TIL Toronto Inspection LTD.
GEO-ENVIRONMENTAL CONSULTANTS

HYDROGEOLOGICAL INVESTIGATION
452 RAGLAN STREET
COLLINGWOOD, ONTARIO

REPORT NO.: 4688-17-HG
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REVISION NO.: 01

PREPARED FOR:
EDEN OAK MCNABB INC.
833 HURONATRIO STREET
COLLINGWOOD, ONTARIO
L9Y 0G7

110 KONRAD CRESCENT, UNIT 16, MARKHAM, ONTARIO L3R 9X2
TEL.: 905-940-8509 FAX: 905-940-8192

Table of Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1 Introduction

1.1 Project Background

Toronto Inspection Ltd. (TIL) was retained by Eden Oak McNabb Inc. (the client) to conduct a hydrogeological investigation at 452 Raglan St, Collingwood, ON (the “Site”). This hydrogeological investigation was conducted in accordance with the *Hydrogeological Assessment Submissions: Conservation Authority Guidelines for Development Applications*, dated June 2013, prepared by Cuddy et al.

The Client’s contact information is as follows:

Eden Oak Mcnabb Inc.
833 Hurontario Street
Collingwood, Ontario
L9Y 0G7

The following drawings and plans were reviewed as part of this investigation:

- Draft Plan of Subdivision – MacNaughton Hermsen Britton Clarkson Planning Limited (MHBC), November 21, 2021
- Preliminary Site Grading Plan – Crozier Consulting Engineers (Crozier), August 2021
- Preliminary Servicing Plan – Crozier Consulting Engineers (Crozier), August 2021
- Preliminary SWM Facility Plan – Crozier Consulting Engineers (Crozier), August 2021

Based on a review of the Draft Plan of Subdivision (MHBC, 2021), the Site is composed of two parts. Part 1 is the area for major development consisting of the construction of 21 single detached units with a 1-level basement, 24 townhouse units with a 1-level basement, a stormwater management (SWM) area, a park, walkways, and open space. Part 2 is an existing gravelly driveway to the property from Raglan Street east of the Site.

The location of the Site is shown in **Figure 1**. Copies of the drawings and plans referenced above are provided in **Appendix A**.

1.2 Site Description

The Site consists of a trapezoid-shaped area as the main body, and a driveway connecting to Ragland Street. The main area is located approximately 250 m west of Raglan Street, 320 m north of Poplar Sideroad, east of a Train Trial, and immediately on the south end of Williams Street and Peel Street. The Site is located within Nottawasaga Concession 8, Lot 44 in the Town of Collingwood, County of Simcoe at the approximate UTM coordinates provided below:

UTM Zone:	17
Easting:	563750
Northing:	4926208

The Site is currently a vacant land. There was a one-storey dwelling in the northwest of the Site, however, it was demolished. More than half of the area in west half of the Site is used as cropland. The area north of the driveway is covered by grasses and some trees, on the south, east of the cropland is a natural conservation area. The area immediately surrounding the Site has land-uses of residential to north, west, and south, and recreational and industrial to the east.

1.3 Objectives of the Hydrogeological Investigation

The objectives of this hydrogeological investigation were to identify regulations applicable to the development of the Site, characterize the existing geological and hydrogeological conditions at the Site, identify dewatering requirements for the during and post-construction phases, qualify potential impacts to underlying aquifers and surrounding receptors resulting from construction and potential dewatering activities and provide recommendations for mitigation.

1.4 Scope of Work

1.4.1 Conceptual Understanding

A conceptual understanding of the regional and local geological and hydrogeological systems was developed through the review of existing reports and available geological information. This included:

- Source water protection plans and associated technical reports;
- Mapping and reports by Nottawasaga Valley Conservation Authority (NVCA);
- Geological and Hydrogeological Information from Ontario Geological Survey (OGS);
- Geological and hydrogeological information from the Oak Ridges Moraine Groundwater Program (ORMGP);
- Geological and Hydrogeological Information from Ontario Ministry of Natural Resources and Forestry (MNRF); and
- Water well and Permit to Take Water (PTTW) records from the Ministry of the Environment, Conservation, and Parks (MECP) Water Well Information System (WWIS) and PTTW database.

1.4.2 Field Investigation

The local scale geological and hydrogeological settings of the Site were characterized using a network of twenty-four boreholes installed by TIL in November 2017. Boreholes were completed to depths ranging from 5.33 m below ground surface (bgs) to 10.67 mbgs. Of these 24 boreholes, seven were completed as monitoring wells, with Schedule 40 PVC riser pipe and 3.05 m (10 foot) long #10-slot sized screens to depths between 4.55 mbgs to 10.67 mbgs. Monitoring wells located on-Site were used to measure static groundwater levels, to conduct in-situ hydraulic conductivity testing, and to collect representative groundwater quality samples.

Monitoring wells were installed according to the relevant provisions of Regulation (Reg.) 903 by a specialized drilling contractor with TIL staff in attendance. Once it is determined that the monitoring wells installed within the Site are no longer required, they should be decommissioned by a licensed well contractor as per Reg. 903.

1.4.3 Data Analysis

The data analysis component of this hydrogeological investigation included the following items:

- Determination of soil stratigraphy and hydrostratigraphy;
- Determination of groundwater elevations, including the seasonal high elevation;
- Assessment of hydraulic conductivity of overburden soils;
- Evaluation of potential dewatering requirements for the Site;
- Identification of groundwater usage in the area and surrounding sensitive receptors; and
- Options for short-term and long-term mitigation of potential impacts to natural features, sensitive receptors, and vulnerable areas from development of the Site.

2 Relevant Regulations and Policies

Environmental regulations and policies which may be relevant for this hydrogeological investigation are listed below and discussed briefly:

- Town of Collingwood Official Plan – Office Consolidation January 2019;
- Simcoe County Official Plan (2016)
- Town of Collingwood Sewer Use By-Law No. 2009-118;
- Nottawasaga Valley Conservation Authority (NVCA) Policies and Regulations (Reg. 172/06);
- The Ontario Water Resource Act (1990);
- Reg. 387/04: Water Taking And Transfer;
- The Clean Water Act (2006); and
- South Georgian Bay Lake Simcoe Source Protection Plan (2021).

Town of Collingwood Official Plan

The Town of Collingwood Official Plan identifies development and land-use objectives for the Town. Based on a review of the Official Plan mapping Schedule ‘A’, the Site is located within a Residential area. The area around Pretty River that flows along the Site’s eastern boundary falls within an Environmental Protection area.

Simcoe County Official Plan

The Simcoe County Official Plan sets out directions and policies that guide economic, environmental and community planning decisions for the County. Based on a review of the Official Plan mapping Schedule 5.1, the Site is located within the Settlements area. As per Schedule 5.2.5, the Site is within a Highly Vulnerable Aquifer (HVA). As per Schedule 5.2.6, the Site is within a Significant Groundwater Recharge Area (SGRA).

The Site does not fall within the Niagara Escarpment Plan Area, the Oak Ridges Moraine Conservation Plan (ORMCP) Area, the Greenbelt Plan Area, the Special Development Area: Big Bay Point, or any Areas of Natural and Scientific Interest (ANSIs) as identified on Official Plan mapping.

Town of Collingwood Sewer Use By-Law No. 2009-118

The Town of Collingwood regulates the discharge of private water to their storm and sanitary sewers, which are located on roads owned and maintained by the Town. Should any private water within the Site require discharge to the Town’s system, be it during or after construction, an approval from the Town will be required. The Town will review discharge plans, water quality, and estimated volumes to determine if the sewers can accommodate the discharge flows and issue a permit authorizing those discharges. Discharge permits are submitted to the Town for final approval before discharge to the sewer system can proceed.

NVCA Policies and Regulations (Reg. 172/06)

Under Section 28 of the Conservation Authorities Act, the local conservation authorities are mandated to protect the health and integrity of the regional greenspace system and to maintain or improve the hydrological and ecological functions performed by valley and stream corridors. The NVCA, through its regulatory mandate, is responsible for issuing permits under *Reg. 172/06: Nottawasaga Valley Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.*

A review of the NVCA (2021) regulation mapping indicates that the Site partially falls within a NVCA regulated area, specifically the area that buffers Pretty River and its associated woodlots and wetland on the eastern and southern portion of the Site. Consultation with the NVCA is recommended to identify any permitting requirements associated with the proposed development.

Ontario Water Resource Act (1990)

Under Section 34 of the Ontario Water Resources Act (OWRA), a PTTW is required from the MECP for any water taking that is greater than 50,000 L/day. For water takings related to construction site dewatering or road construction, water takings of more than 50,000 L/day but less than 400,000 L/day may be registered on the Environmental Activity and Sector Registry (EASR) under Reg. 63/16 – *Water Takings*. Water takings during construction that will exceed more than 400,000 L/day will require a PTTW issued by the MECP; water takings post-construction that will exceed 50,000 L/day will also require a PTTW issued by the MECP.

Reg. 387/04 Water Taking and Transfer Regulation

Reg. 387/04 under the OWRA describes the relevant assessment criteria and outlines certain prohibited water taking and transfer activities that are evaluated by the MECP prior to issuing a PTTW as well as for applicants who are self-registering on the EASR. The regulation also clarifies certain prescribed activities that are exempt from the PTTW/EASR requirements and outlines the data collection and reporting commitments for PTTW and EASR registration holders. Any water taking activity that is regulated by the OWRA will need to be undertaken in accordance with Reg. 387/04.

The Clean Water Act (2006)

The MECP mandates the protection of existing and future sources of drinking water under the Clean Water Act, 2006 (CWA). Initiatives undertaken under the CWA include the delineation of vulnerable drinking water quality areas, Wellhead Protection Areas (WHPA), SGRAs, Intake Protection Zone Areas (IPZs) and HVAs; as well as vulnerable drinking water quantity areas, WHPA-Q1, WHPA-Q2, and IPZ-Q.

Based on the review of the MECP (2021a) Source Protection Information Atlas, the Site falls within the Nottawasaga Valley Source Protection Area within the South Georgian Bay Lake Simcoe Source Protection Region (SGBLS SPR). The Site is within a HVA area with a vulnerability score of 6. The majority of the Site, except for a small area at the northwest corner, is within a SGRA area with a vulnerability score of 6.

South Georgian Bay Lake Simcoe Source Protection Plan

Source Protection Plans (SPPs) are developed under the CWA and identify the policies that restrict, regulate and prohibit land use activities within vulnerable drinking water areas. Local municipalities and regional governments are required under the CWA to implement the SPPs through integration into planning policy. The Site is located within the policy boundaries of the South Georgian Bay Lake Simcoe Source Protection Plan (SGBLS SPR, 2021).

As the proposed development is ‘major development’ located within a SGRA, a water balance study is required to evaluate the changes between pre-development and post-development. It is to our understanding that the water balance analysis will be provided as part of the Stormwater Management Report by Crozier Consulting Engineers.

3 Regional Geological and Hydrogeological Understanding

3.1 Topography and Drainage

The regional topography slopes northward from the topographic highs associated with the Nipissing Shorecliffe, south of the Site, to the topographic lows associated with the Georgian Bay of Lake Huron, north of the Site. The Site has a gentle downgradient slope towards Pretty River in the northeast and has an average elevation of 192 m above sea level (asl). A topographic map for the Site and surrounding area is presented in **Figure 2**.

The Site lies within the Blue Mountains Subwatershed which falls under the jurisdiction of the Nottawasaga Valley Conservation Authority (NVCA). The nearest surface water feature, Pretty River intersects the eastern Site boundary, flows northward and drains into the Georgian Bay of Lake Huron.

3.2 Physiography

The Site is situated within the physiographic region known as the Simcoe Lowlands. The Simcoe Lowlands physiographic region covers a total land area of approximately 2,850 km^2 and is subdivided into the Nottawasaga Basin and the Lake Simcoe Basin (Chapman and Putnam, 1984). The Simcoe Lowlands are generally characterized by flat, low-lying plains composed of silts, clays, and fine to medium-grained sands (Featherstone and Fortini, 2011).

The physiographic map of the Site and surrounding area is shown in **Figure 3**.

3.3 Surficial Geology

Mapping from the OGS (2010) indicates that the surficial geology for the majority of the Site is composed of coarse-textured glaciolacustrine deposits. The surficial geology for area around Pretty River along the east Site boundary is characterized as modern alluvial deposits.

The surficial geology at the Site and in the surrounding area is presented in **Figure 4.**

3.4 Bedrock Geology

Mapping from the OGS (2010) indicates that the bedrock unit underlying the Site is limestone of the Lindsay Formation. The top of bedrock is expected to be at elevations between approximately 186 masl in the northwest and 188 masl in the east (ORMGP, 2021).

The bedrock geology map is presented as **Figure 5**.

3.5 Regional Geology and Hydrogeology

The current understanding of the geological and hydrogeological environment is based on the scientific work conducted by, and information available from York Peel Durham Toronto Groundwater Management Study, Conservation Authorities Moraine Coalition (YPDT-CAMC) via their public mapping portal for the ORMGP (2021), and Approved Assessment Report: Nottawasaga Valley Source Protection Area prepared by South Georgina Bay Lake Simcoe Source Protection Committee (SGBLS SPC, 2015).

3.5.1 Hydrostratigraphy

Based on regional geology mapping available through the ORMGP (2021), the following hydrostratigraphic units overlie the bedrock (from youngest to oldest) within the area of the Site:

A. Recent Deposits
B. Halton Till (Aquitard)
C. Oak Ridges Moraine (Aquifer)
D. Newmarket Till (Aquitard)
E. Thorncliffe Formation (Aquifer)
F. Sunnybrook Drift (Aquitard)
G. Scarborough Formation (Aquifer)

A regional hydrostratigraphic cross-section after SGBLS SPC (2015) is provided in **Figure 6**. The cross-section is provided to illustrate the hydrostratigraphy running in a west-east direction in Nottawasaga Valley, approximately 18 km south of the Site. The cross-section depicts the above units in a slightly different framework. The underlying geology is separated by four major aquitards (Aquitard 1, 2, 3 and 4). In general the shallow aquifers (Aquifer 1 and 2) are correlated to recent deposits, ORM deposits, and where present, the Thorncliffe Formation deposits. The deeper aquifers (Aquifers 3 and 4) are correlated to coarse grained tunnel channel-fill deposits and the Scarborough Formation. The aquitards are correlated to the tills units, e.g., Halton, Newmarket, fine-textured deposits such as the Scarborough Drift, and fine-textured tunnel channel-fill deposits.

A description of each hydrostratigraphic unit is provided below:

- **Recent Deposits** – The uppermost surficial geologic unit consists of glaciolacustrine deposits consisting of mainly glaciolacustrine derived fine sands, silts and clays. Recent deposits are normally present as thin surficial layers but may also reach thicknesses of several meters.
- **Halton Till** – The Halton Till was deposited approximately 13,000 years before present (B.P.) during the last glacial advance in the area. The Halton Till is comprised of deposits of sandy silt till to clayey silt till. The Halton Till is expected to be present at the Site in limited amounts (< 1 m thickness).
- **Oak Ridges Moraine** – The Oak Ridges Moraine (ORM) was deposited approximately 12,000 to 13,000 years B.P. The ORM is a prominent geological feature within the Subwatershed as it supports numerous residential and municipal groundwater supply wells. The deposits of the ORM generally consist of layers of sand and gravel. The ORM is expected to be present at the Site at approximately 191 masl at east end of the driveway, and in limited amounts (< 1 m thickness) towards the northeast corner of the Site.
- **Newmarket Till** – The Newmarket Till was deposited by the Laurentide ice sheet approximately 18,000 to 20,000 years B.P. The aquitard deposits of the Newmarket Till consist mainly of sandy silt to silty sand and the unit is generally 20-30 m thick. The Newmarket Till is expected to be present at the Site at an approximate elevation of 189 masl.
- **Thorncliffe Formation** – The Thorncliffe Formation was deposited approximately 45,000 years B.P. and consists of glaciofluvial deposits containing sand and silty sand. Regionally, the unit acts as an aquifer with variable grain size and thickness. The Thorncliffe Formation is not expected to be present at the Site.

- **Sunnybrook Drift** – The Sunnybrook Drift was deposited approximately 45,000 years B.P. It is interpreted to be a silt and clay formation formed as a result of glacial and lacustrine processes and serves as a confining layer for York Region's deeper municipal wells. The Sunnybrook Drift is expected to be present at the Site in limited amounts (< 1 m thickness).
- **Scarborough Formation** – The Scarborough Formation was deposited during the Wisconsin glaciation approximately 70,000 years to 90,000 years B.P. It is interpreted as a fluvial-deltaic system consisting of sand, silt and clay deposits. The Scarborough Formation is expected to be encountered at an elevation of 187 masl.

3.5.2 Regional Groundwater Flow

At a regional scale, groundwater flows from the topographic highs associated with the Nipissing Shorecliffe, south of the Site, to the topographic lows associated with Georgian Bay of Lake Huron to the north. Regional groundwater flow patterns will be influenced by features such as major watercourses.

4 Local Geology and Hydrogeology

The local geological and hydrogeological Site conditions were characterized based on the results of geotechnical investigations by TIL (2021) and the hydrogeological investigation completed for this report.

4.1 Overburden

Borehole logs from TIL's geotechnical investigation are included in **Appendix B**. Borehole locations are shown in **Figure 7**. **Figure 8** provides a northwest-southeast oriented geological cross-section across the Site that illustrates the interpreted stratigraphy.

Based on the soil characterizations from the boreholes, the overburden material at the Site from ground surface down consists of topsoil up to 0.33 m thick, a fill layer up 1.12 m thick, a sandy silt/silty sand layer up to 2.13 m thick, a clayey silt/silty clay layer up to 3.97 m thick, and silt layer up to 3.43 m thick. A discontinuous layer of gravelly silty sand/sand and gravel was encountered at 17MW-2, 17BH-7, and 17BH-19 below the silt layer at depths between 6.1 mbgs and 7.32 mbgs. Limestone bedrock was encountered in more than half of the boreholes at depths between 5.02 mbgs and 9.19 mbgs; the limestone extended to the terminal investigation depth of 10.67 mbgs.

4.2 Bedrock Geology

Limestone bedrock was encountered at the Site at elevations between 183.68 masl and 186.61 masl.

4.3 Groundwater Conditions

4.3.1 On Site Monitoring Network

A monitoring network consisting of seven on-Site monitoring wells was established as part of the subsurface investigation undertaken by TIL. Monitoring well locations are illustrated in **Figure 7**. A summary of the monitoring well construction details is provided in **Table 4-1** below.

Table 4-1 Summary of Monitoring Well Details

Well ID	Ground Elevation (masl)	Screen Interval		Well Diameter (m)	Screen Length (m)	Screened Unit
		mbgs	masl			
17MW-2	191.61	3.05 - 6.1	188.56 - 185.51	0.051	3.048	Silt
17MW-5	192.13	7.62 - 10.67	184.51 - 181.46	0.051	3.048	Limestone Bedrock
17MW-9	192.99	7.62 - 10.67	185.37 - 182.32	0.051	3.048	Limestone Bedrock
17MW-18	190.10	3.8 - 6.85	186.3 - 183.25	0.051	3.048	Clayey Silt / Silt
17MW-20	191.45	7.62 - 10.67	183.83 - 180.78	0.051	3.048	Limestone Bedrock
17MW-21	192.42	2.45 - 5.5	189.97 - 186.92	0.051	3.048	Clayey Silt / Silt
17MW-22	191.31	1.5 - 4.55	189.81 - 186.76	0.051	3.048	Sandy Silt / Silt

4.3.2 Groundwater Levels

Long-term groundwater monitoring was completed on-Site between January 2018 and April 2019, and March and September 2021. Groundwater levels were measured manually on 6 occasions throughout each monitoring period, and continuously via a datalogger at 17MW-5 and 17MW-18 during the 2018-2019 period, and at 17MW-2 and 17MW-20 during the 2021 period. A summary of manual water level measurements is presented in **Table 4-2** in mbgs relative to existing grade, and in **Table 4-3** in masl. The hydrographs showing groundwater level observations from the two monitoring periods are presented in **Figure 9** and **Figure 10**.

Monitoring wells 17MW-5, 17MW-9 and 17MW-20 have their screens placed within the bedrock. During the first monitoring period, the groundwater levels in bedrock varied in elevation from a low of 186.47 masl measured on July 5, 2018, at 17MW-5, to a high of 187.78 masl measured on April 26, 2019, at 17MW-20. During the second monitoring period, the groundwater levels varied in elevation from a low of 186.53 masl measured on September 16, 2021, at 17MW-20, to a high of 187.49 masl measured on March 15, 2021, at 17MW-20.

Monitoring wells 17MW-2, 17MW-18, 17MW-21, and 17MW-22 have their screens placed in the overburden. During the first monitoring period, the groundwater levels varied in elevation from a low of 186.15 masl measured on July 5, 2018, at 17MW-18, to a high of 191.35 masl measured on April 26, 2019, at 17MW-2. During the second monitoring period, the groundwater levels varied in elevation from a low of 186.01 masl measured on September 16, 2021, at 17MW-18, to a high of 191.09 masl measured on March 15, 2021, at 17MW-22.

Table 4-2 Summary of Water Levels - mbgs

Well ID	Screen Interval (mbgs)	2-Jan-18	22-Mar-18	5-Jul-18	9-Nov-18	11-Jan-19	26-Apr-19	15-Mar-21	6-Apr-21	28-Apr-21	21-May-21	14-Jul-21	16-Sep-21	Variability (m)
17MW-2	3.05 - 6.10	0.86	0.82	1.37	1.19	0.61	0.26	0.59	0.78	0.87	1.10	1.26	1.68	1.42
17MW-5	7.62 - 10.67	5.35	5.24	5.66	5.23	4.89	4.48	4.75	5.02	5.31	5.42	5.49	NA	1.18
17MW-9	7.62 - 10.67	6.17	6.06	6.47	6.05	5.70	5.27	5.54	5.82	6.11	6.22	6.30	NA	1.20
17MW-18	3.80 - 6.85	3.79	3.61	3.96	3.85	3.23	2.91	3.06	3.32	3.62	3.71	3.91	4.09	1.18
17MW-20	7.62 - 10.67	4.58	4.49	4.90	4.50	4.14	3.67	3.96	4.23	4.49	4.61	4.69	4.92	1.25
17MW-21	2.45 - 5.50	2.60	2.06	2.79	3.01	2.07	1.72	1.98	2.01	2.16	2.35	2.94	3.28	1.56
17MW-22	1.50 - 4.55	0.96	0.59	1.35	1.33	0.47	0.05	0.25	0.52	0.60	0.95	1.33	NA	1.29

Notes:

1. Water levels are relative to existing grade.
2. NA - data not available due to well inaccessibility

Table 4-3 Summary of Water Levels - masl

Well ID	Screen Interval (masl)	2-Jan-18	22-Mar-18	5-Jul-18	9-Nov-18	11-Jan-19	26-Apr-19	15-Mar-21	6-Apr-21	28-Apr-21	21-May-21	14-Jul-21	16-Sep-21
17MW-2	188.56 - 185.51	190.75	190.79	190.25	190.43	191.00	191.35	191.02	190.83	190.74	190.51	190.35	189.93
17MW-5	184.51 - 181.46	186.79	186.89	186.47	186.90	187.25	187.65	187.38	187.11	186.82	186.71	186.64	NA
17MW-9	185.37- 182.32	186.83	186.93	186.52	186.94	187.30	187.72	187.45	187.17	186.88	186.77	186.69	NA
17MW-18	186.30 - 183.25	186.31	186.49	186.15	186.25	186.87	187.19	187.04	186.78	186.48	186.39	186.19	186.01
17MW-20	183.83 - 180.78	186.87	186.96	186.55	186.96	187.32	187.78	187.49	187.22	186.96	186.84	186.76	186.53
17MW-21	189.97- 186.62	189.82	190.36	189.64	189.41	190.35	190.70	190.44	190.41	190.26	190.07	189.48	189.14
17MW-22	189.81 - 186.76	190.35	190.72	189.97	189.98	190.84	191.26	191.06	190.79	190.71	190.36	189.98	NA

Notes:

1. NA - data not available due to well inaccessibility

4.3.3 Hydraulic Conductivity

Single well hydraulic response testing in the form of rising-head tests was conducted in January 2018 at all on-Site monitoring wells. Testing was completed to estimate the in-situ hydraulic conductivity (K) of the screened overburden materials. Prior to testing, each well was developed in order to mitigate the influence of native, near-well materials disturbed during the drilling program.

During the rising head test, a pseudo-instantaneous drop in the water level was achieved by extracting water from the well using a manual inertial pump. The water level recovery was measured by a datalogger taking readings at pre-programmed intervals and left in place to record recovery. For the purposes of the test, sufficient recovery to conclude the testing was considered to be at or above approximately 85% of the pre-test water column.

Where applicable for rising-head tests, the K values were estimated using the Hvorslev (1951) method with data obtained from the dataloggers. The corresponding analysis is presented in **Appendix C**. Where available, the K values were calculated using data from grainsize analyses with the Hazen (1911) method. A summary of K values obtained from the rising-head tests and grain size analyses is presented **in Table 4-4.**

Table 4-4 Summary of Hydraulic Conductivity Calculations

Well ID	Screen Interval (mbgs)	Screened Unit	Hvorslev Method K (m/s)	Hazen Method K (m/s)
17MW-2	3.05 - 6.10	Silt	2.1×10^{-8}	1.1×10^{-7}
17MW-5	7.62 - 10.67	Limestone Bedrock	$5.9 \times 10^{-5} – 3.5 \times 10^{-4}$	
17MW-9	7.62 - 10.67	Limestone Bedrock	$8.8 \times 10^{-5} – 7.1 \times 10^{-4}$	
17MW-18	3.80 - 6.85	Clayey Silt / Silt	7.8×10^{-10}	
17MW-20	7.62 - 10.67	Limestone Bedrock	$7.1 \times 10^{-5} – 2.4 \times 10^{-4}$	
17MW-21	2.45 - 5.50	Clayey Silt / Silt	2.9×10^{-7}	
17MW-22	1.50 - 4.55	Sandy Silt / Silt	$7.1 \times 10^{-8} – 1.6 \times 10^{-7}$	
17MW-22	0.8*	Sandy Silt		2.3×10^{-5}
Geometric mean for Sandy Silt / Clay Silt / Silt			3.5×10^{-8}	
Geometric mean for Limestone Bedrock			1.6×10^{-4}	

Notes:

1. * Screen interval is not applicable, the depth where sample was taken is shown instead.

Single well response testing provided estimates of hydraulic conductivity for the sandy silt / clayey silt / silt materials of 7.8×10^{-10} m/s to 2.9×10^{-7} m/s, with a geometric mean of 3.5×10^{-8}; and for the limestone bedrock of 5.9×10^{-5} m/s to 7.1×10^{-4}, with a geometric mean of 1.6×10^{-4}. These overburden estimates fall within the expected range of hydraulic conductivities for glacial till (10^{-12} m/s to 10^{-6} m/s), silt (10^{-9} m/s to 10^{-5} m/s), silty sand (10^{-7} m/s to 10^{-3} m/s); and the bedrock estimates fall within the expected range for range for limestone and dolomite (10^{-7} m/s to 10^{-3} m/s) (Freeze and Cherry, 1979).

4.3.4 Groundwater Flow

It is anticipated that local groundwater flow is generally to the northeast due to the presence of Pretty River which flows along the eastern Site boundary.

4.3.5 Groundwater Quality

Unfiltered groundwater quality samples were collected from 17MW-5 on July 4, 2018. The collected samples were sent to SGS Environmental Services in Lakefield, Ontario. The samples were analyzed for the parameters, and results compared to the *Town of Collingwood Sewer Use By-Law No. 2009-118*.

Based on the laboratory analytical results, the tested parameters met the criteria listed in the *Town of Collingwood Sewer Use By-Law No. 2009-118*. Laboratory analytical results are summarized in **Table 4-5** below. The laboratory Certificate of Analysis is provided in **Appendix D**.

Table 4-5 Groundwater Quality Results

Sample ID	Units	Collingwood Sanitary Limits	Collingwood Storm Limits	RL	17MW-5
pH	no unit	5.5 – 9.5	6.0 – 9.0	NA	7.7
Temperature	Deg C	-	NA	NA	1
E. Coli	Cfu/100mL	-	200	NA	< 2
Biochemical Oxygen Demand (BOD5)	mg/L	300	NA	2	13
Total Suspended Solids	mg/L	300	NA	2	172
Oil & Grease (animal/vegetable)	mg/L	150	NA	4	< 4
Oil & Grease (mineral/synthetic)	mg/L	15	NA	4	< 4
4AAP-Phenolics	mg/L	0.1	NA	0.002	0.005
Total Kjeldahl Nitrogen	as N mg/L	50	NA	0.5	< 0.5
Sulphate (as SO_4)	mg/L	1500	NA	2	30
Sulphide (as H_2S)	mg/L	1	NA	0.02	< 0.02
Cyanide (total)	mg/L	1.2	NA	0.01	< 0.01
Fluoride	mg/L	10	NA	0.06	0.15
Mercury (total)	mg/L	0.01	0.001	0.00001	< 0.00001
Aluminum (total)	mg/L	50	NA	0.001	1.29
Antimony (total)	mg/L	5	NA	0.0002	0.0004
Arsenic (total)	mg/L	1	NA	0.0002	0.0007
Bismuth (Total)	mg/L	5	NA	0.000007	0.00002
Cadmium (total)	mg/L	0.7	NA	0.00000003	0.00001
Chloride	mg/L	1500	NA	1	69
Chromium (total)	mg/L	2.8	0.2	0.00003	0.00237
Cobalt (total)	mg/L	5	NA	0.000004	0.000717
Copper (total)	mg/L	2	0.1	0.00002	0.00198

Table 4-5 Groundwater Quality Results

Sample ID	Units	Collingwood Sanitary Limits	Collingwood Storm Limits	RL	17MW-5
Iron (Total)	mg/L	50	NA	0.007	1.93
Lead (total)	mg/L	0.7	0.05	0.00001	0.00007
Manganese (total)	mg/L	5	NA	0.00001	0.0723
Molybdenum (total)	mg/L	5	NA	0.00001	0.00607
Nickel (total)	mg/L	2	0.05	0.001	0.0018
Phosphorus (total)	mg/L	10	NA	0.003	0.056
Selenium (total)	mg/L	0.8	NA	0.00004	<0.00004
Silver (total)	mg/L	0.4	NA	0.005	<0.00005
Tin (total)	mg/L	5	NA	0.00001	0.00238
Titanium (total)	mg/L	5	NA	0.00005	0.0373
Zinc (total)	mg/L	2	0.05	0.002	0.005
Polychlorinated Biphenyls Total	mg/L	0.004	NA	0.0001	< 0.0001
Benzene	mg/L	0.01	NA	0.0005	< 0.0005
Chloroform	mg/L	0.04	NA	0.0005	< 0.0005
1,2-Dichlorobenzene	mg/L	0.05	NA	0.0005	< 0.0005
1,4-Dichlorobenzene	mg/L	0.08	NA	0.0005	< 0.0005
Ethylbenzene	mg/L	0.06	NA	0.0005	< 0.0005
Hexachlorobenzene	mg/L	0.0001	NA	0.0001	< 0.0001
Methylene Chloride	mg/L	0.09	NA	0.0005	< 0.0005
1,1,2,2-Tetrachloroethane	mg/L	0.06	NA	0.0005	< 0.0005
Tetrachloroethylene	mg/L	0.06	NA	0.0005	< 0.0005
Toluene	mg/L	0.02	NA	0.0005	0.007
Trichloroethylene	mg/L	0.05	NA	0.0005	< 0.0005
Xylene (total)	mg/L	0.3	NA	0.0005	0.001

Notes:

1. RL: reporting limit.

5 Calculation of Dewatering Rates and Estimation of Zone of Influence

This section provides an estimate of the expected dewatering rates and discharge options to complete below ground construction and servicing installation in open cut excavations under suitable conditions. Rates are provided for the purpose of obtaining water taking and/or discharge permits. This section does not provide a design of dewatering operations. The design of dewatering operations and the selection of effective dewatering and discharge measures are the responsibility of the dewatering contractor.

Dewatering rates were estimated based on TIL's interpretation of the hydrogeological Site conditions and available development details. Architectural drawings of the proposed development were not available at the time of this investigation, however Preliminary Site Grading, Servicing and SWM Facility Plans were reviewed. Copies of the reviewed plans are provided in **Appendix A** for reference. Dewatering requirements should be re-evaluated once architectural drawings become available and engineering plans are finalized, as there may be changes in the development details, Site grading, Site servicing and/or building foundation design and footprint that may affect dewatering requirements.

5.1 Aquifer Characteristics

Based on the finding of the borehole investigation, the unconfined overburden aquifer underlying the Site consists of sandy silt/silty sand/clayey silt/silty clay/silt with an approximate thickness range of 4 - 9 m. The limestone bedrock was encountered at the Site at depths between 5.02 - 9.19 m below existing grade. The excavation for building, the SWM facility and servicing is not expected into the bedrock layer given the following:

- It is to our understating that a 1-level basement is proposed for all dwelling units. At the time of writing, the FFE of the basement level was unknown. It was assumed therefore, based on typical building practices, that the basement FFE would be 2.7 m (8 feet) below the final grade.
- Excavation is also required for the stormwater management (SWM) area in Block 46 located at the northeast corner of the development area of the Site. A review of the Preliminary SWM Facility Plan (Crozier, 2021c; Drawing 8, **Appendix A**), indicates that the bottom elevation of the SMW is at 189.30 m. An excavation depth of approximately 0.8 m from the exiting grade would be required.
- At the time of writing, the servicing elevation at the Site is also not available. Based on a review of the Preliminary Site Servicing Plan (Crozier, 2021b, Drawing 7, **Appendix A**), the proposed servicing is assumed to be between 2.7 and 5 m below grade.

As discussed in **Section 4.3.3**, the hydraulic conductivity of the overburden materials of sandy silt/clay silt/silt has a geometric mean of 3.5×10^{-8}; this value was used for dewatering calculations.

The highest groundwater levels measured at the Site from the overburden wells were recorded on April 26, 2019. The highest groundwater elevation recorded among the wells was 191.35 masl at 17MW-2. A value of 187.19 masl was recorded measured at 17MW-18, the nearest well to the proposed SWM Block. For the current dewatering assessment, these high groundwater elevations were used to account for the worst case scenario of dewatering under high water table conditions.

