Hydrogeological Assessment

5026367 Ontario Inc.

Project Name:
Watson Farm Aggregate Resources Study
21875 Nissouri Road
Thorndale, Ontario

Project Number:
LON-00018067-GE

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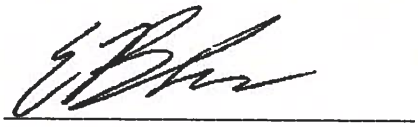

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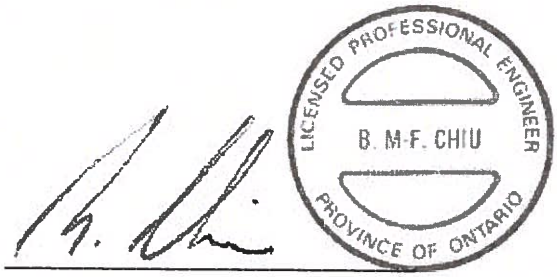

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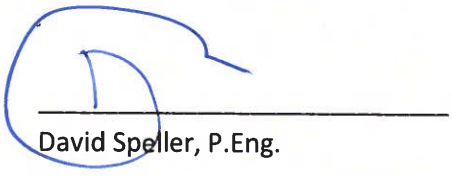

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1. Introduction and Background

1.1 Introduction

EXP Services Inc. (EXP) was retained by **5026367 Ontario Inc.** to carry out a Hydrogeological Assessment and prepare a report for the southwest part of the property located at 21875 Nissouri Road in London, Ontario, hereinafter referred to as the 'Site' (See **Drawing 1**). The Hydrogeological Assessment was completed as part of the requirements for a Category 1, Class A Licence Application under the Aggregate Resources Act (ARA) for the Site which is located northeast of the City of London and northwest of the intersection of Nissouri Road and Thorndale Road. Authorization for EXP to proceed with the Hydrogeological Assessment was given by Mrs. Jane Elliot of **5026367 Ontario Inc**.

The objective of the Level 1 Hydrogeological Assessment was to examine the hydrogeological characteristics of the site by conducting a soil and groundwater investigation at the Site, reviewing available information relating to the topography, drainage, site physiography, quaternary geology, bedrock geology, Ministry of Environment, Conservation and Parks (MECP) well records and reviewing the results of the soil and groundwater investigation provided from a series of sampled boreholes and monitoring wells at the site. This report also addresses the potential effects of the gravel pit operation on local groundwater and surface water features within the zone of influence of the operation.

The proposed depth of gravel extraction provided to EXP by Esher Planning Inc. is 1.5 m above the seasonal high groundwater table. Groundwater levels will be seasonally monitored into the spring of 2021. It is understood that the final extraction elevation will be determined once the seasonal high groundwater level is confirmed.

Based on an interpretation of the factual borehole data, a review of soil and groundwater information from boreholes advanced at the Site and a review of the available MECP well records, EXP has provided a hydrogeological assessment for the Site to fulfill the Hydrogeological Level 1 evaluation requirements needed for the proposed Category 1, Class A Licence Application. More specifically, this report provides comments pertaining to a discussion of the potential for impacts of gravel-taking operations on hydrogeological conditions at the site and surrounding areas and provides recommendations, where applicable, to mitigate this potential for impact.

1.2 Scope of Work

The scope of work is intended to address the current groundwater-related ARA Provincial Standards for the Aggregate Licence Application for the Site. Other ARA requirements such as an Environmental Impact Study (EIS) and a Noise Assessment will be reported under separate cover. The scope of work for the Hydrogeological Assessment consisted of the following tasks:

1. Desktop Study: This task consisted of a review of existing information including site plans, previous reports, geological maps, geological cross sections, groundwater level information, borehole logs, and MECP Water Well Records. The background information was used to develop a site-specific conceptual hydrogeologic model.
2. Field Program: Installation of monitoring wells was carried out as part of this Hydrogeological Site Assessment work. Additional field testing consisted of returning to the monitoring wells to obtain groundwater level measurements for the purposes of characterizing the shallow groundwater conditions at the Site.

3. Data Evaluation: Evaluation of the available field and laboratory data and other information, assessment of the dewatering requirements and potential dewatering effects on the surrounding environment.
4. Reporting: This task consisted of preparing this Assessment Report.

This report is provided on the basis of the terms of reference presented above, and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the hydrogeological analyses, or if any questions arise concerning hydrogeological aspects of the codes and standards, this office should be contacted to review the design.

The information in this report in no way reflects on the environmental aspects of the soil. Should specific information in this regard be needed, additional testing may be required.

Reference is made to **Appendix D** of this report, which contains further information necessary for the proper interpretation and use of this report.

2. Methodology

The fieldwork was carried out on June 15th, 16th, and 29th, 2020. In general, the hydrogeological investigation consisted of the advancement of seven (7) boreholes at the locations denoted on **Drawing 1** as BH101 to BH107. MW was suffixed to the borehole symbol (BH) where monitoring wells were installed.

A Geotechnical and Hydrogeological Investigation was carried out at the neighbouring property to the east as part of a separate study with the final report being issued in November 2020 (EXP, 2020). The investigation consisted of the advancement of six (6) boreholes, three (3) with monitoring wells installed, at the locations denoted on **Drawing 1** as BH1 to BH6. Soil information from these boreholes was used for confirmation purposes only.

Prior to the drilling, buried service clearances were obtained for the test hole locations by EXP.

The boreholes were completed by a specialist drilling subcontractor under the full-time supervision of EXP staff. The boreholes were advanced to depths of 3.5 m to 9.1 m below ground surface (bgs) utilizing a track-mounted drill rig equipped with continuous flight solid and hollow stem augers, soil sampling and soil testing equipment. In each borehole, disturbed soil samples were recovered at depth intervals of 0.75 m and 1.5 m using conventional split spoon sampling equipment and Standard Penetration Test (SPT) methods or auger samples.

During the drilling, the stratigraphy in the test holes was examined and logged in the field by EXP geotechnical personnel.

Short-term groundwater levels within the open boreholes were observed. These observations pertaining to groundwater conditions at the test hole locations and stabilized groundwater levels in the monitoring wells are recorded in the borehole logs found in **Appendix A**. Following the drilling, the boreholes without monitoring wells were backfilled with the excavated materials and bentonite, to satisfy the requirements of O.Reg. 903.

Representative samples of the various soil strata encountered at the test locations were taken to our laboratory in London for further examination by a Geotechnical Engineer and laboratory classification testing. Laboratory testing for this investigation comprised routine moisture content determinations, with results presented on the borehole logs found in **Appendix A**.

Four (4) grain size analyses were carried out on samples recovered from boreholes advanced at the neighbouring property to the east (EXP, 2020), with results presented in **Appendix B**.

Samples remaining after the classification testing will be stored for a period of three months following the issuance of report. After this time, they will be discarded unless prior arrangements have been made for longer storage.

The boreholes and monitoring wells were installed for the purpose of providing insight on potential impacts of extraction on local natural heritage features and local water users, and how groundwater conditions may impact the progress of construction activities such as excavations. Ground surface elevations at each test hole location were surveyed to the top of spindle of hydrant at the southeast corner of Nissouri Road and Elliot Trail. The benchmark has a geodetic elevation of 287.094 m.

A seasonal groundwater level monitoring program is ongoing at the Site. Future winter and spring water level measurements will be taken to determine the seasonal high groundwater elevation.

3. Site Description and Geologic Setting

3.1 Site Description

The subject area is currently used as an agricultural field. The Site is roughly rectangular in shape with a total area of about 14.2 hectares (ha). The Site is generally bounded by agricultural fields to the north and east, Thorndale Road to the south, and a commercial development and landscaped area to the west. A woodlot is located north of the west half of the Site.

The following sections provide a summary of the soil conditions and groundwater conditions.

3.2 Topography and Drainage

The existing topography at the Site is gently undulating with ground surface elevations ranging between about 284 and 281 metres (m). The Site is located in the sub-watershed of the North Thames River. Drainage from the Site is primarily through seepage into the subsurface and overland flow through low areas within the Site. A closed constructed drain originates to the northeast of the Site (**Drawing 2**) and generally flows southwest, north of the Site boundary, eventually connecting to the North Thames River.

3.3 Bedrock Geology

The Site is underlain by limestone, dolostone and shale of the Dundee Formation (OGS, 2011). This formation consists of 60 to 160 feet (18 to 49 m) of light brown, medium-grained with some minor chert (Hewitt, 1972), and is part of the Algonquin Arch, which forms a ridge along the southwestern Ontario peninsula between the Michigan Basin (to the northwest) and the Appalachian Basin (to the southwest). Bedrock is generally not exposed in the area.

Review of bedrock topography mapping (OGS, 1978) indicates the bedrock surface at an elevation in the range of 259 m (850 feet) to 267 m (875 feet) above mean sea level (amsl). The bedrock surface generally slopes to the southwest in this area. Review of Ministry of Environment, Conservation and Parks (MECP) Water Well Records (WWR) for the area indicates 13 wells within 500 m of the Site intersect bedrock at depths of approximately 17 m to 26 m below ground surface (bgs). Based on ground surface elevations detailed in the MECP WWR, this equates to a bedrock elevation of about 263 to 268 m, which is generally consistent with the bedrock topography mapping. Bedrock was not encountered during the drilling work completed as part of this investigation.

3.4 Overburden Geology

The physiography of Southwestern Ontario was altered significantly by the glacial and interglacial periods that took place throughout the Quaternary period. The overburden deposits which are present in the study area were formed by numerous glacial events during the late Wisconsinan glacial stage approximately 10,000 to 23,000 years before present. There were two distinct glacial lobes present in Southwestern Ontario during this period. The Huron Lobe advanced from Lake Huron southwards, and the Erie Lobe advanced from the northeast, receding to the east.

During the advancement of the glacial ice sheets, bedrock and unconsolidated sediments were eroded. During the recession of the glaciers, the eroded materials were deposited in lakes, rivers and along spillways, contributing to the present configuration of moraines, abandoned spillways, drumlins, eskers, abandoned shorelines, and various still-water sediment deposits.

The surficial deposits were mapped and categorized into a number of physiographic regions by Chapman and Putnam (1984). The physiographic regional mapping for the area indicates that the site is situated within the Stratford Till Plain (Chapman and Putnam, 1984). The Stratford Till Plain consists of ground moraine interrupted by several terminal moraines. This till was deposited by the Huron Lobe over previously deposited material, resulting in this till having a fine-grained composition.

Review of physiographic landform mapping indicates that the north and east portions of the Site are located within spillways, while the southwest portion of the Site is within an undrumlinized till plain (**Drawing 4**). Quaternary mapping completed by Barnett *et. al.* (1981) indicates that the quaternary geology at the Site is located in an area characterized by Tavistock Till (**Drawing 5**): sandy silt to silt matrix, silty clay matrix in the south and north.

Surficial geology mapping shows the surficial Site soils to be predominantly gravelly glaciofluvial deposits with sandy silt to silty sand textured till along the north border (**Drawing 6**). Fluvial terraces are mapped to the north and south of the Site and extend into the site as shown in **Drawing 6**.

3.5 Site-Specific Surficial Geology

Generally, the Site consists of sand/sand and gravel underlain by sandy silt till. The depth of the sand/sand and gravel and sandy silt till interface varies across the Site, with deeper sand and gravel deposits to the south and west. Fill and silt are present near the surface of select boreholes. Stratigraphic cross-sections through the Site, as shown on **Drawing 7**, are provided as **Drawings 8, 9 and 10**.

4. Site and Subsurface Conditions

4.1 Soil Stratigraphy

The detailed stratigraphy encountered in the boreholes advanced on Site is shown on the borehole logs (100 series) found in **Appendix A** and summarized in the following paragraphs. It must be noted that the boundaries of the soil indicated on the test hole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for geotechnical design and should not be interpreted as exact planes of geological change.

4.1.1 Topsoil

Each borehole was surfaced with a layer of topsoil. The topsoil ranged in thickness from 200 mm to 350 mm.

It should be noted that topsoil quantities should not be established from the information provided at the test hole locations only. If required, a more detailed analysis (involving additional shallow test pits) is recommended to accurately quantify the amount of topsoil to be removed for construction purposes.

4.1.2 Fill

Beneath the topsoil and extending to between 1.4 m and 2.1 m below ground surface (bgs) in Boreholes BH101/MW and BH105 was a layer of sandy silt fill. The fill was generally brown in colour with some clay and trace gravel. Based on tactile examination and *in situ* moisture contents of 16 to 21 percent, the sandy silt fill was described as moist to very moist.

Trace organics was observed within the fill layer in Borehole BH101/MW.

4.1.3 Sandy Silt

Underlying the topsoil or fill in Boreholes BH104 to BH106/MW was a layer of sandy silt. The sandy silt extended to between 1.0 m and 2.9 m bgs and was brown in colour. It typically contained trace to some clay and was moist to wet based on tactile examination and *in situ* moisture contents of 11 and 25 percent.

4.1.4 Sand/Sand and Gravel

In each borehole besides BH5, a stratum or strata of sand/sand and gravel was observed. The layer greatly varied in thickness, with thicker deposits noted in the south and westmost boreholes. It typically contained trace silt, frequent cobbles and boulders and was generally damp becoming wet with depth.

4.1.5 Glacial Till

With the exception of Boreholes BH103 and BH106/MW, each borehole was terminated in a stratum of glacial till. The till predominantly comprised sandy silt and was brown becoming grey with depth. The till generally contained trace to some clay, trace to some gravel and occasional cobbles. Laboratory testing of the sandy silt till yielded *in situ* moisture contents of 6 to 17 percent, indicative of moist to very moist conditions.

4.2 Groundwater Conditions

Four (4) monitoring wells were installed during the drilling on June 15th, 16th, and 29th, 2020 at the Site. The wells were installed to depths of approximately 4.6 m to 9.1 m bgs. The summary of well construction details is presented in the table below. Wells installed as part of a geotechnical investigation to the east of the Site were also included in the table below.

Table 1 – Monitoring Well Construction Details

Well ID	Ground Surface Elevation (m)	Completion Depth (m bgs)	Screen Length (m)
BH101/MW	284.75	4.57	1.52
BH102/MW	284.21	4.57	1.52
BH106/MW	282.68	9.14	1.52
BH107/MW	282.86	7.47	1.52
BH1/MW (EXP, 2020)	284.20	5.79	1.52
BH4/MW (EXP, 2020)	284.03	2.44	1.52
BH5/MW (EXP, 2020)	284.59	3.35	1.52

The stabilized groundwater levels in the monitoring wells east of the Site were generally measured monthly on 11 occasions between March and November 2020. Water level readings for the Site began in July 2020. A summary table of the stabilized groundwater levels is attached in **Appendix C**.

