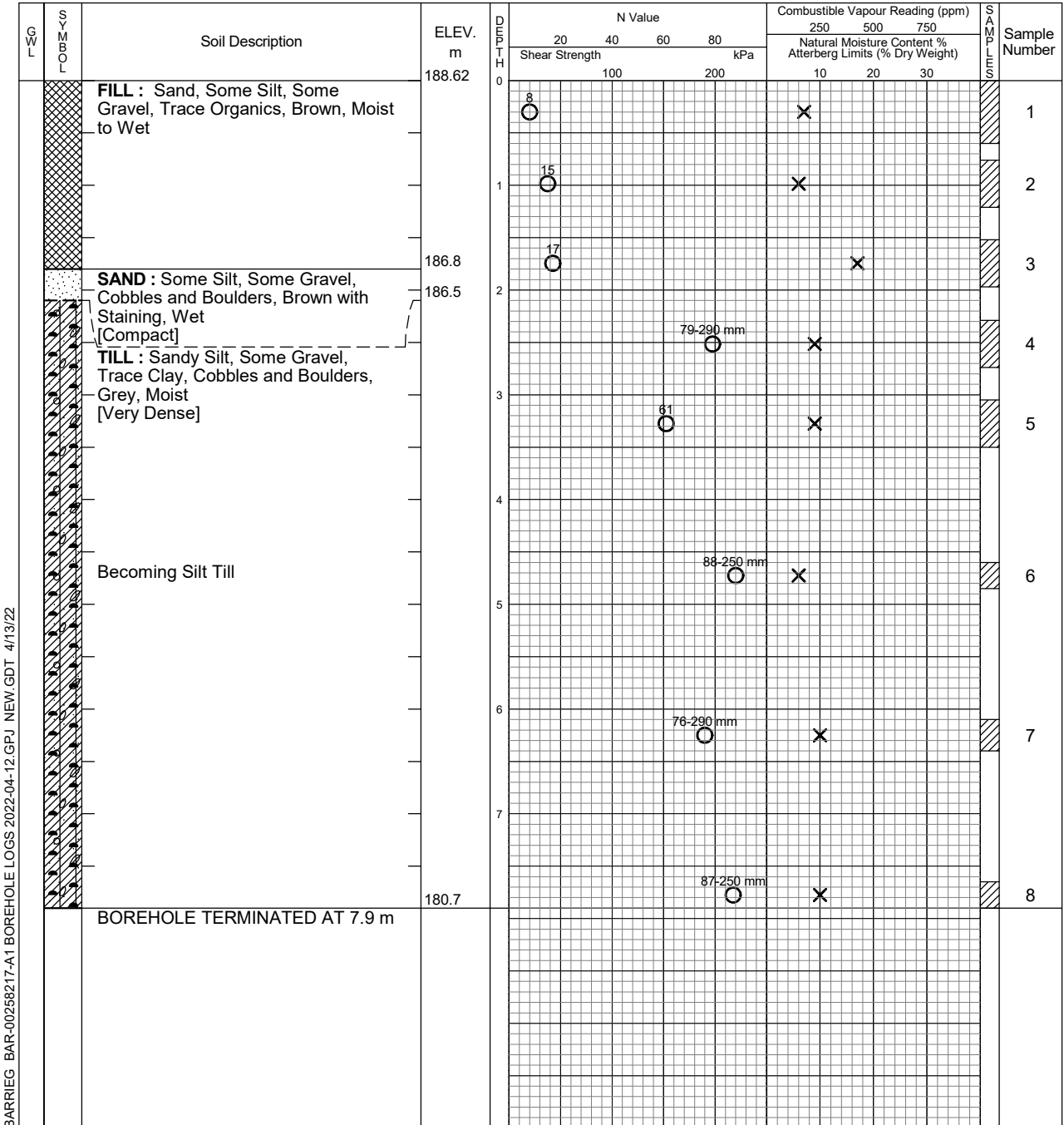
Location: 17T 4934052 544174

Date Drilled: April 11, 2022

Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample		Combustible Vapour Reading	<input type="checkbox"/>
SPT (N) Value		Natural Moisture	
Dynamic Cone Test		Plastic and Liquid Limit	
Shelby Tube		Undrained Triaxial at % Strain at Failure	
Field Vane Test		Penetrometer	



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Borehole data requires interpretation assistance from EXP before use by others.  
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	No Water	Open