5.2 Required Drawdown

Buildings and SWM Block

The residential dwelling units (buildings) and SWM Block were divided into different lot groupings or blocks based on their spatial distribution; potential dewatering requirements were evaluated for each. The following assumptions were made for the purpose of dewatering calculations:

- Finished floor elevation (FFE) data for the proposed dwelling units was not available at the time of writing. However, the Preliminary Site Grading Plan (Crozier, 2021a; Drawing 4, **Appendix A**), was provided with final grading information for proposed streets. It was assumed that ground level FFE or ground surface elevation for the buildings would be similar to that for the streets, as such the ground surface elevation of each lot grouping/block was taken as the average of the highest and the lowest grade at the adjacent street(s).
- The ground surface elevation at 17MW-18 (190.10 masl), which is located at the centre of the SWM Block, was taken as the ground surface elevation of the SWM Block.
- It is understood that each building will have a one level basement. Basement FFEs were not available at the time of writing; as such each dwelling is assumed to have a top of slab at 2.7 m below the ground surface. The base of the excavation required for construction was assumed to be 1 m below the top of basement slab, or 3.7 m below ground surface.
- The base of excavation for the SWM Block is taken as 189.30 masl, the bottom elevation of the SWM Block as shown on the Preliminary SWM Facility Plan (Crozier, 2021c; Drawing 8, **Appendix A**);
- The highest measured groundwater elevations were used to approximate the worst-case scenario of dewatering under high groundwater table conditions. The highest groundwater elevation of 191.35 masl measured at 17MW-2 was used for building dewatering calculations. The highest groundwater elevation of 187.19 masl measured at 17MW-18 was used for SWM dewatering calculation.
- If the groundwater level is above the base of the excavation, then it will be drawn down to 1 m below the base of the excavation (4.7 m ground) for buildings, and 0.5 m below base of the excavation for the SWM Block.
- The dimensions of the excavation for each scenario are obtained from the Draft Plan of Subdivision (MHBC, 2021; DWG No.1, Appendix A)

Servicing

The following assumptions have been made for the servicing dewatering calculations.

- The dewatering requirements for servicing installation were evaluated independently for the services under each street, or each segment of the same street.
- The average elevation between the highest and the lowest grading of each segment was used as ground surface.
- The invert of each segment was taken as the southeast invert of the existing servicing to which it connects on Williams Street or Peel Street; the exception being watermains which were assumed to have an invert of 1.7 m, which is the lowest depth requirement for watermains in the Town of Collingwood.

- The base of the excavation required for servicing installation was assumed to be 1.0 m below the segment invert.
- The highest groundwater elevation of 191.35 masl measured at 17MW-2 was used as the water level to account for the worst-case scenario of dewatering under high water table conditions.
- The groundwater level will be drawn down to 0.5 m below the base of the excavation.
- The length of the excavation was taken as the total length of the longest service present, as shown in the Preliminary Servicing Plan (Croziers, 2021b; Drawing 7, **Appendix A**). The excavation width was assumed to be 2.5 m in the case when only one service is present. An additional 3 m was added to the excavation width when more than one service will be present.
- It should be noted that the excavation required for the storm pipe connection between MH 71 and MH71A along the walkway in Block 48 would be covered in the excavation for building section of Block 30-33, it is therefore not calculated separately.

A summary of the dewatering requirements details for the buildings, SWM block and servicing installation is provided in **Table 5-1**.

5.3 Zone of Influence

Considering the drawdown requirements, dimensions of the excavations and underlying soil conditions, it is anticipated that the dominant mode of groundwater flow to the excavations will be planar to all sides with negligible contributions from the corners. An estimate of the Distance of Influence (L_0) for dewatering excavations in unconfined aquifers can be calculated using the following equation (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

where,

L_0	=	Distance of Influence to a linear source of recharge, beyond which there is negligible drawdown (m)
H	=	Distance from initial static water level to assumed bottom of saturated aquifer contributing flows (m)
S_y	=	Specific yield of the aquifer formation (taken as 0.20 based on the typical specific yield for silt to sand textured soil, after Morris and Johnson, 1967)
t	=	Time, in seconds, required to draw the static groundwater level to the desired level (taken as 14 days for building, and 7 days for servicing); and
K	=	Hydraulic Conductivity of aquifer formation (m/s)

A summary of the DOI estimations for the short-term dewatering calculations is presented in **Table 5-2**. It should be noted that the estimates assume isolated dewatering of each building section or servicing trench. Where dewatering of multiple building sections and/or servicing trenches is to occur simultaneously, there will be an overlap of drawdown curves and subsequently a reduction in the area of influence for any one system operating independently.

Table 5-1 Summary of Dewatering Requirements

Scenario	Ground Surface (masl)	Base of Excavation (masl)	Width of Excavation (m)	Length of Excavation (m)	Maximum Groundwater Elevation (masl)	Drawdown Groundwater Elevation (masl)	Maximum Required Drawdown (m)
Lots 1-9	193.18	189.48	70	96	191.35	188.48	2.87
Lots 10-21	194.48	190.78	64	135	191.35	189.78	1.57
Block 22-25	193.78	190.08	62	79	191.35	189.08	2.27
Block 26-29	191.91	188.21	31	115	191.35	187.21	4.14
Block 30-33	192.32	188.62	30	115	191.35	187.62	3.73
Block 34-37	194.85	191.15	30	107	191.35	190.15	1.20
Block 38-45	194.56	190.86	62	97	191.35	189.86	1.49
Block 46 (SWM)	190.10	189.30	40	40	187.19	NA	NA
SAN MH 37-MH 35/STM MH 73-MH 70/MW	192.32	5.05	187.27	11	127	191.35	186.27
SAN MH 35-MH 28/STM MH101A-MH 103/WM	193.95	5.05	188.90	11	101	191.35	187.90
SAN MH 28-MH 26/STM MH 103-106/MW	194.48	5.05	189.43	11	143	191.35	188.43
SAN MH 33 - MH 31/STM MH 100-MH 109/WM	194.72	5.05	189.67	11	130	191.35	188.67
SAN MH #1A-MH 3/WM	191.91	4.44	187.47	8	189	191.35	186.47
STM MH 101-MH 97-SWM	193.04	3.21	189.83	2.5	42	191.35	188.83

Table 5-1 Summary of Dewatering Requirements

Scenario	Ground Surface (masl)	Base of Excavation (masl)	Width of Excavation (m)	Length of Excavation (m)	Maximum Groundwater Elevation (masl)	Drawdown Groundwater Elevation (masl)	Maximum Required Drawdown (m)
WM along south Site boundary	195.36	2.70	192.66	2.5	147	191.35	NA
STM MH 106-MH 107	195.22	3.21	192.01	2.5	47	191.35	NA
STM in SWM	191.32	3.21	188.11	2.5	28	187.19	NA

Notes:

1. NA: not applicable, underestimated groundwater levels, excavation and/or basement floor is above groundwater. Therefore, no short-term nor long-term groundwater dewatering, respectively, is anticipated to be required.

Table 5-2 Zone of Influence Estimates

Scenarios	H	S_y	K	t	L_0
	(m)		(m/s)	(s)	(m)
Lots 1-9	11.9	0.20	3.5E-08	1,209,600	6.0
Lots 10-21	10.6	0.20	3.5E-08	1,209,600	6.0
Blocks 22-25	11.3	0.20	3.5E-08	1,209,600	6.0
Blocks 26-29	13.1	0.20	3.5E-08	1,209,600	6.0
Blocks 30-33	12.7	0.20	3.5E-08	1,209,600	6.0
Blocks 24-27	10.2	0.20	3.5E-08	1,209,600	6.0
Blocks 38-45	10.5	0.20	3.5E-08	1,209,600	6.0
Block 46 (SWM)	NA	NA	NA	NA	NA
SAN MH 37-MH 35/STM MH 73-MH 70/MW	14.1	0.20	3.5E-08	604,800	5.0
SAN MH 35-MH 28/STM MH101A-MH 103/WM	12.5	0.20	3.5E-08	604,800	4.0
SAN MH 28-MH 26/STM MH 103-106/MW	11.9	0.20	3.5E-08	604,800	4.0
SAN MH 33 - MH 31/STM MH 100-MH 109/WM	11.7	0.20	3.5E-08	604,800	4.0
SAN MH #1A-MH 3/WM	13.9	0.20	3.5E-08	604,800	5.0
STM MH 101-MH 97-SWM	11.5	0.20	3.5E-08	604,800	4.0
WM along south Site boundary	NA	NA	NA	NA	NA
STM MH 106-MH 107	NA	NA	NA	NA	NA
STM in SWM	NA	NA	NA	NA	NA

Notes:

1. NA: not applicable, underestimated groundwater levels, excavation and/or basement floor is above groundwater. Therefore, no short-term nor long-term groundwater dewatering, respectively, is anticipated to be required.

5.4 Dewatering Rate Calculations

5.4.1 Short-Term Dewatering

The calculation of short-term dewatering rates, to control groundwater inflows to the excavation during construction, is based on equations provided in *Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd Edition* (Powers et. al., 2007). The equations have the following assumptions:

- ideal aquifer conditions, i.e., homogeneous, isotropic, uniform thickness, and infinite areal extent;
- fully penetrating pumping well(s);
- horizontal flow to the pumping well(s); and
- a constant pumping rate with the flow to the pumping well(s) corresponding to steady-state conditions.

The analytical assessment assumes steady state flow into an open excavation; however, it should be recognized that a transient condition will exist at the start of dewatering and that during this time, flows mat be higher but will dissipate over time to steady state conditions as aquifer storage is depleted.

The following equation for planar flow to all sides of a rectangular excavation in an unconfined aquifer was used:

$$Q = \left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

where,

Q = Anticipated pumping rate (m^3/day)

K = Hydraulic conductivity (m/day)

H = Distance from initial static water level to assumed bottom of saturated aquifer contributing flows (m)

h = Depth of water in the well while pumping (m)

L_0 = Distance of Influence to a linear source of recharge, beyond which there is negligible drawdown (m)

a = Length of excavation (m)

b = Width of excavation (m)

To account for uncertainties and natural variability in the ground conditions, the calculated short-term dewatering rates for groundwater control are multiplied by a factor of safety of 2. Incorporating the factor of safety also provides flexibility to the dewatering contractor in meeting project schedules and helps to account for the initial pumping period under transient conditions when dewatering volumes are expected to be higher.

5.4.2 Long-Term Dewatering

Long-term dewatering is not anticipated for servicing installation. As per the TIL's Geotechnical Investigation (2021) for the Site, permanent dewatering system with underfloor drainage grid is recommended for the buildings. If this recommendation is implemented, long-term dewatering is anticipated at the Site and estimated at one-third the rate of short-term dewatering would be required.

5.4.3 Allowance for Precipitation

While the excavation remains open it may be necessary to dewater stormwater from direct precipitation into the excavation, assuming surface runoff is directed away from the excavation. Incorporating additional discharge requirements for direct precipitation to the excavation provides an estimate of a worst-case dewatering scenario for the purpose of dewatering discharge permits and/or approvals. To account for this additional dewatering volume, a storm with a 24-hour depth of accumulation of 5 mm was considered. A rainfall depth of 5 mm represents an 82nd percentile accumulation of daily precipitation for the Collingwood Climate Station in 2020 (Environment and Climate Change Canada, 2021). The Collingwood Climate Station is located 2 km northeast of the Site.

5.4.4 Summary

To determine total daily dewatering rates during construction, the anticipated dewatering volumes for groundwater control were added to the estimated dewatering volumes for contributions from direct precipitation into the open excavations. A summary of the estimated dewatering rates for the Site, assuming all excavations are opened simultaneously and dewatering of each occurs contemporaneously, are presented in **Table 5-3** for the short-term and long-term, respectively. The dewatering calculation sheets can be found in **Appendix E**.

5.5 Dewatering Permit Requirements

It is recognized that dwelling lots/units may be constructed in one phase; therefore, for the purposes of dewatering permits and approvals, the cumulative sum of all dwellings and services is considered for the purposes of applying for permits and approvals.

In the short-term, the estimated dewatering rate for groundwater control during construction is 134,100 L/day. As a contingency, dewatering to remove direct precipitation into the excavations, assuming a rainfall depth of 5 mm over 24 hours, is considered. This could account for an additional 229,200 L/day of dewatering for stormwater control. The anticipated total maximum short-term dewatering rate for groundwater and stormwater control is therefore 363,300 L/day. Water takings for construction dewatering consisting of groundwater and stormwater inputs, above 50,000 L/day but less than 400,000 L/day, require an EASR registration to proceed. Depending on construction phasing and/or stormwater control requirements dewatering volumes may be less than 50,000 L/day. A water taking permit is not required for construction dewatering below 50,000 L/day. Consideration of the approach to construction phasing, construction dewatering and requirements for stormwater control is recommended to determine the dewatering permits required for construction.

If foundation drains are proposed to collect perimeter and underfloor drainage, the estimated rate of dewatering in the long-term will be approximately 1/3rd the rate of dewatering during construction, or approximately 18,700 L/day. Water takings below 50,000 L/day do not require a water taking permit to proceed.

Table 5-3 Dewatering Rate Summary

Scenario	H	h	K	L_0	Short-Term Pumping Rate Q			Long-Term Pumping Rate Q	
	m	m	m/day	m	m^3/day	L/day	L/s	L/day	L/s
Lots 1-9	11.9	9.0	3.0E-03	6.0	10.000	10,000	0.12	3,300	0.04
Precipitation					33.600	33,600	0.39	-	-
Sub-Total					43.600	43,600	0.50	3,300	0.04
Lots 10-21	10.6	9.0	3.0E-03	6.0	6.200	6,200	0.07	2,100	0.02
Precipitation					43.200	43,200	0.50	-	-
Sub-Total					49.400	49,400	0.57	2,100	0.02
Blocks 22-25	11.3	9.0	3.0E-03	6.0	6.500	6,500	0.08	2,200	0.03
Precipitation					24.500	24,500	0.28	-	-
Sub-Total					31.000	31,000	0.36	2,200	0.03
Blocks 26-29	13.1	9.0	3.0E-03	6.0	13.500	13,500	0.16	4,500	0.05
Precipitation					17.800	17,800	0.21	-	-
Sub-Total					31.300	31,300	0.36	4,500	0.05
Blocks 30-33	12.7	9.0	3.0E-03	6.0	11.800	11,800	0.14	3,900	0.05
Precipitation					17.300	17,300	0.20	-	-
Sub-Total					29.100	29,100	0.34	3,900	0.05
Blocks 24-27	10.2	9.0	3.0E-03	6.0	3.200	3,200	0.04	1,100	0.01
Precipitation					16.100	16,100	0.19	-	-
Sub-Total					19.300	19,300	0.22	1,100	0.01
Blocks 38-45	10.5	9.0	3.0E-03	6.0	4.700	4,700	0.05	1,600	0.02
Precipitation					30.100	30	30.10	-	-
Sub-Total					34.800	34,800	0.40	1,600	0.02

Table 5-3 Dewatering Rate Summary

Scenario	H	h	K	L_0	Short-Term Pumping Rate Q			Long-Term Pumping Rate Q	
	m	m	m/day	m	m^3/day	L/day	L/s	L/day	L/s
Block 46 (SWM)	NA	NA	NA	NA	NA	NA	NA	-	-
Precipitation					8.000	8,000	0.09	-	-
Sub-Total					8.000	8,000	0.09	-	-
SAN MH 37-MH 35/STM MH 73-MH 70/MW	14.1	9.5	3.0E-03	5.0	18.000	18,000	0.21	-	-
Precipitation					7.000	7,000	0.08	-	-
Sub-Total					25.000	25,000	0.29	-	-
SAN MH 35-MH 28/STM MH101A-MH 103/WM	12.5	9.5	3.0E-03	4.0	11.000	11,000	0.13	-	-
Precipitation					5.600	5,600	0.06	-	-
Sub-Total					16.600	16,600	0.19	-	-
SAN MH 28-MH 26/STM MH 103-106/MW	11.9	9.5	3.0E-03	4.0	12.100	12,100	0.14	-	-
Precipitation					7.900	7,900	0.09	-	-
Sub-Total					20.000	20,000	0.23	-	-
SAN MH 33 - MH 31/STM MH 100-MH 109/WM	11.7	9.5	3.0E-03	4.0	9.800	9,800	0.11	-	-
Precipitation					7.200	7,200	0.08	-	-
Sub-Total					17.000	17,000	0.20	-	-

Table 5-3 Dewatering Rate Summary

Scenario	H	h	K	L_0	Short-Term Pumping Rate Q			Long-Term Pumping Rate Q	
	m	m	m/day	m	m^3/day	L/day	L/s	L/day	L/s
SAN MH #1A-MH 3/WM	13.9	9.5	3.0E-03	5.0	24.400	24,400	0.28	-	-
Precipitation					7.600	7,600	0.09	-	-
Sub-Total					32.000	32,000	0.37	-	-
STM MH 101-MH 97-SWM	11.5	9.5	3.0E-03	4.0	2.900	2,900	0.03	-	-
Precipitation					0.500	500	0.01	-	-
Sub-Total					3.400	3,400	0.04	-	-
WM along south Site boundary	NA	NA	NA	NA	NA	NA	NA	-	-
Precipitation					1.800	1,800	0.02	-	-
Sub-Total					1.800	1,800	0.02	-	-
STM MH 106-MH 107	NA	NA	NA	NA	NA	NA	NA	-	-
Precipitation					0.600	600	0.01	-	-
Sub-Total					0.600	600	0.01	-	-
STM in SWM	NA	NA	NA	NA	NA	NA	NA	-	-
Precipitation					0.400	400	0.00	-	-
Sub-Total					0.400	400	0.00	-	-
Total - Groundwater					**134.100**	**134,100**	**1.60**	**18,700**	**0.22**
Total - Precipitation					**229.200**	**229,200**	**2.70**	**-**	**-**
Total					**363.300**	**363,300**	**4.20**	**-**	**-**

Notes:

1. Rates shown rounded to the nearest 100 L/day
2. Groundwater rates include a factor of safety of 2.

5.6 Disposal Options for Discharge Water

Three potential dewatering discharge options were identified as part of this investigation:

- **Option 1:** Discharge to a Sanitary or Storm Sewer in the Town of Collingwood
- **Option 2:** Discharge Overland to a vegetated area.
- **Option 3:** Removal Via Pump Truck.

The selection of a dewatering discharge option, including mitigation and monitoring for water quantity and quality impacts, is the responsibility of the dewatering contractor. Potential discharge options are discussed in detail below.

Option 1 - Discharge to a Storm Sewer in the Town of Oakville

Dewatering discharge during construction may be directed to a Town's sanitary or storm sewer near the Site. It will be necessary to obtain the relevant approval from the Town prior to discharge. At this time, no pre-treatment of the groundwater is expected, as tested parameters (**Section 4.3.5**) met the quality criteria specified in *Town of Collingwood Sewer use By-Law No. 2009-118*.

Option 2 – Discharge overland to a vegetated area

Dewatering discharge may be discharged to land for infiltration or runoff to a nearby surface water feature. The following controls should be implemented to minimize impacts to the natural environment:

- Dewatering discharge will be dispersed prior to discharge to the ground surface to dissipate the energy from the flow and reduce the potential for erosion;
- Dewatering discharge will pass through a sediment control device prior to discharge to the natural environment;
- Dewatering discharge from the sediment control device will be to a naturally vegetated area where there will be no prior interaction with paved surfaces ahead of release to a natural water body;
- Dewatering discharge will be halted if there is a visible petroleum hydrocarbon film or sheen present in the discharge;
- Dewatering discharge from the sediment control device will be no closer than 30 m from any water body, and as far as practicably possible from the sloped embankments of any water body to prevent scouring and erosion;
- Appropriate erosion and sediment control (ESC) measures shall be implemented to minimize the risk of environmental degradation.

Option 3 – Removal Via Pump Truck

Dewatering discharge may be contained on-site for later pickup and transfer (hauling) off-site to a registered disposal facility. This option should be considered as a contingency in the event that discharge to the natural environment is not feasible due to water quality or quantity concerns, or discharge approval for a sanitary/storm sewer expires, is suspended, or is in any other way terminated. The dewatering contractor is responsible for the selection of the approved hauling contractor and registered waste disposal facility, and for meeting any pre-disposal requirements, e.g., water quality sampling which may be required by the registered disposal facility.

6 Potential Receptors

As part of this program, potential groundwater receptors including domestic or permitted water supplies were identified. Additionally, the surrounding area was evaluated for potential ecological receptors and vulnerable source protection areas, via the following:

- Querying the MECP (2021b) Water Well Information System (WWIS) for records of private water supply within a 500 m radius of the Site.
- Querying the MECP (2021c) PTTW database to identify permitted water takers within a 500 m radius of the Site.
- A review of the MNRF (2021) Natural Heritage Areas mapping portal for potential ecological receptors within a 500 m radius of the Site.
- A review of MECP (2021a) Source Protection Information Atlas for vulnerable source water protection areas.

6.1 MECP Water Well Record Search

A search of the MECP well records database was conducted within 500 m around the Site. The search results showed a total of 18 water well records within the study area. The primary well usage was for Monitoring, Observation or Test Hole (56%). There was one well record with the listed use of domestic water supply. This record was filed in 1955 and it is possible the well is no longer is use as the municipal water supply is available in the area.

Well usage details are summarized in **Table 6-1**. The locations of the MECP water well records are shown on **Figure 11**. A summary of the water well record data is provided in **Appendix F**.

Table 6-1 Water Well Records within 500 m Buffer

Primary Well Use	Number of Wells within 500 m Buffer of Study Area	Percentage of Total
Domestic	1	6
Industrial	3	17
Public	1	6
Monitoring/Observation/Test Hole	10	56
Abandoned/Other/Unknown/Not Used	3	17
Total	18	100%

6.2 Permitted Water Users

A search was conducted to identify the permitted groundwater users within 500 m of the study area. No active permits were located within the 500 m search area as illustrated in **Figure 11**.

6.3 Ecological Receptors

The nearest surface water feature is the Pretty River, which flows through the northeast corner of the Site in an area where no development is planned. Several woodlots with wetlands associated with the river system are present at the eastern Site boundary and to the north and south of the Site. A natural heritage system is present approximately 310 m south of the Site. The environmental features are illustrated in **Figure 12**.

6.4 Vulnerable Source Water Protection Areas

The Site is within a HVA area with a vulnerability score of 6. The majority of the Site, except for a small area at the northwest corner, is within a SGRA area with a vulnerability score of 6. The vulnerable source water protection areas are illustrated in **Figure 12**.

7 Potential Impacts and Proposed Mitigation

7.1 Identification and Mitigation of Short-Term Impacts

7.1.1 Potential Short-Term Impacts to the Groundwater System

Construction dewatering activities in open excavation may draw down the local groundwater level. However, this impact is expected to be short-term in duration with water levels recovering following cessation of dewatering. There is also the potential for infiltration of contaminants to the subsurface through the open excavation. Implementation of site-specific spill control and response measures would be necessary to mitigate this risk.

7.1.2 Potential Short-Term Impacts to the Surface Water System

Dewatering can result in a decline in the groundwater level in shallow unconfined aquifers and changes to groundwater and surface water system interactions. Specifically, there could be a temporary reduction in baseflow to surface water features or wetlands that are supported by groundwater. The nearest surface water body to the Site, Pretty River it is outside the anticipated radius of influence of dewatering, and in are not slated for development. Depending on the phasing of construction dewatering short-term impacts would not be expected.

Release of construction debris, sediment or fluid spills from the Site's alteration area could impact water courses at and within the vicinity of the Site. Implementation of site-specific spill control and response measures would be necessary to mitigate this risk.

7.1.3 Potential Short-Term Impacts to Other Groundwater Users

Dewatering can result in a decline in the groundwater level in shallow unconfined aquifers, resulting in a reduction in the available yield for nearby groundwater takers. A review of PTTW and water well record databases did not suggest any groundwater users within the radius of influence of dewatering. Additionally, the Site is within an area that receives municipal water supply; the availability of municipal water supply in the area would serve to mitigate and short-term impacts.

7.1.4 Mitigation of Short-Term Impacts

A site-specific Spill Prevention and Response Plan, as well as a site-specific ESC Plan are recommended. Routine monitoring to assess and maintain ESC protections on the perimeter of the construction area to prohibit the release of sediments and other spilled contaminants on- and off-Site should be undertaken to evaluate the effectiveness of these plans. Where well designed and implemented environmental management plans are in place, impacts to vulnerable receptors can be minimized.

7.2 Identification and Mitigation of Long-Term Impacts

7.2.1 Potential Long-Term Impacts to the Groundwater System

The Site is located within a HVA; should chemicals, e.g., road salt, be used at the Site over the long-term, best management practices should be employed to protect the groundwater system. As the proposed development is for residential lots it is understood that long-term operation may be the responsibility of individual homeowners and not the client. Homeowners may contact their local municipality or conservation authority for advice on how best to manage their winter salt use.

The Site is located within a SGRA, long-term reductions in groundwater recharge from increased impervious area post-development could pose a risk to long-term water quantity. It is to our understanding that a water balance study will be completed to Crozier Consulting Engineers to assess the potential for this impact and recommend appropriate mitigation.

The installation of Site servicing and/or utilities may introduce pipe bedding materials whose permeabilities are higher than those of the native soils. Where permeable pipe bedding materials are placed in low permeability native soil below the groundwater table, the contrast in permeabilities has the potential to create preferential pathways for groundwater flow. Corresponding impacts may include the localized lowering of the groundwater table as well as subsurface transport of contamination along servicing trenches.

7.2.2 Potential Long-Term Impacts to the Surface Water System

The Pretty River flows through the northeast portion of the Site and it associated wetlands are located due east of the Site. Similar to impacts for the HVA, should chemicals, e.g., road salt, be used at the Site over the long-term, best management practices should be employed to protect the surface water system.

Long-term dewatering will be required if foundation drains are used to manage groundwater seepage around the foundation floor and walls. Dewatering can result in a decline in the groundwater level in shallow unconfined aquifers which could cause a reduction in baseflows to surface water features or wetlands that are supported by groundwater. Given the low volume of long-term dewatering anticipated significant impacts to baseflow are not expected.

7.2.3 Potential Long-Term Impacts to Other Groundwater Users

Long-term dewatering, if required for foundation drains, can result in a decline in the groundwater level in shallow unconfined aquifers. Long-term declines in groundwater levels could reduce the available groundwater for nearby groundwater takers. Available data does not suggest a large number of groundwater wells within the vicinity of the Site and long-term dewatering volumes are low suggesting impacts if any would not be significant. Additionally, the availability of municipal water supply in the area would serve to mitigate and long-term impacts.

7.2.4 Mitigation of Long-Term Impacts

Where there exists a possibility that groundwater may be diverted and follow the path of new/relocated utilities or services, groundwater barriers may be used to prevent groundwater migration along utility/servicing trenches. The requirement for trench seals should be discussed with the engineer responsible for the design on a specific pipe location basis.

8 Summary

A summary of the hydrogeological investigation is provided below:

- The Site is located within the Blue Mountains Subwatersheds under the jurisdiction of the Nottawasaga Valley Conservation Area (NVCA).
- There is a surface water feature, Pretty River, which traverses the Site at the eastern boundary. There are also woodlots with associated wetlands on the eastern and southern portion of the Site. These features are within an NVCA regulated area. Consultation with the NVCA is recommended to determine permitting requirements for development in the regulated areas.
- The Site falls within the Nottawasaga Valley Source Protection Area within the South Georgian Bay Lake Simcoe Source Protection Region. The Site is within an HVA and intersects a SGRA.
- The Site topography slopes gently downward to the northeast towards Pretty River and has an average elevation of 192 masl.
- The Site is within the Simcoe Lowlands physiographic region and the surficial geology across the Site consists of coarse-textured glaciolacustrine deposits, and modern alluvial deposits.
- The overburden geology across the Site consists of topsoil, fill, sand and silt textured deposits, and silt and clay textured deposits. Limestone bedrock was encountered at depths between 5.02 mbgs and 9.19 mbgs and extended to the terminal investigation depth of 10.67 mbgs.
- Long-term groundwater monitoring was completed from January 2018 to April 2019, and March to September 2021. Groundwater elevations in the bedrock aquifer ranged from 186.47 masl to 187.78 masl, and groundwater elevations in the overburden ranged from 186.01 masl to 191.35 masl.
- The hydraulic conductivity of the overburden material was estimated to range between 2.9×10^{-7} m/s and 7.8×10^{-10} m/s, with a geometric mean of 3.5×10^{-8} m/s. The bedrock unit had a hydraulic conductivity ranging between 7.1×10^{-4} m/s and 5.9×10^{-5} m/s, with a geometric mean of 1.6×10^{-4} m/s.
- An unfiltered groundwater quality sample was collected from 17MW-5 on July 4, 2018, and compared with the Town of Collingwood Sewer Use By-Law (By-Law No. 2009-118). Based on laboratory analyses, there were no tested parameters that exceeded the criteria for Storm or Sanitary in By-Law 2009-118.
- Assuming construction is phased such that excavation occurs simultaneously across the Site, the estimated maximum dewatering rate during construction for groundwater control is 134,100 L/day. Allowing for contingency dewatering of stormwater, from direct precipitation due 5 mm of rainfall over 24 hours in all excavations, adds 229,200 L/day giving total dewatering for groundwater and stormwater control of 363,300 L/day. Water takings for construction dewatering consisting of groundwater and stormwater inputs, above 50,000 L/day but less than 400,000 L/day require an EASR registration to proceed. Water takings below 50,000 L/day do not require any water taking permits to proceed. Consideration of the approach to construction phasing, construction dewatering

and requirements for stormwater control, is recommended to determine the dewatering permits required for construction.

- If foundations drains are used to collect perimeter and underfloor drainage at building foundations, the estimated long-term dewatering rate is 18,700 L/day. Water-takings below 50,000 L/day do not require a water-taking permit to proceed.
- Short- and long-term dewatering requirements should be reviewed once architectural design details become available and site grading and servicing plans are updated.
- A site-specific Spill Prevention and Response Plan, as well as a site-specific ESC Plan, are recommended during construction. Where well designed and implemented environmental management plans are in place, short-term impacts to the groundwater system, surface water system and other groundwater uses are not expected.
- Where there exists a possibility that groundwater may be diverted and follow the path of new/relocated utilities or services, groundwater barriers may be used to prevent groundwater migration down servicing/utility trenches.

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9 General Statement of Limitation

The comments presented in this report are based on the soil and groundwater samples gathered from the borehole/monitoring well locations indicated on the plan of this report. There is no warranty expressed or implied or representations made by Toronto Inspection Ltd. that this program has discovered all potential environmental risks or liabilities associated with the subject site.

Although we consider this report to be representative of the subsurface conditions at the subject property in the areas investigated, any interpretation of factual data or unexpected soil conditions which exhibit noticeable discolouration, odour, etc. in areas not investigated in this report, should be discussed in consultation with us prior to any initiation of activity. Our responsibility is limited to an accurate assessment of the soil condition prevailing at the locations investigated at the time of the study.

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

Any use and/or interpretation of the data presented in this report, and any decisions made on it by the third party are responsibility of the third party. Toronto Inspection Ltd. accepts no responsibility for loss of time and damages, if any, suffered by the third party as a result of decisions or actions based on this report.

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

Yours truly,

Toronto Inspection Ltd.