The monitoring wells have been registered with the Ministry of the Environment, Conservation and Parks (MECP), in accordance with Ontario Regulation 903, and remain intact for the purposes of ongoing monitoring of stabilized groundwater conditions, as required. The measurements in **Appendix C** indicate a variation in the shallow overburden groundwater table between elevations 274.88 m and 283.12 m over the monitored period. The water levels observed in Boreholes BH101/MW and BH102/MW on Site and BH4/MW and BH5/MW on the neighbouring property are a perched condition and not considered to be representative of stabilized conditions. Based on the water levels observed in monitoring wells BH106/MW and BH107/MW on Site and BH1/MW on the neighbouring property, the direction of groundwater flow is to the southwest, likely influenced by the North Thames River.

Details of the groundwater conditions observed within the test holes are provided on the attached borehole logs. Upon completion of drilling, the open boreholes without monitoring wells installed were examined for the presence of groundwater and groundwater seepage. All boreholes advanced on Site without monitoring wells installed were dry upon completion of drilling.

It is noted that insufficient time was available for the measurement of the depth to the stabilized groundwater table prior to backfilling the test holes without monitoring wells installed.

It is also noted that the depth to the groundwater table may vary in response to climatic or seasonal conditions, and, as such, may differ at the time of construction, with higher levels in wet seasons. Capillary rise effects should also be anticipated in fine-grained soil deposits.

4.3 Potable Groundwater

To identify the depth of the potable groundwater aquifer for the area, a review of the local Ministry of Environment, Conservation and Parks (MECP) water well records (WWR) was carried out within close proximity (500 m or less) to the investigation area. The findings are summarized in the following table:

Table 2 – Summary of MECP Well Records

Well ID	Well Type	Date Completed	Depth (m)	Water Use	Water Status	Screened Lithology	Water Found at Depth (m)	Static Water Level (m)
4104066	Overburden	4-Oct-64	4.6	Domestic	Water Supply	Gravel	---	3.7
4104067	Bedrock	2-Mar-59	20.4	Domestic	Water Supply	Rock	19.8	4.3
4104068	Bedrock	3-Apr-63	22.6	Domestic	Water Supply	Limestone	15.2	6.1
4104123	Bedrock	5-Nov-59	34.1	Domestic	Water Supply	Limestone	25.9	6.1
4105503	Overburden	14-Aug-71	11.0	Domestic	Water Supply	Sand	6.7	6.7
4107158	Bedrock	2-Apr-75	24.1	Industrial	Water Supply	Limestone	24.1	1.8
4107278	Bedrock	30-Jul-75	47.5	Industrial	Water Supply	Limestone	47.5	10.1
4108825	Bedrock	11-May-79	29.3	Domestic	Water Supply	Limestone	28.0	5.5
4108826	Bedrock	5-May-79	39.6	Domestic	Water Supply	Limestone	38.4	8.2
4109219	Bedrock	26-May-80	20.7	Domestic	Water Supply	Limestone	20.7	3.7
4109814	Bedrock	3-Nov-82	22.3	Commercial	Water Supply	Limestone	22.3	2.4
4110016	Bedrock	26-Mar-84	21.3	Domestic	Water Supply	Limestone	21.3	4.0
4113585	Overburden	7-Feb-97	19.2	Domestic	Water Supply	Gravel	19.2	9.4
4114153	Overburden	30-Jun-99	10.7	Domestic	Water Supply	Gravel	9.1	5.5
4114695	Bedrock	18-Apr-01	25.9	Domestic	Water Supply	Limestone	25.9	11.3
4114788	Bedrock	15-Oct-01	48.8	Domestic	Water Supply	Limestone	33.5	12.8
4115664	Bedrock	8-Jun-04	22.6	Domestic	Water Supply	Limestone	21.9	7.9
7114507	---	30-Sep-08	10.1	Abandoned	---	---	---	---
7134358	Overburden	30-Oct-08	7.6	Monitoring	Test Hole	Gravel/Till	---	3.9
7201840	---	13-May-13	29.3	Abandoned	---	---	---	---
7254859	Overburden	17-Jul-15	20.4	Domestic	Water Supply	Gravel	18.9	8.2
7254883	---	17-Jul-15	22.6	Abandoned	---	---	---	---
7281174	---	16-Jan-17	---	---	---	---	---	---
7309859	Overburden	22-Feb-18	2.7	Monitoring	Test Hole	Silt Till	1.1	0.3

Eighteen (18) potable wells are registered within 500 m of the Site, typically set into bedrock aquifers. The bedrock was generally encountered at depths of 17 m to 26 m below existing grade. Two wells (MECP Well No. 4104066 and 4105503) were found to be drawing from a shallow aquifer, while MECP Well No. 4113585, 4114153, and 7254859 were installed in intermediate to deep confined gravel aquifers. Overburden soils noted in the MECP WWR varied from extensive sand and gravel units to an extensive clay unit with intermediate and deep sand/sand and gravel layers. These variations are consistent with Physiography, Quaternary, and Surficial Geology mapping of spillways, glaciofluvial deposits and till plains in the general area of the Site.

Groundwater flow across the Site is affected by the soil permeability, topography and drainage. The wells in the area indicate that potable water is generally found in intermediate and deep overburden, and bedrock aquifers.

4.4 Hydraulic Characteristics

Due to the dense state of the overburden materials, frequency of cobbles and boulders and sample recovery methods including split spoon sampling and auger samples, minimal sample recovery was available and representative samples of the sand and gravel soils could not be retrieved for gradation analysis from the boreholes advanced on Site.

Four (4) grain size distribution analyses were carried out on select soil samples collected from boreholes at the neighbouring property to the east, with results summarized in **Table 3** and shown graphically in **Appendix B**. Based on the grain size analyses, the hydraulic conductivity for the sand was about 4.6×10^{-3} cm/s and the sand and gravel ranged between 7.3×10^{-4} cm/s and 5.8×10^{-3} cm/s.

Table 3 – Gradation Results

Sample ID	Testing Method	Lithology	Estimated Hydraulic Conductivity (cm/s)
BH1/MW (EXP, 2020) 0.3 – 0.6 m bgs	Grain Size Analysis	Sand and Gravel, some Silt	2.5×10^{-3}
BH2, S2 & S3 (EXP, 2020) 1.5 – 3.0 m bgs	Grain Size Analysis	Sand and Gravel, trace Silt	5.8×10^{-3}
BH3 (EXP, 2020) 0.6 – 0.8 m bgs	Grain Size Analysis	Silty Gravelly Sand	7.3×10^{-4}
BH3, S3 (EXP, 2020) 2.3 – 2.7 m bgs	Grain Size Analysis	Sand, some Silt, trace Gravel	4.6×10^{-3}

The results of the hydraulic conductivity testing of the sand and gravel indicates an average hydraulic conductivity of approximately 3.0×10^{-3} cm/s. These results for a mixture of sand and sand and gravel are generally consistent with values reported by Freeze and Cherry (1979) for similar soils.

5. Hydrogeological Setting

Based on our understanding of the proposed development and the results of the current investigation, the following sections provide hydrogeological comments and discussion pertaining to the proposed development.

5.1 Sourcewater Protection

5.1.1 Significant Groundwater Recharge Areas (SGRA)

Groundwater recharge is largely controlled by soil conditions, and typically occurs in upland areas.

As defined in the Clean Water Act (2006), an area is a significant groundwater recharge area if,

1. The area annually recharges water to the underlying aquifer at a rate that is greater than the rate of recharge across the whole of the related groundwater recharge area by a factor of 1.15 or more; or

2. The area annually recharges a volume of water to the underlying aquifer that is 55% or more of the volume determined by subtracting the annual evapotranspiration for the whole of the related groundwater recharge area from the annual precipitation for the whole of the related groundwater recharge area.

An assessment report for the Upper Thames River Source Protection Area was completed by the Thames-Sydenham and Region Source Protection Committee. As defined by the Clean Water Act (2006) and identified by the Thames-Sydenham and Region Source Protection Committee, the Site is located within a SGRA.

5.1.2 Highly Vulnerable Aquifers (HVA)

The susceptibility of an aquifer to contamination is a function of the susceptibility of its recharge area to the infiltration of contaminants. As defined in the Clean Water Act (2006), the vulnerability of groundwater within a source protection area shall be assessed using one or more of the following groundwater vulnerability assessment methods:

1. Intrinsic susceptibility index (ISI).

2. Aquifer vulnerability index (AVI).

3. Surface to aquifer advection time (SAAT).

4. Surface to well advection time (SWAT).

In the Thames-Sydenham and Region, HVAs were mapped using the ISI method. The ISI method is an indexing approach using existing provincial Water Well Information System (WWIS) database. The ISI method is described in detail in the MECP's Technical Terms of Reference (2001). However, in short, the ISI method is a scoring system that takes into consideration the unique hydrogeologic conditions at a particular location. The scores are determined using a combination of the saturated thickness of each unit and an index number related to the soil type, and as such, the scores reflect the susceptibility of the aquifer to contamination.

As defined in the MECP's 2001 Technical Rules:

- an area having an ISI score of less than 30 is considered to be an area of high vulnerability;
- an area having an ISI score greater than or equal to 30, but less than or equal to 80, is considered to be an area of medium vulnerability; and,
- an area having an ISI score of greater than 80 is considered to be an area of low vulnerability.

The Thames-Sydenham and Region Source Protection Committee has determined, using the ISI method, that the Site is located within a HVA.

5.2 Shallow Overburden Groundwater Flow Direction

Shallow groundwater flow across the site is typically affected by the soil permeability, topography and drainage. Intermediate and deep aquifers are significantly less affected by surface conditions. The monitoring wells installed at the Site are set into the shallow groundwater. Boreholes BH101/MW and BH102/MW on Site as well as BH4/MW and BH5/MW on the neighbouring property to the east show a perched groundwater condition and are were not used to determine the direction of groundwater flow. Based on the groundwater depth measurements taken at monitoring wells BH106/MW, and BH107/MW on Site and BH1/MW on the neighbouring property on July 31, 2020, the inferred direction of shallow groundwater flow at the Site is in an southwesterly direction towards the North Thames River that is located west of the Site (**Drawing 11**). The groundwater generally appears to be found within the shallow sand & gravel layer in the boreholes. Further groundwater depth measurements over the winter and spring months will be evaluated to verify this.

No visible surface drainage features were observed on-Site however a surface drain is depicted on the adjacent property located immediately north of the Site (**Drawing 2**). This drain appears to run west and eventually discharge into the North Thames River. This surface drain is unlikely to be affected by the planned gravel extraction activities at the Site since the elevations along the north side of the Site are higher than measured groundwater elevations in the monitoring wells.

The highest groundwater elevations observed within the Site wells to date occur in July 2020. The lowest groundwater elevations were recorded on December 28, 2020.

5.3 Cross Section Drawings

Cross section drawings have been prepared to further illustrate the overall setting (**Drawings 8**, **9**, and **10**). The cross section locations are shown on **Drawing 7**. The sections are based on information from the topographical survey of the Site conducted by Harrington McAvan Ltd., and the borehole observations of the current investigation and the investigation performed on the property to the east of the Site.

Cross Sections A – A' and C – C' run generally from the west boundary through the length of the Site from west to east through to the neighbouring property. The sections depict the variation in topography along the length of the Site, the depth to groundwater and the natural undulations of the subsurface till.

Cross Section B – B' generally runs from southwest to northeast through the property and is terminated at the Site boundaries.

6. Considerations for Gravel Taking Activities

The proposed licence area is approximately 14.2 ha (hectares). Before aggregate extraction occurs, the topsoil and subsoil overlying the gravel deposits will be removed from each successive operational area and the material will be stored on-site generally within berms or used for progressive rehabilitation.

6.1 Well Decommissioning

No existing potable wells were observed onsite during EXP's Site work.

Monitoring wells were installed at the Site to document stabilized groundwater conditions. The wells are positioned such that they are on the edge of the planned gravel extraction activities and should be useful for ongoing monitoring of the groundwater levels at the Site as gravel extraction activities proceed in the future.

When the wells are determined to be no longer be required they should be properly decommissioned in accordance with Ontario Regulation 903. This regulation identifies that only certified and qualified well drilling technicians are permitted to direct the decommissioning work for existing wells.

Decommissioning a well which is no longer in use helps to ensure the safety of those in the vicinity of the well, prevents surface water infiltration into an aquifer via the well, prevents the vertical movement of water within a well, conserves aquifer yield and hydraulic head and can potentially remove a physical hazard.

Care should be taken to ensure that the disturbed soils are suitably restored, to satisfy the intended land use.

6.2 Site Rehabilitation

Iterative rehabilitation of extraction areas should be conducted on an ongoing basis as extraction proceeds, essentially filling the trailing edge of the extraction area as the extraction operations proceed across the Site. As recorded in the borehole logs, the overburden used for backfill will be the existing sandy silt fill and native sandy silt that currently overlies the aggregate deposit. In the event that imported materials are utilized to restore grades in the gravel extraction areas, the characteristics of the imported material (such as grain size and moisture content) should be reviewed by the geotechnical consultant to confirm that the material is suitable for use, and will not cause a significant reduction to the post-construction infiltration capacity.

The final proposed land use for the extraction area is rural/agricultural, after the subsoil and topsoil is replaced. The overall surface drainage patterns for the rehabilitated areas of the Site are expected to be similar to current conditions.

7. Proposed Extraction Impacts

7.1 Impacts to the Shallow Water Table

No significant changes or impact to the shallow groundwater table are anticipated as aggregate extraction will remain about 1.5 m above the seasonal high groundwater table. The presence of granular material extends below the shallow groundwater table and will permit shallow groundwater flow to occur below the area of extraction.

The extraction area may be limited to the west and south areas of the Site, where extensive sand and gravel deposits were encountered.

7.2 Impacts to Potable Wells and Local Water Supply

Based on the review of MECP Well Records, the recorded potable wells in the area are typically sourced from bedrock aquifers. Three (3) wells were sourced from intermediate to deep overburden aquifers which are generally confined below clay and glacial till strata. The two (2) shallow overburden wells are not expected to be impacted by excavations associated with the proposed gravel-taking operations at the site, given that the depth of extraction will remain 1.5 m above the seasonal high groundwater table.

The shallow depth aquifer is generally unconfined and tends to follow the surface topography. The underlying shallow sandy silt till exhibits a moderate to low permeability. The lower glacial till strata, contacted in most of the boreholes at the Site during the hydrogeological investigation, will effectively limit both the vertical and horizontal zone of influence impacting the wells, due to the low permeability of these soils. Any temporary dewatering operations which may be required to deal with groundwater seepage from the overlying sandy soils and gravel deposits are not expected to cause any long-term impacts to the aquifers which supply the nearby potable wells.

Based on a review of the well records recorded by MECP, no significant long-term impact is anticipated on the intermediate or deep wells, either quantitatively and qualitatively since the depth of the excavations for the gravel-taking operations are not expected to be deep enough to penetrate into the underlying aquifers.

7.3 Impacts to Shallow Groundwater Recharge

As noted previously, the Site is located within a significant groundwater recharge area. All extraction activities will take place above the stabilized groundwater level and short-term impacts to the shallow groundwater quantity are not anticipated.