# Log of Borehole 103

Project No. BAR-00258217-A0

Figure No. 12

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

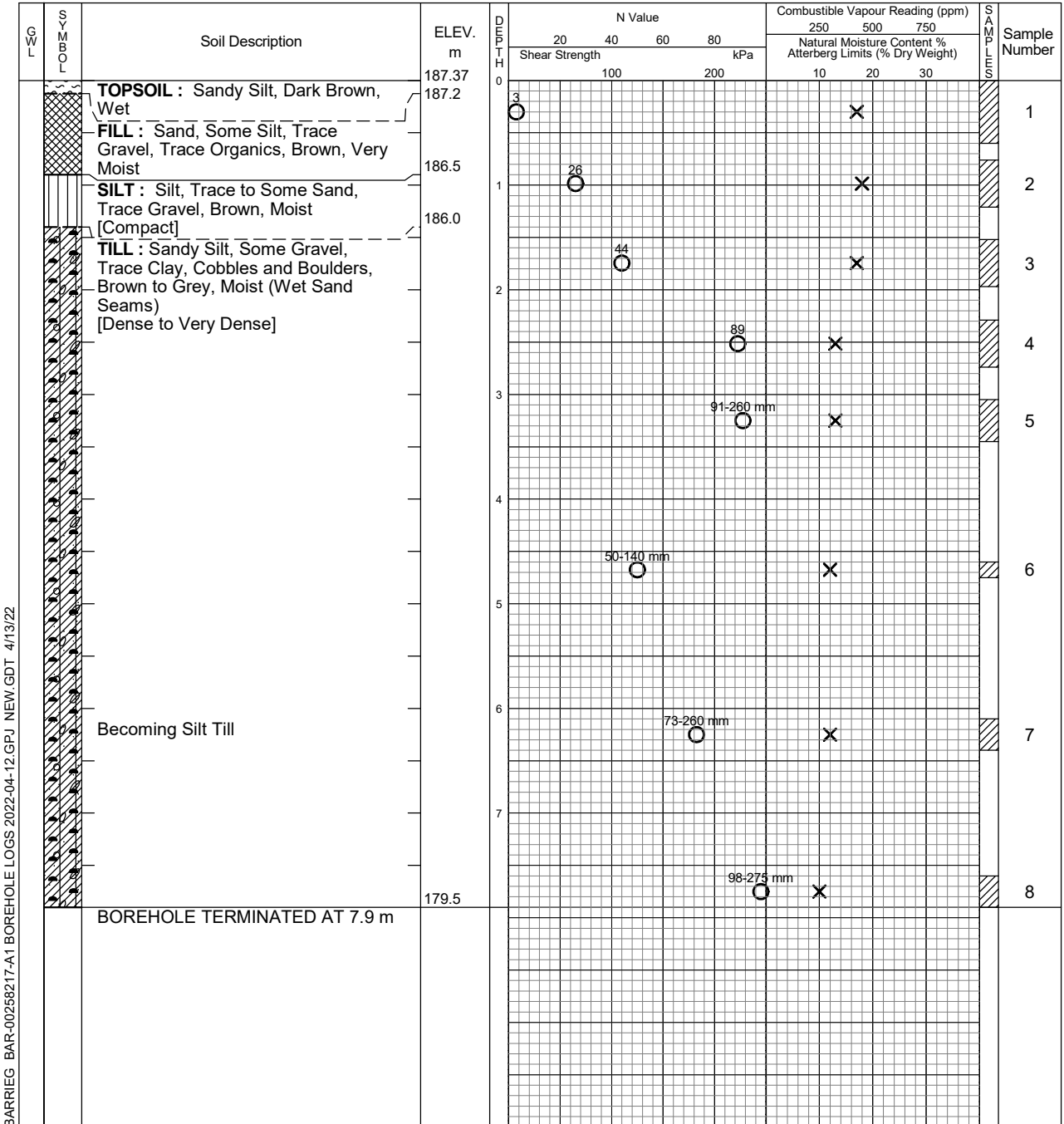
Location: 17T 4934003 544239

Date Drilled: April 11, 2022

Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample	<input checked="" type="checkbox"/>	Combustible Vapour Reading	<input type="checkbox"/>
SPT (N) Value	<input checked="" type="checkbox"/>	Natural Moisture	<input checked="" type="checkbox"/>
Dynamic Cone Test	<input type="checkbox"/>	Plastic and Liquid Limit	<input type="checkbox"/>
Shelby Tube	<input type="checkbox"/>	Undrained Triaxial at % Strain at Failure	<input type="checkbox"/>
Field Vane Test	<input type="checkbox"/>	Penetrometer	<input type="checkbox"/>



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Borehole data requires interpretation assistance from EXP before use by others.  
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.1	Open