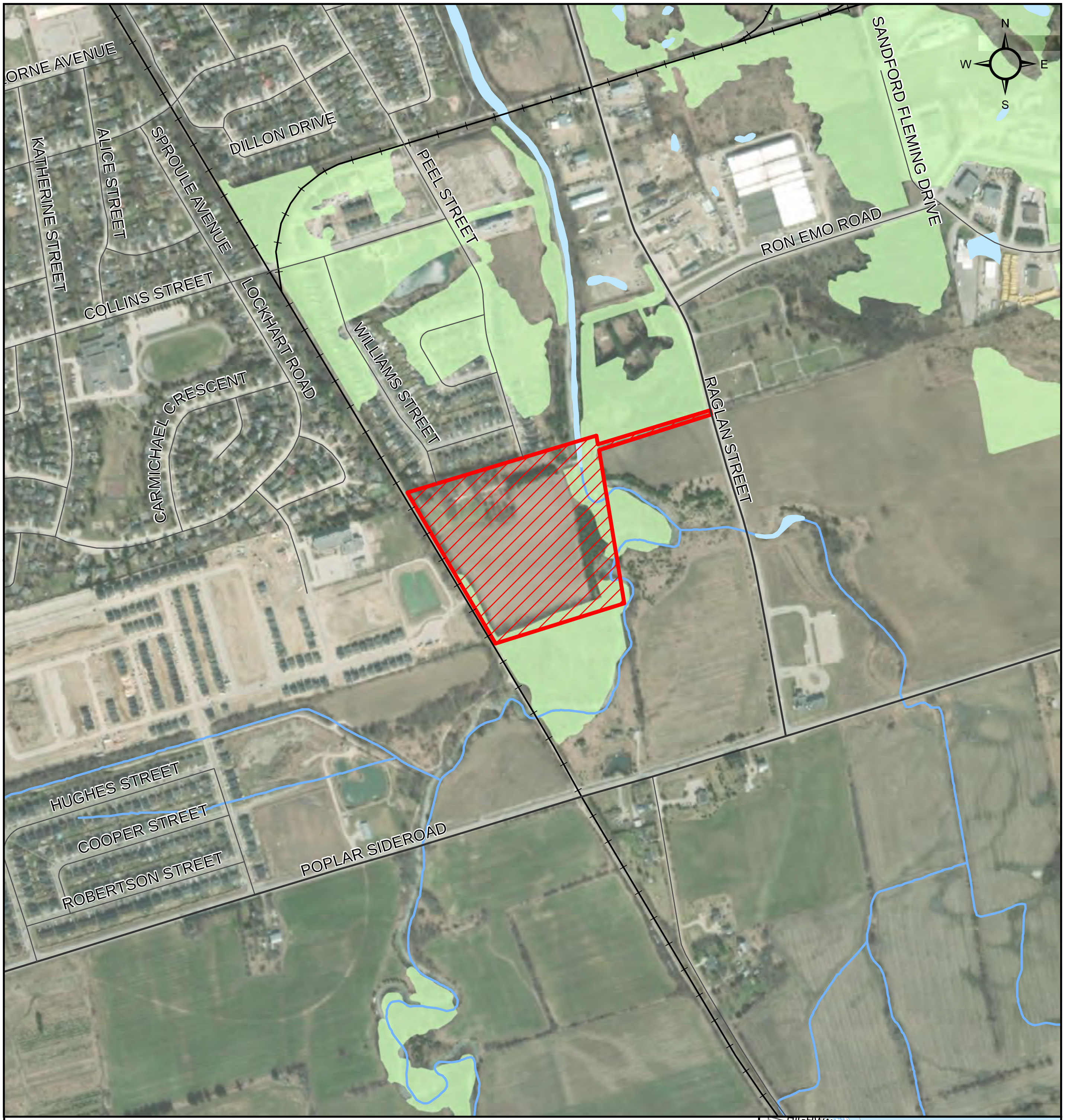
PROFESSIONAL GEOSCIENTIST
RASHEEDA D. BYER-COWARD
PRACTISING MEMBER
1933
21-JAN-2022
ONTARIO

Sanjay Goel, B.E.S.
Environmental Scientist
Vice-President

Rasheeda Byer-Coward, P.Geo.
Hydrogeologist

pg/rbc

FIGURES



Legend

- Highway
- Arterial Road
- Local Road
- Railway
- Watercourse
- ▨ Site Location
- Waterbody
- 🟩 Wooded Area

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GEO-ENVIRONMENTAL CONSULTANTS
110 Konrad Crescent, Unit 16, Markham, On L3R 9X2
Tel: 905-940 8509 Fax: 905-940 8192

TITLE: Site Location

LOCATION: 452 Raglan Street, Collingwood, Ontario

PROJECT NO. 4688-17-HG

DATE: January 2022

FIGURE NO. 1

REFERENCE
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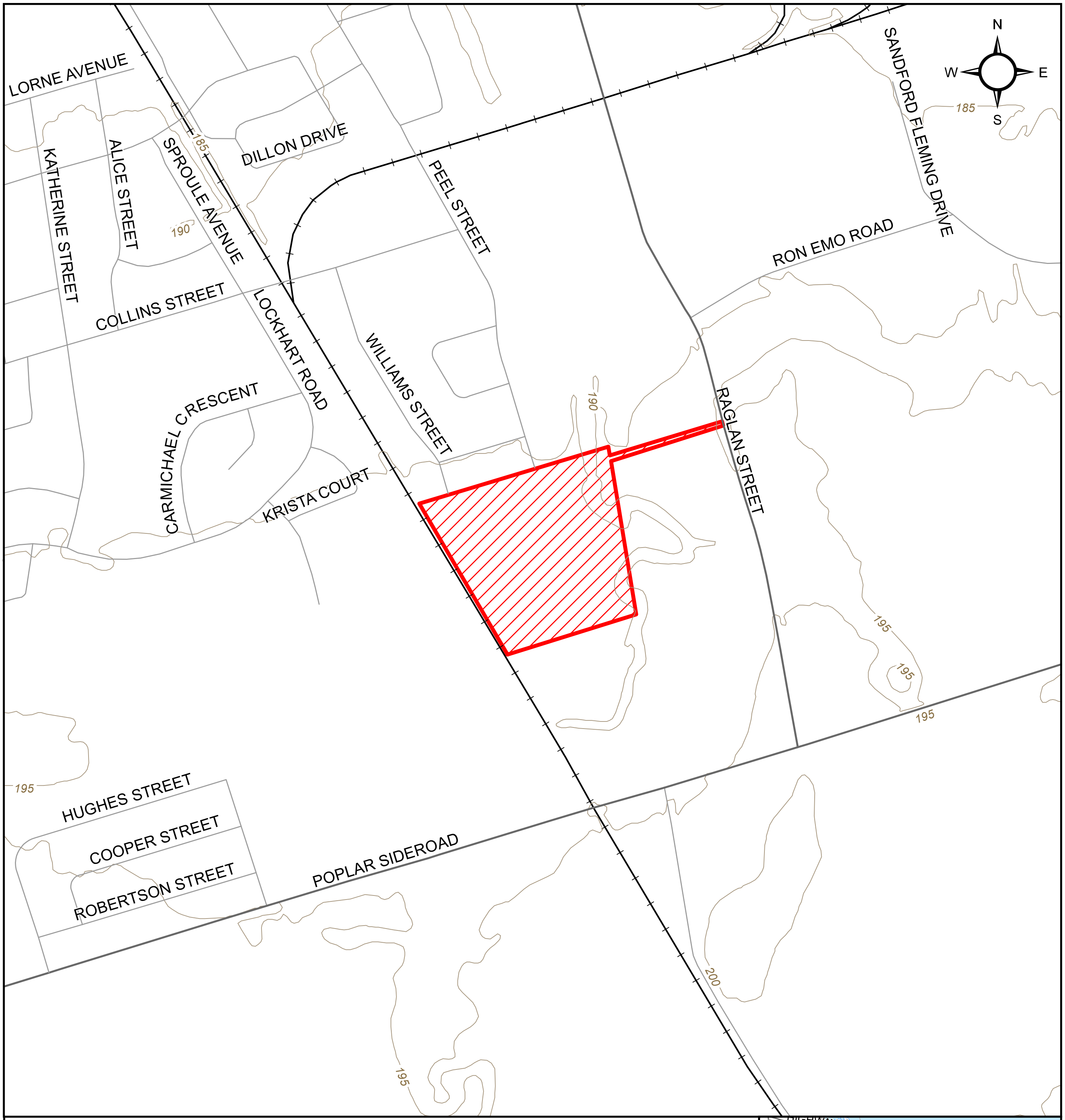

Legend

- Highway
- Arterial Road
- Local Road
- Railway
- Ground Surface Topography (5m Contour)
- ▨ Site Location

0 75 150 300 450 m

1:10,000

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TITLE:	Topography
LOCATION:	452 Raglan Street, Collingwood, Ontario

PROJECT NO.	DATE:	FIGURE NO.
4688-17-HG	January 2022	2

REFERENCE

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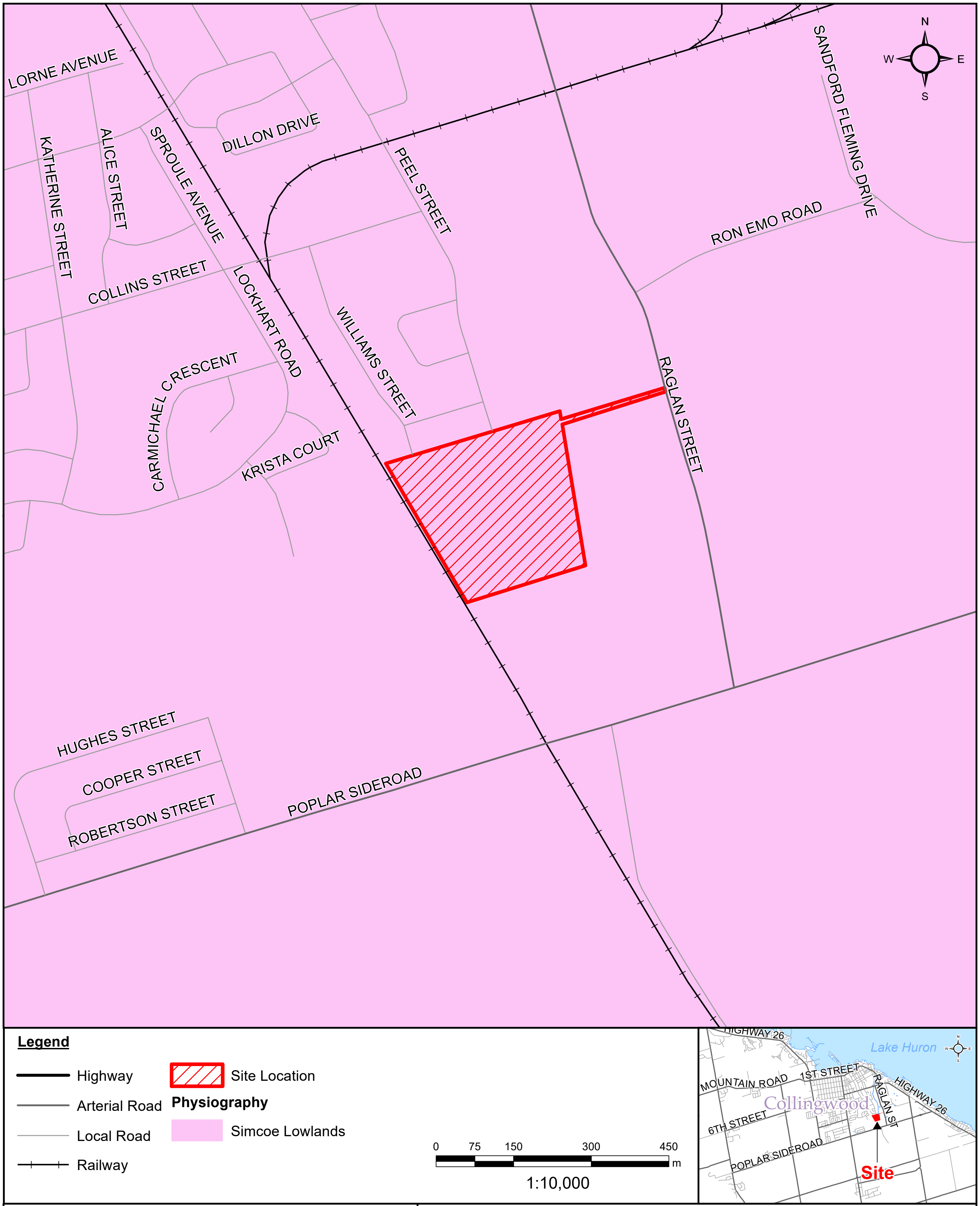

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Tel: 905-940 8509 Fax: 905-940 8192

TITLE: Physiography

LOCATION: 452 Raglan Street, Collingwood, Ontario

PROJECT NO. 4688-17-HG

DATE: January 2022

FIGURE NO. 3

REFERENCE

Service Layer Credits: Source: Chapman, L.J. and Putnam, D.F. 2007. Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228.
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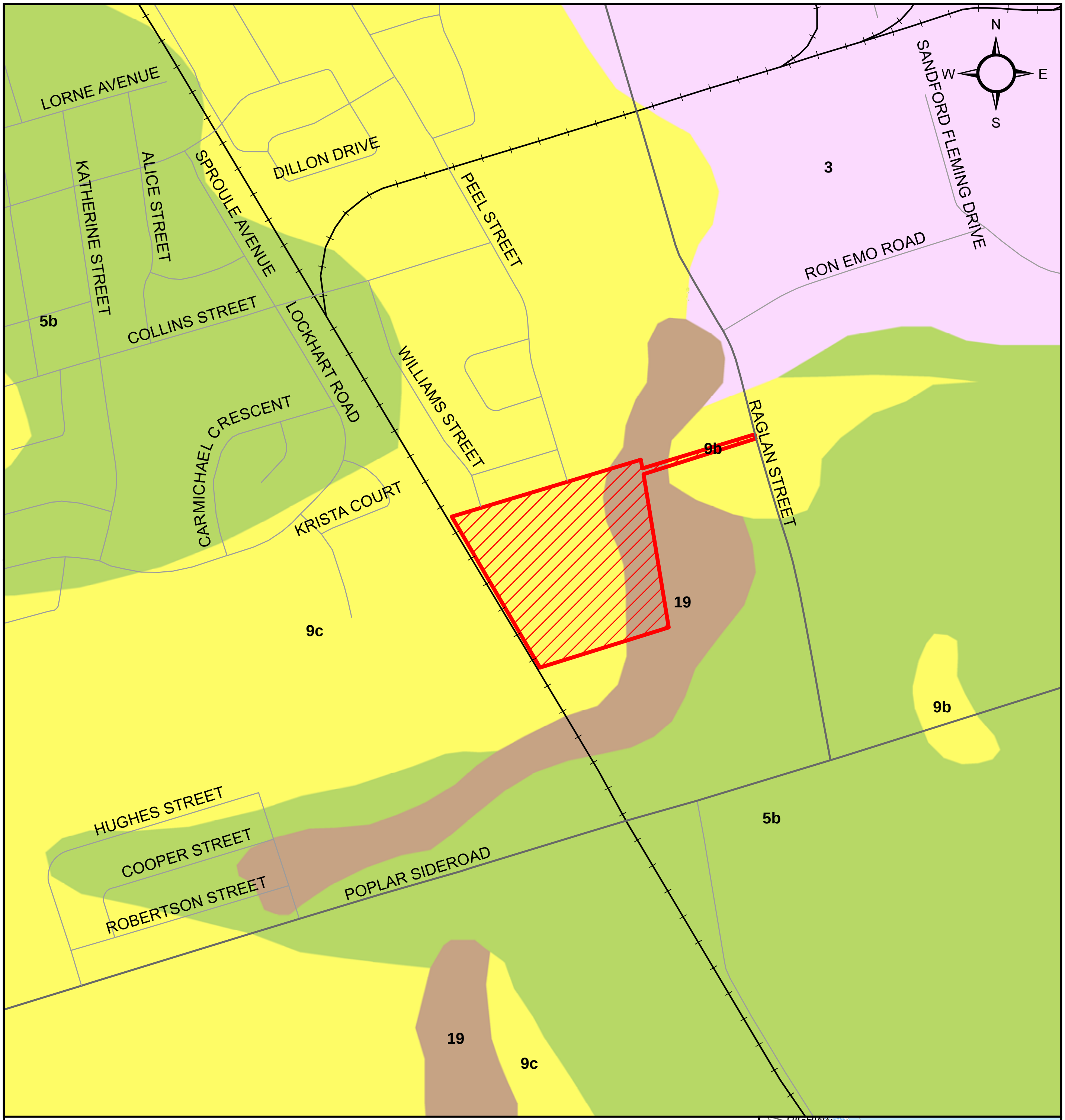

Legend

— Highway
— Arterial Road
— Local Road
┼ Railway
▨ Site Location

Surficial Geology

🟪 3: Paleozoic bedrock
🟩 5b: Stone-poor, carbonate-derived silty to sandy till
🟨 9b: Littoral-foreshore deposits
🟨 9c: Course-textured glaciolacustrine deposits (sand, gravel, minor silt and clay)
🟫 19: Modern alluvial deposits

0 75 150 300 450 m
1:10,000

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Tel: 905-940 8509 Fax: 905-940 8192

TITLE: Surficial Geology

LOCATION: 452 Raglan Street, Collingwood, Ontario

PROJECT NO. 4688-17-HG
DATE: January 2022
FIGURE NO. 4

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Legend

- ▬ Driveway
- ▬ Highway
- ▬ Arterial Road
- ─ Local Road
- ┼┼ Railway
- ▨ Site Location

Bedrock Geology

- 🟦 11: Lindsay

1:10,000

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TITLE: Bedrock Geology

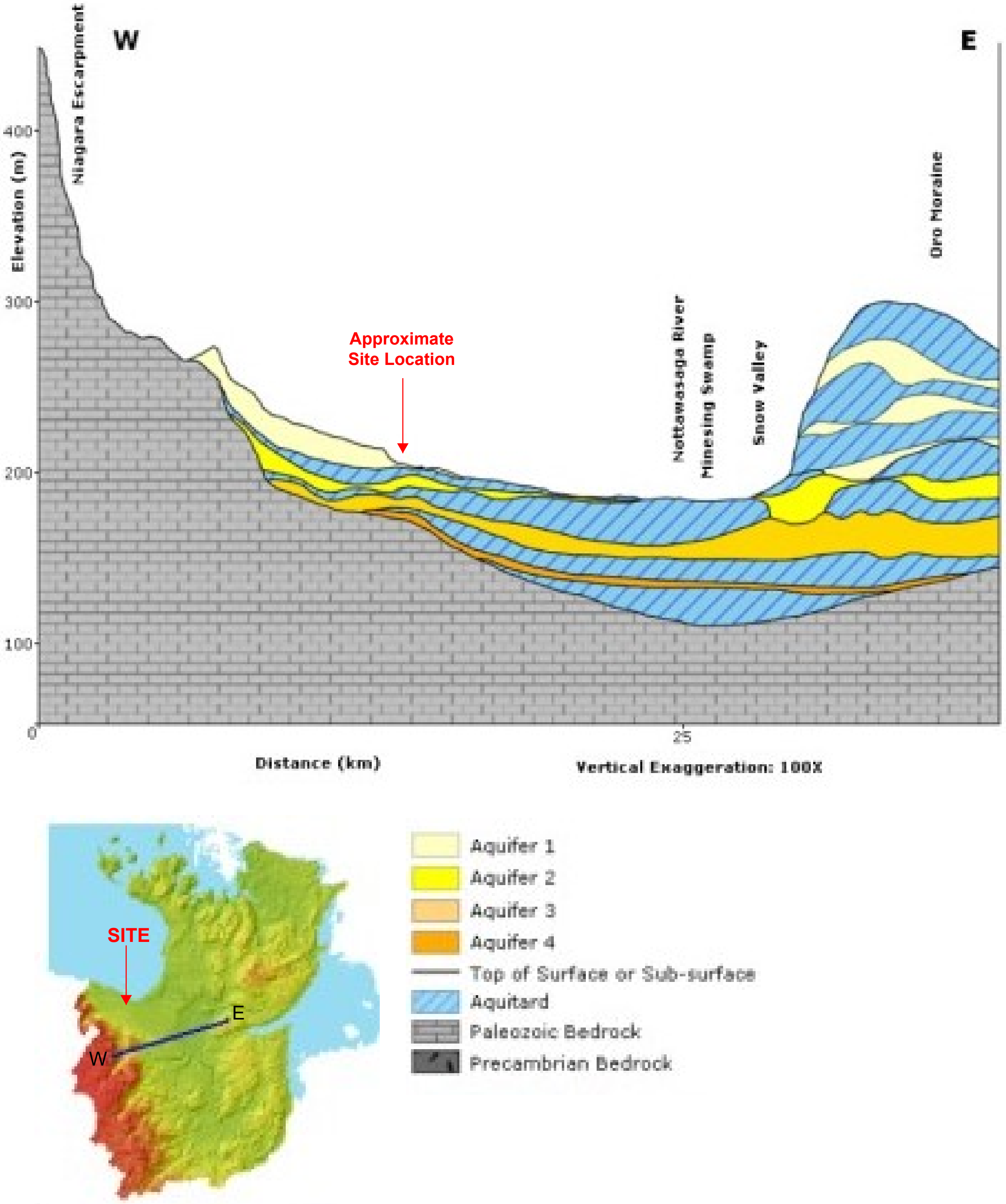
LOCATION: 452 Raglan Street, Collingwood, Ontario

PROJECT NO.	DATE:	FIGURE NO.
4688-17-HG	January 2022	5

REFERENCE

Armstrong, D.K. and Dodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219.

East-West Cross-Section in Nottawasaga Valley



Source: EastWest Cross-Section of the NVCA Watershed (South Georgian Bay-Lake Simcoe Protection Committee, 2015)

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TITLE: Regional Cross-Section

LOCATION: 452 Raglan Street, Collingwood, Ontario

PROJECT NO. 4688-17-HG

DATE: January 2022

FIGURE NO. 6

REFERENCE
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Legend

● Borehole

⊕ Monitoring Well

— Driveway

+—+ Railway

— Highway

— Arterial Road

— Local Road

🟥 Site Location

0 25 50 100 m

1:2,500

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Tel: 905-940 8509 Fax: 905-940 8192

TITLE: Borehole and Monitoring Well Locations

LOCATION: 452 Raglan Street, Collingwood, Ontario

PROJECT NO. 4688-17-HG

DATE: January 2022

FIGURE NO. 7

REFERENCE
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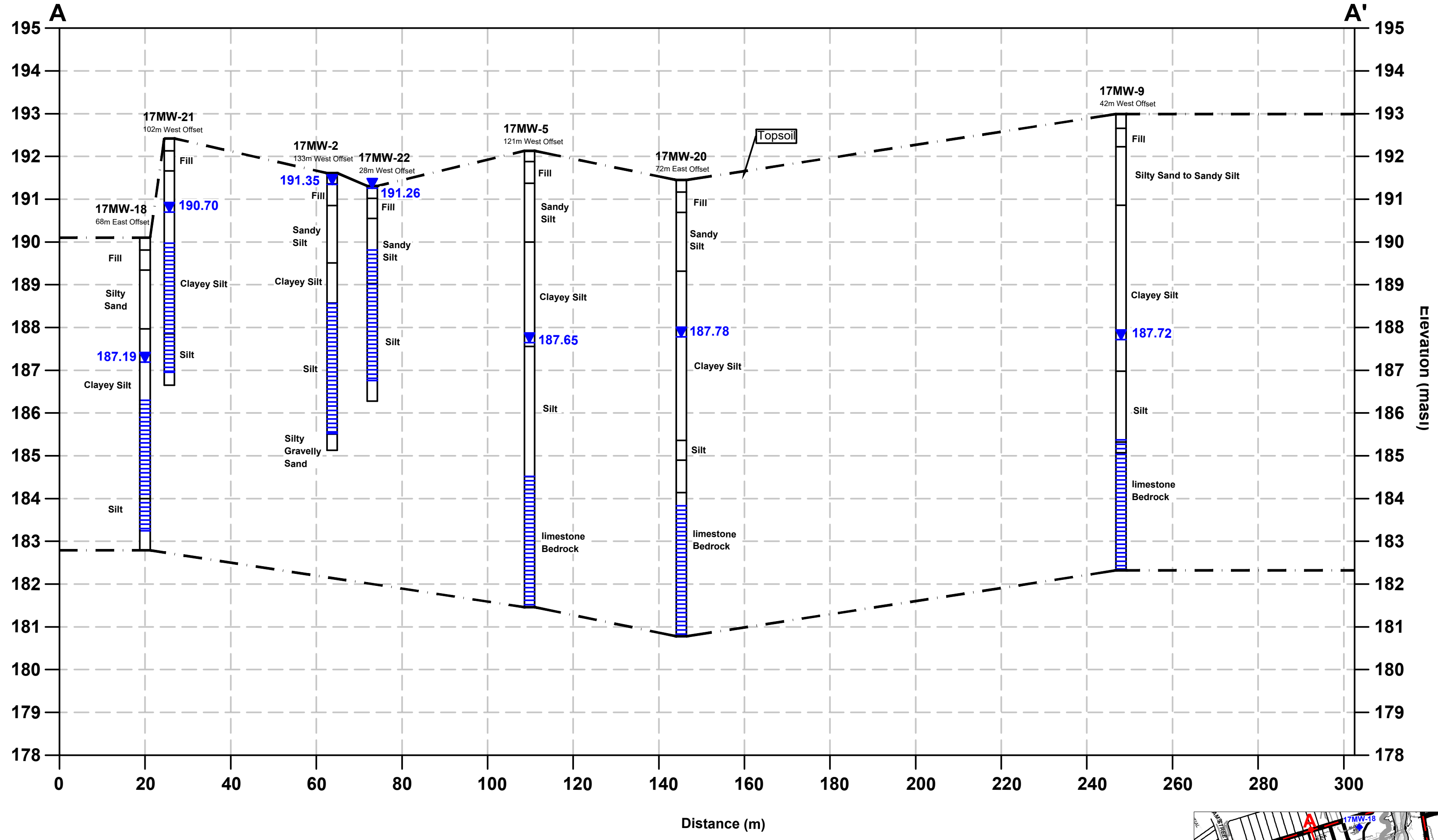


LEGEND

▼ Water Level Measurement (masl)
Measured on April 26, 2019

Monitoring Well Screen

⊕ Borehole and
Monitoring Well Location

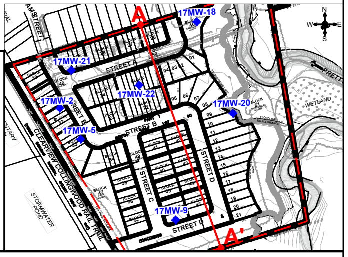
Inferred Geological Boundary

Site Boundary

Cross-Section A-A'

NOTE:

Vertical Exaggeration: 10x



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Markham, Ontario
L3R 9X2

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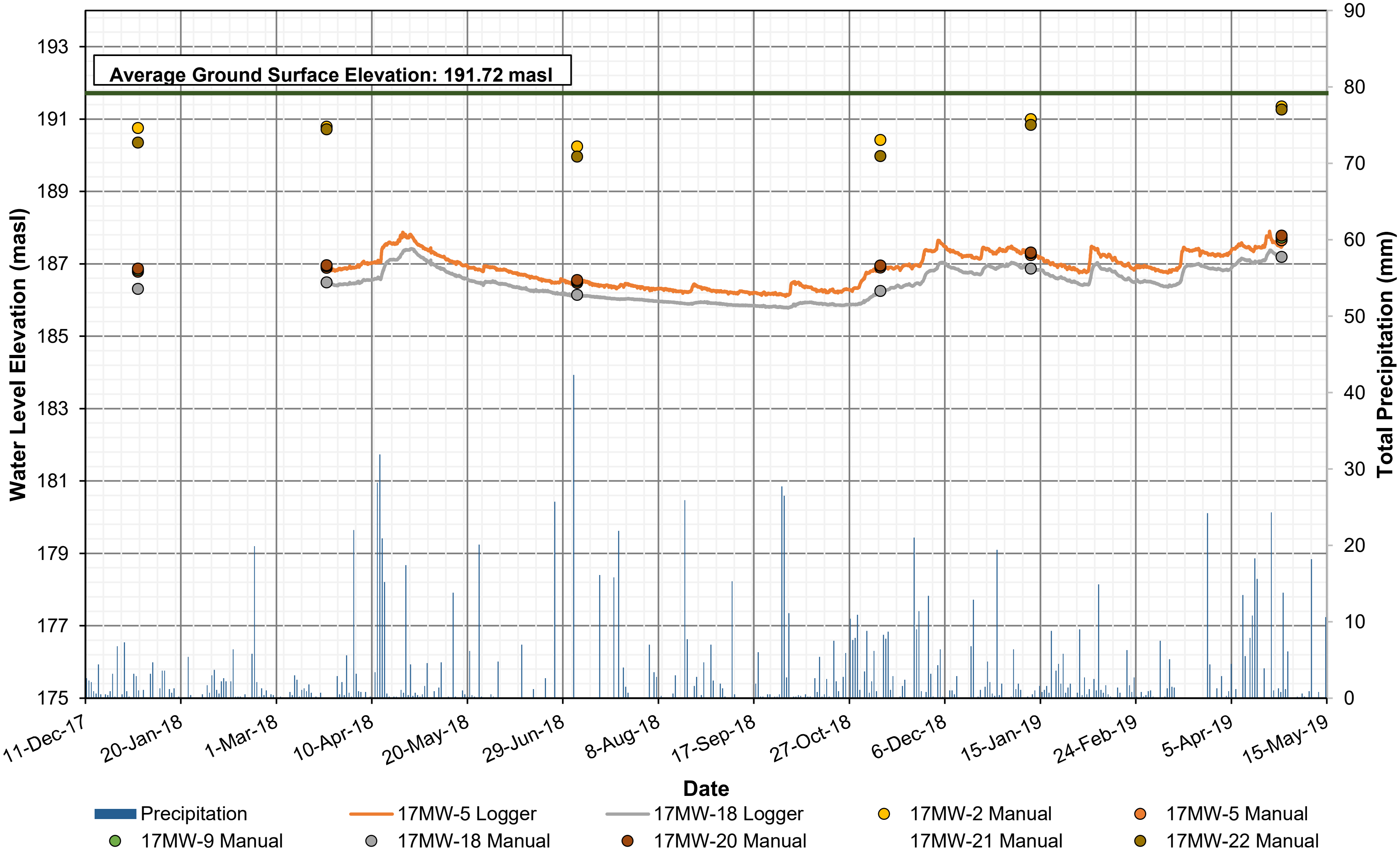
TITLE: Local Geological Cross-Section A-A'

LOCATION: 452 Raglan Street, Collingwood, Ontario

PROJECT NO. 4688-17-HG DATE : January 2022 FIGURE NO. 8



Notes:
Precipitation data obtained from Environment and Climate Change Canada for the Collingwood climate station, which is located 2.11 km northwest of the Site.

GROUNDWATER LEVEL HYDROGRAPH (2017 - 2019)

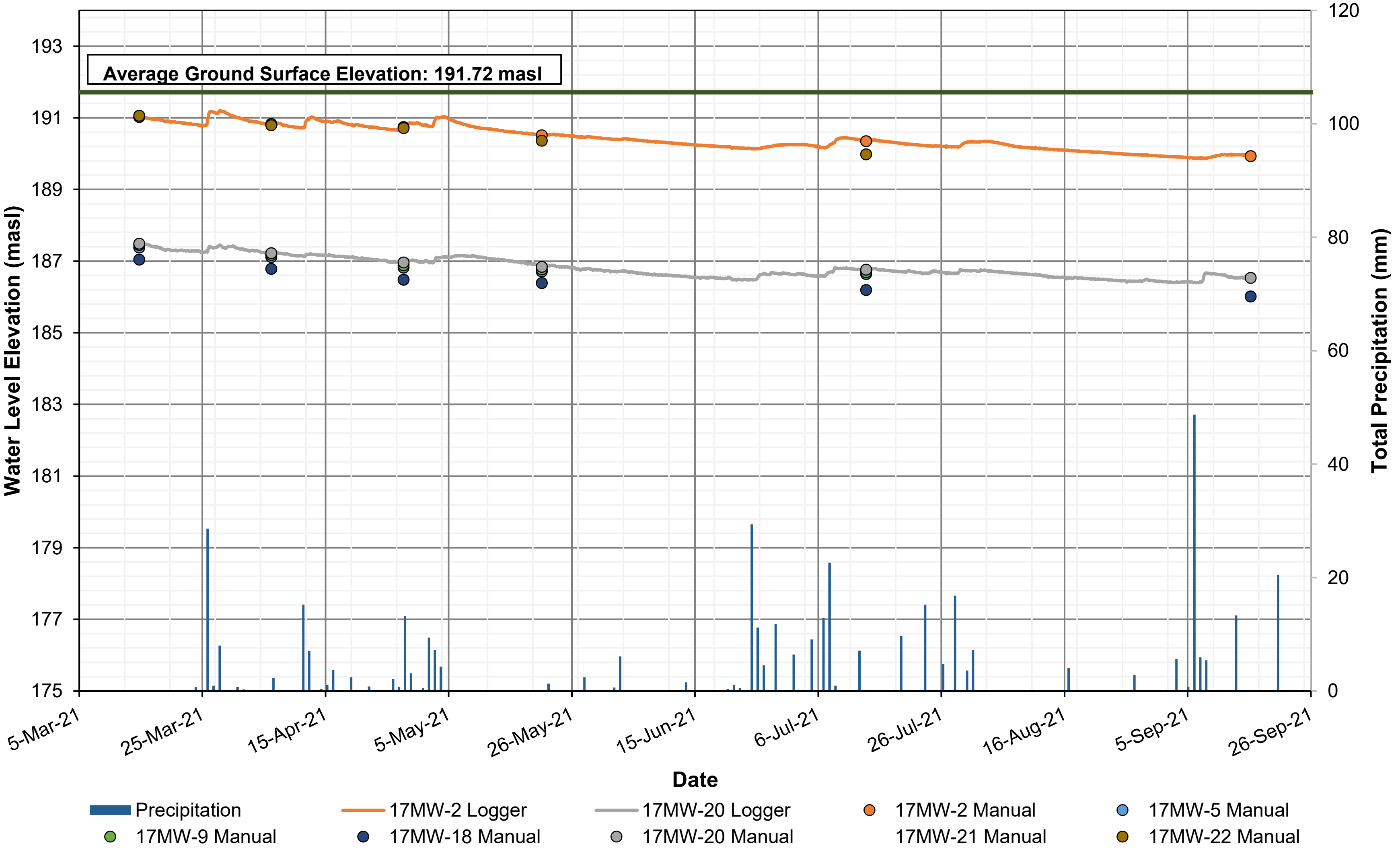
452 Raglan Street, Collingwood, Ontario

Eden Oak Mcnabb Inc.

Figure No.: 9

Project No: 4688-17-HG

Date: January 2022



Notes:
Precipitation data obtained from Environment and Climate Change Canada for the Collingwood climate station, which is located 2.11 km northwest of the Site.