7.4 At-Source Infiltration

The soils encountered in the boreholes located over the southern and western portion of the Site generally comprise topsoil overlying sand/sand and gravel deposits underlain by sandy silt till. The soils above the till in these areas have a lower percentage of fines (silt and clay) content, which is unlikely to significantly impact the feasibility of groundwater infiltration at the site, during and following gravel extraction activities.

The soil encountered in Boreholes BH101/MW, BH104 and BH105 located in the central, north, and eastern portions of the Site generally included topsoil overlying sandy silt fill and sandy silt with little or no depth of sand/sand and gravel overlying the sandy silt till. These soils have a higher percentage of fines (silt and clay), which could reduce the rate of groundwater infiltration if these soils are used as fill in other areas of the Site. Post-extraction changes to the Site could occur due to re-grading and replacing the granular materials with the lower conductivity excavated native sandy silt and fill soils.

7.5 Environmental Considerations and Water Quality

Analytical testing on the natural subgrade soils was not conducted as part of this investigation. However, it is important to note that Ontario Regulation 153 provides applicable standards for any fill material which will be brought to Site. For the purpose of importing and stockpiling materials at the Site, consideration should be given to selecting material which has concentrations consistent with, or less than the standard concentrations identified in O. Reg. 153 (last amended April 15, 2011) for Table 1 (residential land-use) compliance.

The proposed pit will have a spills action plan in place and controlled use and/or storage of fuel.

Concerns related to water quality during gravel extraction activities are generally limited to leaks and spills from heavy equipment, the use of lubricants, and fuel handling at the Site. These should be mitigated by confining fuel handling activities to the northeast portion of the Site where less permeable soil is found and no gravel-taking activities are planned. The use of spill containment equipment where fuel handling occurs, putting a spill action response plan in place and locating appropriate spill response equipment/materials on-Site so that any petroleum spills from trucks and heavy equipment (eg. fuel, hydraulic oil) can be quickly addressed will be necessary.

With the aforementioned measures in place, the use of fuel and lubricants on the Site will not present a significantly increased risk to the groundwater in the area.

7.6 Impact to Surface Water Features

There are no significant surface water features present within the area to be licensed. Natural environmental features that may rely on some groundwater contribution are not present at the Site.

As discussed earlier, the proposed extraction will not significantly or permanently affect water table elevations or groundwater flow patterns in the vicinity of the Site. Based on the proposed gravel extraction in relation to the hydrogeological setting and natural environmental features in the area of the Site, there is no potential for groundwater impacts on natural environmental features in the vicinity of the Site.

7.7 Monitoring, Mitigation and Contingency Plan

It is proposed that the final rehabilitated ground surface elevation at the Site will be above the elevation of the water table. Considering the scale of the proposed operations and the results of the impact assessment, additional mitigation and contingency plans are not anticipated to be necessary.

Monitoring at the Site should consist of routine compliance reporting for the operation, to ensure good operational practices and to ensure that the rehabilitation plan is completed. In addition, monitoring of the groundwater depths at the Site should continue on a quarterly basis to document the groundwater table elevations throughout the seasons.

8. Conclusions and Recommendations

8.1 Conclusions

Based on the results of Hydrogeological Assessment, the following findings are presented:

1) The predominant surficial materials at the subject site include natural deposits of sandy silt, sand/sand and gravel, and sandy silt till. Typically, the sandy silt till was encountered underlying the sand/sand and gravel layers and continued to borehole termination depth.

2) The predominant shallow groundwater flow direction (based on the recent groundwater depth measurements) is towards the southwest.

3) The area surrounding the subject site is not municipally serviced with water and sewer. Subdivision development east of Nissouri Road is however, municipally serviced. Based on a review of the Ministry of Environment, Conservation and Parks (MECP) Well Records, there are 18 potable water wells, two shallow monitoring wells, three abandoned wells, and one well with unknown use in the buffer area located within 500 m of the Site boundaries. The actual number of these wells that are still in use is unknown. With the exception of the monitoring and abandoned wells, the water supply wells in the area are set at various depths, generally ranging from approximately 5 to 49 m, into water-bearing sand and sand and gravel deposits or the underlying limestone (at depths of approximately 17 m or greater below ground surface). Overburden soils noted in the MECP WWR varied from extensive sand and gravel units to an extensive clay unit with intermediate and deep sand/sand and gravel layers. The majority of the potable wells are set into intermediate to deep overburden or bedrock aquifers. Based on the maximum depth of gravel extraction being 1.5 m above the seasonal high groundwater level, the few shallow wells are not expected to be impacted by gravel-taking operations at the Site. Based on a review of the well records recorded by MECP, no significant long-term impacts are anticipated to the wells, either quantitatively and qualitatively since the depth of the excavations for the gravel-taking operations are not expected to be deep enough to penetrate into the underlying water supply aquifers.

4) No existing potable groundwater wells were observed onsite during EXP's site work however MECP Well Records indicate possibly two water supply wells are located at the west border of the Site, near the commercial building. The bordering wells consist of one well installed in bedrock at 21 m below ground surface and another installed in the overburden materials. The overburden well was screened 9.8 m below ground surface in a gravel aquifer, confined below 9.1 m of clay soils.

5) The Site is located within a Significant Groundwater Recharge Area (SGRA) and the subject site is also located in an area that is classified as a highly vulnerable aquifer (HVA).

6) Hydraulic conductivities were estimated from samples obtained as part of the Geotechnical and Hydrogeological Investigation east of the Site (EXP, 2020), based on the results of Grain Size Distribution Analysis and calculations using Hazen's Formula. Hydraulic conductivities (K values) estimated for the sand/sand and gravel soils ranged from 7.3×10^{-4} cm/s to 5.8×10^{-3} cm/s. These hydraulic conductivities are consistent with published values for sand/sand and gravel.

7) Excavations could extend to a maximum depth of approximately 1.5 m above the stabilized groundwater level.

Seasonal groundwater depth measurements are currently underway at the Site and should continue until the spring of 2021 to ensure that the full range of seasonal variation in groundwater depths is observed at the Site. After that, once gravel-taking operations are underway, groundwater monitoring should be conducted on a quarterly basis and follow the requirements of the Aggregate Resources Act.

8.2 Recommendations

8.2.1 Spill Action Response Plan

Fuel handling activities should be directed towards the northeast portion of the Site where less permeable soil is found and limited gravel-taking activities are planned. Spill containment equipment should be utilized where fuel handling occurs, and the operators should be aware of the spill action response plan. The location of appropriate spill response equipment/materials should be clearly identified onsite, so that any petroleum spills from trucks and heavy equipment (eg. fuel, hydraulic oil) can be quickly addressed.

8.2.2 Groundwater Monitoring

Seasonal groundwater measurements are currently underway at the Site, and should continue until the spring of 2021, to ensure that a full range of seasonal groundwater levels are recorded for the Site. When gravel extraction operations commence, monitoring of the groundwater depths at the Site should continue on a quarterly basis to document the groundwater table elevations.

8.2.3 Well Decommissioning

When the wells are determined to be no longer required, they should be properly decommissioned in accordance with Ontario Regulation 903.

8.2.4 Site Restoration with Overburden Soils

The near surface overburden soils at the Site generally comprise sandy silt fill and sandy silt material, which overlies the granular deposits which are to be extracted from the Site. This material is expected to be stockpiled onsite and/or used to construct berms at the Site during the aggregate extraction operation and then later re-used to restore grades within the extracted area, as part of the Site rehabilitation work.

For the purpose of importing and stockpiling materials at the site, consideration should be given to selecting material which has concentrations consistent with, or less than the standard concentrations identified in O. Reg. 153 (last amended April 15, 2011) for Table 1 (residential land-use) compliance.

9. References

Barnett, P.J., Cowan, W.R. and Henry, A.P. 1981. Quaternary geology of Ontario, southern sheet; Ontario Geological Survey, Map 2556.

Chapman, L.J. and Putnam, D.F., 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, 270p.

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Freeze, R. A. and J.A. Cherry. 1979. Groundwater. Prentice-Hall Inc. New Jersey. 604 pp

Hewitt D. F. 1972. Paleozoic Geology of Southern Ontario, Ontario Div. Mines, GR105, Map 2254.

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Ontario Department of Mines and North Affairs. 1972. 1:253,440 scale, Physiography of the Southwestern Portion of Southern Ontario. Ontario Geological Survey, Map 2225.

Ontario Geological Survey (OGS0. 2010. Surficial geology of Southern Ontario, Miscellaneous Release--Data 128-REV.

Ontario Geological Survey (OGS). 2011. Bedrock Geology of Ontario, 1:250 000 scale, Miscellaneous Release Data 126-Revision 1.

10. Qualifications of Assessors

EXP Services Inc. provides a full range of environmental services through a full-time Earth and Environmental Services Group. EXP's Environmental Services Group has developed a strong working relationship with clients in both the private and public sectors and has developed a positive relationship with the Ontario Ministry of the Environment, Conservation and Parks (MECP). Personnel in the numerous branch offices form part of a large network of full-time dedicated environmental professionals in the EXP organization.

This report was authored by Mr. Eric Buchanan, P.Eng. Mr. Buchanan works in the Earth and Environment Discipline and has been thoroughly trained in conducting geotechnical and hydrogeological assessments. He obtained a Bachelor of Engineering Degree from Lakehead University and has been working in the geo-science field for 9 years. He has authored and reviewed reports for numerous projects including residential and commercial developments that require geotechnical and hydrogeological input, Level 2 hydrogeological assessments for underwater aggregate extraction, groundwater impact assessments and calculated groundwater removal quantities for short- and long-term construction. Mr. Buchanan oversees coordinating all of EXP's hydrogeological field operations for London and surrounding area. His responsibilities include designing work plans and hydrogeological modelling.

This assessment was completed under the supervision and direction of Mr. David Speller, P.Eng. who has been thoroughly trained in conducting geotechnical and hydrogeological assessments. Mr. Speller is a licensed professional engineer in the Province of Ontario. He obtained a Bachelor of Applied Science from University of Windsor in 1987. He practices and provides geoscience services under the Professional Engineers Act in Ontario. Mr. Speller is a Senior Project Manager in the Geotechnical Group in our London office, and has over 30 years of direct experience in the geotechnical and hydrogeological consulting industry. Over 8,000 projects have been completed under his supervision. Mr. Speller is an expert in the industry related to groundwater hydrogeology and geotechnical matters for land development and construction. He has been retained for many projects directly by landowners and developers as a Project Manager and as a geotechnical and hydrogeological consultant.

The senior review of this report was performed by Mr. Botel Chiu, M.Eng., P. Eng., QP. who is qualified in conducting geotechnical and hydrogeological assessments. He has obtained a master's degree specializing in geotechnical engineering, environmental and hydrogeological assessments and is a Qualified Person (QP) registered with the Ontario Ministry of Environment, Conservation and Parks (MECP). He has been a geoscience practitioner with over 32 years of direct experience in the earth and environmental consulting industry. Mr. Chiu has supervised over 10,000 projects under his direction, including groundwater impact, soil feasibility and aggregate resource assessments. He is currently the Regional Manager and Vice President of Earth and Environment Practice for Southwestern Ontario and is practicing geoscience assessment under the Guideline of Professional Engineers Providing Geotechnical Engineering Services within the Professional Engineers Act in Ontario and the Conservation Authority Guidelines for Development. He is a recognized technical specialist within the EXP organization and in the industry for the geotechnical and environmental fields. He has been qualified as an Exempted Engineer to conduct geoscience assessments such as hydrogeological evaluation and groundwater taking. Mr. Chiu has been retained by various developers, municipalities and conservation authorities as the technical expert in hydrogeological assessments and has testified as an expert witness in Ontario Municipal Board hearings and Municipal Councils related to environmental, geotechnical and hydrogeological matters for land development and construction. He has been retained by the City of London and other municipalities, and Provincial Agencies to be a consultant for his field of expertise.

11. General Comments

The information presented in this report is based on the interpretation of hydrogeological information provided to EXP and a limited investigation carried out by EXP designed to provide information to support an assessment of the current geotechnical and hydrogeological conditions within the subject property. The conclusions and recommendations presented in this report reflect site conditions existing at the time of the investigation. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent. Should this occur, EXP Services Inc. should be contacted to assess the situation, and the need for additional testing and reporting. EXP has qualified personnel to provide assistance in regards to any future geotechnical and environmental issues related to this property.

Our undertaking at EXP, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the engineering profession.

The comments given in this report are intended only for the guidance of design engineers. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be much 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 test pit results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

EXP Services Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not afforded the privilege of making this review, EXP Services Inc. will assume no responsibility for interpretation of the recommendations in this report.

This report was prepared for the exclusive use of **5026367 Ontario Inc.** and may not be reproduced in whole or in part, without the prior written consent of EXP, or used or relied upon in whole or in part by other parties for any purposes whatsoever. Any use which a third party makes of this report, or any part thereof, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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

Drawings

-LEGEND-

Approximate Site Boundary

BH101/MW Approximate Borehole/Monitoring Well Location

BH1/MW Approximate Borehole Monitoring Well Location (EXP, 2020)

Image Source: Google Earth Pro (July, 2018)

Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Borehole/Monitoring Well Location Plan
Prepared By: E.B.	Reviewed By: D.S.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
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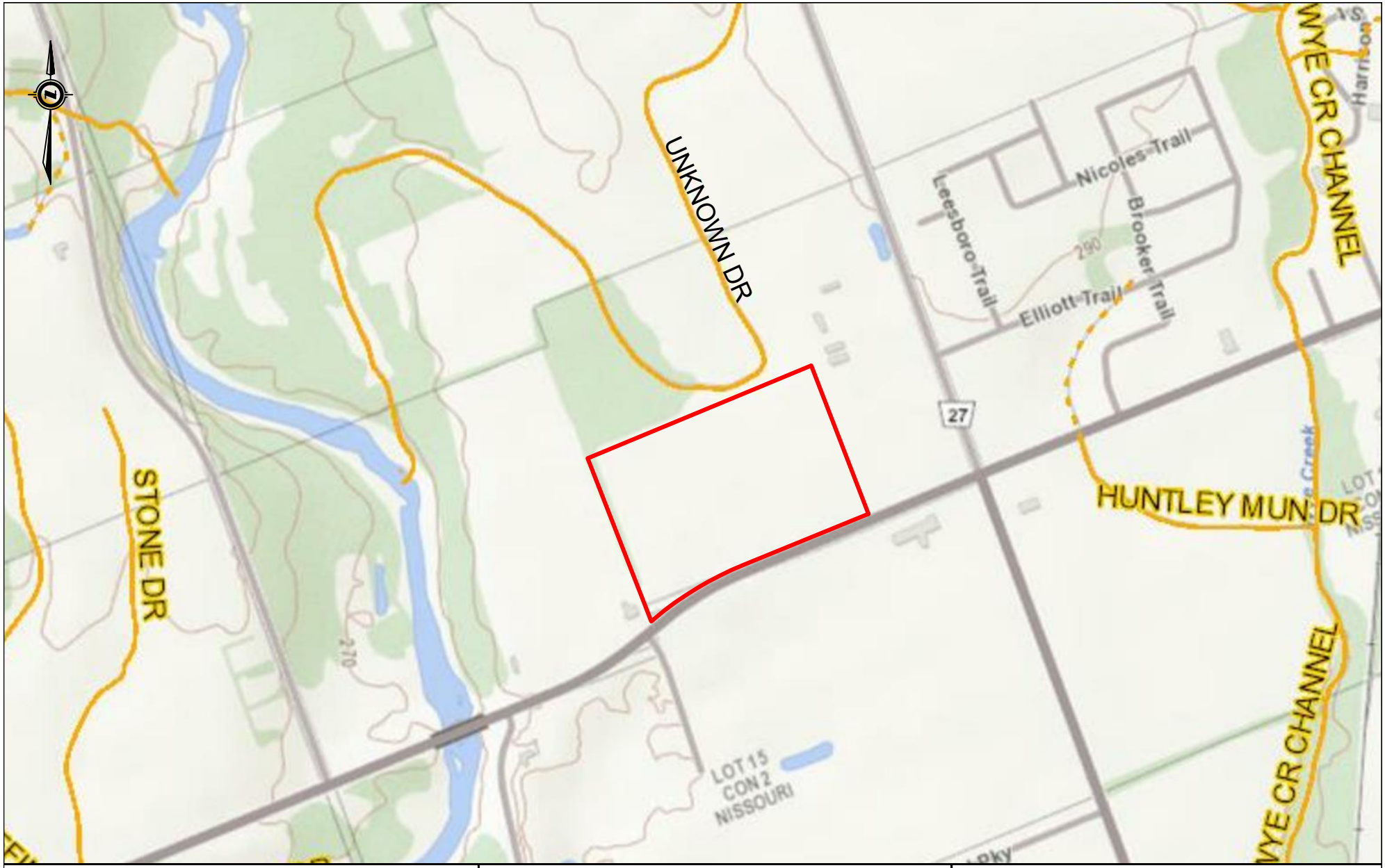

-LEGEND-

- Approximate Site Boundary
- Constructed Open/Unknown Drain
- Constructed Closed/Tiled Drain

Image Source: OMAFRA Mapping; www.giscoeapp.lrc.on.ca

Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Site Area Drainage
Prepared By: E.B.	Reviewed By: D.S.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
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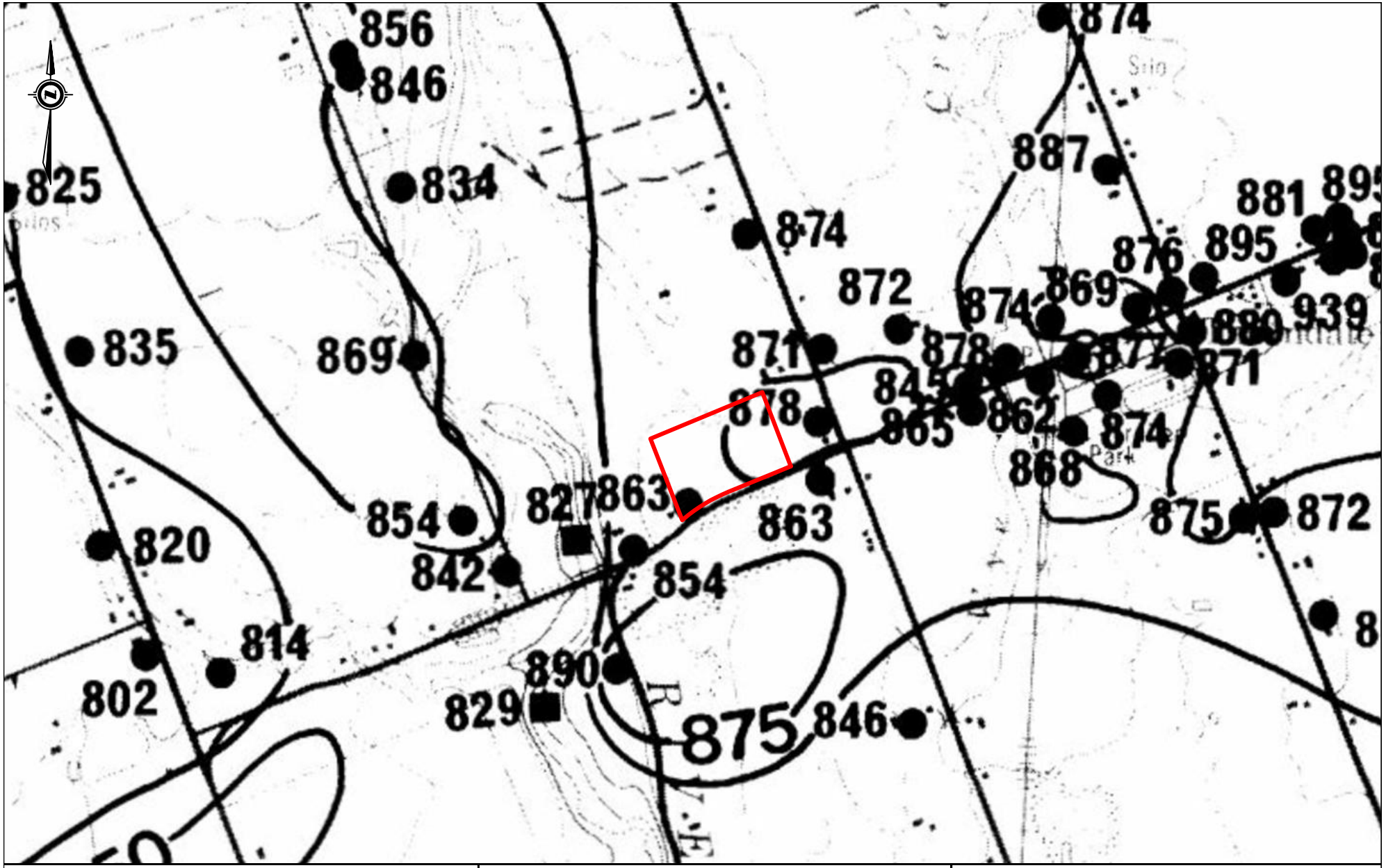


-LEGEND-

- Approximate Site Boundary
- 863 — Bedrock Surface Elevation in a Well or Test Hole (feet)
- 875 — Contours on Bedrock Surface (feet)

Image Source: Ontario Geological Survey. 1980. Bedrock Topography Series, Bedrock Topography of the Lucan Area, Southern Ontario. Preliminary Map P. 291 (REV).

Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Bedrock Topography
Prepared By: E.B.	Reviewed By: D.S.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
NOVEMBER 2020	1:20,000	LON-00018067-GE	3

-LEGEND-

- Approximate Site Boundary
- 3 — Spillways
- 5 — Till Plains (Undrumlinized)
- 11 — Sand Plains

Image Source: Chapman, L.J. and Putnam, D.F. 1984. Physiography of the Southwestern Portion of Southern Ontario; Ontario Geological Survey, Map P.2225.

Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Physiographic Landforms
Prepared By: E.B.	Reviewed By: D.S.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
NOVEMBER 2020	1:50,000	LON-00018067-GE	4

-LEGEND-

- Approximate Site Boundary
- 5 — Tavistock Till
- 22 — Glaciofluvial Ice
- 23 — Glaciofluvial Outwash deposits

Image Source: Barnett, P.J., Cowan, W.R. and Henry, A.P. 1991. Quaternary geology of Ontario, southern sheet; Ontario Geological Survey, Map 2556.

Hydrogeological Assessment

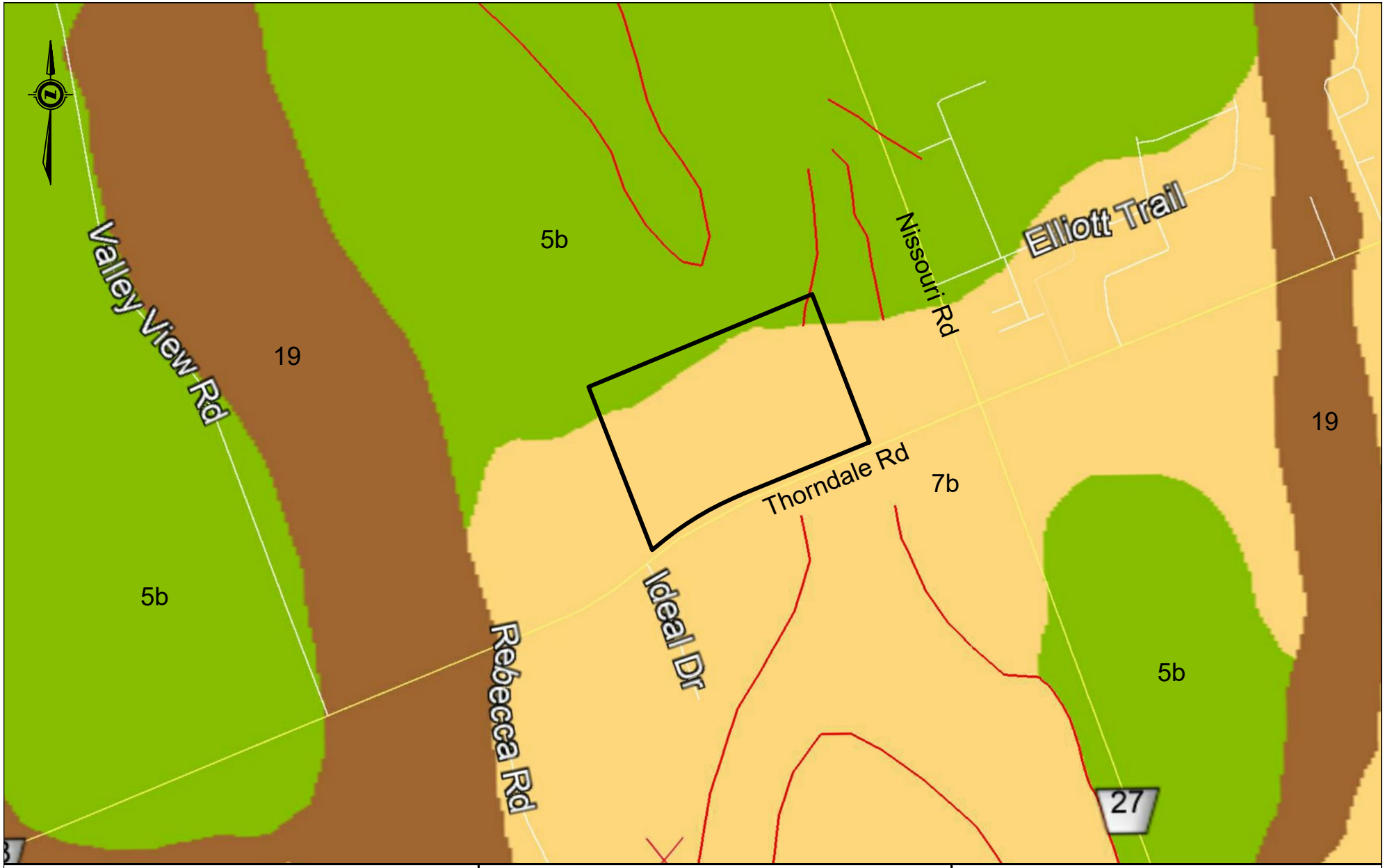
Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Quaternary Geology
Prepared By: E.B.	Reviewed By: D.S.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
NOVEMBER 2020	1:50,000	LON-00018067-GE	5



-LEGEND-

- Approximate Site Boundary
- 5b — 5b Till - Stone-poor, sandy silt to silty sand-textured till
- 7b — Glaciofluvial deposits
- 19 — Modern Alluvial deposits
- Fluvial Terrace

Image Source: The Ontario Geological Survey. 2003. Surficial Geology of Southern Ontario.

Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Surficial Geology
Prepared By: E.B.	Reviewed By: D.S.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

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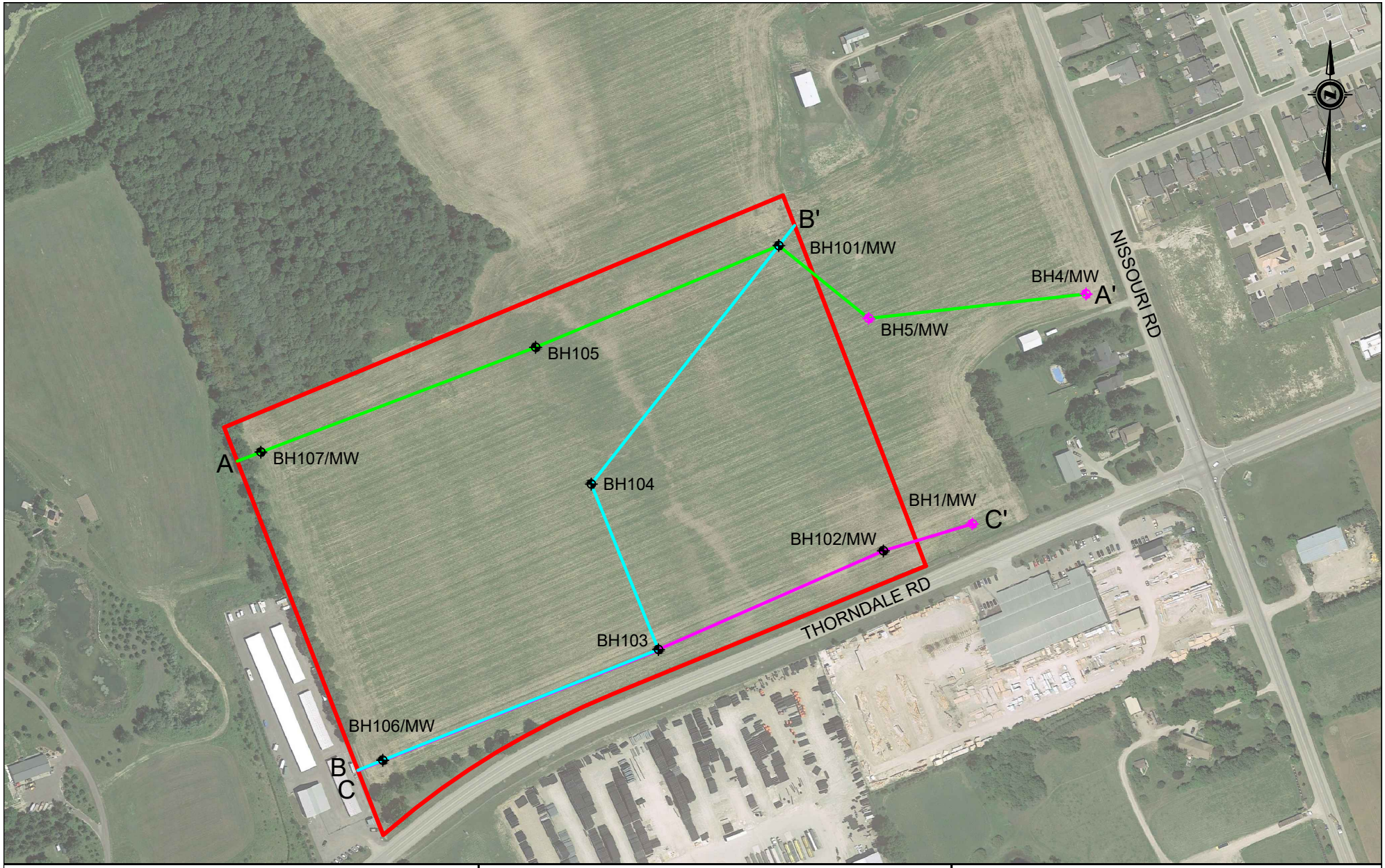
NOVEMBER 2020	1:10,000	LON-00018067-GE	6