# Log of Borehole 104

Project No. BAR-00258217-A0

Figure No. 13

Project: Proposed Three-Storey Hotel & Apartment Buildings

Sheet No. 1 of 1

City/  
Municipality: Thornbury, ON

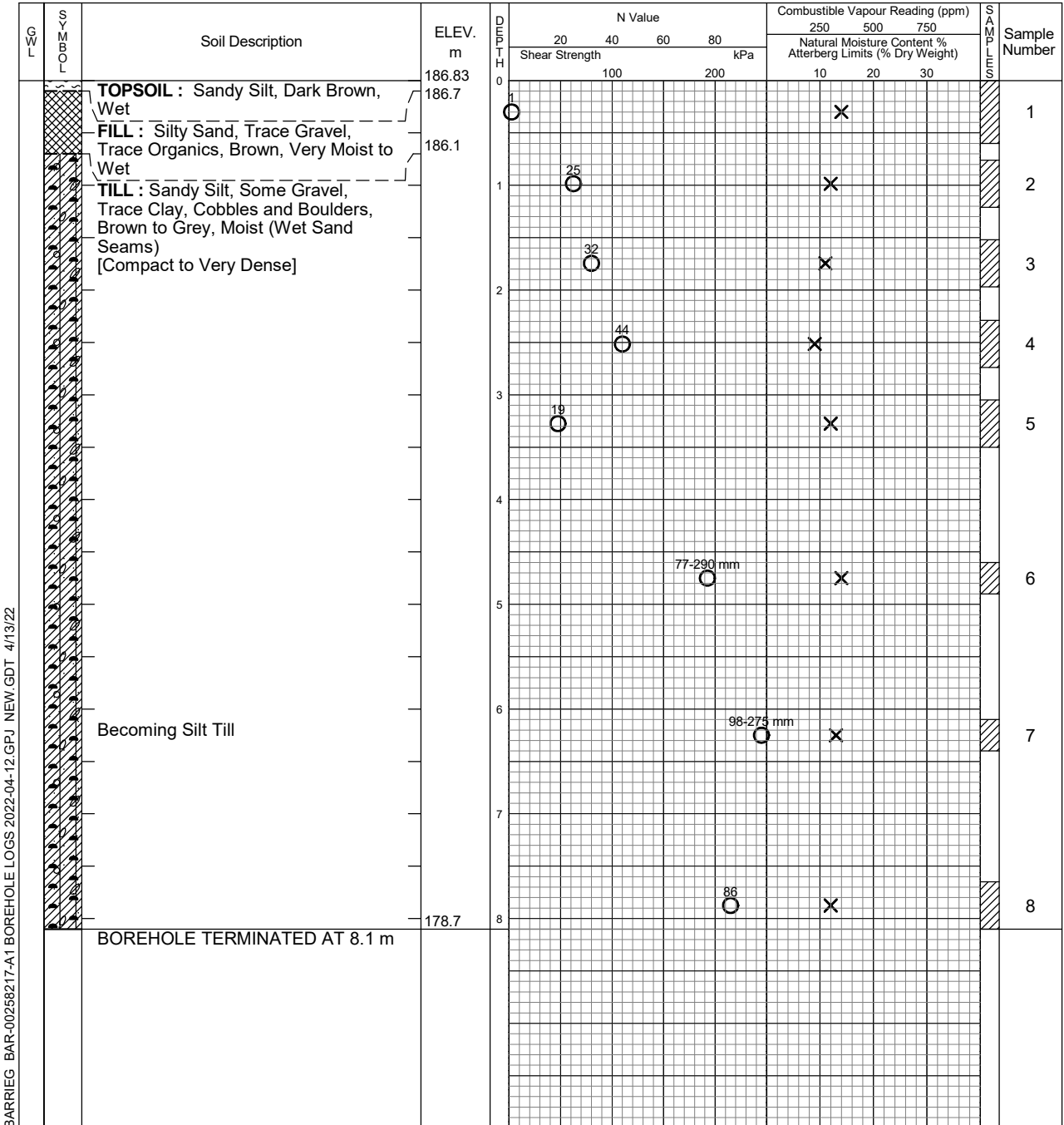
Location: 17T 4933975 544279

Date Drilled: April 11, 2022

Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample	<input checked="" type="checkbox"/>	Combustible Vapour Reading	<input type="checkbox"/>
SPT (N) Value	<input checked="" type="checkbox"/>	Natural Moisture	<input checked="" type="checkbox"/>
Dynamic Cone Test	<input type="checkbox"/>	Plastic and Liquid Limit	<input type="checkbox"/>
Shelby Tube	<input type="checkbox"/>	Undrained Triaxial at % Strain at Failure	<input type="checkbox"/>
Field Vane Test	<input checked="" type="checkbox"/>	Penetrometer	<input type="checkbox"/>



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Borehole data requires interpretation assistance from EXP before use by others.  
See Figures 1A and 1B for Notes on Sample Descriptions.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	1.5	Open



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 E-Mail: barrie@exp.com www.exp.com