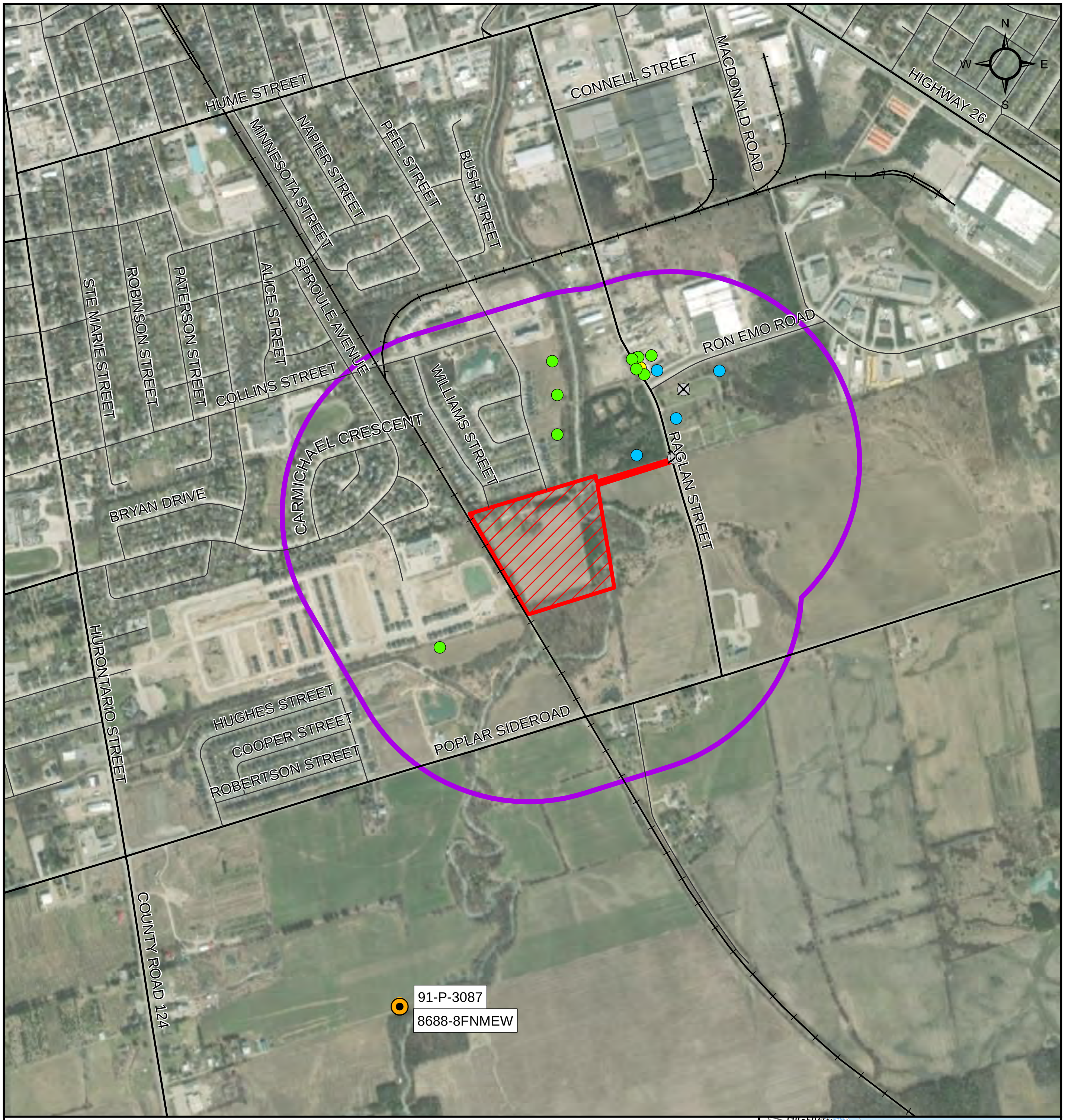
GROUNDWATER LEVEL HYDROGRAPH (2021)

452 Raglan Street, Collingwood, Ontario Eden
Oak Mcnabb Inc.

Figure No.: 10

Project No: 4688-17-HG

Date: January 2022



Legend

MECP Water Wells

●	Water Supply Well	◉	Permit to Take Water	▬	Highway
●	Monitoring Well	▨	Site Location	—	Arterial Road
☒	Abandoned	☐	500m Buffer of Site Location	—	Local Road
●	Unknown Well	—+—	Railway		

0 75 150 300 450 m

1:15,000

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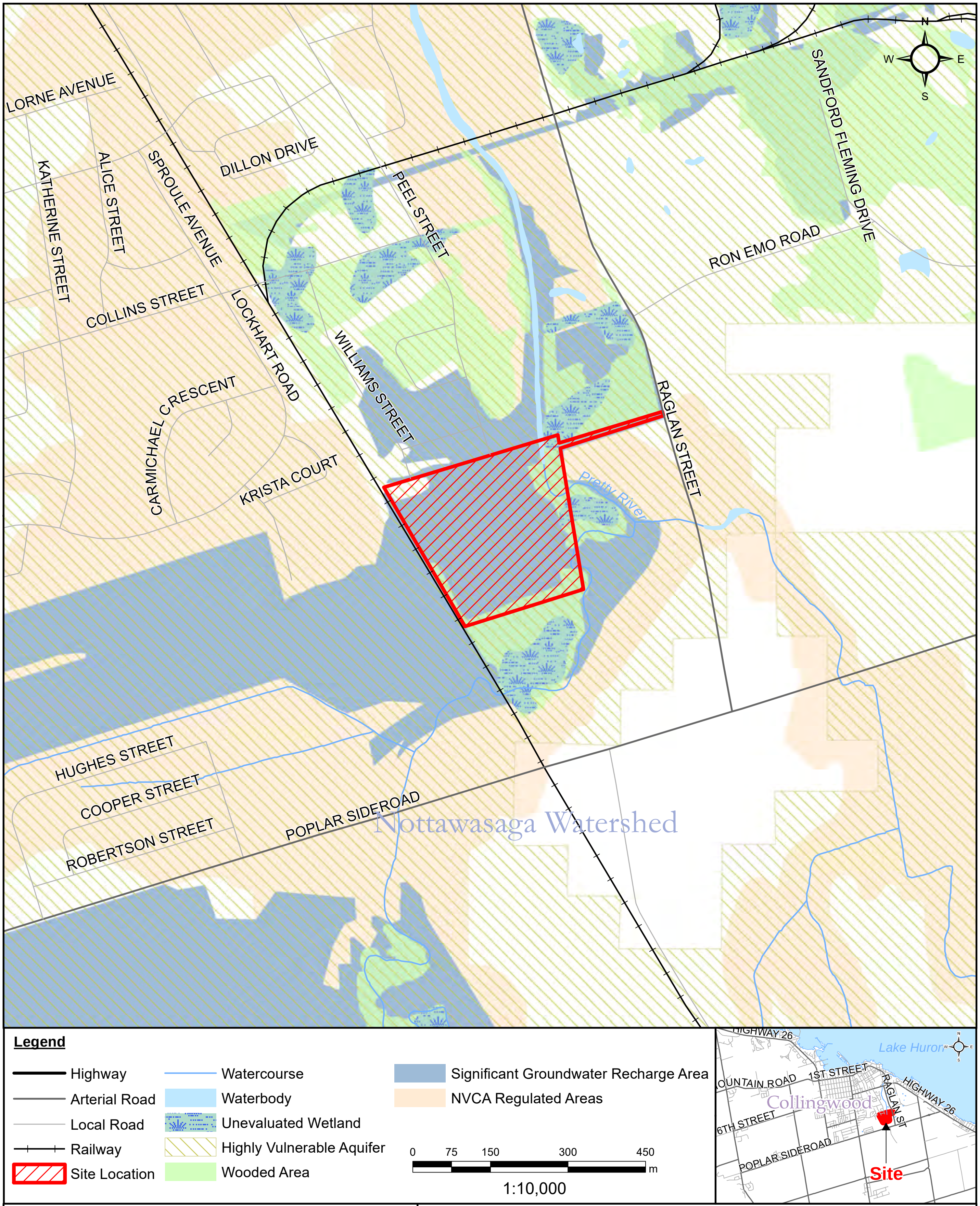
110 Konrad Crescent, Unit 16, Markham, On L3R 9X2
Tel: 905-940 8509 Fax: 905-940 8192

TITLE: MECP Water Well Records and Permits to Take Water

LOCATION: 452 Raglan Street, Collingwood, Ontario

PROJECT NO.	DATE:	FIGURE NO.
4688-17-HG	January 2022	11

REFERENCE
Service Layer Credits: Source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User.



TorontoInspection LTD.
GEO-ENVIRONMENTAL CONSULTANTS
110 Konrad Crescent, Unit 16, Markham, On L3R 9X2
Tel: 905-940 8509 Fax: 905-940 8192

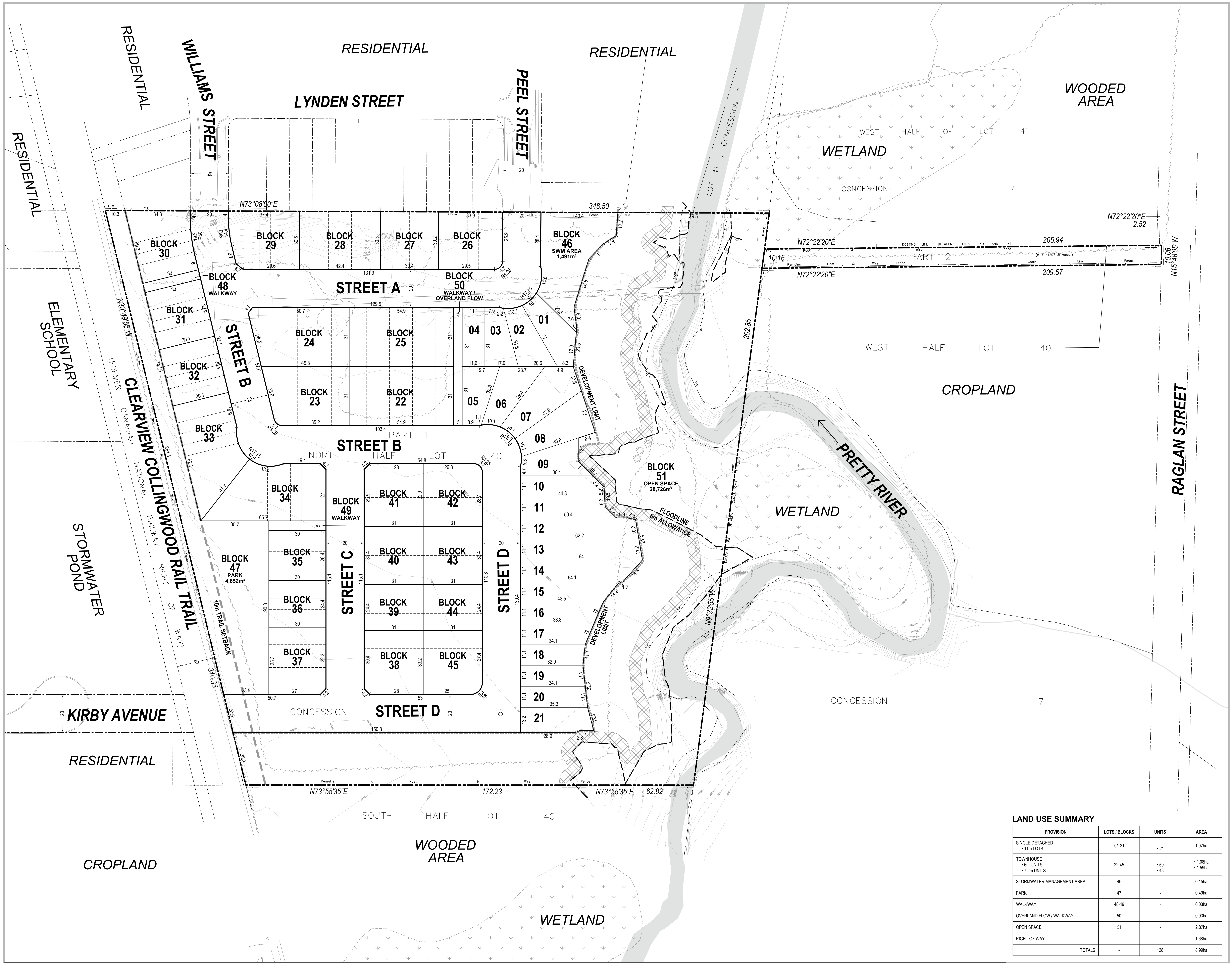
TITLE:	Environmental Features
LOCATION:	452 Raglan Street, Collingwood, Ontario

PROJECT NO.	DATE:	FIGURE NO.
4688-17-HG	January 2022	12

REFERENCE

APPENDIX A

Site Plans



LEGAL DESCRIPTION

PART OF LOT 40,
IN CONCESSION SEVEN AND EIGHT
TOWNSHIP OF NOTTAWASAGA
COUNTY OF SIMCOE

OWNER'S CERTIFICATE

I HEREBY AUTHORIZE MACNAUGHTON HERMSEN BRITTON CLARKSON PLANNING LIMITED TO SUBMIT THIS PLAN FOR APPROVAL.

DATE: ____________________

____
XXXXXXXXXXXXX - PRESIDENT
XXXXXXXXXXXXXXX

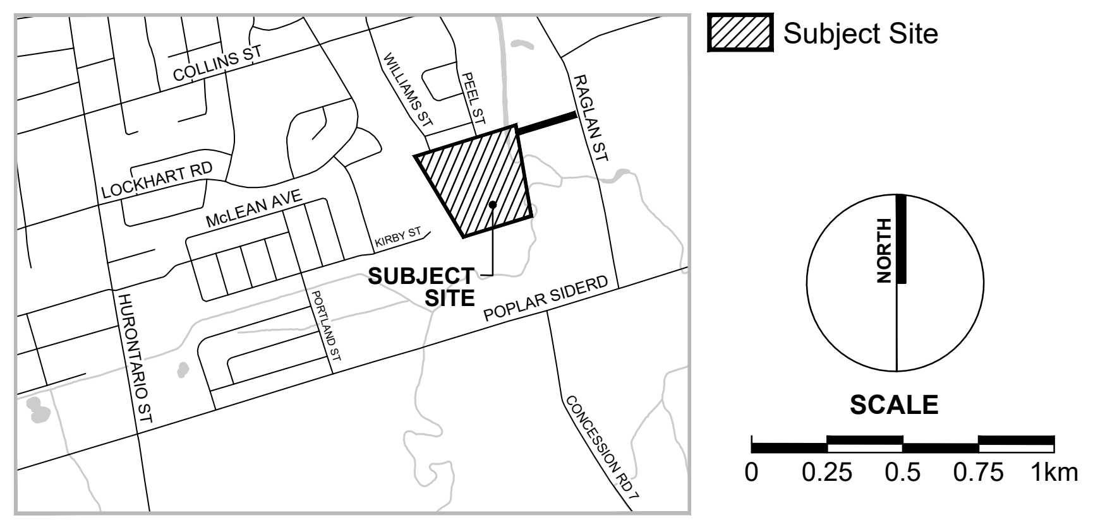
SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE: ____________________

____
XXXXXXXXXXXXX - O.L.S.
XXXXXXXXXXXXXXX

KEY PLAN



LEGEND

- PROJECT BOUNDARY LINE
- RIGHT OF WAY LINE
- BLOCK LINE
- LOT LINE
- UNIT LINE
- LOT FRONTAGE
- PARCEL FABRIC

REVISION No.	DATE	ISSUED / REVISION	BY

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT R.S.O. 1990 C.P.13 AS AMENDED

- **A.** AS SHOWN
- **B.** AS SHOWN
- **C.** AS SHOWN
- **D.** 21 SINGLE DETACHED & 107 TOWNHOUSE UNITS
- **E.** AS SHOWN
- **F.** AS SHOWN
- **G.** AS SHOWN
- **H.** MUNICIPAL WATER SUPPLY
- **I.** SOIL?
- **J.** AS SHOWN
- **K.** FULL MUNICIPAL SERVICES
- **L.** AS SHOWN

113 COLLIER STREET
BARRIE, ON, L4M 1H2
P: 705 728 0045 F: 705 728 2010
WWW.MHBCPLAN.COM

PLANNING
URBAN DESIGN
& LANDSCAPE
ARCHITECTURE
MHBC PLANNING

STAMP

DATE	**NOV. 16, 2021**
FILE No.	**Y537R**
SCALE	**1:900** **(ARCH D)**
DRAWN BY	**M.M.**
CHECKED BY	**K.C.**
OTHER	

PROJECT

452 RAGLAN STREET

EDEN OAK INC.
1443 HURONTARIO STREET
MISSISSAUGA, ONTARIO
L5G 3H5

FILE NAME **DRAFT PLAN OF SUBDIVISION**

DWG No. **1 of 1**

SCALE BAR

0 4 8 12 16 20 30 40 60 80m

MEASUREMENTS SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

N:\Collingwood\Eden Oak – 452 Raglan St, Collingwood – Y537R\Drawings\Draft Plan\CAD\Y537R – Draft Plan – 2021-11-16.dwg

LAND USE SUMMARY

PROVISION	LOTS / BLOCKS	UNITS	AREA
SINGLE DETACHED • 11m LOTS	01-21	• 21	1.07ha
TOWNHOUSE • 6m UNITS • 7.2m UNITS	22-45	• 59 • 48	• 1.08ha • 1.59ha
STORMWATER MANAGEMENT AREA	46	-	0.15ha
PARK	47	-	0.49ha
WALKWAY	48-49	-	0.03ha
OVERLAND FLOW / WALKWAY	50	-	0.03ha
OPEN SPACE	51	-	2.87ha
RIGHT OF WAY	-	-	1.68ha
TOTALS	-	128	8.99ha

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4. DO NOT SCALE THE DRAWINGS.
5. ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

TEMPORARY BENCHMARKS

TBM#1 ELEV 191.37m
TOP NUT OF FIRE HYDRANT LOCATED AT THE SOUTH END OF PEEL STREET

TOPOGRAPHIC SURVEY COMPLETED BY JoeTOPO SURVEYS AND CADD INC., DATED AUG. 2017 AND NOV. 2017.

Town

No.	ISSUE	DATE: MM/DD/YYYY
0	ISSUED FOR 1st SUBMISSION	01/15/2018
1	ISSUED FOR 2nd SUBMISSION	08/XX/2021

Engineer

Engineer

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

PROFESSIONAL … PROVINCE OF ONTARIO

Project

452 RAGLAN
TOWN OF COLLINGWOOD

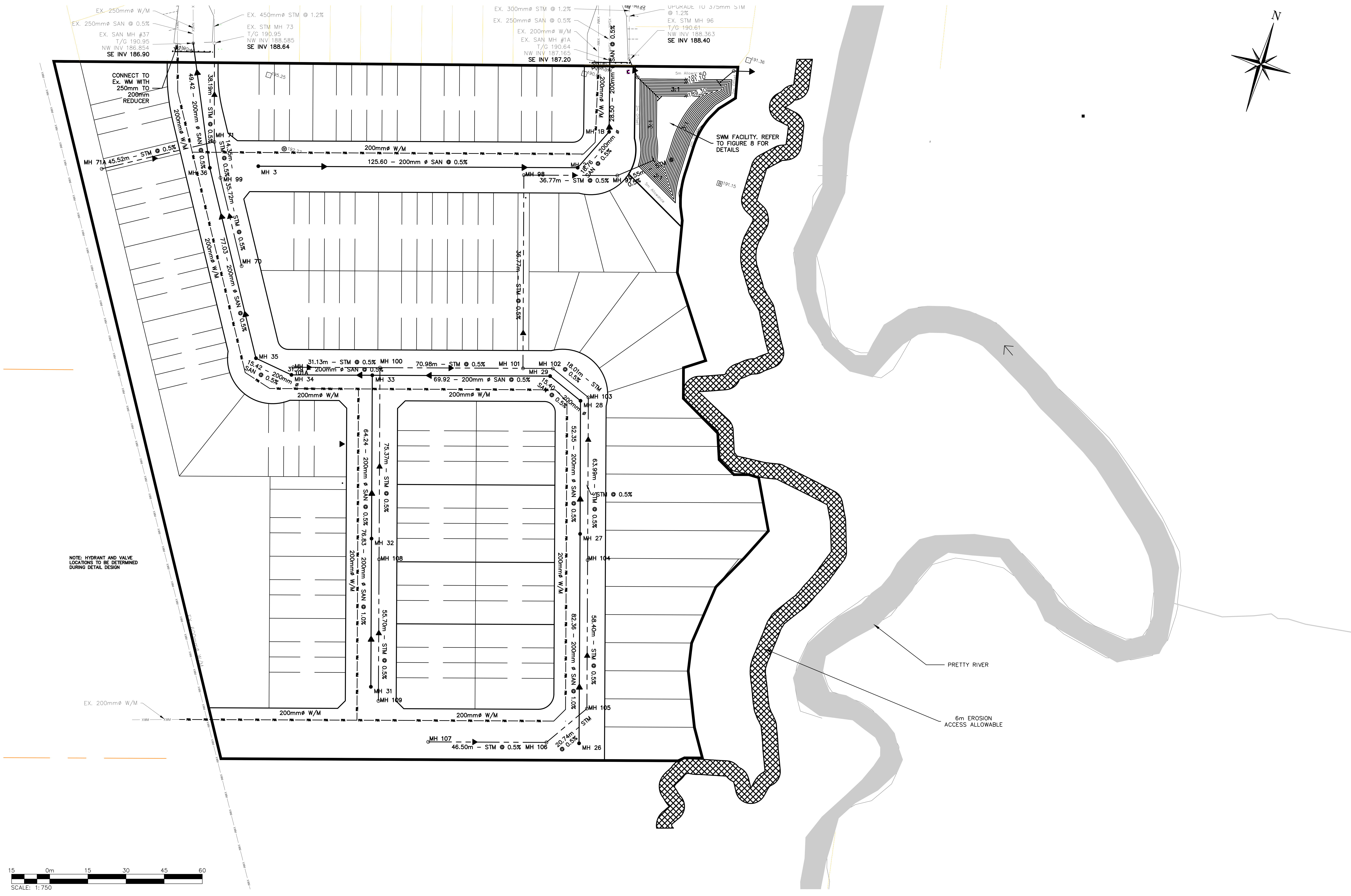
Drawing

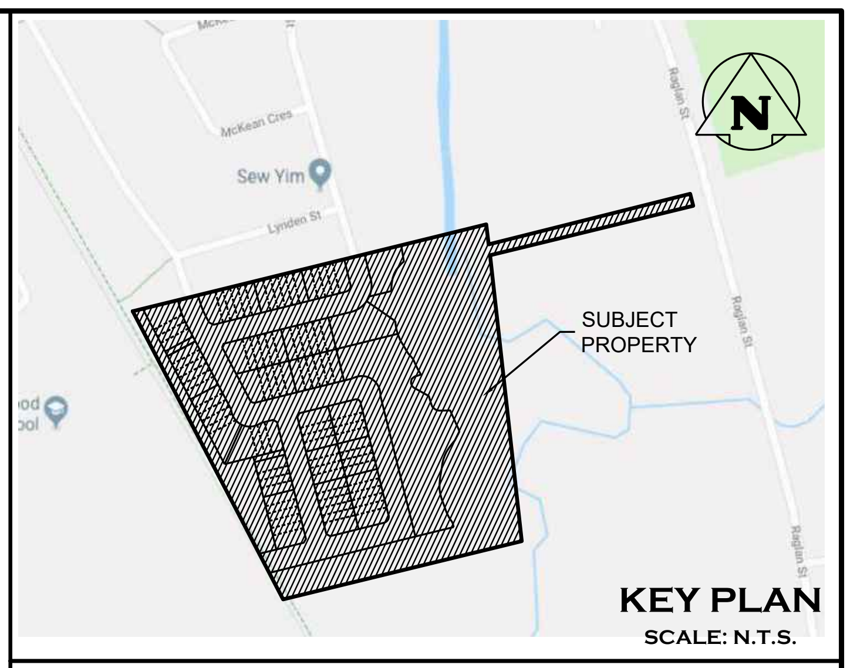
PRELIMINARY
SITE GRADING PLAN

CROZIER
CONSULTING ENGINEERS

ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
705 446-3510 T
705 446-3520 F
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

Drawn By D.T	Design By A.C	Project 218–5833	
Check By XX	Check By R.A	Scale 1:750	Drawing 4





KEY PLAN
SCALE: N.T.S.

LEGEND

DEVELOPMENT AREA
SANITARY SEWER AND MANHOLE
STORM SEWER AND MANHOLE
WATERMAIN
PROPOSED LOT LINE

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TEMPORARY BENCHMARKS

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TOP NUT OF FIRE HYDRANT LOCATED AT THE SOUTH END OF PEEL STREET

TOPOGRAPHIC SURVEY COMPLETED BY JoeTOPO SURVEYS AND CADD INC., DATED AUG. 2017 AND NOV. 2017.

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Engineer

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Engineer

PROFESSIONAL … PROVINCE OF ONTARIO

Project

452 RAGLAN
TOWN OF COLLINGWOOD

Drawing

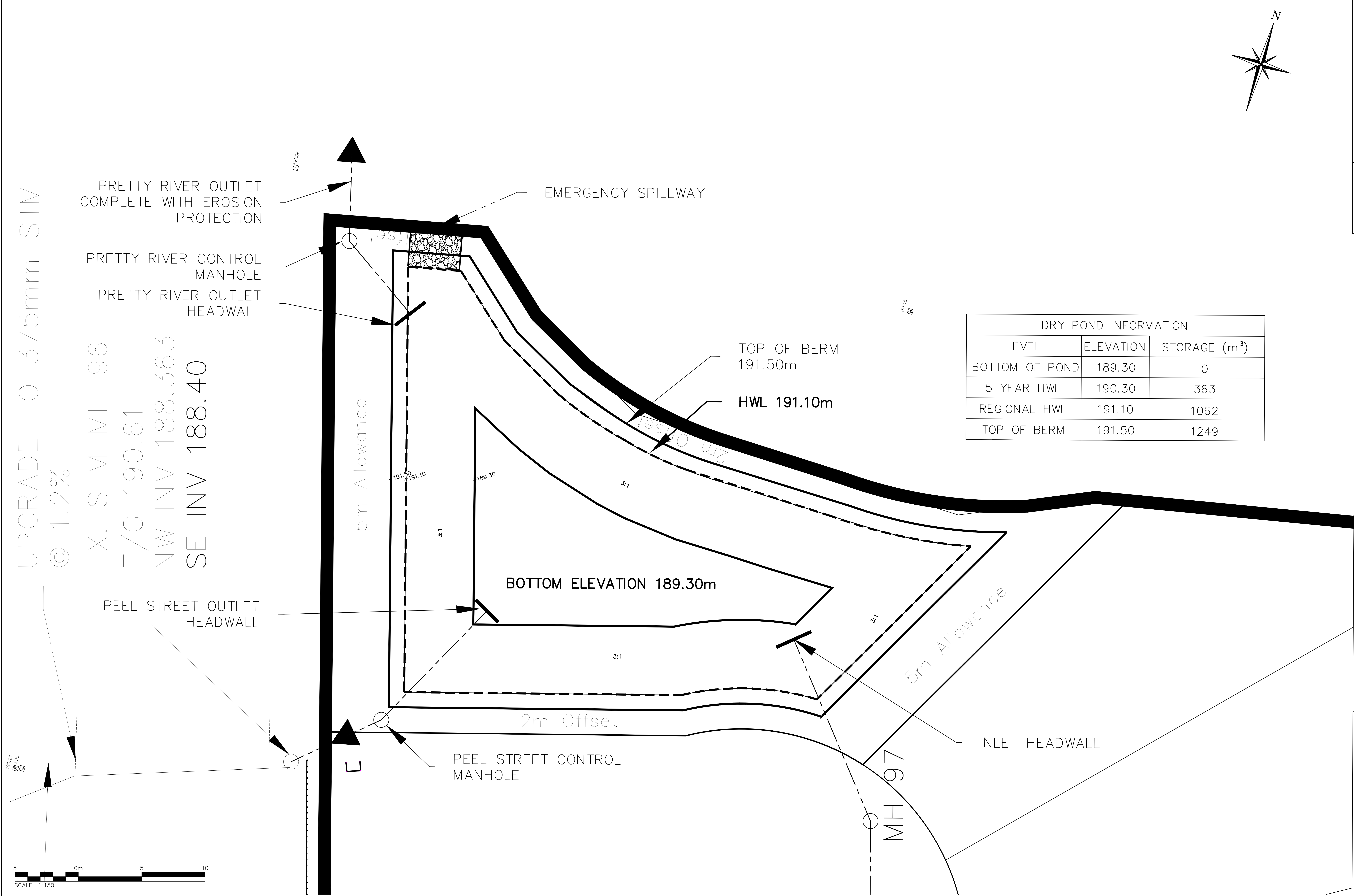
PRELIMINARY
SERVICING PLAN

CROZIER
CONSULTING ENGINEERS

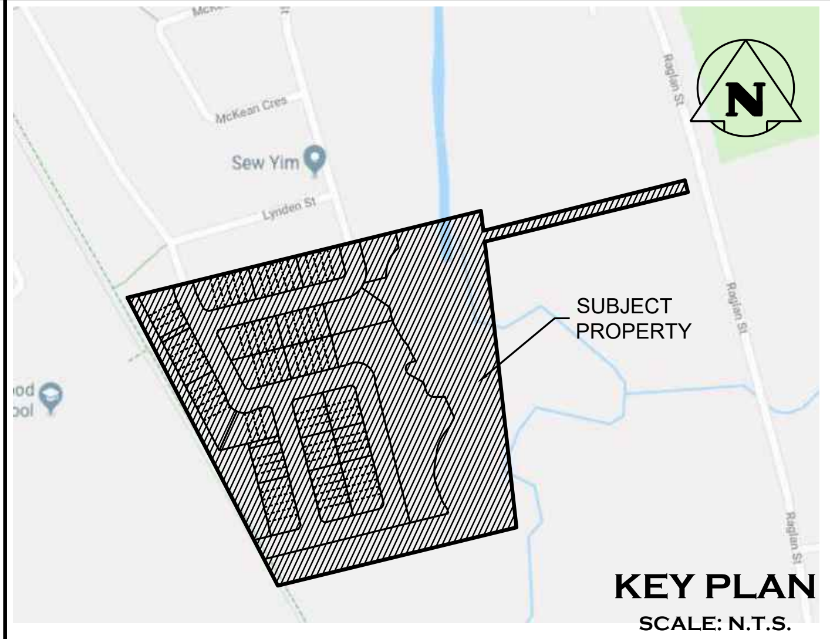
ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
705 446-3510 T
705 446-3520 F
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

Drawn By D.T	Design By A.C	Project 218–5833	
Check By XX	Check By R.A	Scale 1: 750	Drawing 7

J:\200\218 - Eden Oak\5833-452 Raglan St\CAD\Civil_Sheets\5833_7xx Figures.dwg, 2021-11-30 12:04:01 PM, AutoCAD PDF (General Documentation).pc3



DRY POND INFORMATION		
LEVEL	ELEVATION	STORAGE (m^3)
BOTTOM OF POND	189.30	0
5 YEAR HWL	190.30	363
REGIONAL HWL	191.10	1062
TOP OF BERM	191.50	1249



KEY PLAN
SCALE: N.T.S.

LEGEND

■	DEVELOPMENT AREA
—	PROPOSED LOT LINE

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TEMPORARY BENCHMARKS

TBM#1 ELEV 191.37m
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TOPOGRAPHIC SURVEY COMPLETED BY JoeTOPO SURVEYS AND CADD INC., DATED AUG. 2017 AND NOV. 2017.

Town

No.	ISSUE	DATE: MM/DD/YYYY
0	ISSUED FOR 1st SUBMISSION	01/15/2018
1	ISSUED FOR 2nd SUBMISSION	08/XX/2021

Engineer

Engineer

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Project
452 RAGLAN
TOWN OF COLLINGWOOD

Drawing
PRELIMINARY
SWM FACILITY PLAN

CROZIER
CONSULTING ENGINEERS

ADMIRAL BUILDING
1 FIRST STREET, SUITE 200
COLLINGWOOD, ON, L9Y 1A1
705 446-3510 T
705 446-3520 F
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

Drawn By D.T	Design By A.C	Project 218–5833	
Check By XX	Check By R.A	Scale 1:150	Drawing 8

APPENDIX B

Borehole Logs

Project No. 4688-17-GC

Log of Borehole 1

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

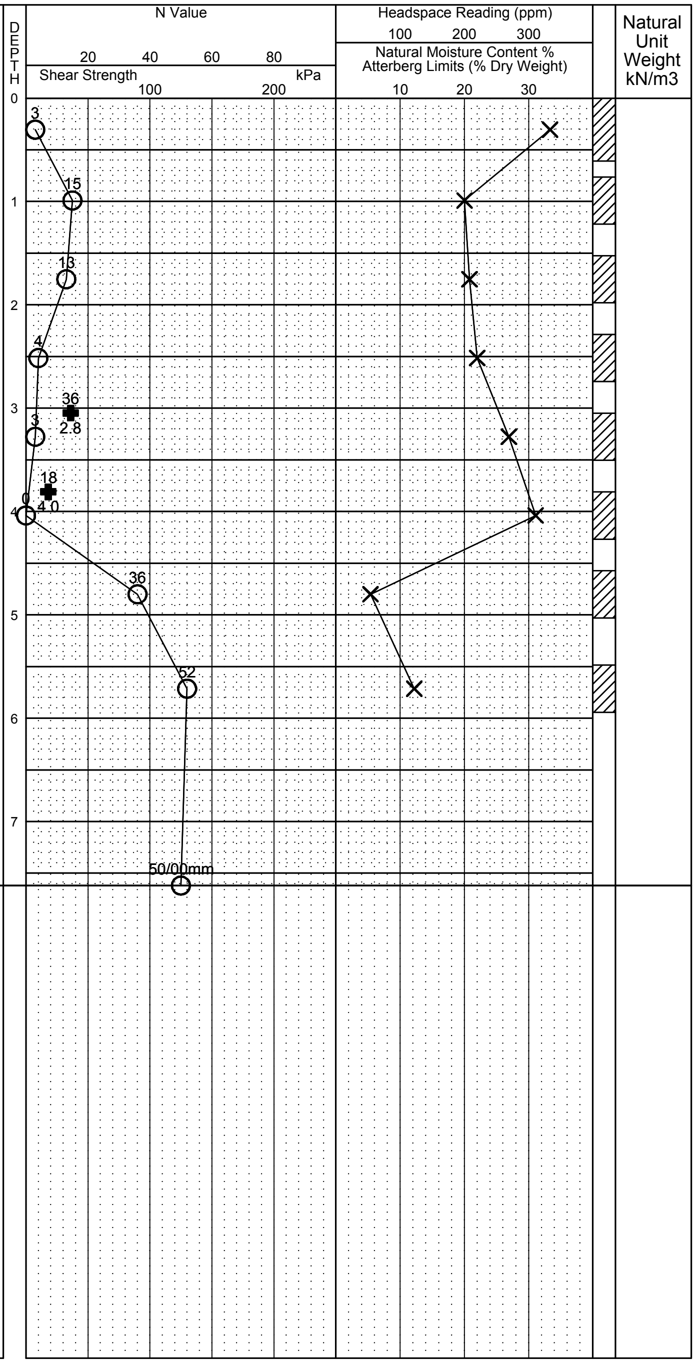
Date Drilled: 11/20/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	●
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	191.30
	TOPSOIL, 300mm	190.99
	FILL, black to brown silty sand to sandy silt, very moist to wet	190.10
	SANDY SILT - compact - brown - very moist	189.32
	CLAYEY SILT - very soft to soft - brown - very moist to wet	
▼		187.30
		186.73
	SILT TILL - dense to very dense - occasional gravels - brown - moist	183.68
	END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 4.0m - cave-in at 6.1m	



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 2

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

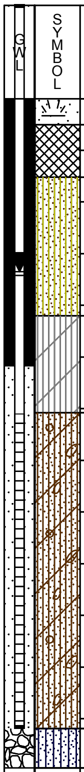
Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/20/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲



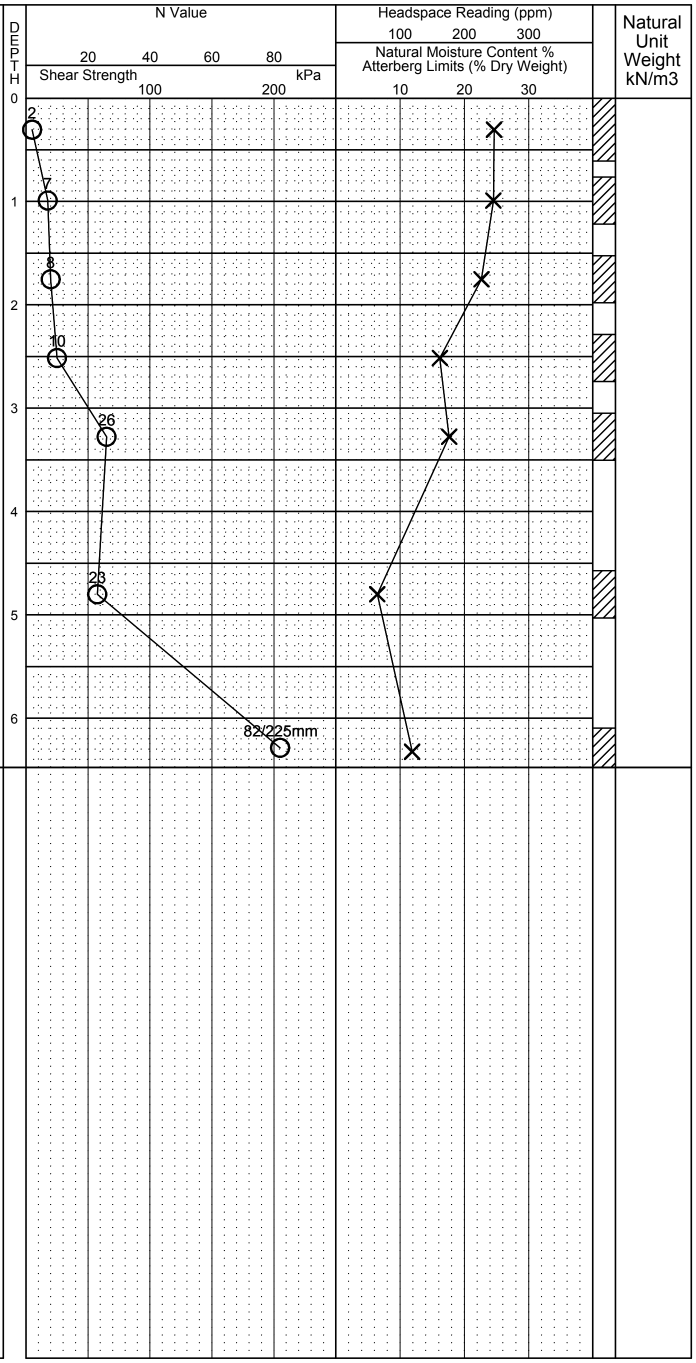
Soil Description	ELEV. m
Ground Surface	191.61
TOPSOIL, 250mm	191.36
FILL, black to brown silty sand to sandy silt, very moist	190.85
SANDY SILT - loose, brown - very moist	189.90 189.51
CLAYEY SILT - stiff, grey - moist	188.57
SILT TILL - compact, grey - occasional gravels - moist to very moist	185.51
SILTY GRAVELLY SAND - very dense - some clay - moist	185.13