-LEGEND-

- Approximate Site Boundary
- A — A' Cross Section Location
- BH101/MW Approximate Borehole/Monitoring Well Location
- BH1/MW Approximate Borehole/Monitoring Well Location (EXP, 2020)

Image Source: Google Earth Pro (July, 2018)

Hydrogeological Assessment

Watson Farm Aggregate Resources Study

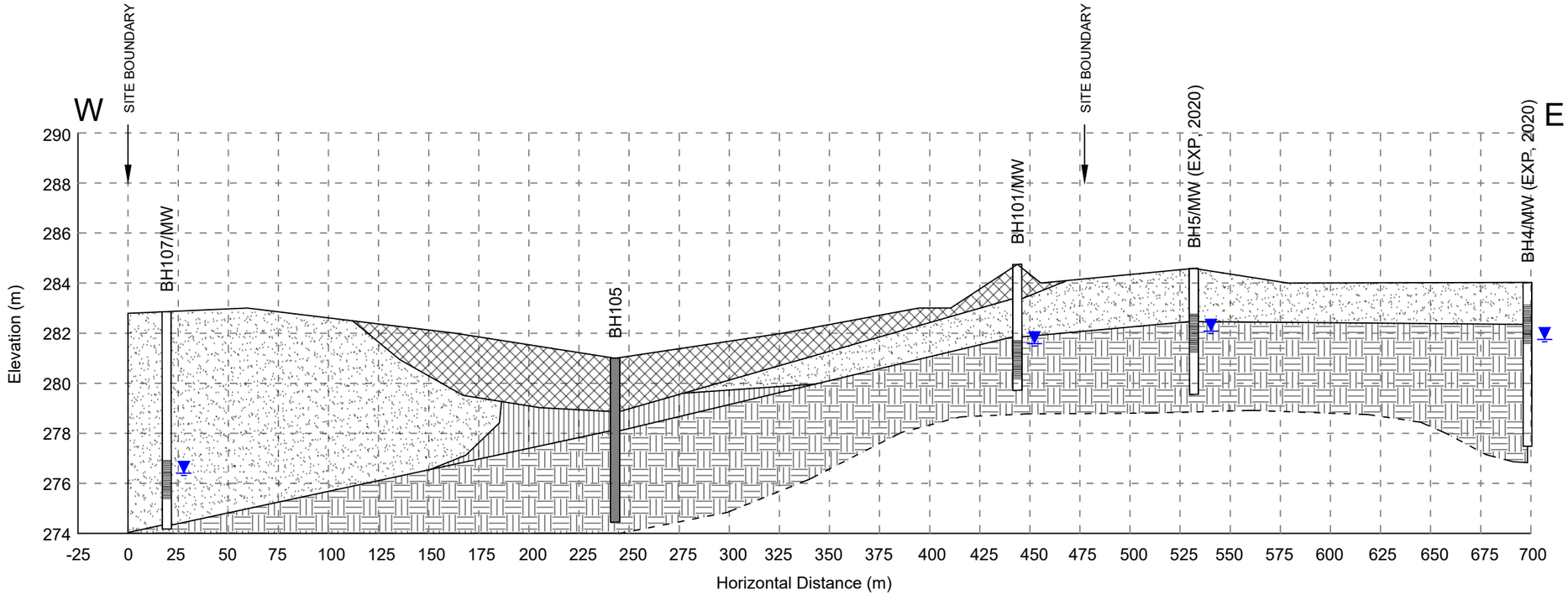
21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Cross Section Location Plan
Prepared By: E.B.	Reviewed By: D.S.

EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
NOVEMBER 2020	1:4,000	LON-00018067-GE	7

Generalized Cross Section A - A'



-LEGEND-

- Groundwater Measurement
- Fill
- Glacial Till
- Sandy Silt
- Sand/Sand and Gravel

-NOTES-

1. The cross section should be read in conjunction with EXP Hydrogeological Assessment LON-00018067-GE.

2. The water levels in the monitoring wells displayed in the cross section were measured on July 31, 2020.

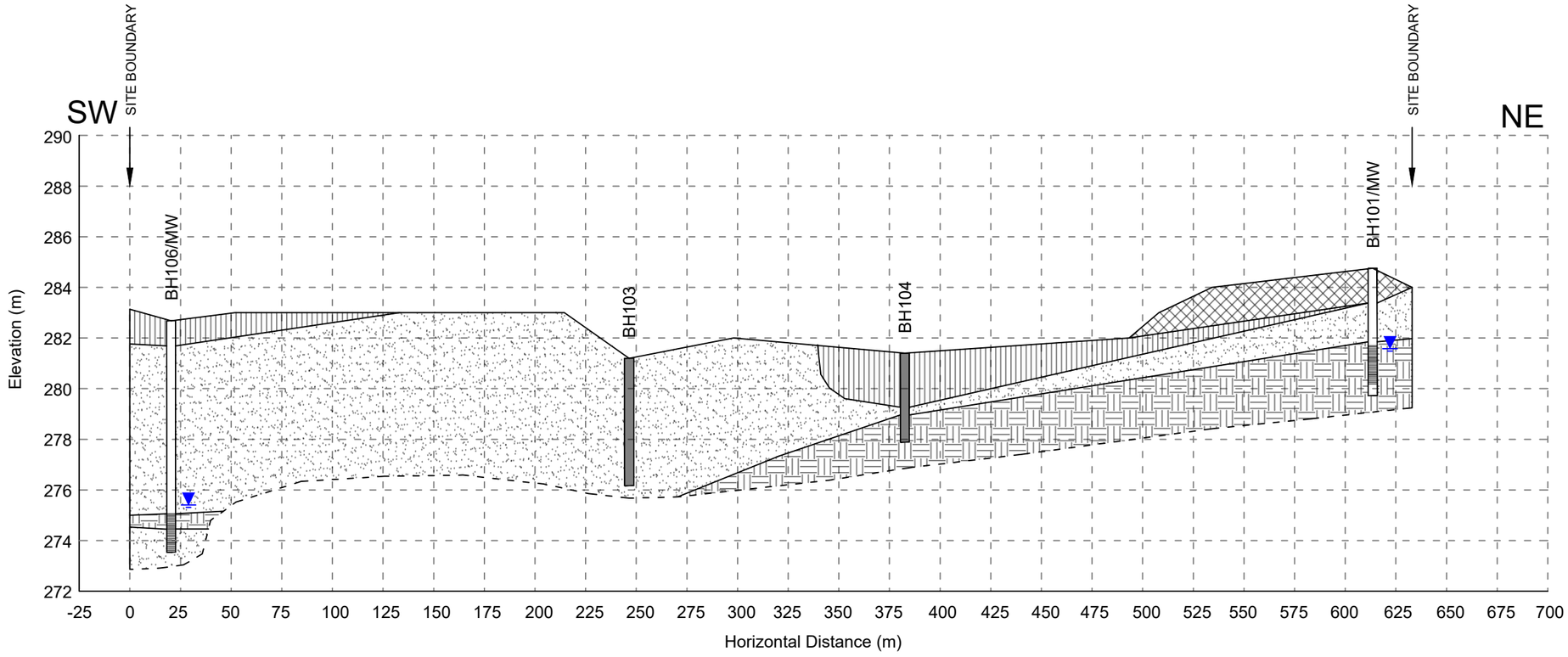
Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT: 1732435 Ontario Ltd.		
TITLE: Generalized Cross Section A - A'		
DRAWN BY: E.B.	REVIEWED BY: D.S.	DATE: NOVEMBER 2020
EXP Services Inc. 15701 Robin's Hill Road London, ON, N5V 0A5		
SCALE: H=1:2500, V=1:200	PROJECT NO.: LON-00018067-GE	DWG.: 8

Generalized Cross Section B - B'



-LEGEND-

- Groundwater Measurement
- Fill
- Glacial Till
- Sandy Silt
- Sand/Sand and Gravel

-NOTES-

1. The cross section should be read in conjunction with EXP Hydrogeological Assessment LON-00018067-GE.

2. The water levels in the monitoring wells displayed in the cross section were measured on July 31, 2020.

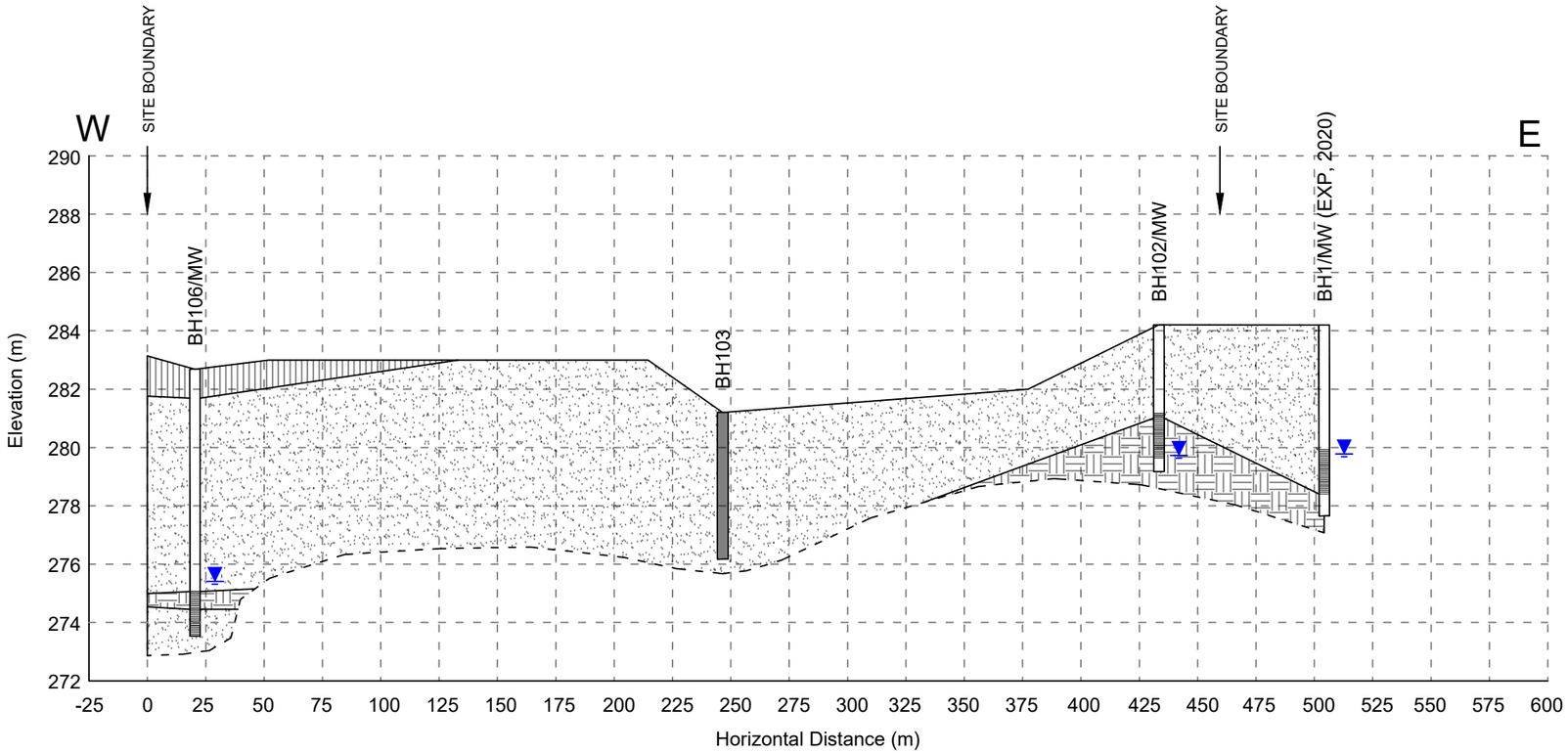
Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Generalized Cross Section B - B'
DRAWN BY:	E.B.
REVIEWED BY:	D.S.
DATE	NOVEMBER 2020
	EXP Services Inc. 15701 Robin's Hill Road London, ON, N5V 0A5
SCALE	H=1:2500, V=1:200
PROJECT NO.	LON-00018067-GE
DWG.	9

Generalized Cross Section C - C'



-LEGEND-

- Groundwater Measurement
- Fill
- Glacial Till
- Sandy Silt
- Sand/Sand and Gravel