# Grain Size Analysis Report

Project Name: Proposed Three-Storey Hotel

Figure No.: 14

Project No.: BAR-00258217-A1

Date Tested: March 27, 2020

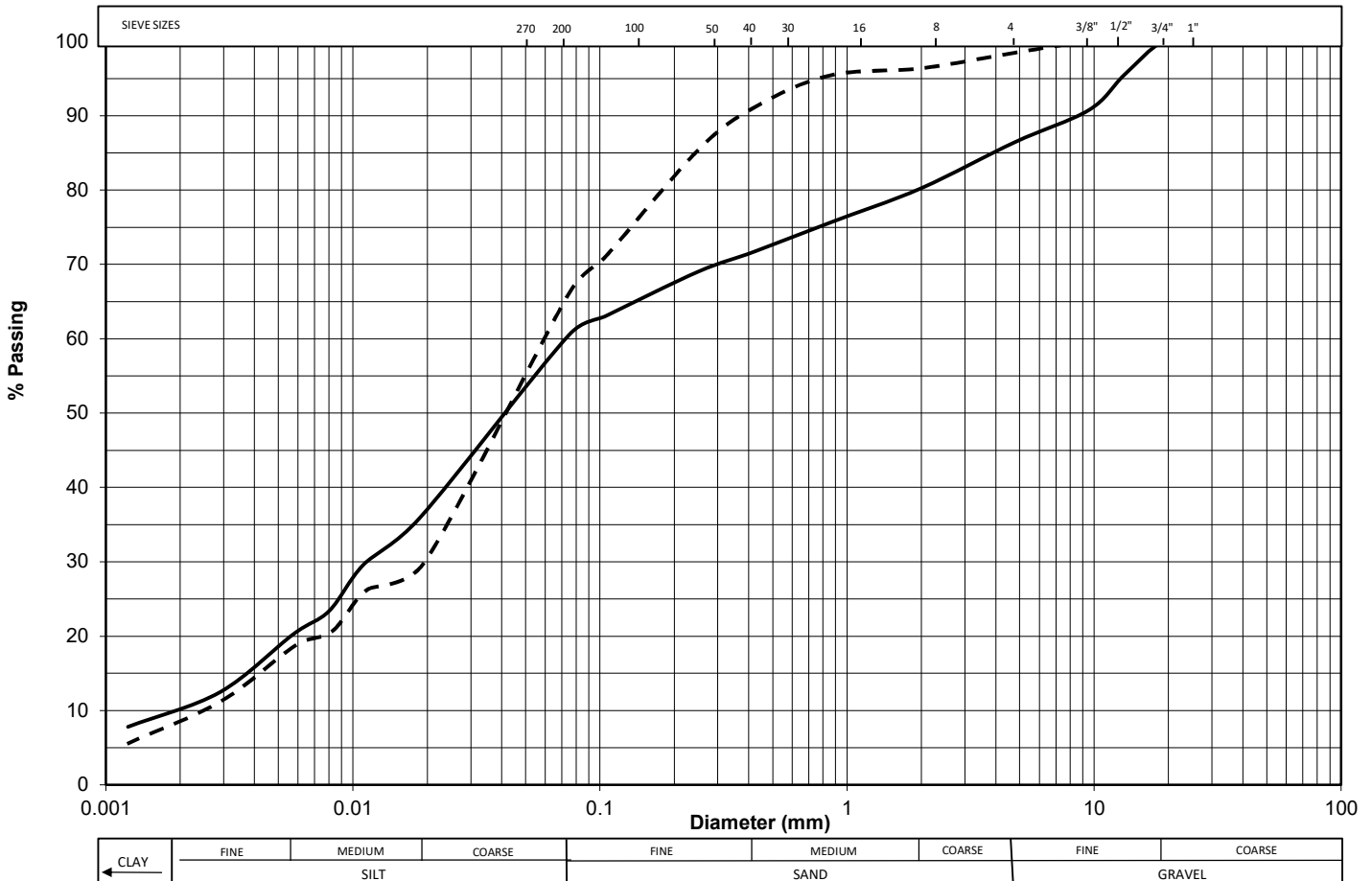
Client: 2706499 Ontario Limited

Date Sampled: March 24, 2020

## SAMPLE INFORMATION

Material	Borehole No. and Sample No.	Sample Depth	Material Description	Graph Line Type
1	BH1 SS3	1.5 - 1.7	TILL: Sandy Silt, Some Gravel, Trace Clay	—————
2	BH7 SS1	0.0 - 0.6	Sandy Silt, Trace Clay	- - - - -

## Sieve Analysis



**DISTRIBUTION:**  
 2706499 Ontario Limited

**Prepared By:**  
 EH  
 Ethan Hunter, B.A.Sc.

**Checked By:**  
  
 Richard Blair, P. Eng.