END OF BOREHOLE

NOTE:

Upon completion of drilling:

- water level at 4.6m



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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 3

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

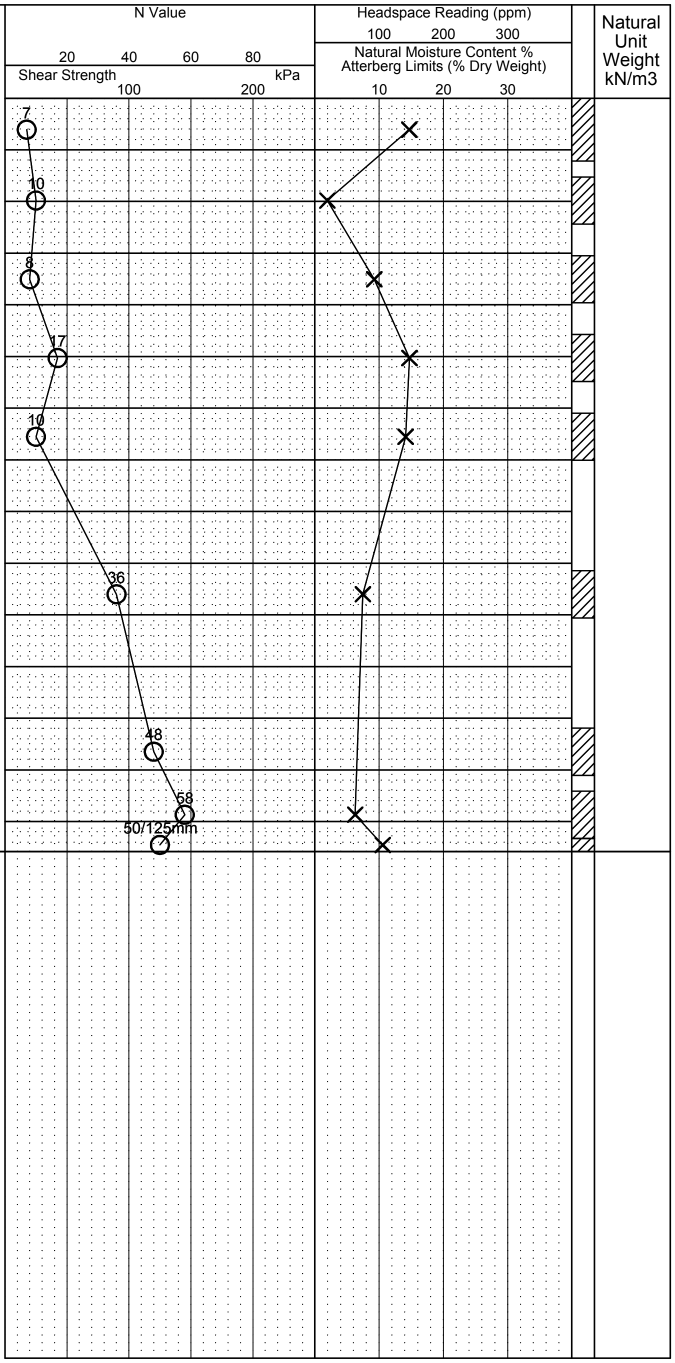
Date Drilled: 11/20/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	Soil Description	ELEV. m	DEPTH
	Ground Surface	192.87	0
	TOPSOIL, 250mm	192.62	
	FILL, black to brown silty sand to sandy silt, very moist	192.11	
	SILTY SAND TO SANDY SILT - loose to compact - brown - moist to very moist	189.98	1 2
▼	**CLAYEY SILT** - stiff, grey - moist	188.67 188.30	3 4
	SILT TILL - dense to very dense - grey - occasional gravels - moist	185.58	5 6 7
	END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level 4.2m - cave-in at 5.5m		



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 4

Dwg No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

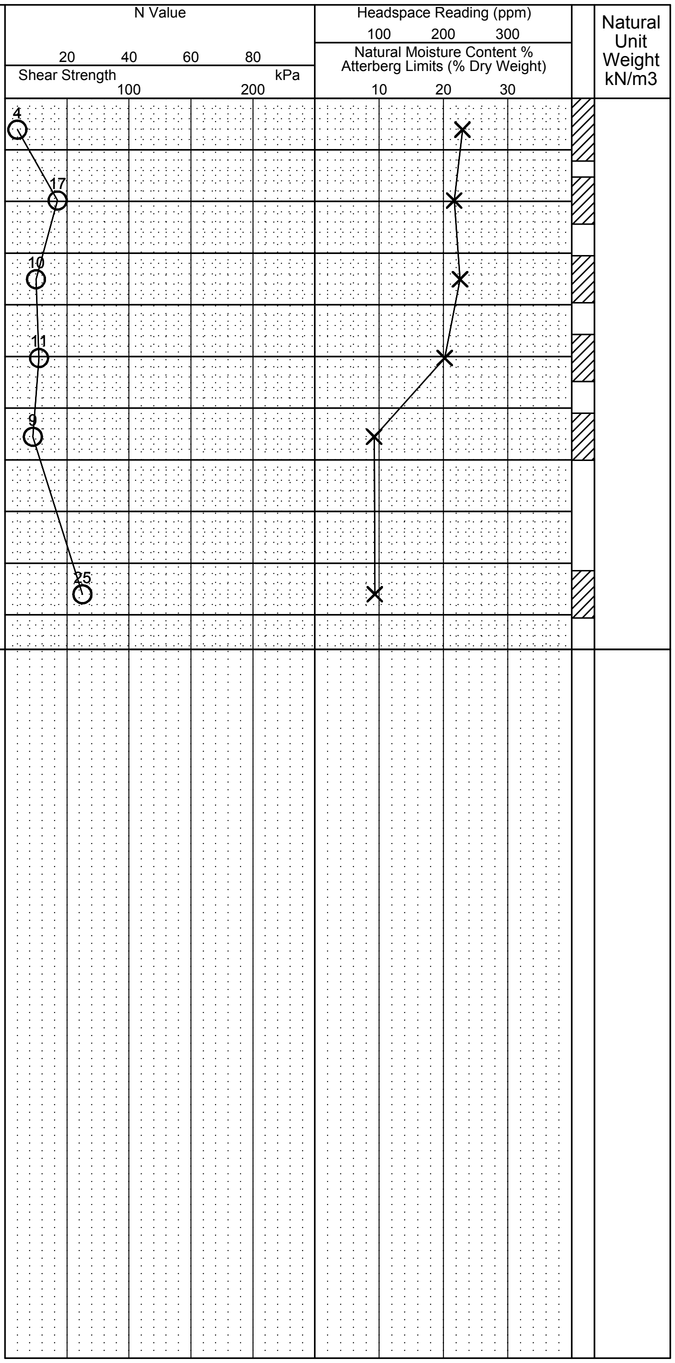
Date Drilled: 11/20/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	Soil Description	ELEV. m	DEPTH
	Ground Surface	191.42	0
	TOPSOIL, 300mm	191.12	
	FILL, black to brown silty sand to sandy silt, very moist	190.66	1
	SANDY SILT - compact, brown - very moist	189.29	2
	CLAYEY SILT - stiff, brown - moist		
▼		188.42	3
		186.85	4
	SILT TILL - compact, grey - occasional gravels - moist	186.09	5
	END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 3.0m - cave-in at 4.9m		



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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 5

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

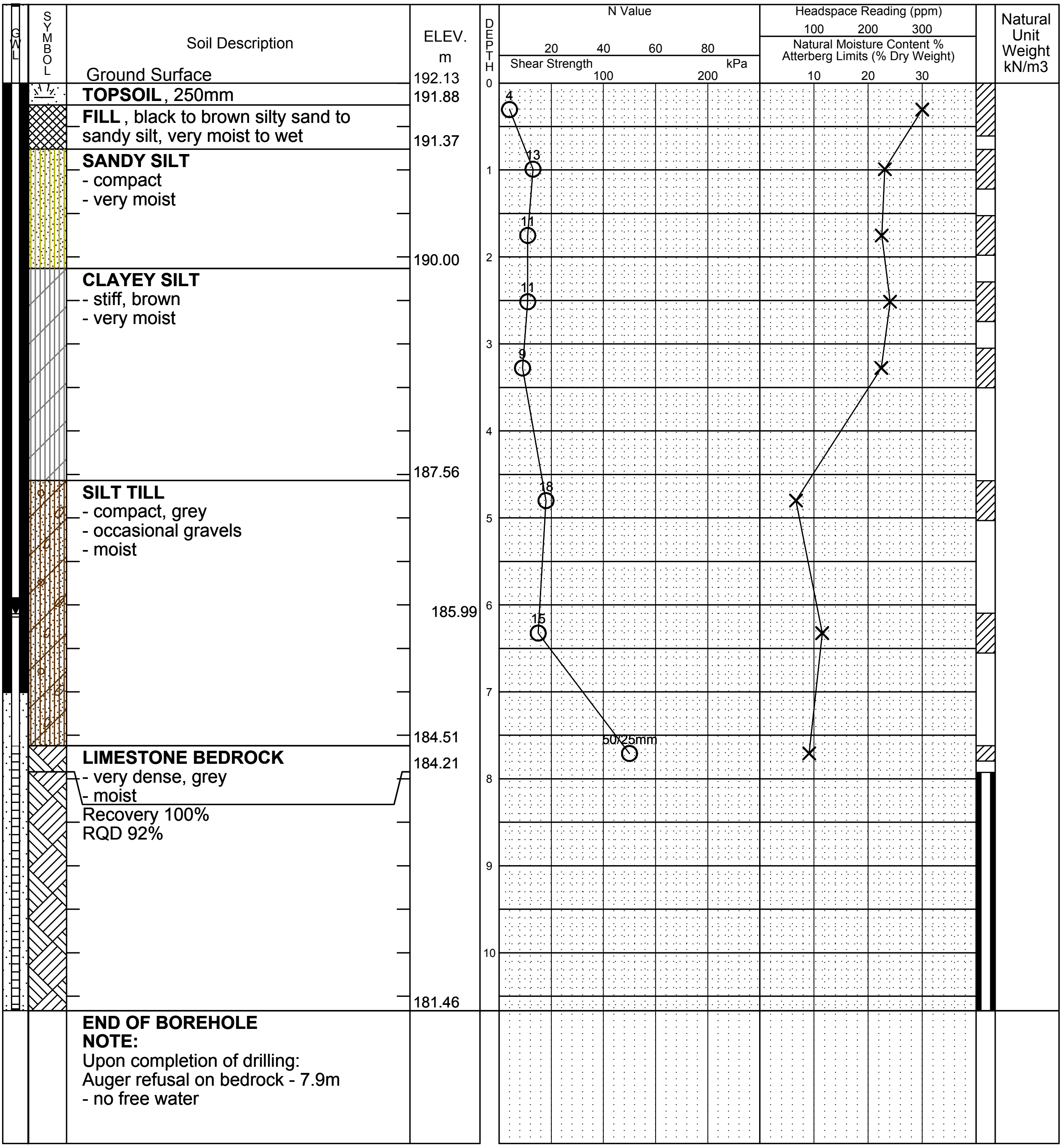
Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/23/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲



Soil Description	ELEV. m
Ground Surface	192.13
TOPSOIL, 250mm	191.88
FILL, black to brown silty sand to sandy silt, very moist to wet	191.37
SANDY SILT - compact - very moist	190.00
CLAYEY SILT - stiff, brown - very moist	187.56
SILT TILL - compact, grey - occasional gravels - moist	185.99 184.51
LIMESTONE BEDROCK - very dense, grey - moist Recovery 100% RQD 92%	184.21 181.46

END OF BOREHOLE
NOTE:
Upon completion of drilling:
Auger refusal on bedrock - 7.9m
- no free water

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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 6

Dwg No. 7

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

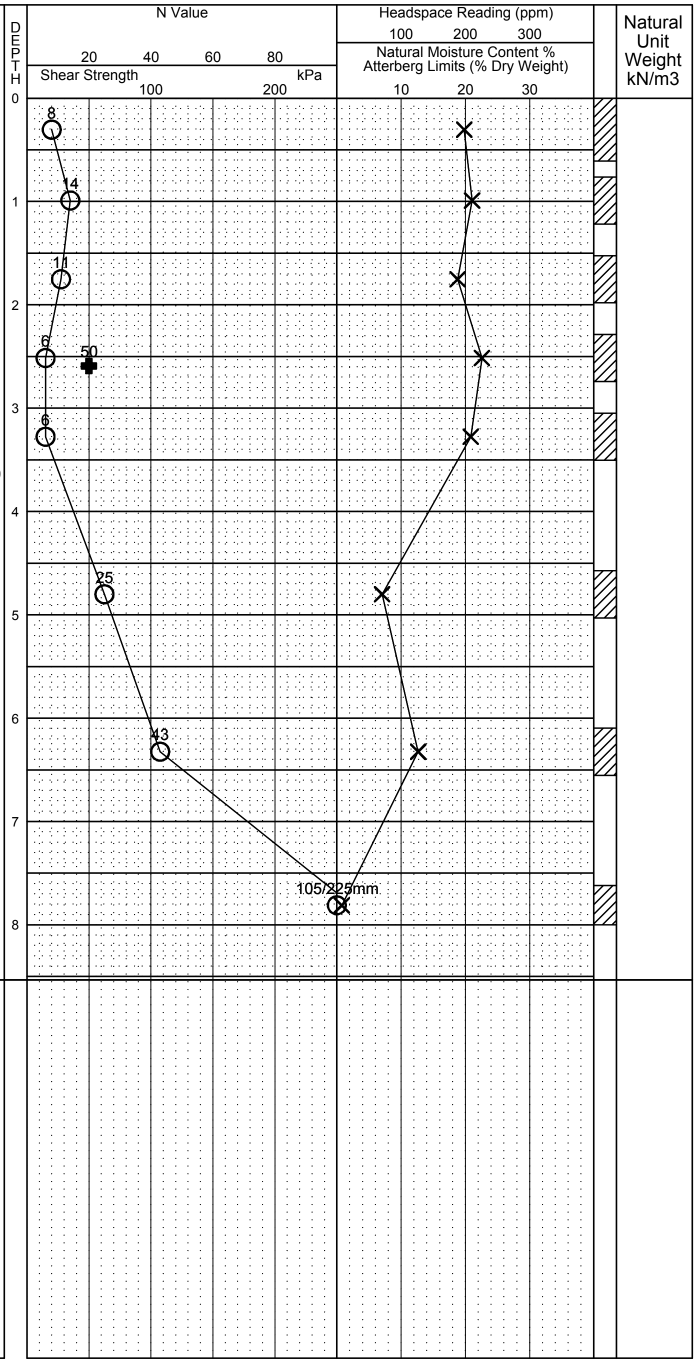
Date Drilled: 11/14/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	192.59
	TOPSOIL, 300mm	192.29
	FILL, black to brown silty sand to sandy silt, very moist	191.83
	SANDY SILT - compact, brown - very moist	190.46
	CLAYEY SILT - firm, grey - very moist	
▼		188.89
		188.02
	SILT TILL - compact to very dense - grey - occasional gravels - moist	
		184.59
	LIMESTONE BEDROCK - very dense, grey - moist	184.06
	END OF BOREHOLE **NOTE:** Upon completion of drilling: Auger refusal on bedrock - 8.5m - water level at 3.7m - cave-in at 1.5m	



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 7

Dwg No. 8

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

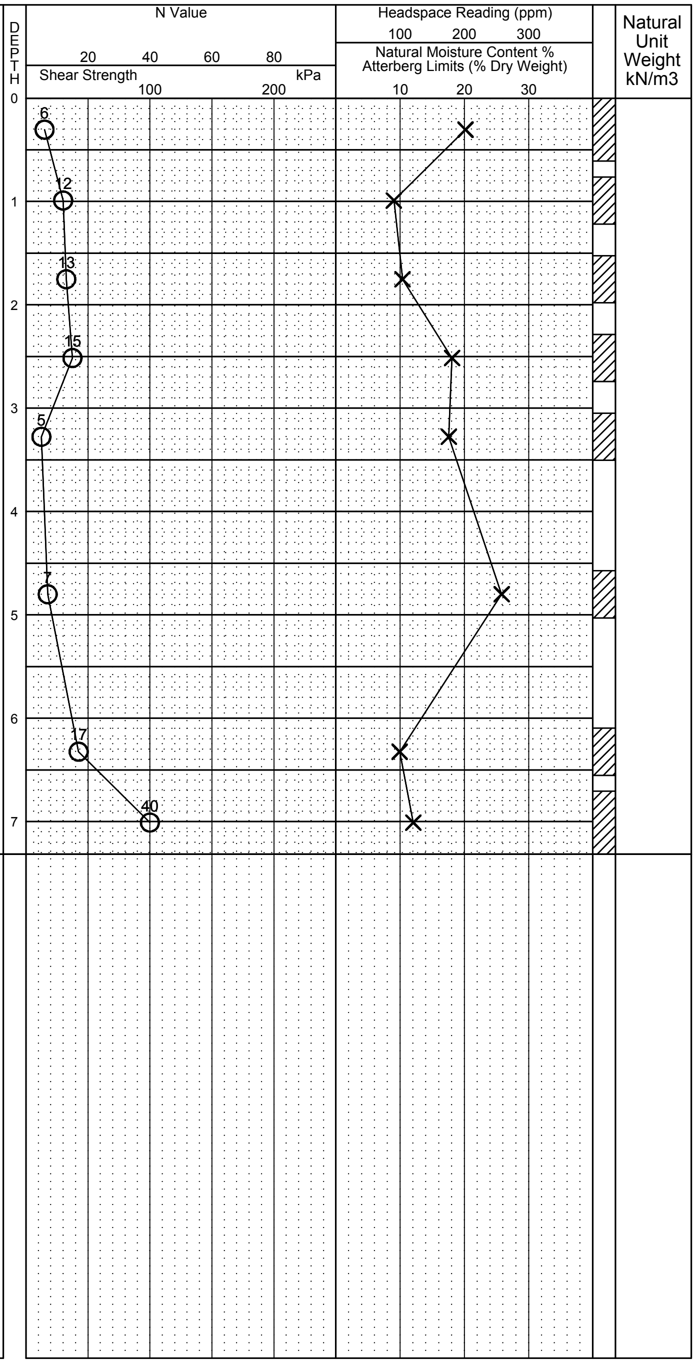
Date Drilled: 11/14/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	193.01
	TOPSOIL, 250mm	192.76
	FILL, black to brown silty sand to sandy silt, moist to very moist	192.25
▼	**SILTY SAND** - compact - moist	191.51
		190.88
	CLAYEY SILT - firm to stiff - grey - very moist	188.44
	SILT TILL - loose to compact - grey - occasional gravels - moist	186.30
	SANDY SILT TO SILTY SAND - dense, moist	185.69
	END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 1.5m - cave-in at 5.5m	



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 8

Dwg No. 9

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/14/17

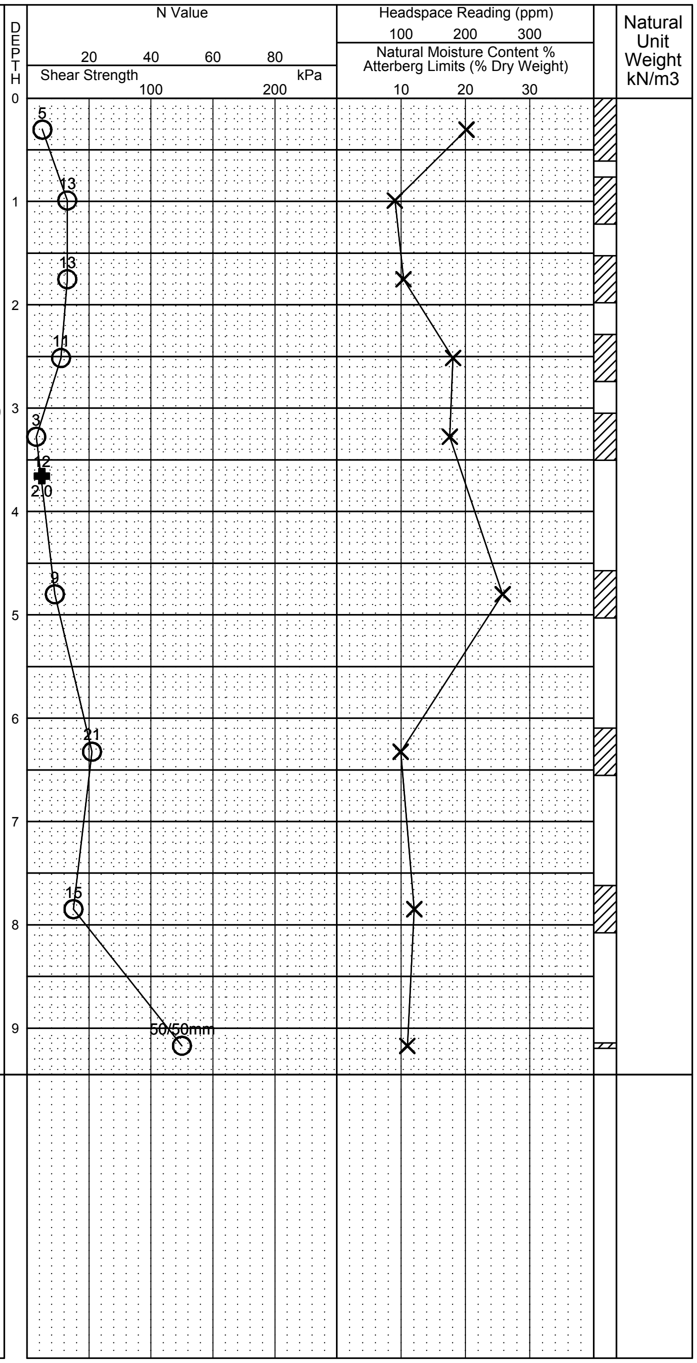
Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	193.59
	TOPSOIL, 310mm	193.28
	FILL, brown to black silty sand to sandy silt, very moist	192.83
	SILTY SAND - compact, brown - moist to very moist	190.70
▼		190.49
	CLAYEY SILT - soft to stiff - brown to grey - moist to very moist	187.58
	SILT TILL - compact, grey - occasional gravels - moist	184.40
	LIMESTONE BEDROCK - very dense, grey - moist	184.14

END OF BOREHOLE
NOTE:
Upon completion of drilling:
Auger refusal on bedrock - 9.5m
- water level at 3.1m
- cave-in at 5.2m



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 9

Dwg No. 10

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/24/17

Drill Type: Track Mounted Drill Rig

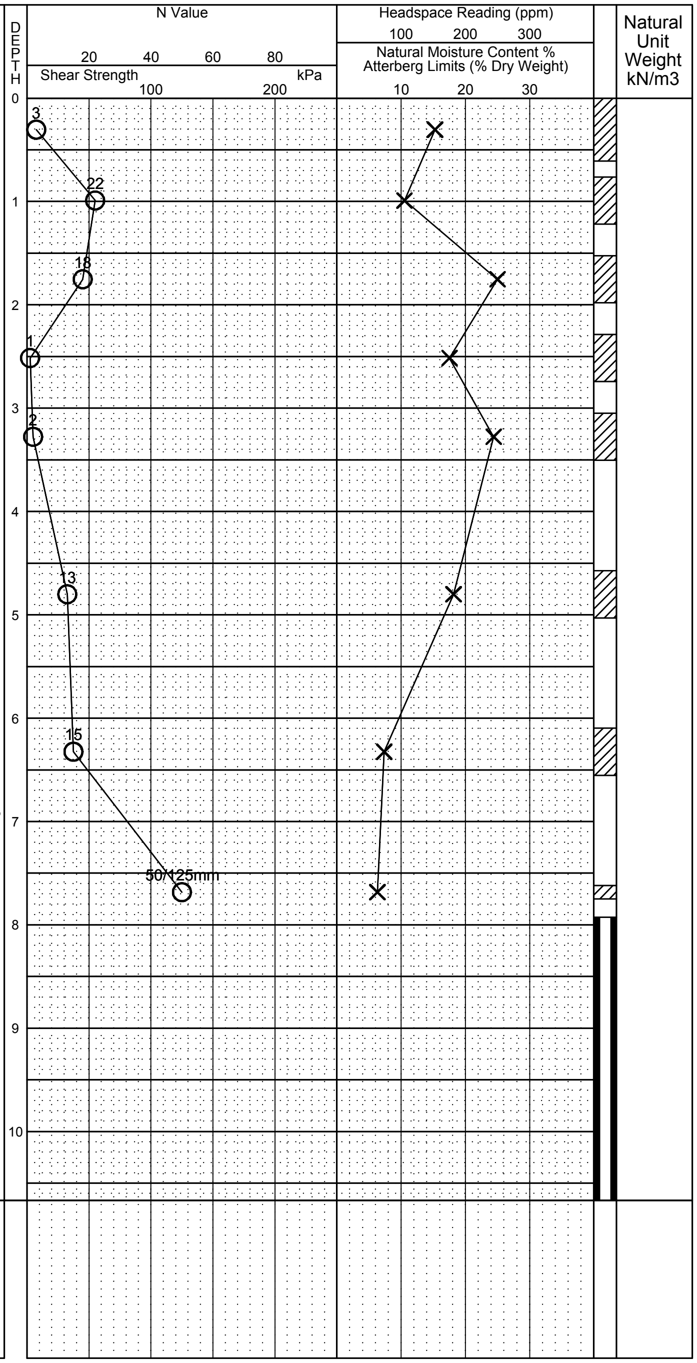
Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

Soil Description	ELEV. m
Ground Surface	192.99
TOPSOIL, 325mm	192.66
FILL, brown to black silty sand to sandy silt, very moist	192.23
SILTY SAND TO SANDY SILT - compact, brown - moist to very moist	190.86
CLAYEY SILT - very soft to stiff - brown to grey - very moist	186.98
SILT TILL - compact to very dense - grey - occasional gravels - moist	186.03 185.32
LIMESTONE BEDROCK - very dense, grey - moist Recovery 100% RQD 89%	185.07 182.32

END OF BOREHOLE

NOTE:
Upon completion of drilling:
Auger refusal on bedrock - 7.9m
- water level at 3.7m



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 10

Dwg No. 11

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/16/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	●
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

Soil Description	ELEV. m
Ground Surface	192.31
TOPSOIL, 300mm	192.01
FILL, brown to black silty sand to sandy silt, very moist	190.91
SANDY SILT - compact, brown - very moist	190.18
CLAYEY SILT - firm - brown to grey - very moist	189.31 187.74
SILT TILL - compact to very dense - grey - occasional gravels - moist	185.76
LIMESTONE BEDROCK - very dense, grey - moist	185.45

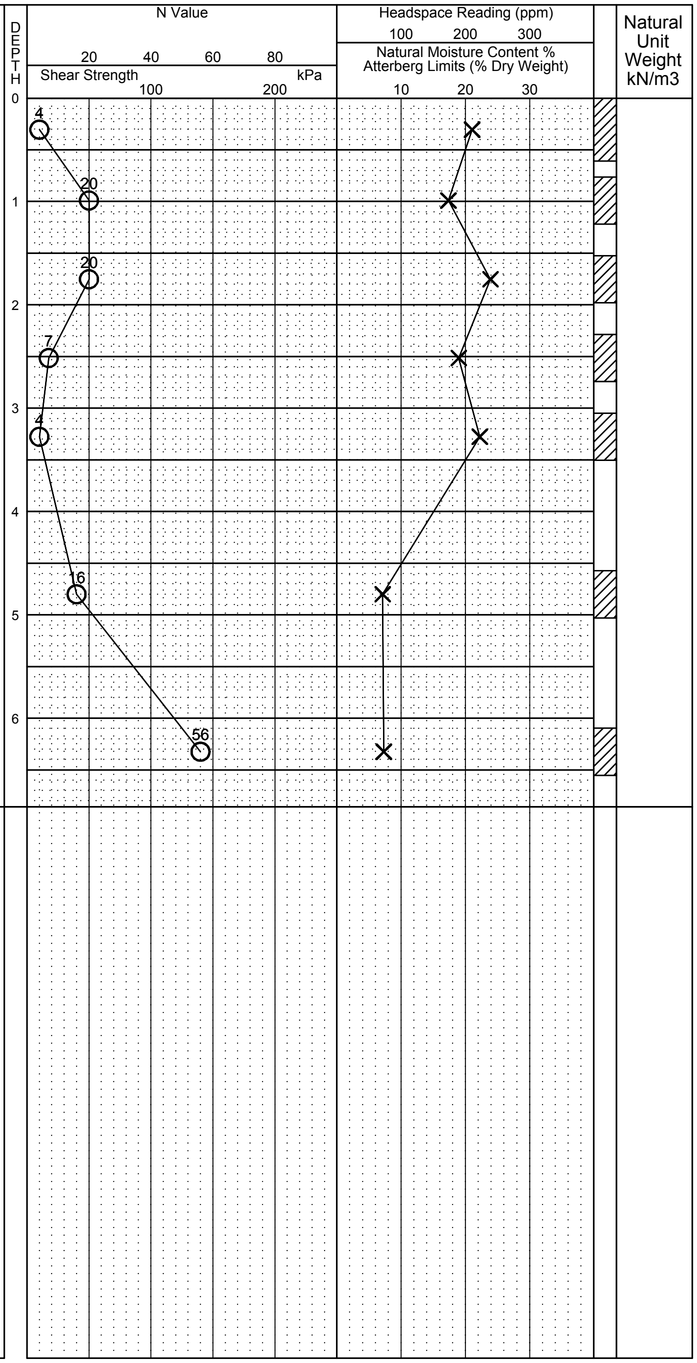
END OF BOREHOLE

NOTE:

Upon completion of drilling:

Auger refusal on bedrock - 6.9m

- water level at 3.0m
- cave-in at 3.0m



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 11

Dwg No. 12

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

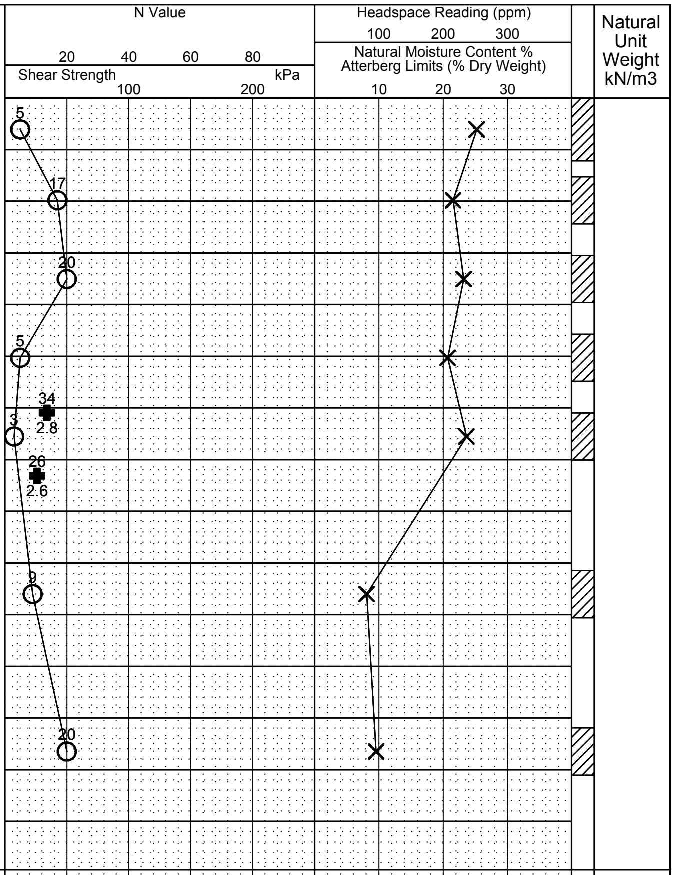
Date Drilled: 11/18/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	✕
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	192.70	0
		TOPSOIL, 250mm	192.45	
		FILL, brown to black silty sand to sandy silt, very moist		1
		SANDY SILT - compact, brown - very moist	191.33	
▼		**CLAYEY SILT** - soft to firm - brown to grey - very moist	190.57 190.40	2 3 4
		SILT TILL - loose to compact - grey - occasional gravels - moist	188.13	5 6
		LIMESTONE BEDROCK - very dense, grey - moist	186.15	7
			185.23	
		END OF BOREHOLE **NOTE:** Upon completion of drilling: Auger refusal on bedrock - 7.5m - water level at 2.3m - cave-in at 2.3m		



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 12

Dwg No. 13

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/17/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