-NOTES-

1. The cross section should be read in conjunction with EXP Hydrogeological Assessment LON-00018067-GE.

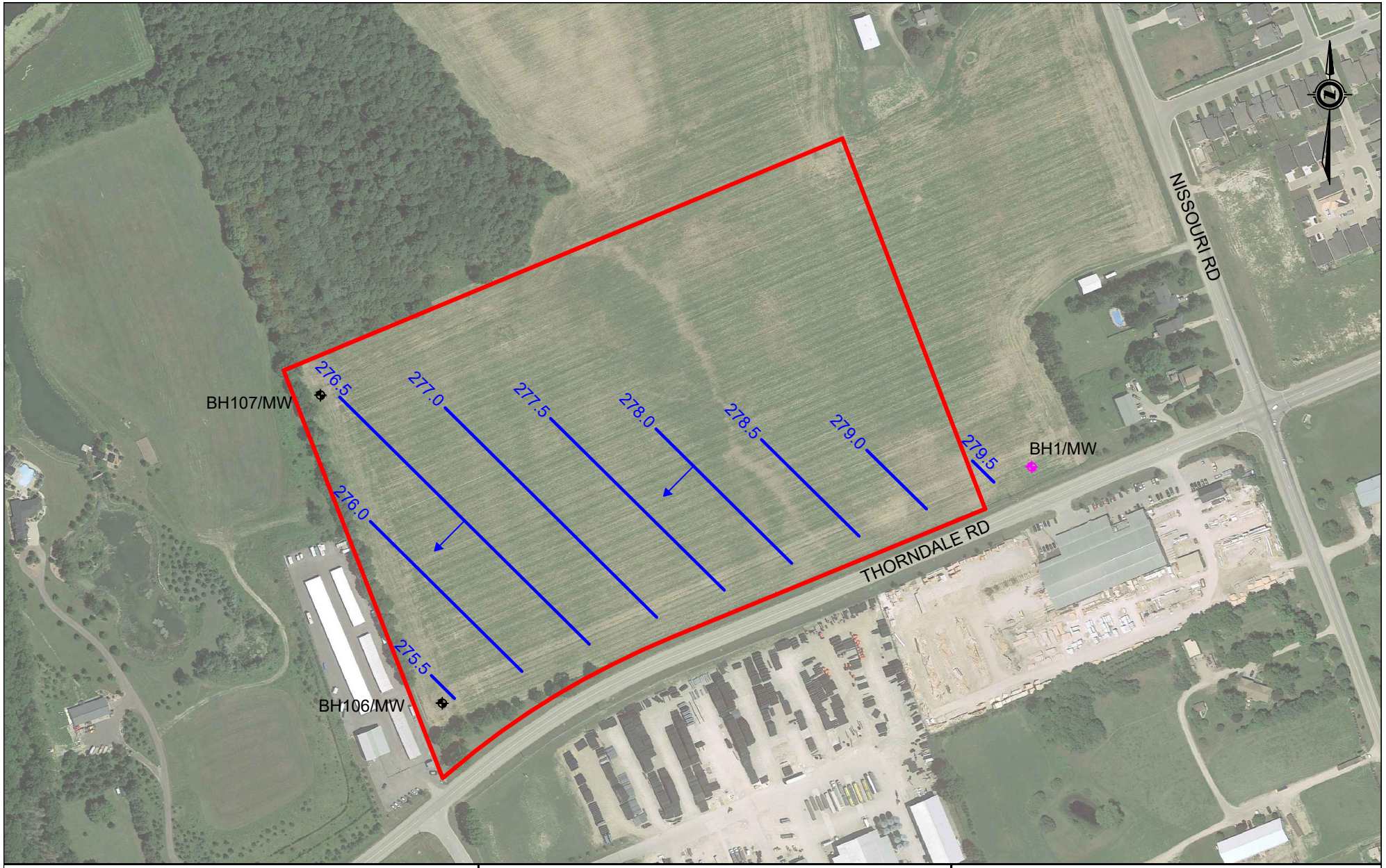
2. The water levels in the monitoring wells displayed in the cross section were measured on July 31, 2020.

Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT: 1732435 Ontario Ltd.			
TITLE: Generalized Cross Section C - C'			
DRAWN BY: E.B.	REVIEWED BY: D.S.	DATE: NOVEMBER 2020	
EXP Services Inc. 15701 Robin's Hill Road London, ON, N5V 0A5			
SCALE: H=1:2500, V=1:200	PROJECT NO.: LON-00018067-GE	DWG.: 10	



-LEGEND-

- Approximate Site Boundary
- BH101/MW — Approximate Borehole/Monitoring Well Location
- BH1/MW — Approximate Borehole/Monitoring Well Location (EXP, 2020)
- (279.78) — Groundwater Elevation (July 31, 2020)
- Groundwater Equipotential Line
- Inferred Groundwater Flow Direction

Image Source: Google Earth Pro (July, 2018)

Hydrogeological Assessment

Watson Farm Aggregate Resources Study

21875 Nissouri Road, Thorndale, Ontario

CLIENT	1732435 Ontario Ltd.
TITLE	Groundwater Flow Direction
Prepared By: E.B.	Reviewed By: D.S.

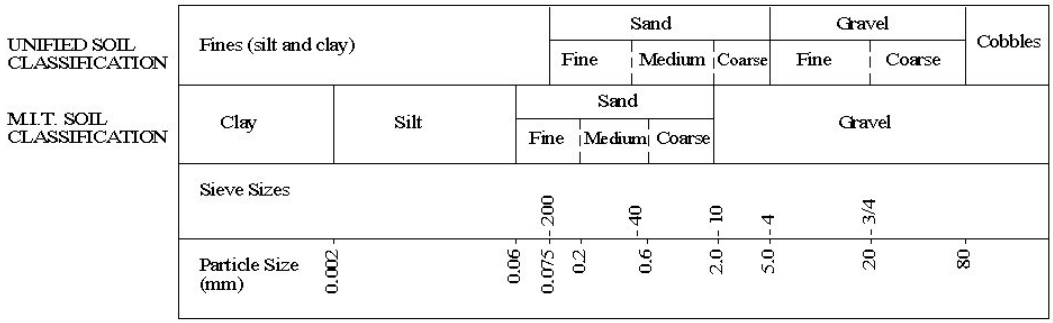
EXP Services Inc.
15701 Robin's Hill Road, London, ON, N5V 0A5

DATE	SCALE	PROJECT NO.	DWG.
NOVEMBER 2020	1:4,000	LON-00018067-GE	11

Appendix A – Borehole Logs

NOTES ON SAMPLE DESCRIPTIONS

1. All descriptions included in this report follow the 'modified' Massachusetts Institute of Technology (M.I.T.) soil classification system. The laboratory grain-size analysis also follows this classification system. Others may designate the Unified Classification System as their source; a comparison of the two is shown for your information. Please note that, with the exception of those samples where the grain size analysis has been carried out, all samples are classified visually and the accuracy of the visual examination is not sufficient to differentiate between the classification systems or exact grain sizing. The M.I.T. system has been modified and the EXP classification includes a designation for cobbles above the 75 mm size and boulders above the 200 mm size.



2. **Fill**: Where fill is designated on the test hole 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 test hole description therefore, may not be applicable as a general description of the site fill material. All fills should be expected to contain obstructions such as large concrete pieces or subsurface basements, floors, tanks, even though none of these obstructions may have been encountered in the test hole. Despite the use of test holes, the heterogeneous nature of fill will leave some ambiguity as to the exact and correct 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. The fill at this site has been monitored for the presence of methane gas and the results are recorded on the test hole logs. The monitoring process neither indicates the volume of gas that can be potentially generated or pinpoints the source of the gas. These readings are to advise of a potential or existing problem (if they exist) and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic waste that renders the material unacceptable for deposition in any but designated land fill sites; unless specifically stated, the fill on the site has not been tested for contaminants that may be considered hazardous. This testing and a potential hazard study can be carried out if you so request. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common, but not detectable using conventional geotechnical procedures.

3. **Glacial Till**: The term till on the test hole 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 in diameter) or boulders (greater than 200 mm diameter) and therefore, contractors may encounter them during excavation, even if they are not indicated on the test hole logs. It should be appreciated that normal sampling equipment can not differentiate the size or type of obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited area; therefore, caution is essential when dealing with sensitive excavations or dewatering programs in till material.

BOREHOLE LOG

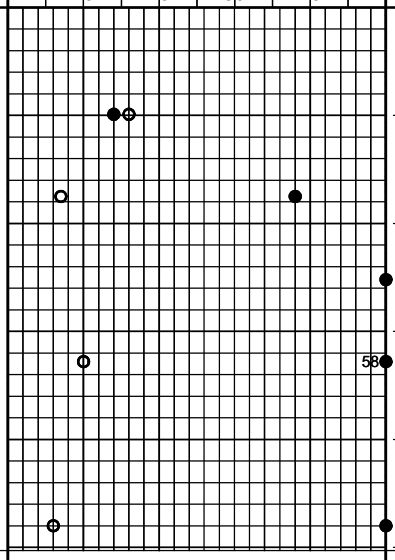
BH101/MW
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00018067-GE**
PROJECT **Watson Farm Aggregate Resources Study** DATUM **Geodetic**
LOCATION **21875 Nissouri Road, Thorndale, ON** DATES: Boring **June 15, 2020** Water Level **Jul 31/20**

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	284.7								
	284.4	**TOPSOIL** - 350 mm							
1		**FILL** - sandy silt, brown, some clay, trace gravel, trace organics, compact, moist			SS	S1	150	14	16
	283.4								
2		**SAND AND GRAVEL** - brown, trace to some silt, dense to very dense, damp - frequent cobbles and boulders throughout			SS	S2	100	38	7
					SS	S3	0	50 *	
	281.8								
3		**SANDY SILT TILL** - brown/grey, trace clay, trace gravel, very dense, very moist to moist - occasional cobbles			SS	S4	150	58	10
4									
	279.7				SS	S5	50	50 *	6
5		**End of Borehole at 5.0 m bgs.**							
6									
7									
8									
9									
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value Dynamic Cone
10 20 30 40



NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00018067-GE.
2) bgs denotes below ground surface.
3) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH102/MW
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00018067-GE**
PROJECT **Watson Farm Aggregate Resources Study** DATUM **Geodetic**
LOCATION **21875 Nissouri Road, Thorndale, ON** DATES: Boring **June 15, 2020** Water Level **Jul 31/20**

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	284.2								
	284.0	**TOPSOIL** - 250 mm							
1		**SAND AND GRAVEL** - brown, trace silt, dense to very dense, damp - frequent cobbles and boulders throughout			SS	S1	150	50 *	1
2					SS	S2	200	59	2
					SS	S3	250	41	2
3	281.0								
		SANDY SILT TILL - brown/grey, some clay, some gravel, compact to very dense, very moist to moist - occasional cobbles			SS	S4	350	19	13
4									
5	279.2				SS	S5	0	50 *	
		End of Borehole at 5.0 m bgs.							
6									
7									
8									
9									
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00018067-GE.
2) bgs denotes below ground surface.
3) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH103
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00018067-GE**

PROJECT **Watson Farm Aggregate Resources Study** DATUM **Geodetic**

LOCATION **21875 Nissouri Road, Thorndale, ON** DATES: Boring **June 15, 2020** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	281.2								
	281.0	**TOPSOIL** - 200 mm							
1		**SAND** - brown, fine to medium grained, trace silt, damp							
	279.7								
2		**SAND AND GRAVEL** - brown, trace silt, very dense, damp - frequent cobbles and boulders throughout			SS	S1	100	50*	1
3					SS	S2	100	50*	3
4									
5	276.2				SS	S3	0	50*	
		End of Borehole at 5.0 m bgs.							
6									
7									
8									
9									
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value Dynamic Cone
10 20 30 40

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00018067-GE.
2) bgs denotes below ground surface.
3) Borehole open and dry upon completion of drilling.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH104
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00018067-GE**

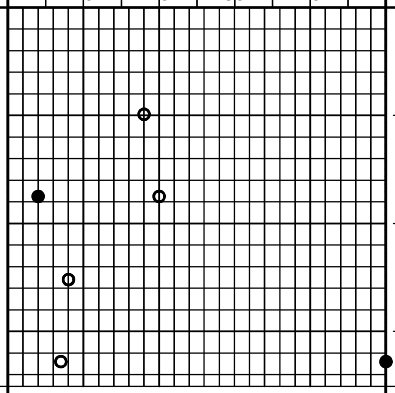
PROJECT **Watson Farm Aggregate Resources Study** DATUM **Geodetic**

LOCATION **21875 Nissouri Road, Thorndale, ON** DATES: Boring **June 16, 2020** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	281.4								
	281.1	**TOPSOIL** - 300 mm							
1		**SANDY SILT** - brown, some clay, loose, very moist			AS	S1			18
		- becoming wet with trace clay near 1.4 m bgs			SS	S2	200	4	20
2	279.3								
	279.0	**SAND AND GRAVEL** - brown, trace silt, damp							
		SANDY SILT TILL - brown, trace clay, some gravel, very dense, moist			AS	S3			8
3		- occasional cobbles - becoming grey near 2.9 m bgs							
	277.9	- possible boulder near 3.0 m bgs			SS	S4	0	50*	7
		End of Borehole at 3.5 m bgs.							
4									
5									
6									
7									
8									
9									
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value Dynamic Cone
10 20 30 40



NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00018067-GE.
2) bgs denotes below ground surface.
3) Borehole open and dry upon completion of drilling.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH105
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00018067-GE**

PROJECT **Watson Farm Aggregate Resources Study** DATUM **Geodetic**

LOCATION **21875 Nissouri Road, Thorndale, ON** DATES: Boring **June 16, 2020** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	281.0								
	280.8	**TOPSOIL** - 250 mm							
		FILL - sandy silt, brown, some clay, trace gravel, loose, very moist			AS	S1			21
1									
					SS	S2	100	4	20
2	278.9								
		SANDY SILT - brown, some clay, trace gravel, very moist to wet			AS	S3			25
	278.1								
3		**SANDY SILT TILL** - grey, some clay, trace gravel, compact to very dense, very moist to moist - occasional cobbles			SS	S4	250	11	17
4									
					SS	S5	300	61	9
5									
6									
	274.5				SS	S6	250	50*	6
		End of Borehole at 6.6 m bgs.							
7									
8									
9									
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

61

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00018067-GE.
2) bgs denotes below ground surface.
3) Borehole open to 5.8 m bgs and dry upon completion of drilling.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH106/MW
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00018067-GE**
PROJECT **Watson Farm Aggregate Resources Study** DATUM **Geodetic**
LOCATION **21875 Nissouri Road, Thorndale, ON** DATES: Boring **June 29, 2020** Water Level **Jul 31/20**

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	282.7								
	282.4	**TOPSOIL** - 300 mm							
		SANDY SILT - brown, trace clay, compact, moist							
1	281.7	**SAND AND GRAVEL** - brown, trace silt, compact to very dense, damp - occasional cobbles throughout			SS	S1	150	17	11
2					SS	S2	150	50*	2
					SS	S3	300	68	2
3					SS	S4	300	39	1
4									
5		- possible boulder encountered near 4.9 m bgs **Refusal met at 5.0 m bgs during initial drilling attempt (June 16, 2020).**			SS	S5	75	50*	2
6									
7	275.1								
		SANDY SILT TILL - brown/grey, some clay, some gravel, very moist							
8	274.4	**SAND AND GRAVEL** - brown, trace silt, very dense, wet - occasional cobbles			SS	S6	200	58	
9	273.5								
		End of Borehole at 9.1 m bgs.							
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

68
58

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00018067-GE.
2) bgs denotes below ground surface.
3) Borehole open to 4.3 m bgs and dry upon completion of drilling.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH107/MW
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00018067-GE**
PROJECT **Watson Farm Aggregate Resources Study** DATUM **Geodetic**
LOCATION **21875 Nissouri Road, Thorndale, ON** DATES: Boring **June 29, 2020** Water Level **Jul 31/20**

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	282.9								
	282.7	**TOPSOIL** - 200 mm							
		SAND AND GRAVEL - brown, trace silt, dense to very dense, damp - occasional cobbles throughout			SS	S1	100	44	2
1					SS	S2	50	50*	1
2					SS	S3	200	50*	4
3					SS	S4	0	50*	
		- possible boulder encountered near 3.7 m bgs **Refusal met at 3.7 m bgs during initial drilling attempt (June 16, 2020).**							
4									
5									
6									
7									
8									
	274.3								
	274.2	**SANDY SILT TILL** - grey, some clay, some gravel, very moist							
9		**End of Borehole at 8.7 m bgs.**							
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa
Atterberg Limits and Moisture
W_P W W_L
SPT N Value Dynamic Cone
10 20 30 40