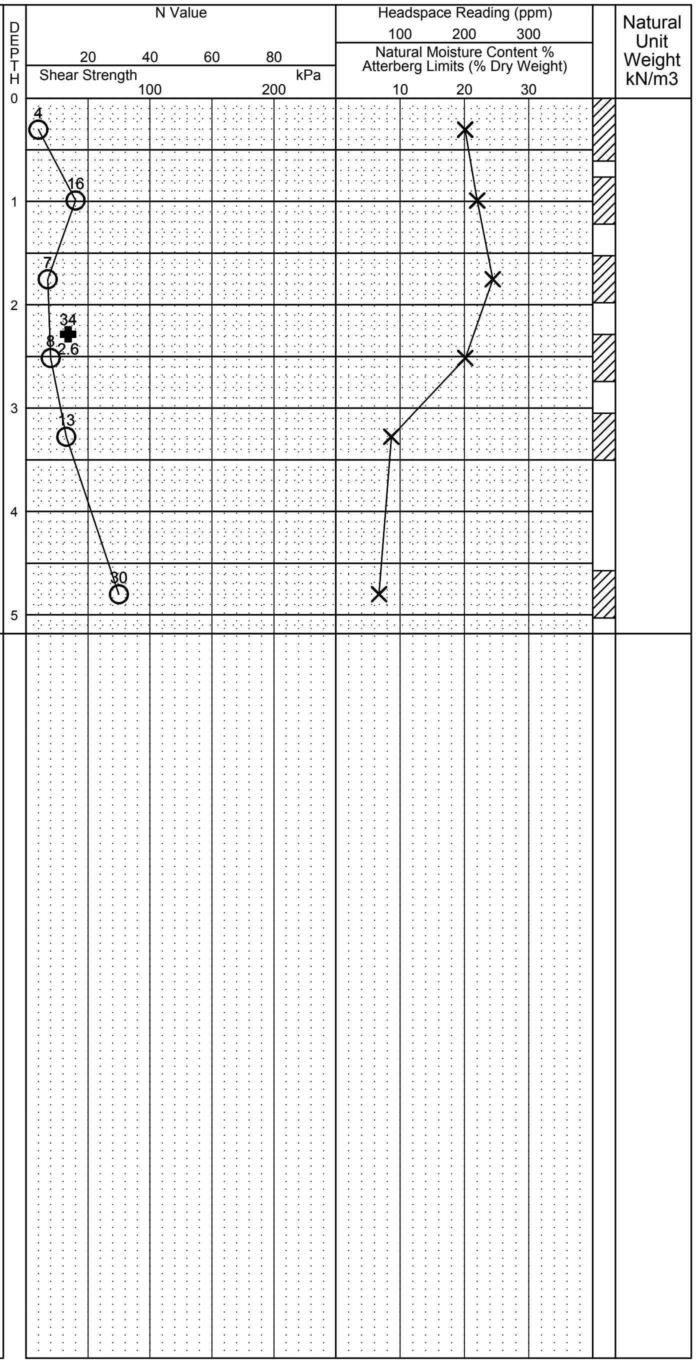
Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	✕
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	191.63
	TOPSOIL, 255mm	191.37
	FILL, brown to black silty sand to sandy silt, very moist	190.26
	SANDY SILT - loose, brown - very moist	189.50
▼	**CLAYEY SILT** - stiff - brown to grey - very moist to moist	189.23 187.06
	SILT TILL - dense - occasional gravels - moist	186.61
	LIMESTONE BEDROCK - very dense, grey - moist	186.45

END OF BOREHOLE

NOTE:

Upon completion of drilling:
Auger refusal on bedrock - 5.2m
- water level at 2.4m
- cave-in at 2.4m



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 13

Dwg No. 14

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/17/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	191.46
	TOPSOIL, 220mm	191.24
	FILL, black to brown silty sand to sandy silt, very moist	190.70
	SANDY SILT - compact, brown - very moist	
▼		189.66
		189.33
	CLAYEY SILT - soft - brown to grey - very moist	186.89
	SILT TILL - compact to very dense - grey - occasional gravels - moist	184.91
	LIMESTONE BEDROCK - very dense, grey - moist	184.75

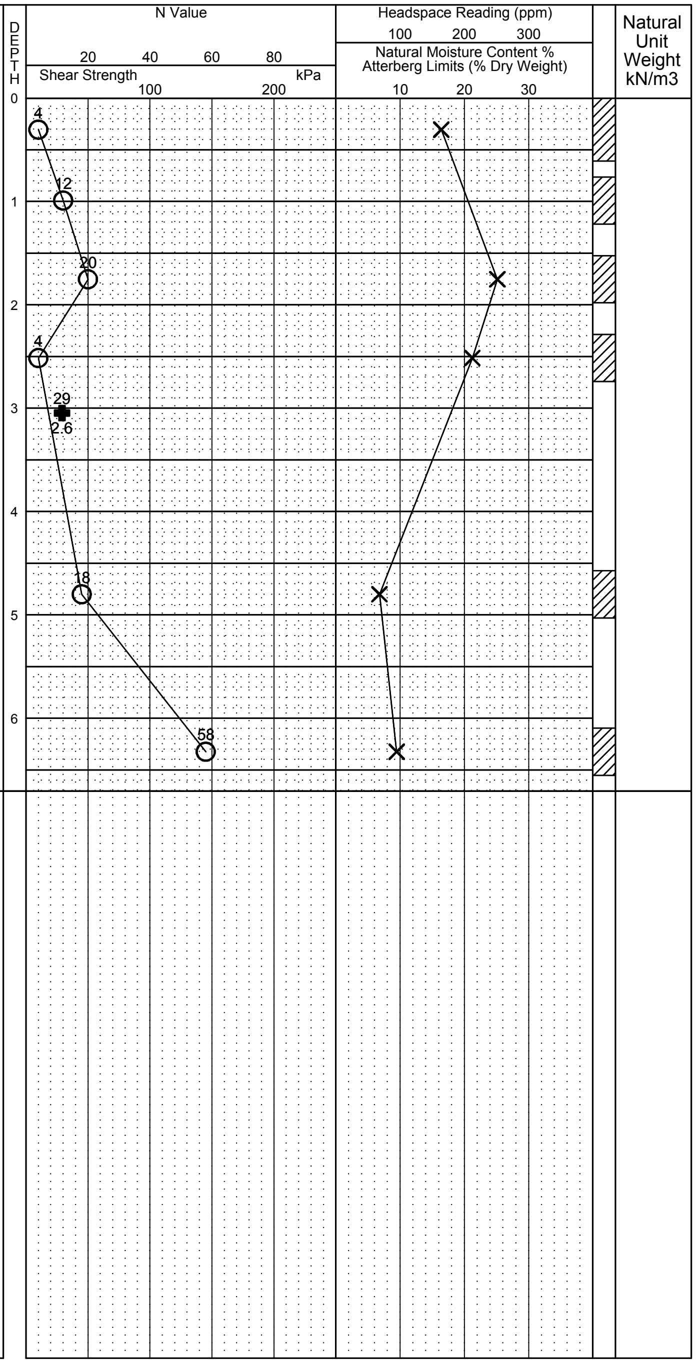
END OF BOREHOLE

NOTE:

Upon completion of drilling:

Auger refusal on bedrock - 6.7m

- water level at 1.8m
- cave-in at 1.8m



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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 14

Dwg No. 15

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/19/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

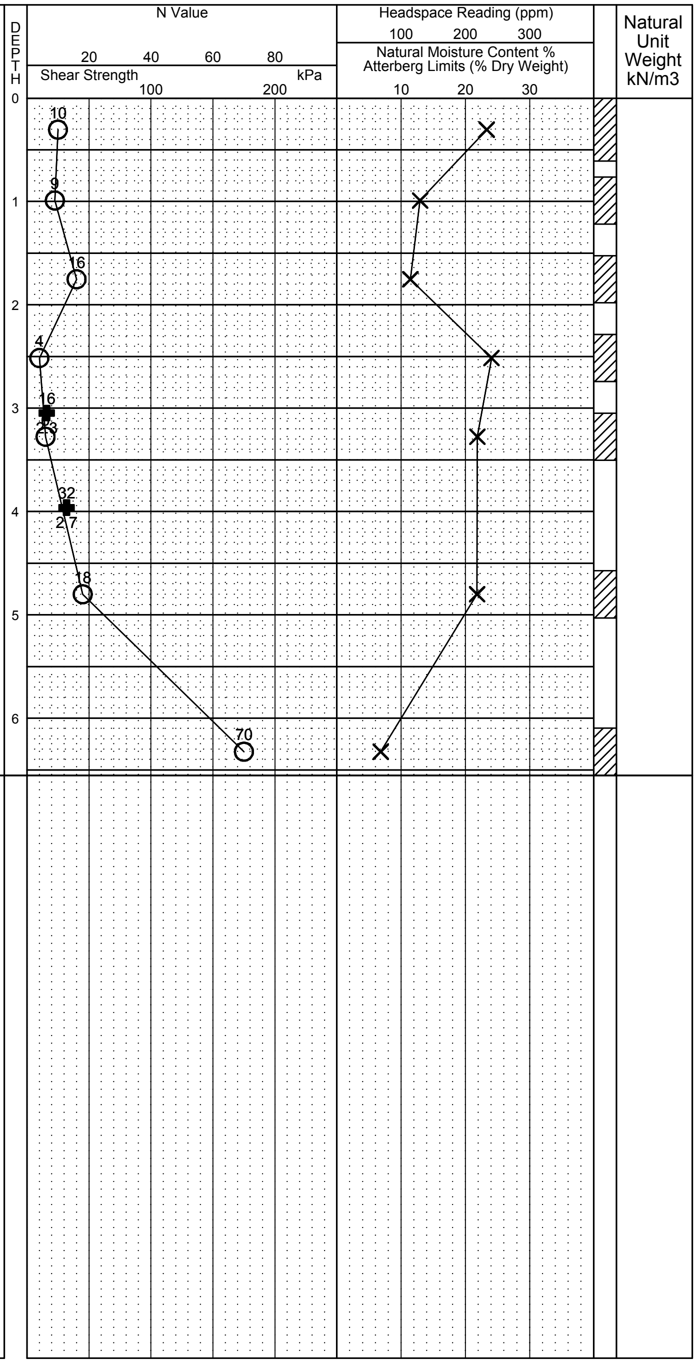
Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	✕
Dynamic Cone Test	—	Plastic and Liquid Limit	├──┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	190.08
	TOPSOIL, 275mm	189.80
	FILL, black to brown silty sand to sandy silt, very moist	189.32
	SILTY SAND - loose to compact - brown - moist to very moist	187.95
	CLAYEY SILT - firm to stiff - brown to grey - very moist	183.99
	SILT TILL - very dense, grey - occasional gravels - moist	183.68
	LIMESTONE BEDROCK - very dense, grey, moist	183.53

END OF BOREHOLE

NOTE:

Upon completion of drilling:
Auger refusal on bedrock - 6.6m
- no free water
- cave-in at 5.6m



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 15

Dwg No. 16

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/17/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	───
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	●
Natural Moisture	×
Plastic and Liquid Limit	├──┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	191.78
	TOPSOIL, 290mm	191.48
	FILL, black to brown silty sand to sandy silt, very moist	191.02
	SANDY SILT - compact, brown - very moist	189.65
▼ 189.38	**CLAYEY SILT** - stiff, grey - very moist	188.74
	SILT TILL - compact to very dense - grey - occasional gravels - moist	185.23

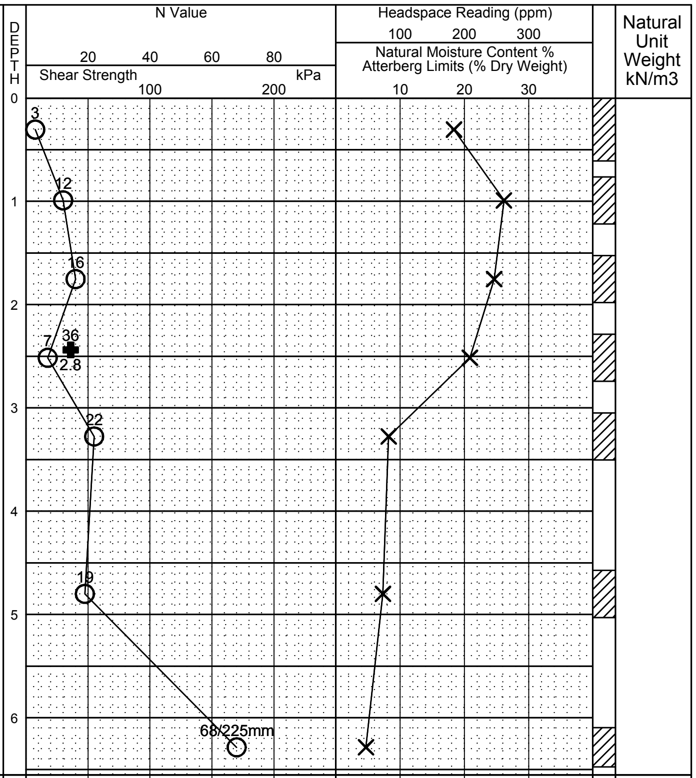
END OF BOREHOLE

NOTE:

Upon completion of drilling:

Auger refusal on bedrock - 6.6m

- water level at 2.4m
- cave-in at 5.3m



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 16

Dwg No. 17

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/18/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	191.99
	TOPSOIL, 300mm	191.69
	FILL, black to brown silty sand to sandy silt, very moist	190.62
	SANDY SILT - compact, brown - very moist	189.86
▼	**CLAYEY SILT / SILTY CLAY** - soft - brown to grey - very moist	188.99 187.42
	SILT TILL - dense to very dense - grey - occasional gravels - moist	185.50
	LIMESTONE BEDROCK - very dense, grey - moist	185.28

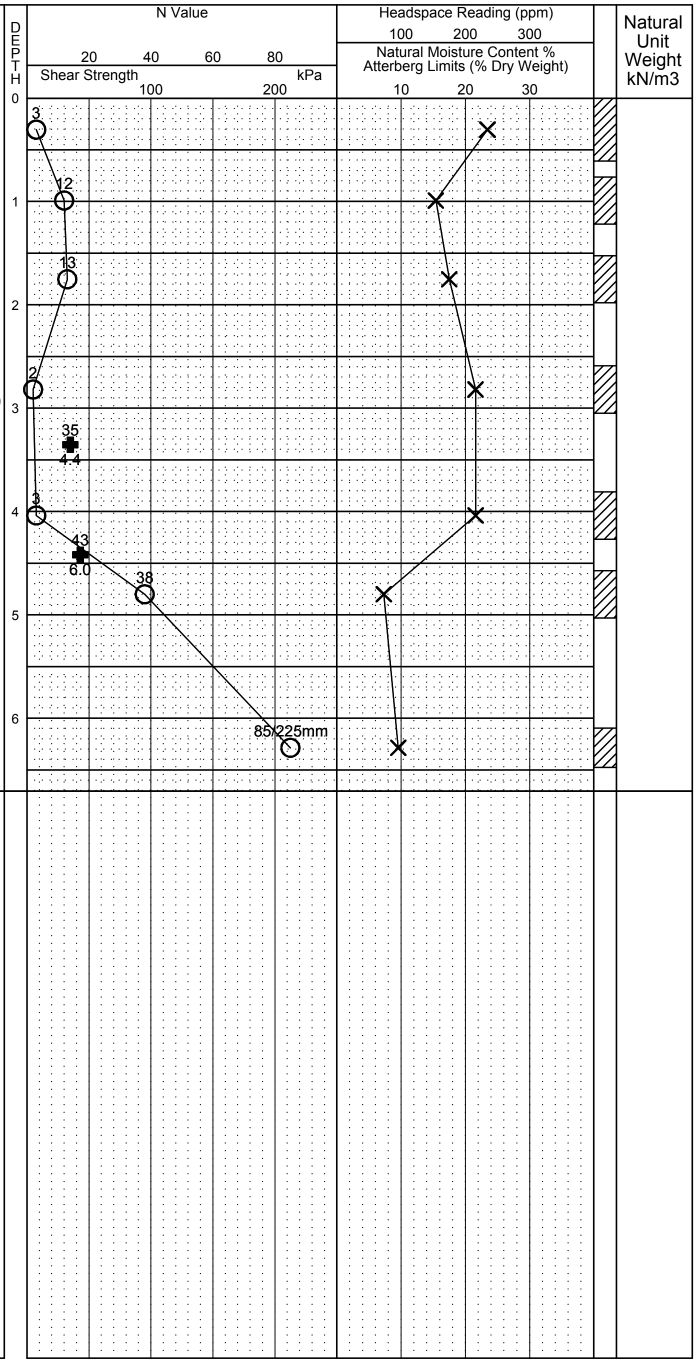
END OF BOREHOLE

NOTE:

Upon completion of drilling:

Auger refusal on bedrock - 6.7m

- water level at 3.0m
- cave-in at 1.0m



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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 17

Dwg No. 18

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/18/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

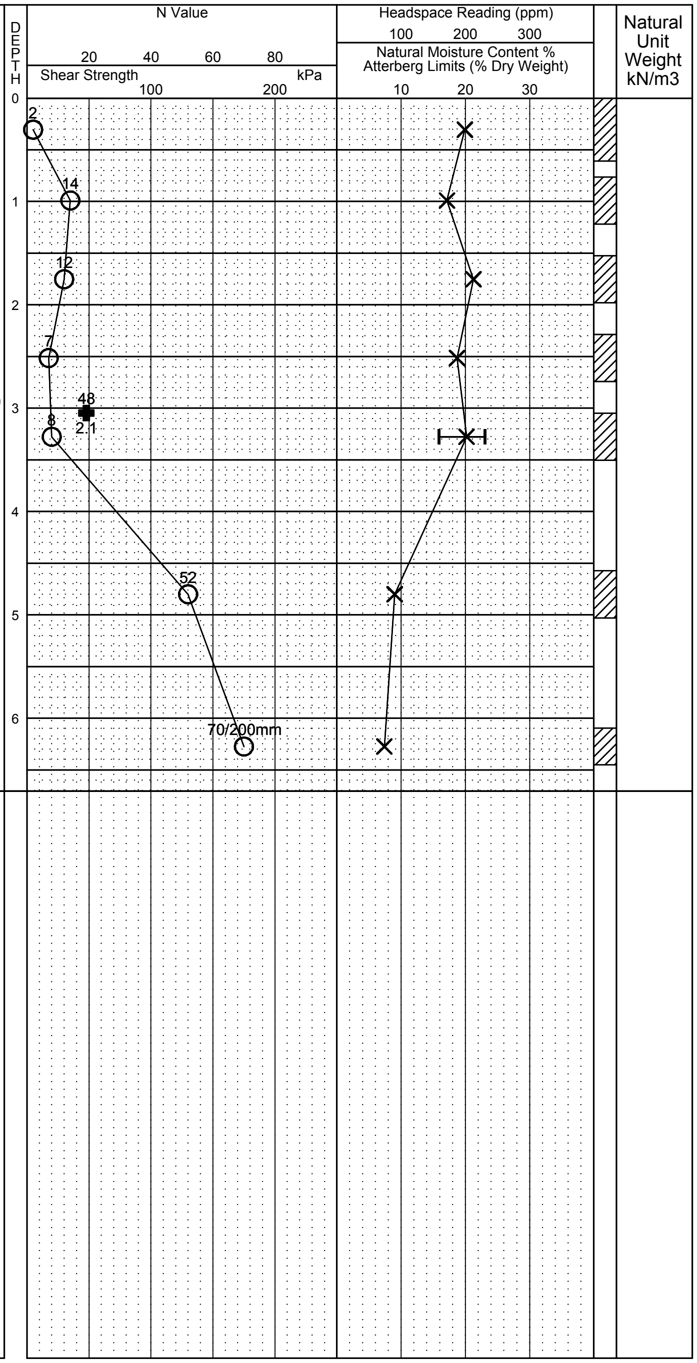
Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	192.30
	TOPSOIL, 310mm	191.99
	FILL, black to brown silty sand to sandy silt, very moist	190.93
	SANDY SILT - compact - very moist	190.17
▼	**CLAYEY SILT / SILTY CLAY** - firm - very moist	189.30 187.73
	SILT TILL - very dense - occasional gravels - moist to very moist	185.80
	LIMESTONE BEDROCK - very dense, grey - moist	185.60

END OF BOREHOLE

NOTE:

Upon completion of drilling:
Auger refusal on bedrock - 6.7m
- water level at 3.0m
- cave-in at 1.6m



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 18

Dwg No. 19

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

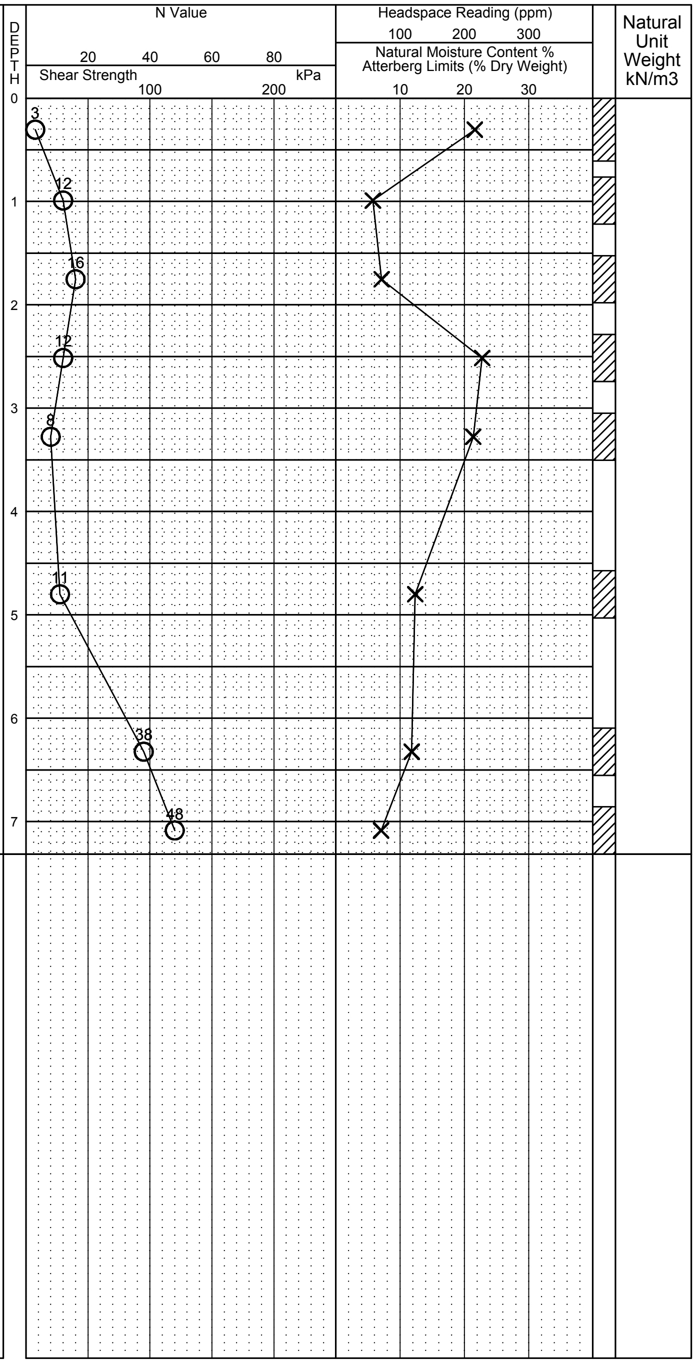
Date Drilled: 11/19/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

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



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

Toronto Inspection Ltd.

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

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

Project No. 4688-17-GC

Log of Borehole 19

Dwg No. 20

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/17/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	Soil Description	ELEV. m	DEPTH
	Ground Surface	191.64	0
	TOPSOIL, 250mm	191.39	
	FILL, black to brown silty sand to sandy silt, very moist	190.88	
	SILTY SAND - compact - moist	189.51	1 2
▼	**CLAYEY SILT / SILTY CLAY** - soft - brown to grey - very moist	188.64 187.07	3 4
	SILT TILL - very dense to compact - grey - occasional gravels - moist	184.32	5 6 7
	SAND AND GRAVEL - very dense, brown - auger refusal at bedrock - moist to very moist	183.72	

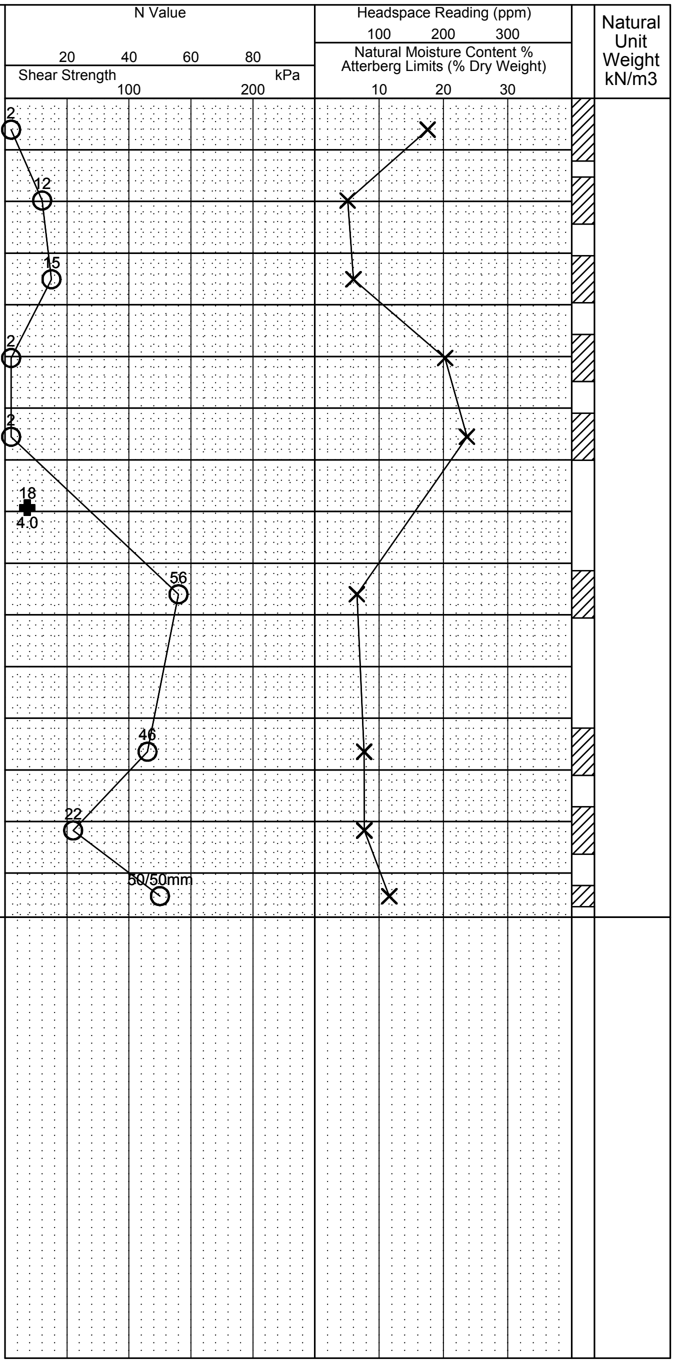
END OF BOREHOLE

NOTE:

Upon completion of drilling:

Auger refusal on bedrock - 7.9m

- water level at 3.0m
- cave-in at 2.4m



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 20

Dwg No. 21

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

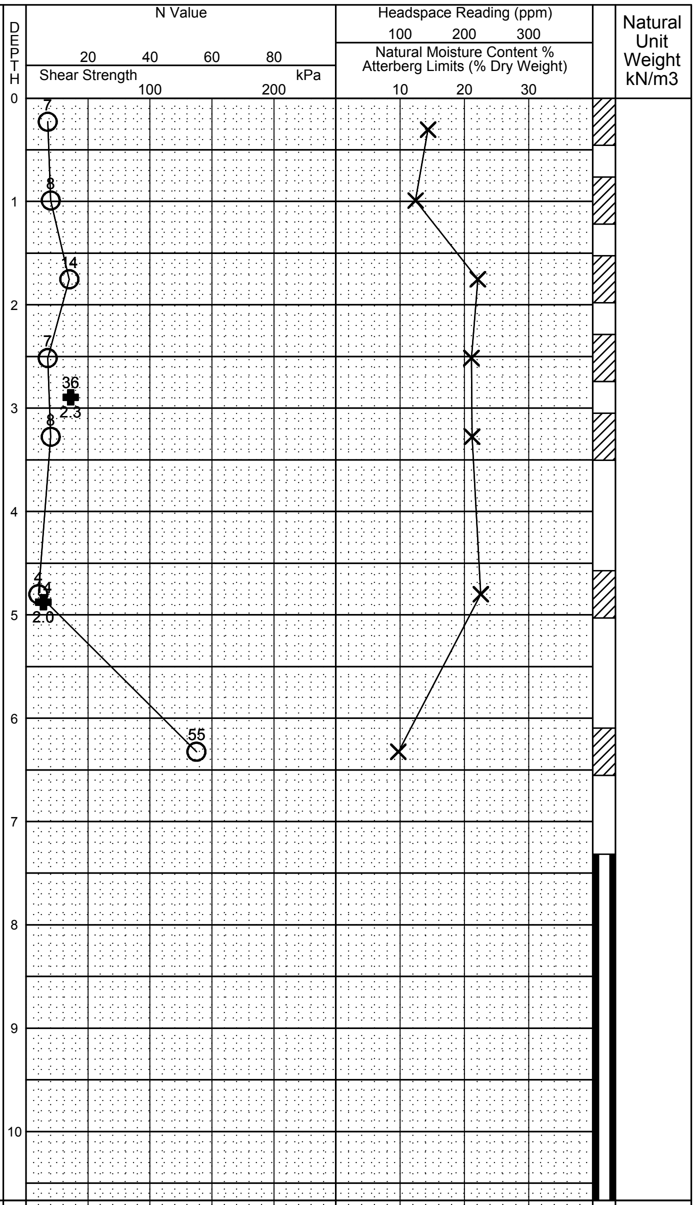
Date Drilled: 11/24/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

Soil Description	ELEV. m
Ground Surface	191.45
TOPSOIL, 275mm	191.17
FILL, black to brown silty sand to sandy silt, very moist	190.69
SANDY SILT - loose to compact - brown - moist to very moist	189.32
CLAYEY SILT - firm - brown to grey - very moist	
	186.05
	185.36
SILT TILL - very dense, grey - occasional gravels - moist	184.90
LIMESTONE BEDROCK - very dense, grey - moist Recovery 89% RQD 83%	184.14
	180.78
END OF BOREHOLE **NOTE:** Upon completion of drilling: Auger refusal on bedrock - 7.3m - water level at 3.0m	



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 21

Dwg No. 22

Project: Geotechnical Investigation

Sheet No. 1 of 1

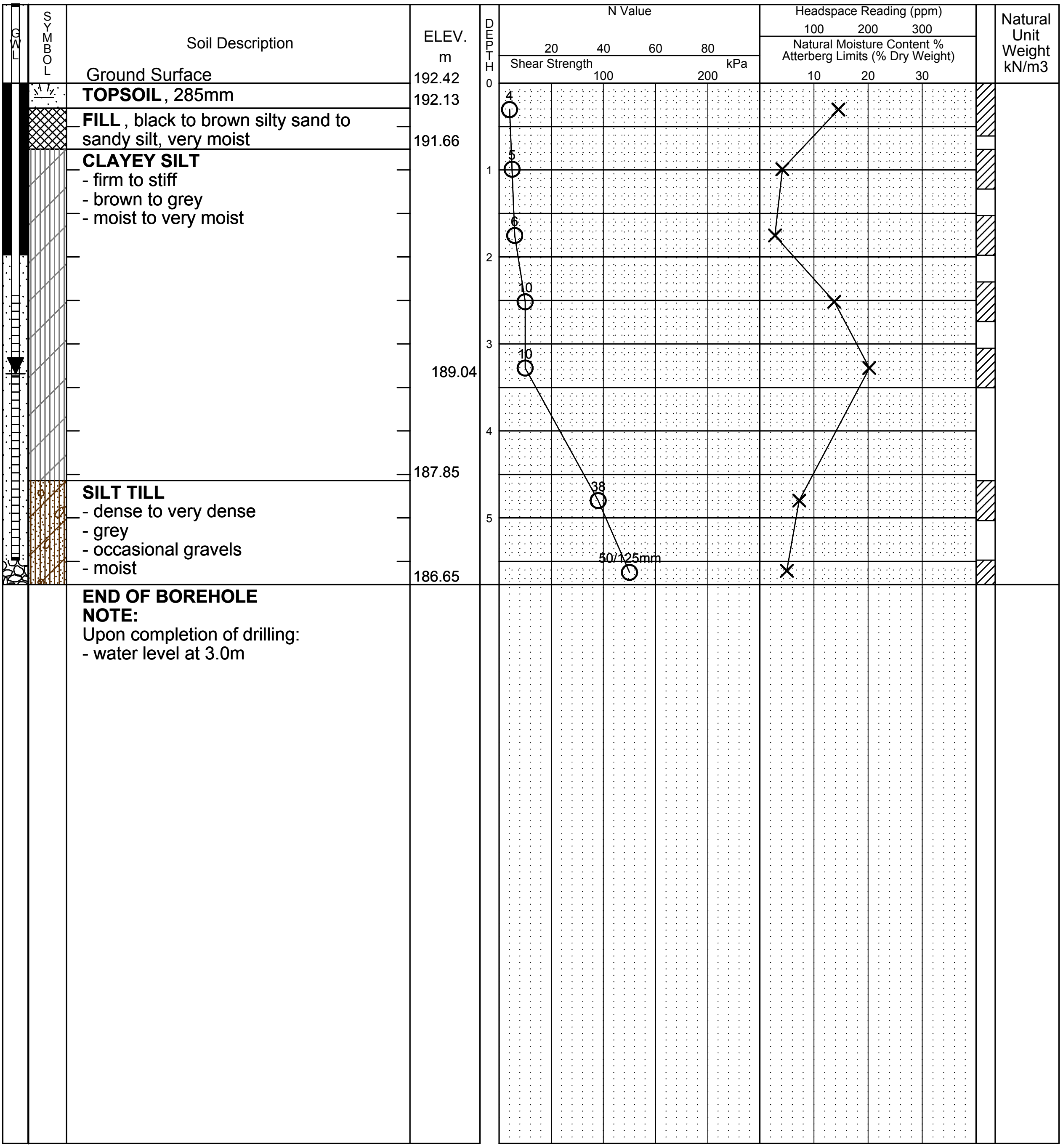
Location: 452 Raglan Street, Collingwood, Ontario

Date Drilled: 11/23/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲



Soil Description	ELEV. m
Ground Surface	192.42
TOPSOIL, 285mm	192.13
FILL, black to brown silty sand to sandy silt, very moist	191.66
CLAYEY SILT - firm to stiff - brown to grey - moist to very moist	189.04 187.85
SILT TILL - dense to very dense - grey - occasional gravels - moist	186.65

END OF BOREHOLE

NOTE:

Upon completion of drilling:

- water level at 3.0m

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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 22

Dwg No. 23

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

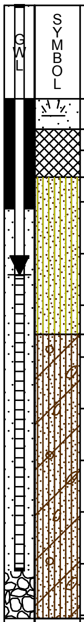
Date Drilled: 11/19/17

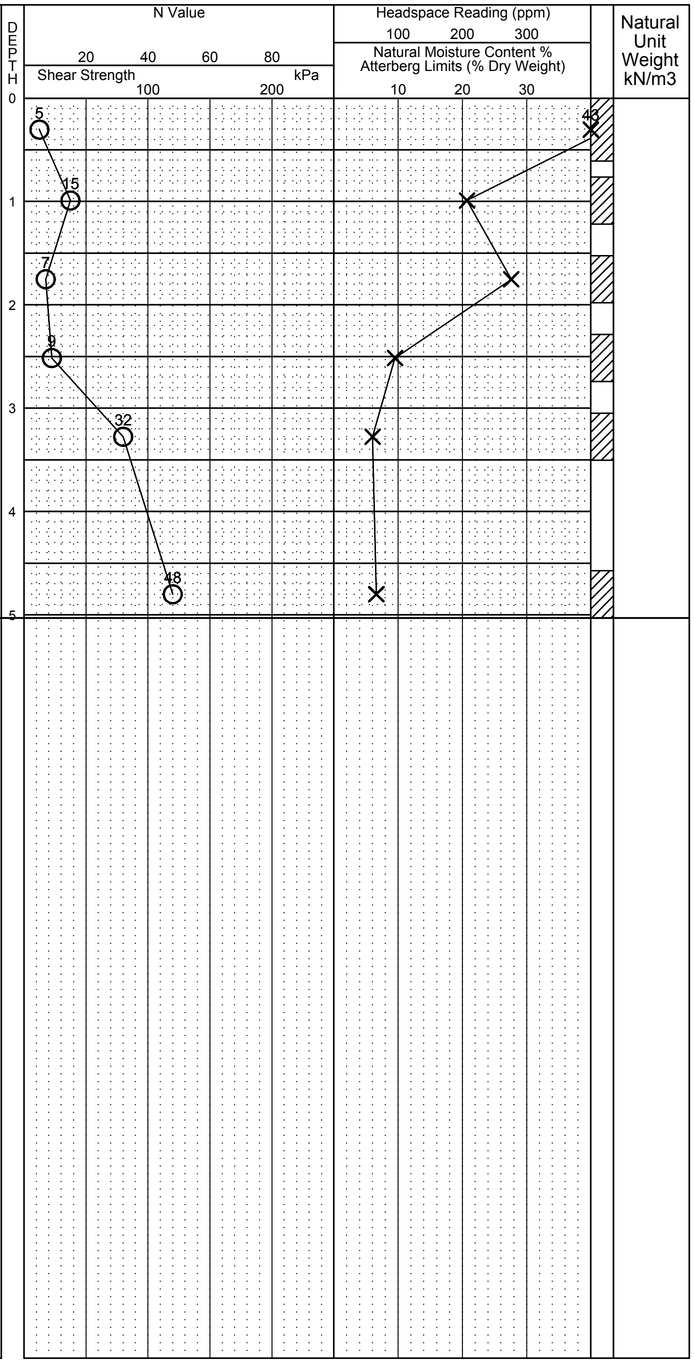
Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

Soil Description	ELEV. m
Ground Surface	191.31
TOPSOIL, 290mm	191.02
FILL, black to brown silty sand to sandy silt, very moist to wet	190.55
SANDY SILT - loose to compact - brown - very moist	189.57
SILT TILL - loose to dense - grey - occasional gravels - moist	189.03
	186.28





END OF BOREHOLE
NOTE:
Upon completion of drilling:
- water level at 2.3m

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

Toronto Inspection Ltd.

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

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

Project No. 4688-17-GC

Log of Borehole 23

Dwg No. 24

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

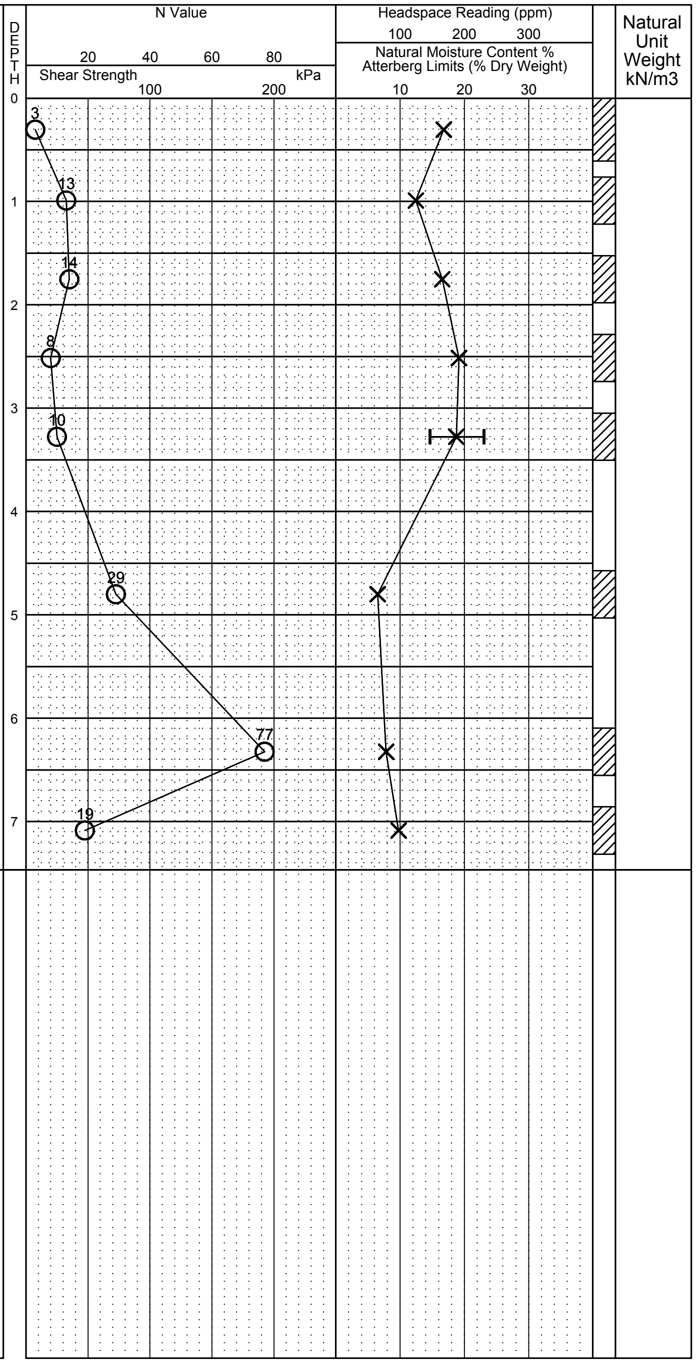
Date Drilled: 11/24/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	191.10
	TOPSOIL, 300mm	190.80
	FILL, black to brown silty sand to sandy silt, very moist	190.34
	SILTY SAND - compact to loose - brown - occasional gravels - moist to very moist	188.21
▼		188.10
	CLAYEY SILT - stiff to very stiff - brown to grey - very moist to moist	186.22
	SILT TILL - very dense to compact - grey - moist	183.79
	LIMESTONE BEDROCK	183.63
	END OF BOREHOLE **NOTE:** Upon completion of drilling: Auger refusal on bedrock - 7.5m - water level at 3.0m - cave-in at 3.7m	



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

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

Toronto Inspection Ltd.

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

Project No. 4688-17-GC

Log of Borehole 24

Dwg No. 25

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 452 Raglan Street, Collingwood, Ontario

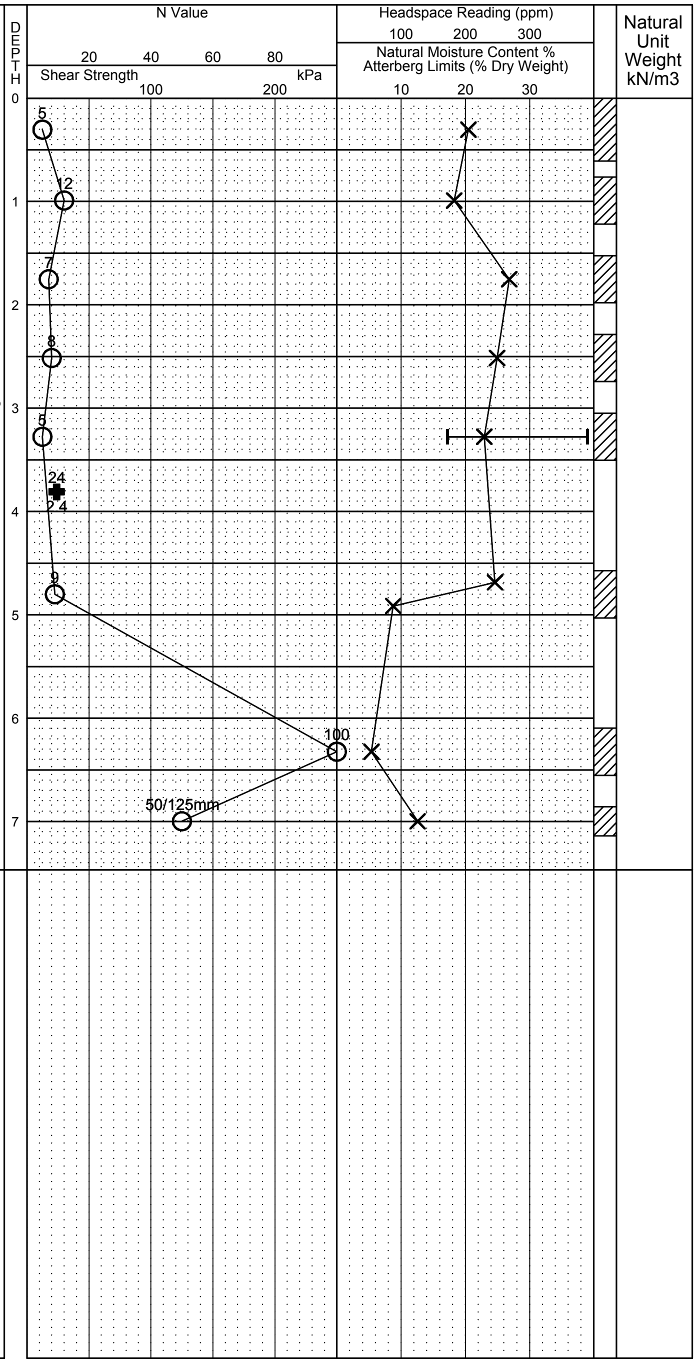
Date Drilled: 11/24/17

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	•
Natural Moisture	×
Plastic and Liquid Limit	├─┤
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

GWL	Soil Description	ELEV. m
	Ground Surface	191.95
	TOPSOIL, 310mm	191.64
	FILL, black to brown silty sand to sandy silt, very moist	191.19
	SANDY SILT - compact to loose - brown - very moist	189.67
▼	**CLAYEY SILT / SILTY CLAY** - firm - brown to grey - a layer of silty clay at 3.0m to 3.5m - very moist	188.95 187.15
	SILT TILL - loose to very dense - grey - very moist to moist	184.94
	LIMESTONE BEDROCK	184.48
	END OF BOREHOLE **NOTE:** Upon completion of drilling: Auger refusal on bedrock - 7.5m - water level at 3.0m - cave-in at 4.6m	



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

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

Toronto Inspection Ltd.

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

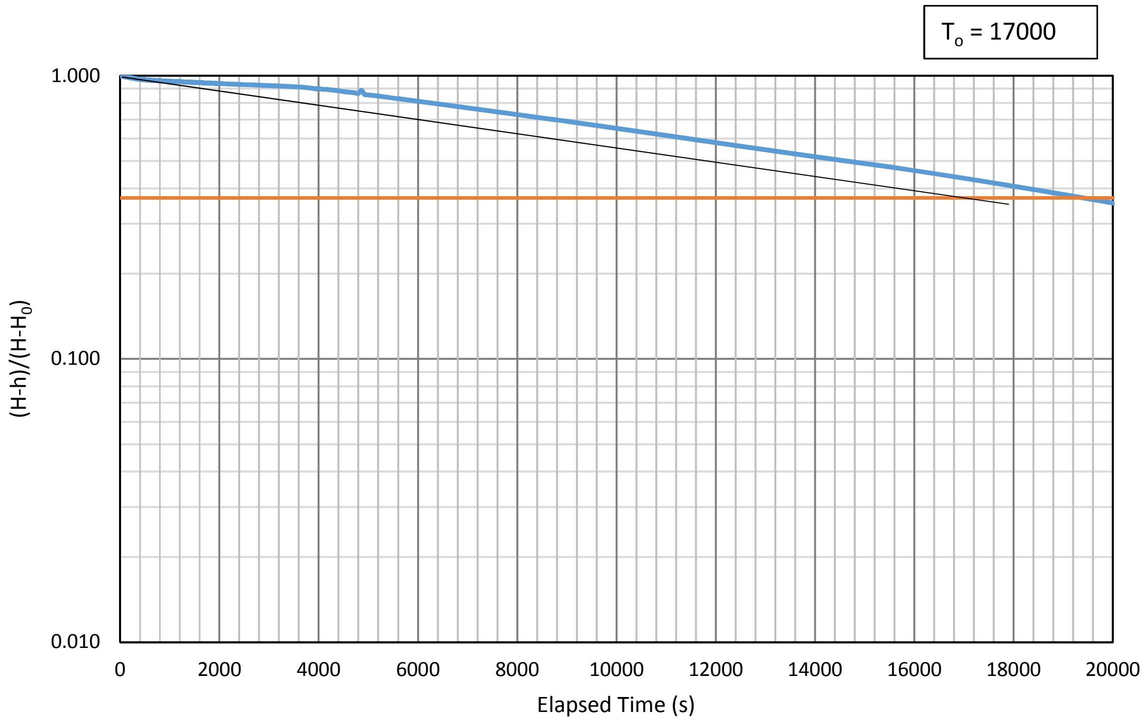
APPENDIX C

Hydraulic Conductivity Analysis

In-Situ Hydraulic Conductivity Analyses - 17MW-2

Appendix B

Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	452 Raglan St, Collingwood, ON
Test Well:	17MW-2
Test Date:	2-Jan-18
Test conducted by:	IG

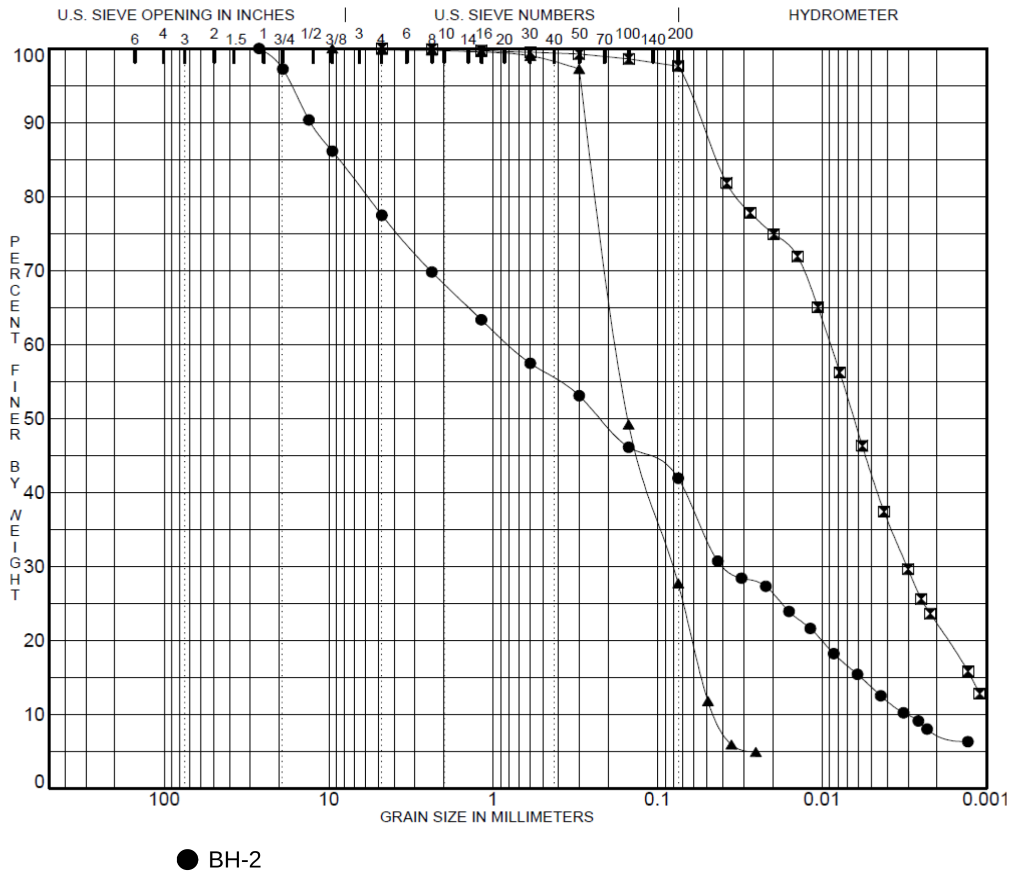


Well Depth:	6.10	**Screened Unit:**	Silt Till
Initial Water Level:	1.02	**Screened Length (L):**	3.0
Available Drawdown (H):	5.08	**Head at Time = 0 (H_o):**	1.1
Borehole Radius (R):	0.1016	**Monitoring Well Radius (r):**	0.025
Solution Method:	Hvorslev	**To (s):**	17000
K (m/s)	2.1E-08	**Recovery (%):**	100%

In-Situ Hydraulic Conductivity Analyses - 17MW-2

Appendix B

Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	452 Raglan Street, Collingwood, ON
Test Well:	17MW-2
Test Date:	14/Dec/17
Test conducted by:	TIL

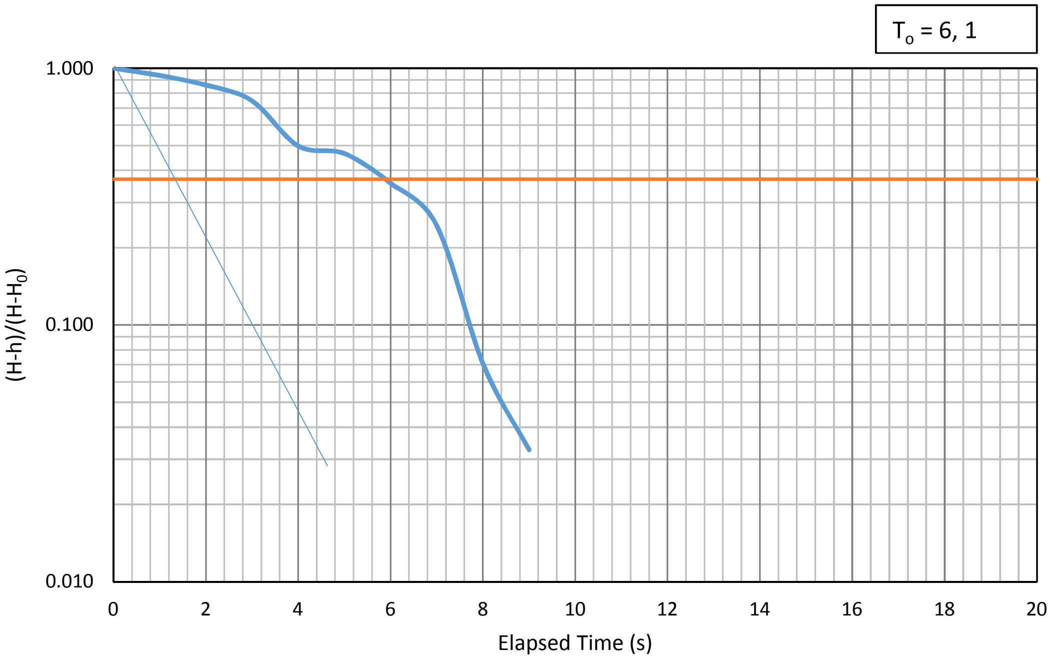


Well Depth:	6.10	**Screened Unit:**	Silt Till
Initial Water Level:	1.02	**Screened Length (L):**	3.0
Borehole Radius (R):	0.1016	**Monitoring Well Radius (r):**	0.025
Solution Method:	Hazen	**Specimen identification (D10):**	0.0031
		Sample Depth (mbgs):	6.1
K (m/s)	1.10E-07	**Temperature (°C):**	10

In-Situ Hydraulic Conductivity Analyses - 17MW-5

Appendix B

Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	452 Raglan St, Collingwood, ON
Test Well:	17MW-5
Test Date:	2-Jan-18
Test conducted by:	IG

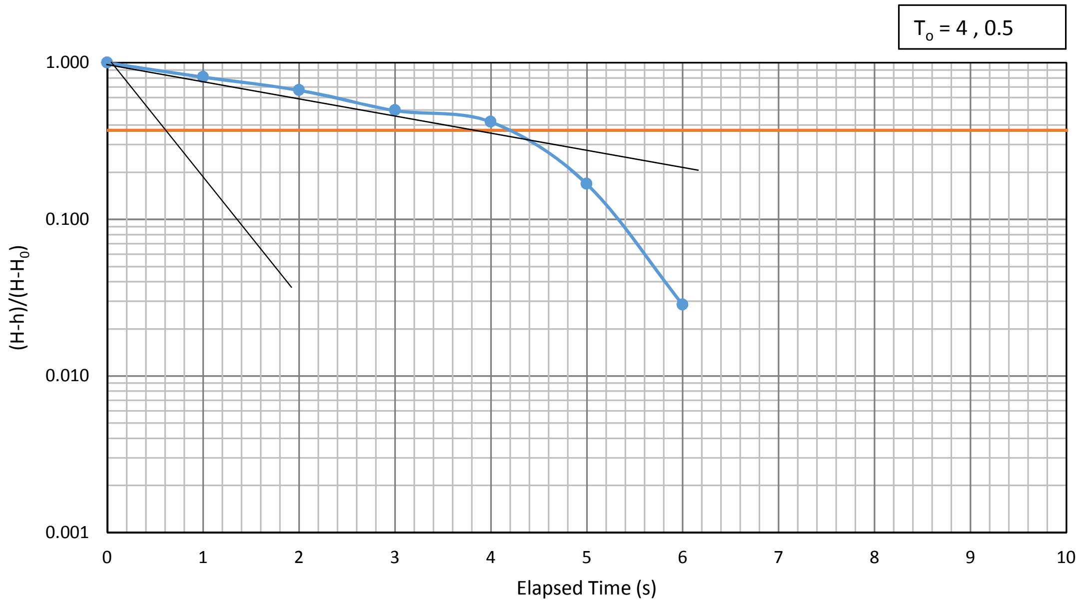


Well Depth:	10.67	**Screened Unit:**	Limestone Bedrock
Initial Water Level:	5.48	**Screened Length (L):**	3.0
Available Drawdown (H):	5.19	**Head at Time = 0 (H_o):**	0.4
Borehole Radius (R):	0.1016	**Monitoring Well Radius (r):**	0.025
Solution Method:	Hvorslev	**To (s):**	6
K (m/s)	5.9E-05	**To (s):**	1
K (m/s)	3.5E-04	**Recovery (%):**	100%

In-Situ Hydraulic Conductivity Analyses - 17MW-9

Appendix B

Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	452 Raglan St, Collingwood, ON
Test Well:	17MW-9
Test Date:	2-Jan-18
Test conducted by:	IG

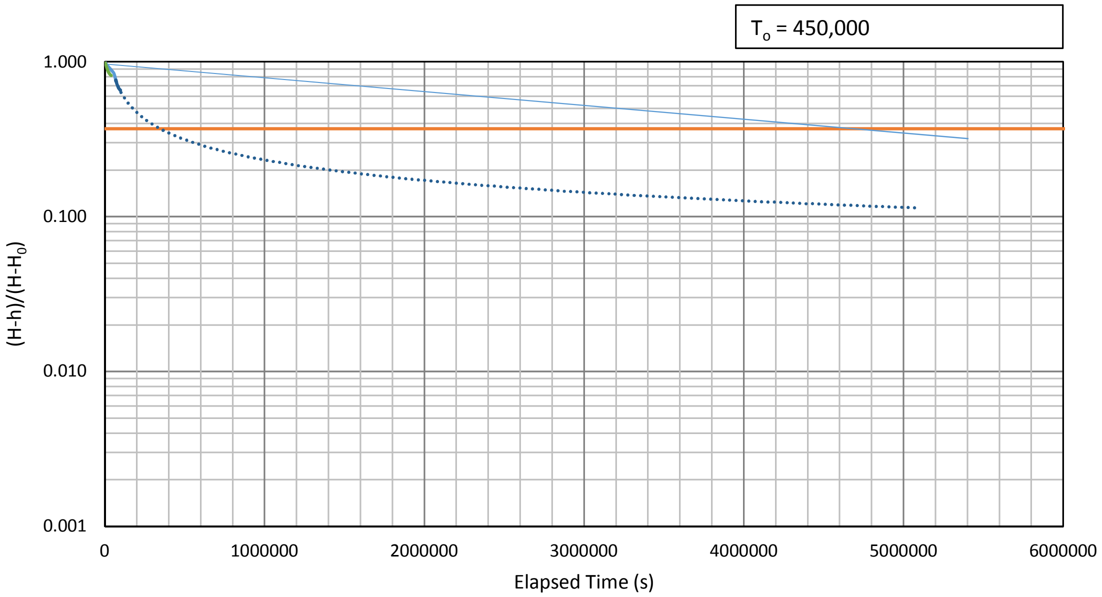


Well Depth:	10.67	**Screened Unit:**	Limestone Bedrock
Initial Water Level:	6.39	**Screened Length (L):**	3.0
Available Drawdown (H):	4.28	**Head at Time = 0 (H_o):**	0.8
Borehole Radius (R):	0.1016	**Monitoring Well Radius (r):**	0.025
Solution Method:	Hvorslev	**To (s):**	4
K (m/s)	8.8E-05	**To (s):**	0.5
K (m/s)	7.1E-04	**Recovery (%):**	100%

In-Situ Hydraulic Conductivity Analyses - 17MW-18

Appendix B

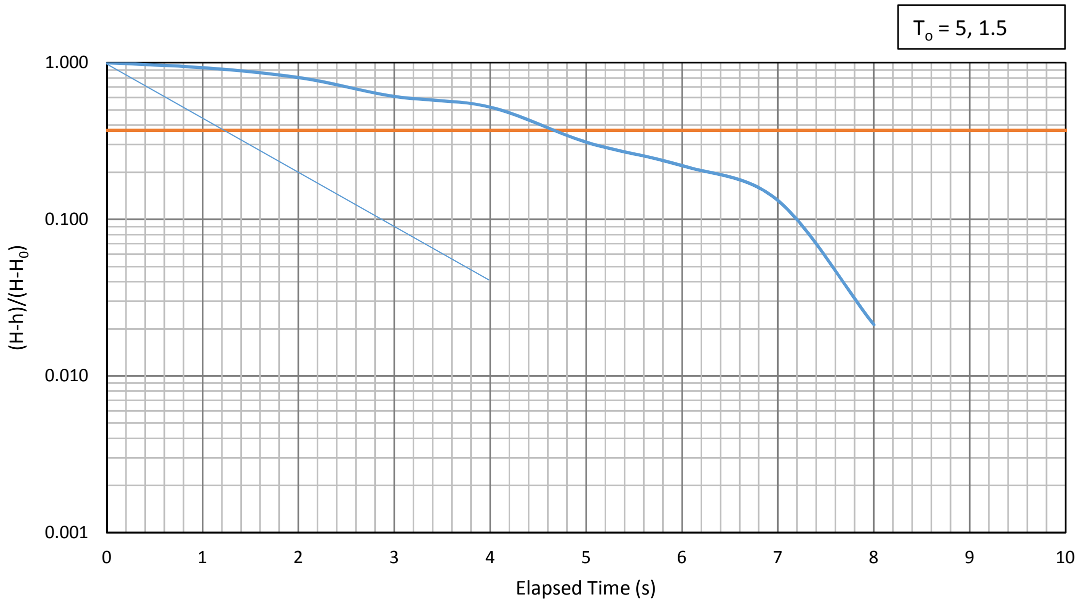
Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	452 Raglan St, Collingwood, ON
Test Well:	17MW-18
Test Date:	2-Jan-18
Test conducted by:	IG



Well Depth:	6.86	**Screened Unit:**	Clayey Silt/Silt Till
Initial Water Level:	4.02	**Screened Length (L):**	3.0
Available Drawdown (H):	2.84	**Head at Time = 0 (H_o):**	0.1
Borehole Radius (R):	0.1016	**Monitoring Well Radius (r):**	0.025
Solution Method:	Hvorslev	**To (s):**	450000
K (m/s)	7.8E-10	**Recovery (%):**	63%

In-Situ Hydraulic Conductivity Analyses - 17MW-20

Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	452 Raglan St, Collingwood, ON
Test Well:	17MW-20
Test Date:	January-02-18
Test conducted by:	IG

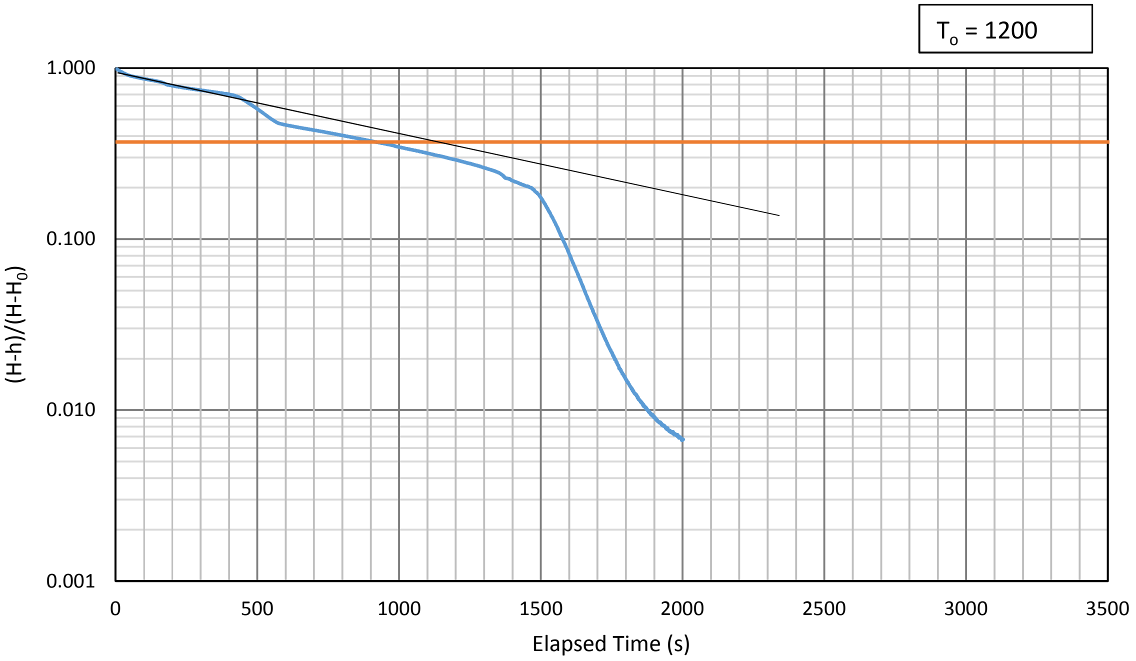


Well Depth:	10.67	**Screened Unit:**	Limestone Bedrock
Initial Water Level:	4.58	**Screened Length (L):**	3.0
Available Drawdown (H):	6.09	**Head at Time = 0 (H_o):**	0.7
Borehole Radius (R):	0.1016	**Monitoring Well Radius (r):**	0.025
Solution Method:	Hvorslev	**To (s):**	5
K (m/s)	7.1E-05	**To (s):**	1.5
K (m/s)	2.4E-04	**Recovery (%):**	100%

In-Situ Hydraulic Conductivity Analyses - 17MW-21

Appendix B

Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	542 Raglan St, Collingwood, ON
Test Well:	17MW-21
Test Date:	3-Jan-18
Test conducted by:	IG

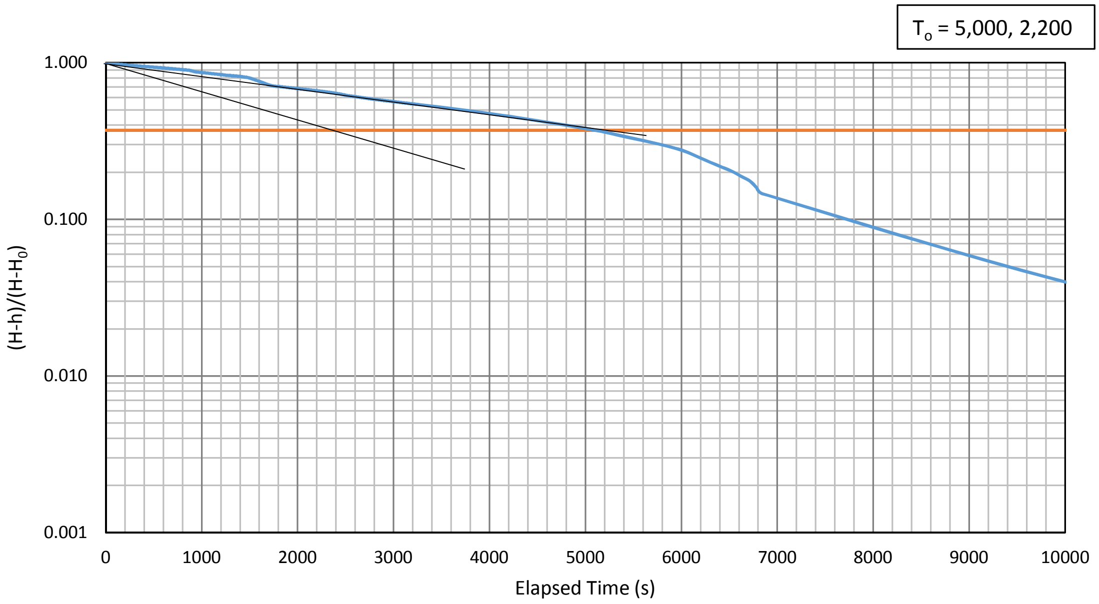


Well Depth:	5.49	**Screened Unit:**	Clayey Silt/Silt Till
Initial Water Level:	2.79	**Screened Length (L):**	3.0
Available Drawdown (H):	2.70	**Head at Time = 0 (H_o):**	0.0
Borehole Radius (R):	0.1016	**Monitoring Well Radius (r):**	0.025
Solution Method:	Hvorslev	**To (s):**	1200
K (m/s)	2.9E-07	**Recovery (%):**	100%

In-Situ Hydraulic Conductivity Analyses - 17MW-22

Appendix B

Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	452 Raglan St, Collingwood, ON
Test Well:	17MW-22
Test Date:	January-02-18
Test conducted by:	IG