NOTES

1) Borehole Log interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00018067-GE.
2) bgs denotes below ground surface.
3) Borehole open and dry upon completion of drilling.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

Borehole Logs (EXP, 2020)

BOREHOLE LOG

BH1/MW
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00017870-GE**
PROJECT **Watson Farm Development** DATUM **Geodetic**
LOCATION **21829 Nissouri Road, Thorndale, ON** DATES: Boring **March 24, 2020** Water Level **Jul 31/20**

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	284.2						
	283.9	**TOPSOIL** - 300 mm					
1		**SAND AND GRAVEL** - brown, trace to some silt, compact to dense, moist	SS	S1	300	18	5
2			SS	S2	200	30	5
3			SS	S3	250	28	4
			SS	S4	200	29	4
4		- becoming wet near 3.7 m bgs	SS	S5	200	32	6
5		- clayey silt layering encountered near 4.6 m bgs	SS	S6	250	30	
	278.4						
6	277.7	**CLAYEY SILT TILL** - grey, some sand, some gravel, hard, moist	SS	S7	250	50*	11
		End of Borehole at 6.6 m bgs.					
7							
8							
9							
10							

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00017870-GE.
2) bgs denotes below ground surface.
3) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH2
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00017870-GE**
PROJECT **Watson Farm Development** DATUM **Geodetic**
LOCATION **21829 Nissouri Road, Thorndale, ON** DATES: Boring **March 24, 2020** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	284.4								
	284.1	**TOPSOIL** - 250 mm							
	283.7	**CLAYEY SILT** - brown, weathered, trace sand, moist							
1		**SAND AND GRAVEL** - brown, trace silt, compact to dense, moist - cobble encountered near 1.0 m bgs			SS	S1	300	40	5
2					SS	S2	250	42	5
					SS	S3	200	28	7
3					SS	S4	300	17	4
4	280.3								
		SAND - brown, fine to medium grained, trace to some silt, compact, wet							
5					SS	S5	300	18	22
6	278.1								
	277.8	**SANDY SILT TILL** - grey, trace clay, some gravel, compact, wet			SS	S6	300	23	19
		End of Borehole at 6.6 m bgs.							
7									
8									
9									
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00017870-GE.
2) Borehole open to 2.4 m bgs and dry upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH3
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00017870-GE**

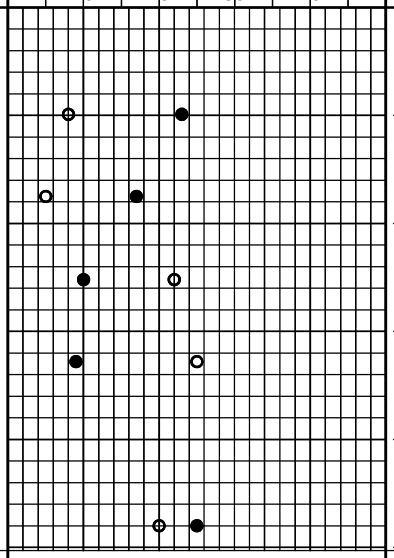
PROJECT **Watson Farm Development** DATUM **Geodetic**

LOCATION **21829 Nissouri Road, Thorndale, ON** DATES: Boring **March 24, 2020** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	283.6								
	283.3	**TOPSOIL** - 300 mm							
	283.0	**CLAYEY SILT** - brown, weathered, trace sand, moist							
1		**SAND AND GRAVEL** - brown, trace to some silt, compact, moist - silty in upper levels - cobble encountered near 1.0 m bgs			SS	S1	150	23	8
2					SS	S2	150	17	5
	281.4	- becoming wet near 2.0 m bgs							
		SAND - brown, fine to medium grained, trace to some silt, trace gravel, loose to compact, wet		▽	SS	S3	300	10	22
3					SS	S4	400	9	25
	279.5								
4		**SAND AND GRAVEL** - brown, trace silt, compact, wet							
	278.5				SS	S5	300	25	20
5		**End of Borehole at 5.0 m bgs.**							
6									
7									
8									
9									
10									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40



NOTES

1) Borehole interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00017870-GE.
2) Borehole open to 3.7 m bgs and groundwater measured near 3.0 m bgs upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

BOREHOLE LOG

BH4/MW
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00017870-GE**
PROJECT **Watson Farm Development** DATUM **Geodetic**
LOCATION **21829 Nissouri Road, Thorndale, ON** DATES: Boring **March 24, 2020** Water Level **Jul 31/20**

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	284.0								
	283.7	**TOPSOIL** - 300 mm							
1		**SAND AND GRAVEL** - brown, trace silt, compact to very dense, moist - cobble encountered near 1.0 m bgs			SS	S1	200	52	5
	282.3	- becoming wet near 1.7 m bgs							
2		**CLAYEY SILT TILL** - brown, trace sand, trace gravel, very stiff, moist			SS	S2	300	21	7
					SS	S3	400	17	15
3		- becoming grey near 2.9 m bgs			SS	S4	450	17	16
4	280.0								
		SANDY SILT TILL - grey, trace to some clay, trace gravel, very dense, moist			SS	S5	200	50*	7
5									
6					SS	S6	200	50*	6
	277.5								
		End of Borehole at 6.6 m bgs.							
7									
8									
9									
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00017870-GE.
2) bgs denotes below ground surface.
3) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH5/MW
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00017870-GE**
PROJECT **Watson Farm Development** DATUM **Geodetic**
LOCATION **21829 Nissouri Road, Thorndale, ON** DATES: Boring **March 24, 2020** Water Level **Jul 31/20**

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	284.6								
	284.3	**TOPSOIL** - 300 mm							
1		**SAND AND GRAVEL** - brown, trace silt, compact to dense, moist			SS	S1	200	23	4
					SS	S2	200	31	4
2	282.5	- becoming wet near 2.1 m bgs							
		SILT TILL - brown, trace to some clay, trace to some sand, trace gravel, very dense, moist			SS	S3	300	57	15
3					SS	S4	200	50*	18
		- becoming grey near 3.7 m bgs							
4					SS	S5	300	56	13
	279.6				SS	S6	300	50*	11
5		**End of Borehole at 5.0 m bgs.**							
6									
7									
8									
9									
10									

SHEAR STRENGTH
S Field Vane Test (#=Sensitivity)
Penetrometer Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
SPT N Value × Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00017870-GE.
2) bgs denotes below ground surface.
3) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
AS Auger Sample SS Split Spoon ST Shelby Tube
Rock Core (eg. BQ, NQ, etc.) VN Vane Sample

OTHER TESTS
G Specific Gravity C Consolidation
H Hydrometer CD Consolidated Drained Triaxial
S Sieve Analysis CU Consolidated Undrained Triaxial
γ Unit Weight UU Unconsolidated Undrained Triaxial
P Field Permeability UC Unconfined Compression
K Lab Permeability DS Direct Shear

WATER LEVELS
Apparent Measured Artesian (see Notes)

BOREHOLE LOG

BH6
Sheet 1 of 1

CLIENT **1732435 Ontario Ltd.** PROJECT NO. **LON-00017870-GE**

PROJECT **Watson Farm Development** DATUM **Geodetic**

LOCATION **21829 Nissouri Road, Thorndale, ON** DATES: Boring **March 24, 2020** Water Level

DEPTH (m bgs)	ELEVATION (~m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N VALUE (blows)	MOISTURE CONTENT (%)
0	283.7								
	283.4	**TOPSOIL** - 300 mm							
1		**SANDY SILT** - brown, weathered, some clay, loose, very moist			SS	S1	150	8	17
	282.5								
2		**SAND AND GRAVEL** - brown, trace silt, dense to very dense, moist - becoming wet near 2.1 m bgs		▽	SS	S2	150	35	13
		- silt layering encountered near 2.5 m bgs			SS	S3	150	60	12
3	280.5								
		SANDY SILT TILL - grey, trace clay, trace gravel, very dense, moist - very moist to wet in upper 0.6 m			SS	S4	300	21	9
4									
5	278.5				SS	S5	150	50 *	8
		- possible cobble/boulder encountered near 5.2 m bgs **End of Borehole at 5.2 m bgs due to auger refusal.**							
6									
7									
8									
9									
10									

SHEAR STRENGTH
✤ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
100 200 kPa

Atterberg Limits and Moisture
W_P W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

60

NOTES

1) Borehole interpretation requires assistance by EXP before use by others. Borehole Log must be read in conjunction with EXP Report LON-00017870-GE.
2) Borehole open to 2.1 m bgs and groundwater measured near 1.8 m bgs upon completion of drilling.
3) bgs denotes below ground surface.
4) No significant methane gas concentration was detected upon completion of drilling.

SAMPLE LEGEND
☒ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▯ Rock Core (eg. BQ, NQ, etc.) ▯ VN Vane Sample

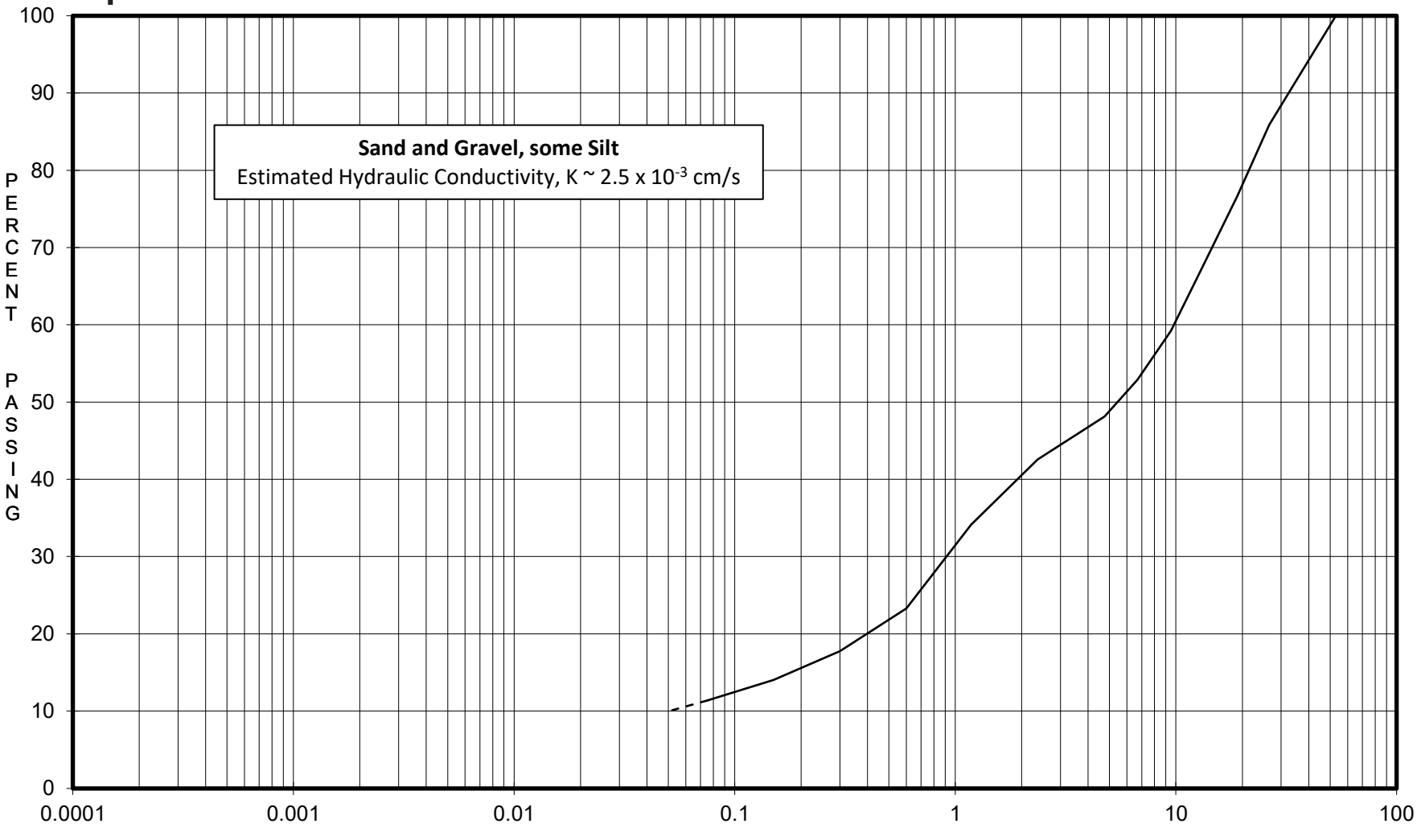
OTHER TESTS

G Specific Gravity	C Consolidation
H Hydrometer	CD Consolidated Drained Triaxial
S Sieve Analysis	CU Consolidated Undrained Triaxial
γ Unit Weight	UU Unconsolidated Undrained Triaxial
P Field Permeability	UC Unconfined Compression
K Lab Permeability	DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

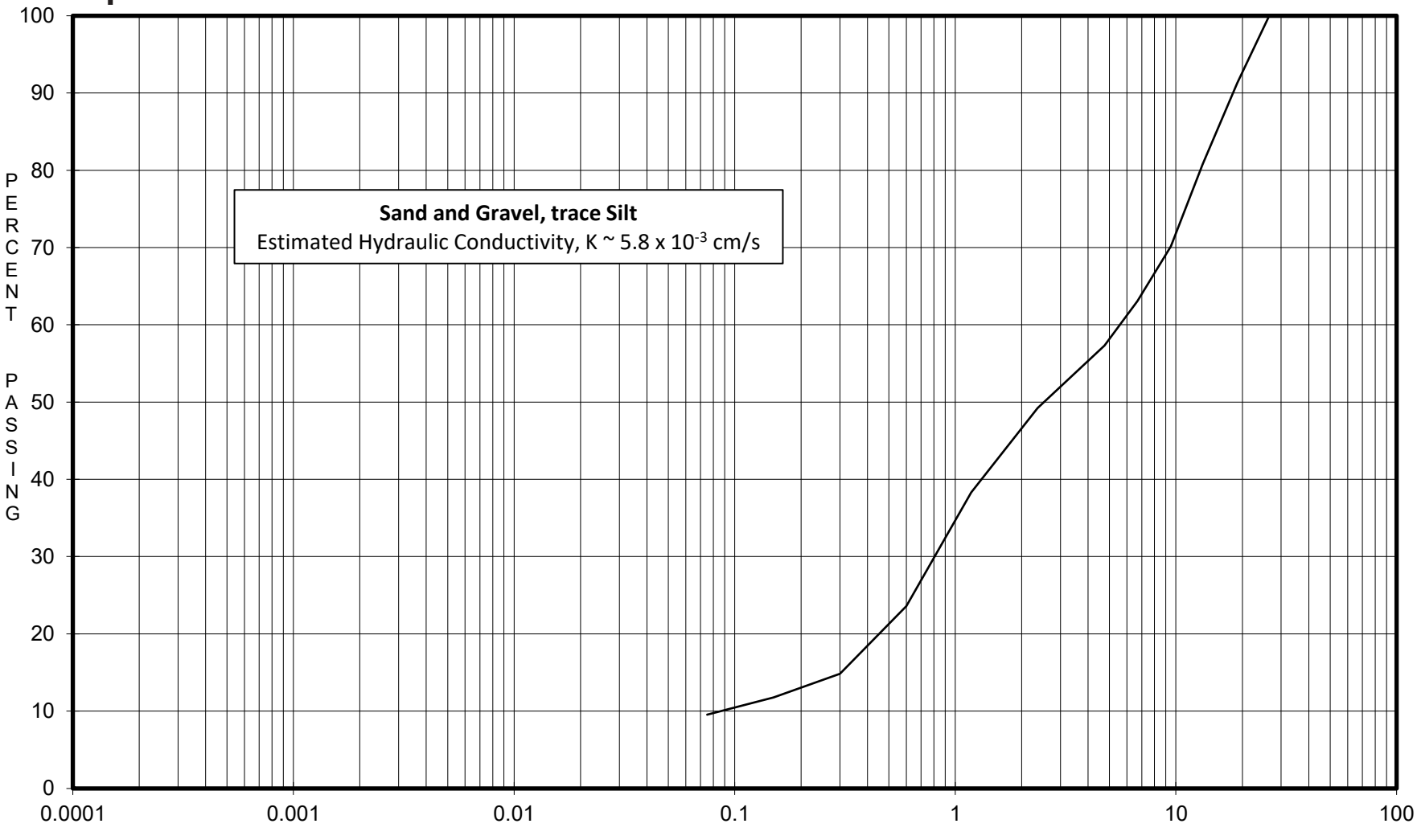
Appendix B – Grain Size Distribution Analyses

MECHANICAL GRAIN SIZE ANALYSIS



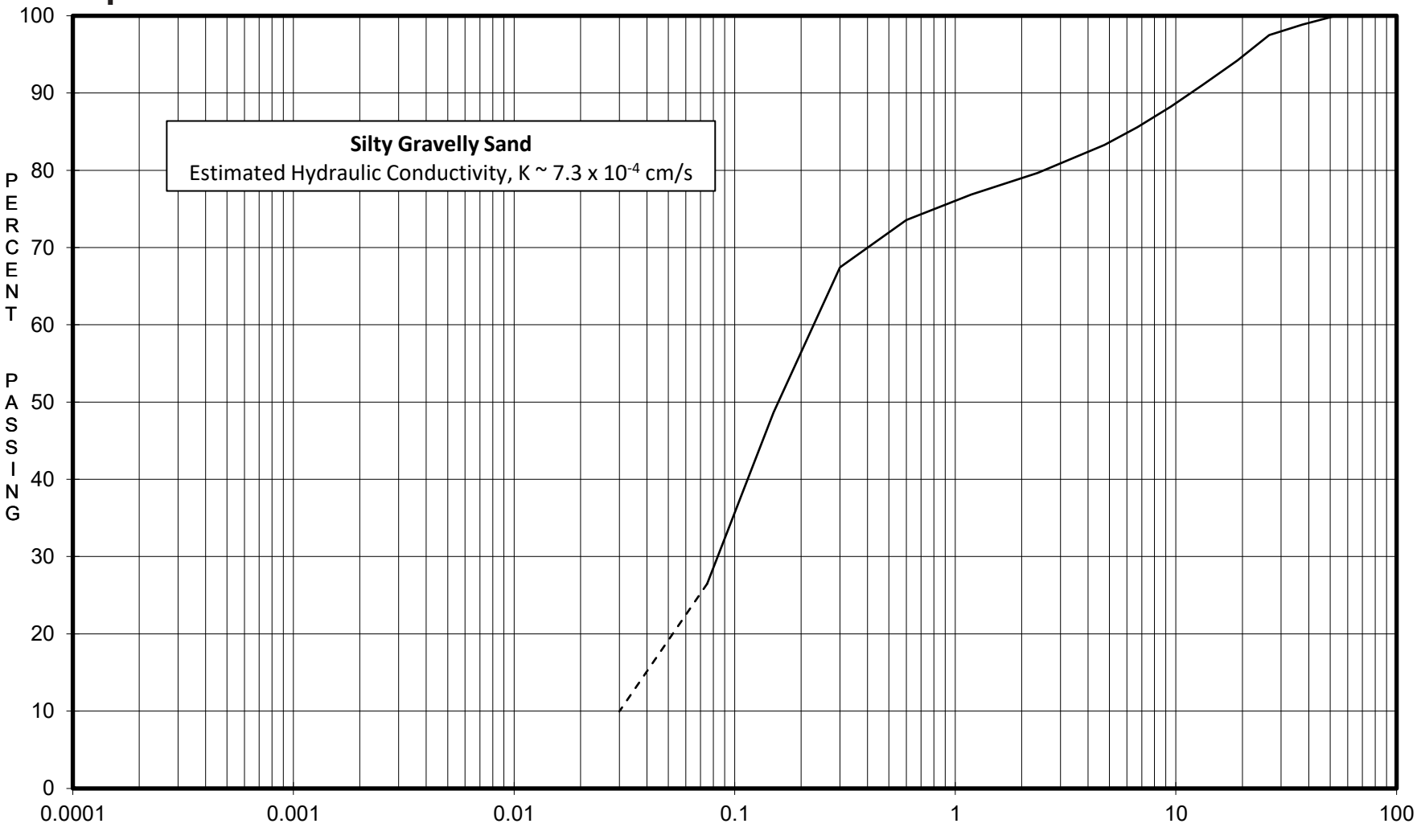
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			
MODIFIED M.I.T. CLASSIFICATION	**Sample Description:** **Sand and Gravel (Borehole BH1, 0.3 to 0.6 m depth)**						**Watson Farm Development** **Project: LON-00017870-GE**			**Figure 1**

MECHANICAL GRAIN SIZE ANALYSIS



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			
MODIFIED M.I.T. CLASSIFICATION	**Sample Description:** **Sand and Gravel (BH2 S2&S3, 1.5 to 3.0 m depth)**						**Watson Farm Development** **Project: LON-00017870-GE**			**Figure 2**

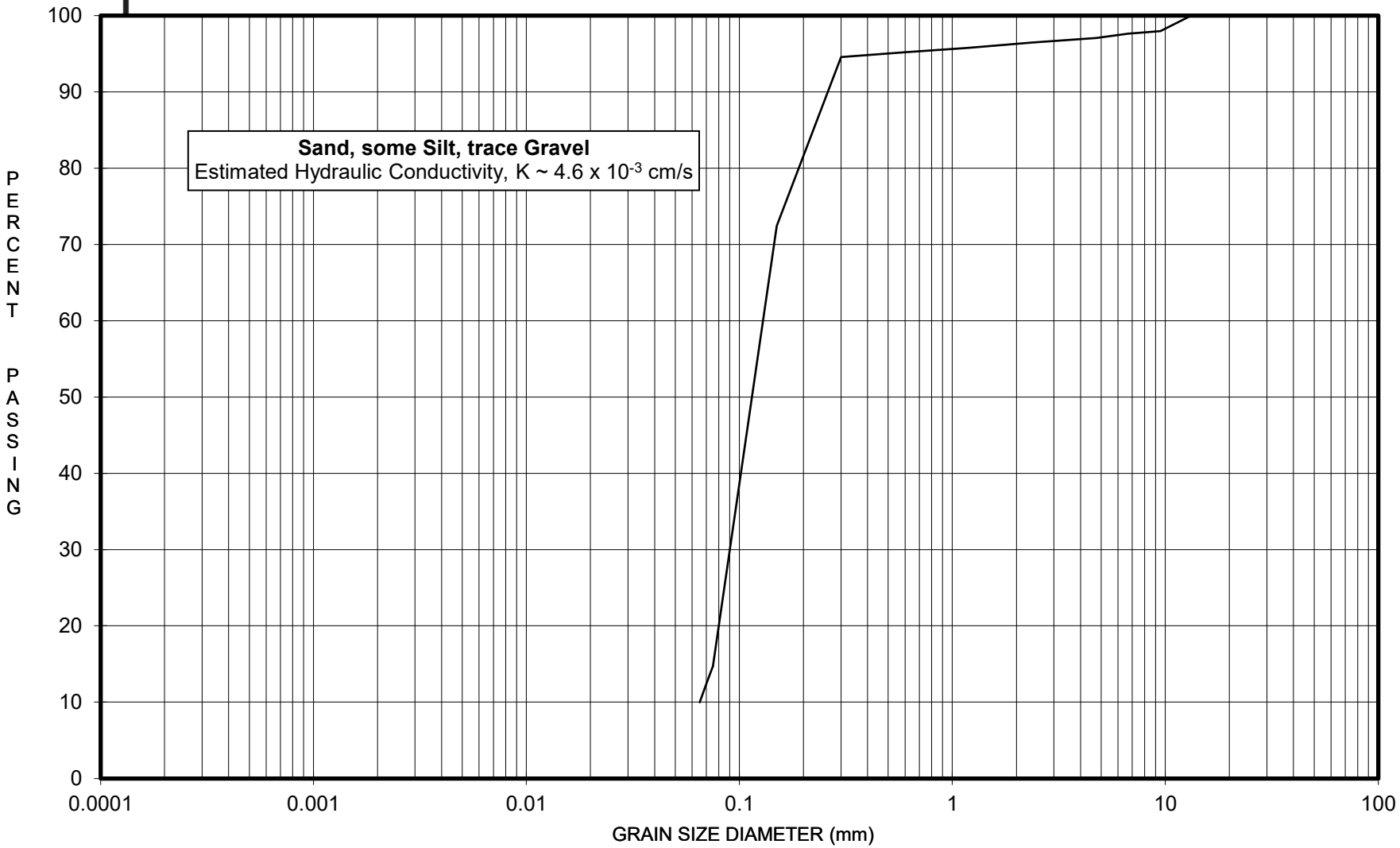
MECHANICAL GRAIN SIZE ANALYSIS



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			

MODIFIED M.I.T. CLASSIFICATION	**Sample Description:** **Silty Gravelly Sand (Borehole BH3, 0.6 to 0.8 m depth)**	**Watson Farm Development** **Project: LON-00017870-GE**	**Figure 3**

MECHANICAL GRAIN SIZE ANALYSIS



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	
	SILT			SAND			GRAVEL			

MODIFIED M.I.T. CLASSIFICATION	**Sample Description:** **Sand (BH3 S3, 2.3 to 2.7 m depth)**	**Watson Farm Development** **Project: LON-00017870-GE**	**Figure 4**

Appendix C – Stabilized Groundwater Measurements

Table C-1 - Stabilized Groundwater Measurements

Well ID	Ground Surface Elevation	Top of Pipe Elevation	Groundwater Elevation (m)										
	(m)	(m)	26-Mar-20	10-Apr-20	15-Apr-20	19-May-20	15-Jun-20	31-Jul-20	31-Aug-20	30-Sep-20	22-Oct-20	25-Nov-20	28-Dec-20
BH101/MW	284.75	285.70	---	---	---	---	---	281.58	281.49	281.24	281.24	281.11	281.07
BH102/MW	284.21	285.13	---	---	---	---	---	279.73	279.72	279.73	279.71	279.70	279.68
BH106/MW	282.68	283.40	---	---	---	---	---	275.41	275.20	275.05	274.98	274.90	274.88
BH107/MW	282.86	283.61	---	---	---	---	---	276.41	276.28	276.20	276.15	276.09	276.06
BH1/MW (17870)	284.20	284.98	280.59	280.63	280.57	280.29	280.17	279.78	279.38	279.17	279.13	279.09	279.07
BH4/MW (17870)	284.03	284.65	282.51	282.55	282.53	282.42	282.14	281.75	281.59	281.59	281.55	281.57	281.57
BH5/MW (17870)	284.59	285.49	283.12	282.51	282.46	282.32	282.37	282.08	282.04	282.04	282.02	Dry	Dry

Appendix D – Limitations and Use of Report

LIMITATIONS AND USE OF REPORT

BASIS OF REPORT

This report ("Report") is based on site conditions known or inferred by the geotechnical investigation undertaken as of the date of the Report. Should changes occur which potentially impact the geotechnical condition of the site, or if construction is implemented more than one year following the date of the Report, the recommendations of EXP may require re-evaluation.

The Report is provided solely for the guidance of design engineers and on the assumption that the design will be in accordance with applicable codes and standards. Any changes in the design features which potentially impact the geotechnical analyses or issues concerning the geotechnical aspects of applicable codes and standards will necessitate a review of the design by EXP. Additional field work and reporting may also be required.

Where applicable, recommended field services are the minimum necessary to ascertain that construction is being carried out in general conformity with building code guidelines, generally accepted practices and EXP's recommendations. Any reduction in the level of services recommended will result in EXP providing qualified opinions regarding the adequacy of the work. EXP can assist design professionals or contractors retained by the Client to review applicable plans, drawings, and specifications as they relate to the Report or to conduct field reviews during construction.

Contractors contemplating work on the site are responsible for conducting an independent investigation and interpretation of the test pit results contained in the Report. The number of test pits necessary to determine the localized underground conditions as they impact construction costs, techniques, sequencing, equipment and scheduling may be greater than those carried out for the purpose of the Report.

Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates are based on investigations performed in accordance with the standard of care set out below and require the exercise of judgment. As a result, even comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations or building envelope descriptions involve an inherent risk that some conditions will not be detected. All documents or records summarizing investigations are based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated. Some conditions are subject to change over time. The Report presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, these should be disclosed to EXP to allow for additional or special investigations to be undertaken not otherwise within the scope of investigation conducted for the purpose of the Report.

RELIANCE ON INFORMATION PROVIDED

The evaluation and conclusions contained in the Report are based on conditions in evidence at the time of site inspections and information provided to EXP by the Client and others. The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose as communicated by the Client. EXP has relied in good faith upon such representations, information and instructions and accepts no responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of any misstatements, omissions, misrepresentation or fraudulent acts of persons providing information. Unless specifically stated otherwise, the applicability and reliability of the findings, recommendations, suggestions or opinions expressed in the Report are only valid to the extent that there has been no material alteration to or variation from any of the information provided to EXP.

STANDARD OF CARE

The Report has been prepared in a manner consistent with the degree of care and skill exercised by engineering consultants currently practicing under similar circumstances and locale. No other warranty, expressed or implied, is made. Unless specifically stated otherwise, the Report does not contain environmental consulting advice.

COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment form part of the Report. This material includes, but is not limited to, the terms of reference given to EXP by its client ("Client"), communications between EXP and the Client, other reports, proposals or documents prepared by EXP for the Client in connection with the site described in the Report. In order to properly understand the suggestions, recommendations and opinions expressed in the Report, reference must be made to the Report in its entirety. EXP is not responsible for use by any party of portions of the Report.

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