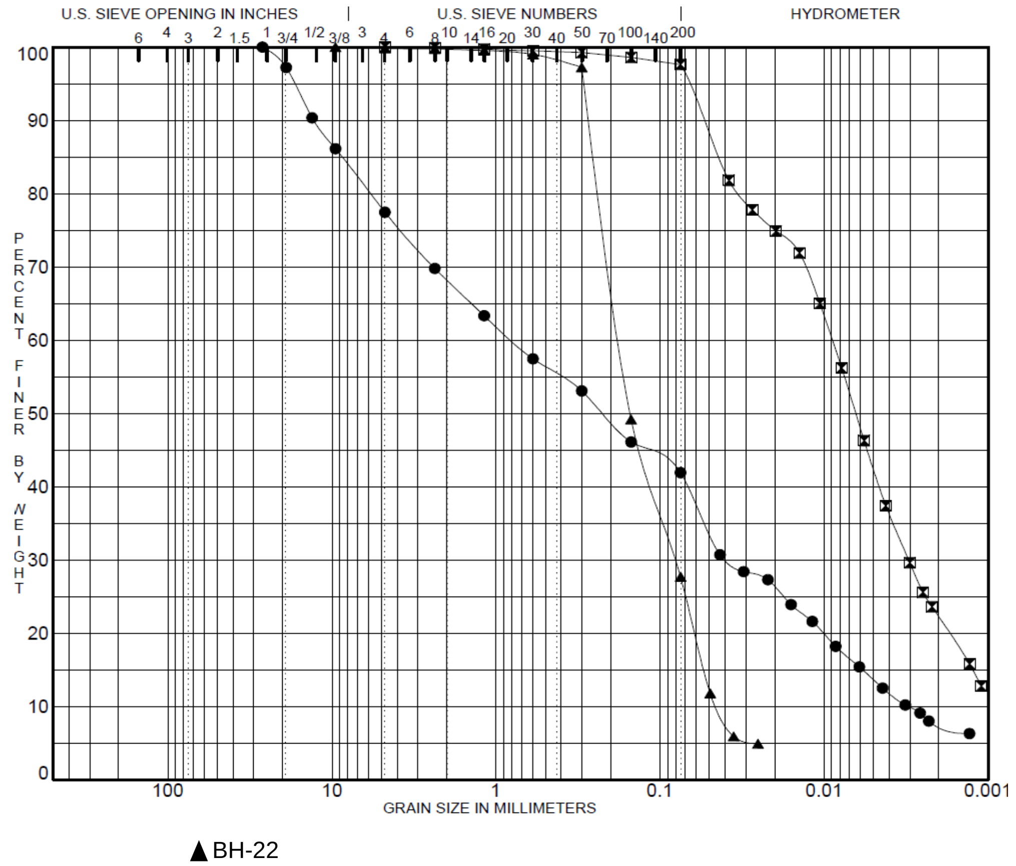


Well Depth:	4.57	**Screened Unit:**	Sandy Silt/Silt Till
Initial Water Level:	1.09	**Screened Length (L):**	3.0
Available Drawdown (H):	3.48	**Head at Time = 0 (H_o):**	0.5
Borehole Radius (R):	0.1016	**Monitoring Well Radius (r):**	0.025
Solution Method:	Hvorslev	**To (s):**	5000
K (m/s)	7.1E-08	**To (s):**	2200
K (m/s)	1.6E-07	**Recovery (%):**	100%

In-Situ Hydraulic Conductivity Analyses - 17MW-22

Appendix B

Company:	Toronto Inspection Ltd.
Client:	Banford Apartments
Project:	4688-17-HG
Location:	452 Raglan St, Collingwood, ON
Test Well:	17MW-20
Test Date:	December-14-17
Test conducted by:	TIL



Well Depth:	4.57	Sampled Unit:	Sandy Silt
Initial Water Level:	1.09	Screened Length (L):	3.0
Borehole Radius (R):	0.1016	Monitoring Well Radius (r):	0.025
Solution Method:	Hazen	Specimen identification (D10):	0.0448
		Sample Depth (mbgs):	0.8
K (m/s)	2.3E-05	Temperature (°C):	10

APPENDIX D

Groundwater Quality Certificate of Analysis

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Collingwood

Project : 4688-17 452 Raglan St

10-January-2018

Toronto Inspection Ltd.
Attn : Ian Gardiner

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

Phone: 905-940-8509
Fax:905 940 8192

Date Rec. : 04 January 2018
LR Report: **CA14069-JAN18**
Reference: 4688-17 Ian Gardiner

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	**1: Analysis Start Date**	**2: Analysis Start Time**	**3: Analysis Completed Date**	**4: Analysis Completed Time**	**5: Collingwood Sanitary By-law Limit**	**6: Collingwood Storm By-law Limit**	**7: RL**	**8: 17MW-5**
Sample Date & Time								03-Jan-18 12:50
Temperature Upon Receipt [°C]	---	---	---	---	---	---	---	1.0
E. Coli [cfu/100mL]	05-Jan-18	12:00	08-Jan-18	10:10	---	200	---	< 2
pH [no unit]	05-Jan-18	08:21	05-Jan-18	15:16	5.5-9.5	6.0-9.0		7.70
Biochemical Oxygen Demand (BOD5) [mg/L]	04-Jan-18	18:00	09-Jan-18	13:21	300	---	2	13
Total Suspended Solids [mg/L]	09-Jan-18	13:49	10-Jan-18	15:04	300	---	2	172
Oil & Grease (total) [mg/L]	05-Jan-18	14:26	08-Jan-18	11:56	---	---	2	< 2
Oil & Grease (animal/vegetable) [mg/L]	05-Jan-18	14:26	08-Jan-18	11:56	150	---	4	< 4
Oil & Grease (mineral/synthetic) [mg/L]	05-Jan-18	14:26	08-Jan-18	11:56	15	---	4	< 4
4AAP-Phenolics [mg/L]	07-Jan-18	09:00	08-Jan-18	15:15	0.1	---	0.002	0.005
Total Kjeldahl Nitrogen [as N mg/L]	05-Jan-18	17:30	09-Jan-18	13:00	50	---	0.5	< 0.5
Cyanide (total) [mg/L]	05-Jan-18	06:45	08-Jan-18	11:38	1.2	---	0.01	< 0.01
Chloride [mg/L]	08-Jan-18	09:09	09-Jan-18	09:12	1500	---	1	69
Sulphate [mg/L]	08-Jan-18	09:11	09-Jan-18	09:12	1500	---	2	30
Fluoride [mg/L]	05-Jan-18	10:33	05-Jan-18	14:56	10	---	0.06	0.15
Sulphide [mg/L]	05-Jan-18	12:10	05-Jan-18	15:24	1	---	0.02	< 0.02
Mercury (total) [mg/L]	09-Jan-18	16:55	10-Jan-18	08:43	0.01	0.001	0.00001	< 0.00001

Analysis	**1: Analysis Start Date**	**2: Analysis Start Time**	**3: Analysis Completed Date**	**4: Analysis Completed Time**	**5: Collingwood Sanitary By-law Limit**	**6: Collingwood Storm By-law Limit**	**7: RL**	**8: 17MW-5**
Aluminum (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	50	---	0.001	1.29
Antimony (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	5	---	0.0002	0.0004
Arsenic (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	1	---	0.0002	0.0007
Bismuth (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	5	---	0.000007	0.000020
Cadmium (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	0.7	---	0.000003	0.000010
Chromium (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	2.8	0.2	0.00003	0.00237
Cobalt (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	5	---	0.000004	0.000717
Copper (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	2	0.1	0.00002	0.00198
Iron (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	50	---	0.007	1.93
Lead (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	0.7	0.05	0.00001	0.00070
Manganese (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	5	---	0.00001	0.0723
Molybdenum (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	5	---	0.00001	0.00607
Nickel (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	2	0.05	0.0001	0.0018
Phosphorus (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	10	---	0.003	0.056
Selenium (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	0.8	---	0.00004	< 0.00004
Silver (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	0.4	---	0.0005	< 0.00005
Tin (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	5	---	0.00001	0.00238
Titanium (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	5	---	0.00005	0.0373
Zinc (total) [mg/L]	09-Jan-18	09:29	09-Jan-18	16:36	2	0.05	0.002	0.005
Polychlorinated Biphenyls (PCBs) - Total [mg/L]	09-Jan-18	08:38	10-Jan-18	09:46	0.004	---	0.0001	< 0.0001
Benzene [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.01	---	0.0005	< 0.0005
Chloroform [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.04	---	0.0005	< 0.0005
1,2-Dichlorobenzene [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.05	---	0.0005	< 0.0005
1,4-Dichlorobenzene [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.08	---	0.0005	< 0.0005
Ethylbenzene [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.06	---	0.0005	< 0.0005
Methylene Chloride [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.09	---	0.0005	< 0.0005
1,1,2,2-Tetrachloroethane [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.06	---	0.0005	< 0.0005
Tetrachloroethylene (perchloroethylene) [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.06	---	0.0005	< 0.0005
Toluene [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.02	---	0.0005	0.0070
Trichloroethylene [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.05	---	0.0005	< 0.0005
Xylene (total) [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	0.3	---	0.0005	0.0010

Analysis	**1: Analysis Start Date**	**2: Analysis Start Time**	**3: Analysis Completed Date**	**4: Analysis Completed Time**	**5: Collingwood Sanitary By-law Limit**	**6: Collingwood Storm By-law Limit**	**7: RL**	**8: 17MW-5**
m-p-xylene [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	---	---	0.0005	0.0007
o-xylene [mg/L]	05-Jan-18	16:07	08-Jan-18	13:14	---	---	0.0005	< 0.0005
Hexachlorobenzene [mg/L]	09-Jan-18	09:16	10-Jan-18	15:56	0.0001	---	0.0001	< 0.0001

RL - SGS Reporting Limit

Temperature of Sample upon Receipt 1 degrees C
Cooling Agent Present
Custody Seal Not Present

Chain of Custody Number: 01122

No exceedences are present above the Regulatory limit(s) indicated

Deanna Edwards

Deanna Edwards, B.Sc, C.Chem
Project Specialist
Environmental Services, Analytical

Method Descriptions

Parameter	Units	SGS Method Code	Reference Method Code
Anions by discrete analyzer	mg/L	ME-CA-[ENV]EWL-LAK-AN-026	US EPA 325.2
Anions by discrete analyzer	mg/L	ME-CA-[ENV]EWL-LAK-AN-026	US EPA 375.4
Biochemical Oxygen Demand	mg/L	ME-CA-[ENV]EWL-LAK-AN-007	SM 5210
Cyanide by SFA	mg/L	ME-CA-[ENV]SFA-LAK-AN-005	SM 4500
Flouride by Specific Ion Electrode	mg/L	ME-CA-[ENV]EWL-LAK-AN-014	SM 4500
Mercury by CVAAS	mg/L	ME-CA-[ENV]SPE-LAK-AN-004	EPA 7471A/SM 3112B
Metals in aqueous samples - ICP-MS	mg/L	ME-CA-[ENV]SPE-LAK-AN-006	SM 3030/EPA 200.8
Metals in aqueous samples - ICP-OES	mg/L	ME-CA-[ENV]SPE-LAK-AN-003	SM 3030/EPA 200.8
Microbiology	cfu/100mL	ME-CA-[ENV]MIC-LAK-AN-001	OMOE MICROMFDC-E3407A
Oil & Grease	mg/L	ME-CA-[ENV]GC-LAK-AN-019	MOE E3401
Oil & Grease-AV/MS	mg/L	ME-CA-[ENV]GC-LAK-AN-019	MOE E3401/SM 5520F
pH	no unit	ME-CA-[ENV]EWL-LAK-AN-006	SM 4500
Phenols by SFA	mg/L	ME-CA-[ENV]SFA-LAK-AN-006	SM 5530B-D
Polychlorinated Biphenyls	mg/L	ME-CA-[ENV]GC-LAK-AN-001	MOE E3400/EPA 8082A
Semi-Volatile Organics	mg/L	ME-CA-[ENV]GC-LAK-AN-005	EPA 3510C/8270D
Sulphide by SFA	mg/L	ME-CA-[ENV]SFA-LAK-AN-008	SM 4500
Suspended Solids	mg/L	ME-CA-[ENV]EWL-LAK-AN-004	SM 2540D
Total Nitrogen	as N mg/L	ME-CA-[ENV]SFA-LAK-AN-002	SM 4500-N C/4500-NO3- F
Volatile Organics	mg/L	ME-CA-[ENV]GC-LAK-AN-004	EPA 5030B/8260C

Quality Control Report

Organic Analysis												
Parameter	Reporting Limit	Unit	Method Blank				LCS / Spike Blank			Matrix Spike / Reference Material		
					RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
						%		Low	High		Low	High
Oil & Grease - QCBatchID: GCM0068-JAN18												
Oil & Grease (total)	2	mg/L	<2				106	80	120			
Oil & Grease-AV/MS - QCBatchID: GCM0068-JAN18												
Oil & Grease (animal/vegetable)	4	mg/L	< 4				NA	80	120			
Oil & Grease (mineral/synthetic)	4	mg/L	< 4				NA	80	120			
Polychlorinated Biphenyls - QCBatchID: GCM0090-JAN18												
Polychlorinated Biphenyls (PCBs) - Total	0.0001	mg/L	<0.0001		NSS	30	107	60	140	112	60	140
Semi-Volatile Organics - QCBatchID: GCM0093-JAN18												
Hexachlorobenzene	0.00001	mg/L	< 1		NSS	30	81	50	140			
Volatile Organics - QCBatchID: GCM0060-JAN18												
1,1,2,2-Tetrachloroethane	0.0005	mg/L	<0.0005		ND	30	112	60	130	107	50	140
1,2-Dichlorobenzene	0.0005	mg/L	<0.0005		ND	30	104	60	130	97	50	140
1,4-Dichlorobenzene	0.0005	mg/L	<0.0005		ND	30	102	60	130	96	50	140
Benzene	0.0005	mg/L	<0.0005		ND	30	102	60	130	99	50	140
Chloroform	0.0005	mg/L	<0.0005		ND	30	101	60	130	98	50	140
Ethylbenzene	0.0005	mg/L	<0.0005		ND	30	100	60	130	95	50	140
m-p-xylene	0.0005	mg/L	<0.0005		ND	30	100	60	130	95	50	140
Methylene Chloride	0.0005	mg/L	<0.0005		ND	30	99	60	130	100	50	140
o-xylene	0.0005	mg/L	<0.0005		ND	30	100	60	130	94	50	140
Tetrachloroethylene (perchloroethylene)	0.0005	mg/L	<0.0005		ND	30	102	60	130	95	50	140
Toluene	0.0005	mg/L	<0.0005		ND	30	101	60	130	96	50	140
Trichloroethylene	0.0005	mg/L	<0.0005		ND	30	102	60	130	97	50	140

Inorganic Analysis												
Parameter	Reporting Limit	Unit	Method Blank				LCS / Spike Blank			Matrix Spike / Reference Material		
					RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
						%		Low	High		Low	High
Anions by discrete analyzer - QCBatchID: DIO0086-JAN18												
Chloride	1	mg/L	<1		1	20	103	80	120	102	75	125
Sulphate	2	mg/L	<2		ND	20	107	80	120	110	75	125
Biochemical Oxygen Demand - QCBatchID: BOD0007-JAN18												
Biochemical Oxygen Demand (BOD5)	2	mg/L	< 2		1	30	99	70	130	100	70	130
Cyanide by SFA - QCBatchID: SKA0035-JAN18												
Cyanide (total)	0.01	mg/L	<0.01		ND	10	95	90	110	100	75	125
Flouride by Specific Ion Electrode - QCBatchID: EWL0051-JAN18												
Fluoride	0.06	mg/L	<0.06		0	10	101	90	110	103	75	125

Inorganic Analysis

Parameter	Reporting Limit	Unit	Method Blank				LCS / Spike Blank			Matrix Spike / Reference Material		
					RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
						%		Low	High		Low	High
Mercury by CVAAS - QCBatchID: EHG0010-JAN18												
Mercury (total)	0.00001	mg/L	< 0.00001		ND	20	99	80	120	111	70	130
Metals in aqueous samples - ICP-MS - QCBatchID: EMS0028-JAN18												
Aluminum (total)	0.001	mg/L	<0.001		4	20	91	90	110	NV	70	130
Antimony (total)	0.0002	mg/L	<0.0002		ND	20	97	90	110	87	70	130
Arsenic (total)	0.0002	mg/L	<0.0002		6	20	96	90	110	97	70	130
Bismuth (total)	0.000007	mg/L	<0.000007		ND	20	100	90	110	87	70	130
Cadmium (total)	0.000003	mg/L	<0.000003		16	20	95	90	110	91	70	130
Chromium (total)	0.00003	mg/L	<0.00003		16	20	97	90	110	NV	70	130
Cobalt (total)	0.000004	mg/L	<0.000004		10	20	96	90	110	101	70	130
Copper (total)	0.00002	mg/L	<0.00002		9	20	96	90	110	113	70	130
Iron (total)	0.007	mg/L	<0.007		9	20	100	90	110	NV	70	130
Lead (total)	0.00001	mg/L	<0.00001		17	20	99	90	110	96	70	130
Manganese (total)	0.00001	mg/L	<0.00001		10	20	98	90	110	NV	70	130
Molybdenum (total)	0.00001	mg/L	<0.00001		8	20	101	90	110	100	70	130
Nickel (total)	0.0001	mg/L	<0.0001		10	20	96	90	110	101	70	130
Selenium (total)	0.00004	mg/L	<0.00004		ND	20	101	90	110	84	70	130
Silver (total)	0.00005	mg/L	<0.00005		ND	20	97	90	110	99	70	130
Tin (total)	0.00001	mg/L	<0.00001		ND	20	97	90	110	NV	70	130
Titanium (total)	0.00005	mg/L	<0.00005		8	20	98	90	110	NV	70	130
Zinc (total)	0.002	mg/L	<0.002		10	20	96	90	110	85	70	130
Metals in aqueous samples - ICP-OES - QCBatchID: EMS0028-JAN18												
Phosphorus (total)	0.003	mg/L	<0.003		8	20	96	90	110	NV	70	130
pH - QCBatchID: EWL0049-JAN18												
pH	0.05	no unit	NA		0		100			NA		
Phenols by SFA - QCBatchID: SKA0037-JAN18												
4AAP-Phenolics	0.002	mg/L	<0.002		10	10	108	90	110	101	75	125
Sulphide by SFA - QCBatchID: SKA0033-JAN18												
Sulphide	0.02	mg/L	<0.02		ND	20	104	80	120	121	75	125
Suspended Solids - QCBatchID: EWL0093-JAN18												
Total Suspended Solids	2	mg/L	< 2		3	10	97	90	110	NA		
Total Nitrogen - QCBatchID: SKA0038-JAN18												
Total Kjeldahl Nitrogen	0.5	as N mg/L	<0.5		3	10	109	90	110	88	75	125

Microbiological

Parameter	Method Blank	Duplicate
Microbiology - QCBatchID: BAC9090-JAN18		
E. Coli	ACCEPTED	ACCEPTED

OnLine LIMS

0001252909

APPENDIX E

Dewatering Analysis

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)
a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	193.18	**masl**
WL	1.83	**m**
	191.35	**masl**
a	96	**m**
b	70	**m**
D	3.70	**m**
	189.48	**masl**

Project Details

Location: 452 Raglan Street, Collingwood
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: Lots 1 - 9
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	6	**m**	
H	12	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	1,209,600	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)
K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	5.01	**m^3/day**
	0.058	**L/s**
K	3.0E-03	**m/day**
H	12	**m**
h	9	**m**
L0	6	**m**
a	96	**m**
b	70	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	6,720	m^2
Volume =	33.600	m^3/day
	33,600	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	**Short-Term Pumping Rate Q**			**Long-Term Pumping Rate Q**
	m^3/day	**L/day**	**L/s**	**L/day**
Groundwater	10.000	10,000	0.12	3,300
Precipitation	33.600	33,600	0.39	-
Total	43.600	43,600	0.50	3,300

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	194.48	**masl**
WL	3.13	**m**
	191.35	**masl**
a	135	**m**
b	64	**m**
D	3.70	**m**
	190.78	**masl**

Project Details

Location: 452 Raglan Street, Collingwood
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: Lots 10 - 21
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}\mathrm{t}}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	6	**m**	
H	11	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	1,209,600	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	3.08	**m^3/day**
	0.036	**L/s**
K	3.0E-03	**m/day**
H	11	**m**
h	9	**m**
L0	6	**m**
a	135	**m**
b	64	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	8,640	m^2
Volume =	43.200	m^3/day
	43,200	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	**Short-Term Pumping Rate Q**			**Long-Term Pumping Rate Q**
	m^3/day	**L/day**	**L/s**	**L/day**
Groundwater	6.200	6,200	0.07	2,100
Precipitation	43.200	43,200	0.50	-
Total	49.400	49,400	0.57	2,100

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	193.78	**masl**
WL	2.43	**m**
	191.35	**masl**
a	79	**m**
b	62	**m**
D	3.70	**m**
	190.08	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: Block 22 - 25
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	6	**m**	
H	11	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	1,209,600	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2-h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2-h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	3.27	**m^3/day**
	0.038	**L/s**
K	3.0E-03	**m/day**
H	11	**m**
h	9	**m**
L0	6	**m**
a	79	**m**
b	62	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	4,898	m^2
Volume =	24.490	m^3/day
	24,490	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	Short-Term Pumping Rate Q			Long-Term Pumping Rate Q
	m^3/day	L/day	L/s	L/day
Groundwater	6.500	6,500	0.08	2,200
Precipitation	24.500	24,500	0.28	-
Total	31.000	31,000	0.36	2,200

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)
a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	191.91	**masl**
WL	0.56	**m**
	191.35	**masl**
a	115	**m**
b	31	**m**
D	3.70	**m**
	188.21	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: Block 26 - 29
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}\mathrm{t}}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	6	**m**	
H	13	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	1,209,600	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2-h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2-h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)
K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	6.75	**m^3/day**
	0.078	**L/s**
K	3.0E-03	**m/day**
H	13	**m**
h	9	**m**
L0	6	**m**
a	115	**m**
b	31	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	3,565	m^2
Volume =	17.825	m^3/day
	17,825	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	**Short-Term Pumping Rate Q**			**Long-Term Pumping Rate Q**
	m^3/day	**L/day**	**L/s**	**L/day**
Groundwater	13.500	13,500	0.16	4,500
Precipitation	17.800	17,800	0.21	-
Total	31.300	31,300	0.36	4,500

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)
a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	192.32	**masl**
WL	0.97	**m**
	191.35	**masl**
a	115	**m**
b	30	**m**
D	3.70	**m**
	188.62	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: Block 30 - 33
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	6	**m**	
H	13	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	1,209,600	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	5.92	**m^3/day**
	0.069	**L/s**
K	3.0E-03	**m/day**
H	13	**m**
h	9	**m**
L0	6	**m**
a	115	**m**
b	30	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	3,450	m^2
Volume =	17.250	m^3/day
	17,250	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	Short-Term Pumping Rate Q			Long-Term Pumping Rate Q
	m^3/day	L/day	L/s	L/day
Groundwater	11.800	11,800	0.14	3,900
Precipitation	17.300	17,300	0.20	-
Total	29.100	29,100	0.34	3,900

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	194.85	**masl**
WL	3.50	**m**
	191.35	**masl**
a	107	**m**
b	30	**m**
D	3.70	**m**
	191.15	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: Block 34 - 37
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	6	**m**	
H	10	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	1,209,600	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	1.59	**m^3/day**
	0.018	**L/s**
K	3.0E-03	**m/day**
H	10	**m**
h	9	**m**
L0	6	**m**
a	107	**m**
b	30	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	3,210	m^2
Volume =	16.050	m^3/day
	16,050	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	**Short-Term Pumping Rate Q**			**Long-Term Pumping Rate Q**
	m^3/day	**L/day**	**L/s**	**L/day**
Groundwater	3.200	3,200	0.04	1,100
Precipitation	16.100	16,100	0.19	-
Total	19.300	19,300	0.22	1,100

Notes:

1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	194.56	**masl**
WL	3.21	**m**
	191.35	**masl**
a	97	**m**
b	62	**m**
D	3.70	**m**
	190.86	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: Block 38 - 45
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}\mathrm{t}}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	6	**m**	
H	10	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	1,209,600	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	2.33	**m^3/day**
	0.027	**L/s**
K	3.0E-03	**m/day**
H	10	**m**
h	9	**m**
L0	6	**m**
a	97	**m**
b	62	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	6,014	m^2
Volume =	30.070	m^3/day
	30,070	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	Short-Term Pumping Rate Q			Long-Term Pumping Rate Q
	m^3/day	L/day	L/s	L/day
Groundwater	4.700	4,700	0.05	1,600
Precipitation	30.100	30,100	0.35	-
Total	34.800	34,800	0.40	1,600

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	192.32	**masl**
WL	0.97	**m**
	191.35	**masl**
a	127	**m**
b	11	**m**
D	5.05	**m**
	187.27	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: SAN MH 37-MH 35/STM MH 73-MH 70/MW
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	5	**m**	
H	14	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	604,800	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2-h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2-h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	9.01	**m^3/day**
	0.104	**L/s**
K	3.0E-03	**m/day**
H	14	**m**
h	10	**m**
L0	5	**m**
a	127	**m**
b	11	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	1,397	m^2
Volume =	6.985	m^3/day
	6,985	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	**Short-Term Pumping Rate Q**		
	m^3/day	**L/day**	**L/s**
Groundwater	18.000	18,000	0.21
Precipitation	7.000	7,000	0.08
Total	25.000	25,000	0.29

Notes:

1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	193.95	**masl**
WL	2.60	**m**
	191.35	**masl**
a	101	**m**
b	11	**m**
D	5.05	**m**
	188.90	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: SAN MH 35-MH 28/STM MH101A-MH 103/WM
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	4	**m**	
H	12	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	604,800	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	5.48	**m^3/day**
	0.063	**L/s**
K	3.0E-03	**m/day**
H	12	**m**
h	10	**m**
L0	4	**m**
a	101	**m**
b	11	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	1,111	m^2
Volume =	5.555	m^3/day
	5,555	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	**Short-Term Pumping Rate Q**		
	m^3/day	**L/day**	**L/s**
Groundwater	11.000	11,000	0.13
Precipitation	5.600	5,600	0.06
Total	16.600	16,600	0.19

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	194.48	**masl**
WL	3.13	**m**
	191.35	**masl**
a	143	**m**
b	11	**m**
D	5.05	**m**
	189.43	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: SAN MH 28-MH 26/STM MH 103-106/MW
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	4	**m**	
H	12	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	604,800	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	6.04	**m^3/day**
	0.070	**L/s**
K	3.0E-03	**m/day**
H	12	**m**
h	10	**m**
L0	4	**m**
a	143	**m**
b	11	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	1,573	m^2
Volume =	7.865	m^3/day
	7,865	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	Short-Term Pumping Rate Q		
	m^3/day	L/day	L/s
Groundwater	12.100	12,100	0.14
Precipitation	7.900	7,900	0.09
Total	20.000	20,000	0.23

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	194.72	**masl**
WL	3.37	**m**
	191.35	**masl**
a	130	**m**
b	11	**m**
D	5.05	**m**
	189.67	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: SAN MH 33 - MH 31/STM MH 100-MH 109/WM
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units	
L0	4	**m**	
H	12	**m**	
K	3.5E-08	**m/s**	
S_y	0.20	**[-]**	(Morris and Johnson, 1967)
t	604,800	**s**	

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	4.92	**m^3/day**
	0.057	**L/s**
K	3.0E-03	**m/day**
H	12	**m**
h	10	**m**
L0	4	**m**
a	130	**m**
b	11	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	1,430	m^2
Volume =	7.150	m^3/day
	7,150	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	**Short-Term Pumping Rate Q**		
	m^3/day	**L/day**	**L/s**
Groundwater	9.800	9,800	0.11
Precipitation	7.200	7,200	0.08
Total	17.000	17,000	0.20

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	191.91	masl
WL	0.56	m
	191.35	masl
a	189	m
b	8	m
D	4.44	m
	187.47	masl

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: SAN MH #1A-MH 3/WM
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}\mathrm{t}}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units
L0	5	m
H	14	m
K	3.5E-08	m/s
S_y	0.20	[-]
t	604,800	s

(Morris and Johnson, 1967)

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2-h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2-h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	12.20	m^3/day
	0.141	L/s
K	3.0E-03	m/day
H	14	m
h	10	m
L0	5	m
a	189	m
b	8	m

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	1,512	m^2
Volume =	7.560	m^3/day
	7,560	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	Short-Term Pumping Rate Q		
	m^3/day	L/day	L/s
Groundwater	24.400	24,400	0.28
Precipitation	7.600	7,600	0.09
Total	32.000	32,000	0.37

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

Dewatering Calculations

Details of Excavation

GS = Ground Surface (masl)
WL = Assumed Depth of Groundwater (m/masl)

a = Length of excavation (m)
b = Width of excavation (m)
D = Depth of Excavation (m/masl)

Parameter	Value	Units
GS	193.04	**masl**
WL	1.69	**m**
	191.35	**masl**
a	42	**m**
b	3	**m**
D	3.21	**m**
	189.83	**masl**

Project Details

Location: 452 Raglan Street, Collingwood, ON
Project No.: 4688-17-HG

Date: Wednesday, January 19, 2022
Scenario: STM MH 101-MH 97-SWM
Prepared By: PG
Checked By: RBC

Distance of Influence Formula (Cashman and Preene, 2013):

$$L_0 = \sqrt{\frac{12HK}{S_y}t}$$

Where:
L0 = Distance of influence to line source of recharge (m)
H = Distance from initial static water level to bottom of saturated aquifer (m)
K = Hydraulic conductivity (m/s)
S_y = Specific yield of the aquifer formation [-]
t = Time (s) required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)

Parameter	Value	Units
L0	4	**m**
H	12	**m**
K	3.5E-08	**m/s**
S_y	0.20	**[-]**
t	604,800	**s**

(Morris and Johnson, 1967)

Dewatering Rate Formula for Planar Flow to All Sides of Excavation (Powers et al., 2007):

$$Q = 2\left[\frac{aK(H^2 - h^2)}{2L_0}\right] + 2\left[\frac{bK(H^2 - h^2)}{2L_0}\right]$$

Where:
Q = Anticipated pumping rate (m^3/day)

K = Hydraulic Conductivity (m/day)
H = Distance from initial static water level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
L0 = Distance of influence to line source of recharge (m)
a = Length (m)
b = Width (m)

Parameter	Value	Units
Q	1.43	**m^3/day**
	0.017	**L/s**
K	3.0E-03	**m/day**
H	12	**m**
h	10	**m**
L0	4	**m**
a	42	**m**
b	3	**m**

Incident Precipitation		
Design Event =	5	mm in 24-hours
Area =	105	m^2
Volume =	0.525	m^3/day
	525	L/day

* 5 mm/24-hr =82% Percentile Accumulation

Summary

Summary	**Short-Term Pumping Rate Q**		
	m^3/day	**L/day**	**L/s**
Groundwater	2.900	2,900	0.03
Precipitation	0.500	500	0.01
Total	3.400	3,400	0.04

Notes:
1. Considering a groundwater factor of safety of: **2**
2. Long-term pumping rate approximately 1/3rd short-term groundwater rate.
Does not include infiltration from rain.

APPENDIX F

MECP Water Well Records

WATER WELL RECORDS WITHIN 500M OF SITE

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
COLLINGWOOD TOWN	17 563990 4926448 W	1960/07 5510	4 4	FR 0028	10/12/5/2:0	DO		5700395 ()	LOAM 0002 MSND 0009 CLAY STNS 0015 LMSN 0028
COLLINGWOOD TOWN	17 564095 4926546 W	1966/09 5510	4 4	SU 0036	17/27/3/2:0	PS		5700435 ()	CLAY MSND STNS 0017 LMSN 0039
COLLINGWOOD TOWN	17 564044 4926674 W	1973/05 4716	7	FR 0015	5/15/20/2:0	IN		5709858 ()	BLCK LOAM FILL 0002 BRWN SAND 0005 GREY SHLE 0033
COLLINGWOOD TOWN 07 041	17 564211 4926673 W	1980/05 4716	6	FR 0033	10/16/15/8:0			5716663 ()	BRWN SAND GRVL 0003 BRWN GRVL SAND 0008 GREY CLAY GRVL 0013 GREY SHLE 0036
NOTTAWASAGA TOWNSHIP CON 07 041	17 564114 4926624 W	1981/08 4716	6	UK 0030	5///:			5717614 () A	GREY CLAY STNS 0003 GREY SHLE 0044
NOTTAWASAGA TOWNSHIP CON 07 041	17 564088 4926442 W	1987/11 1565				IN		5722903 (22406) A	SAND 0005 GREY SHLE ROCK HARD 0060
CON 07 041	4926446 W	1987/12 1565	6 6			IN		A	SAND 0004 SHLE ROCK HARD 0060
COLLINGWOOD TOWN	17 563778 4926503 W	2015/11 7472	2			MO	0010 10	7255139 (Z224551) A197554	BRWN FSND PCKD 0020
COLLINGWOOD TOWN	17 563778 4926609 W	2015/11 7472	2			MO	0010 10	7255140 (Z224552) A197604	BRWN FSND PCKD 0010 GREY SILT CLAY PCKD 0020
COLLINGWOOD TOWN	17 563765 4926699 W	2015/11 7472	2			MO	0010 10	7255141 (Z224553) A197605	BRWN SILT CLAY PCKD 0010 GREY SILT CLAY PCKD 0020
COLLINGWOOD TOWN	17 564000 4926681 W	2017/08 6607						7295099 (C31110) A224252 P	
COLLINGWOOD TOWN	17 564029 4926714 W	2017/11 7383	2			TH MO	0005 10	7300025 (Z269685) A238871	SAND GRVL ROCK 0015
COLLINGWOOD TOWN	17 563987 4926707 W	2017/11 7383	2			TH MO	0005 10	7300026 (Z269684) A238942	SAND GRVL ROCK 0015

WATER WELL RECORDS WITHIN 500M OF SITE

COLLINGWOOD TOWN	17 563994 4926710 W	2017/11 7383	2			TH MO	0005 10	7300027 (Z269683) A238991	SAND GRVL ROCK 0015
COLLINGWOOD TOWN	17 564010 4926663 W	2017/11 7383	2			TH MO	0005 10	7300028 (Z269682) A238877	SAND GRVL ROCK 0015
COLLINGWOOD TOWN	17 563978 4926704 W	2017/11 7383	2			TH MO	0005 10	7300029 (Z269680) A238993	SAND GRVL ROCK 0015
COLLINGWOOD TOWN	17 563989 4926678 W	2017/11 7383	2			TH MO	0005 10	7300030 (Z269681) A235327	SAND GRVL ROCK 0015
COLLINGWOOD TOWN CON 08 040	17 563465 4925935 W	2020/07 7366	1		///:	MO	0005 5	7362864 (BEFC9JVL) A294938	BRWN SAND GRVL 0010 GREY SILT 0015

Notes:

UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completed and Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Feet. See Table 4 for Meaning of Code
PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag. A : Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

Table 1. Core Material and Descri

Code	Description
BLDR	BOULDERS
BSLT	BASALT
CGRD	COARSE-GRAINED
CGVL	COARSE GRAVEL
CHRT	CHERT
CLAY	CLAY
CLN	CLEAN
CLYY	CLAYEY
CMTD	CEMENTED
CONG	CONGLOMERATE
CRYS	CRYSTALLINE
CSND	COARSE SAND
DKCL	DARK-COLOURED
DLMT	DOLOMITE
DNSE	DENSE
DRTY	DIRTY
DRY	DRY
FCRD	FRACTURED
FGRD	FINE-GRAINED
FGVL	FINE GRAVEL
FILL	FILL
FLDS	FELDSPAR
FLNT	FLINT
FOSS	FOSILIFEROUS
GNIS	GNEISS
GRNT	GRANITE

Code	Description
GRSN	GREENSTONE
GRVL	GRAVEL
GRWK	GREYWACKE
GVLY	GRAVELLY
GYPS	GYPSUM
HARD	HARD
HPAN	HARDPAN
IRFM	IRON FORMATION
LIMY	LIMY
LMSN	LIMESTONE
LOAM	TOPSOIL
LOOS	LOOSE
LTCL	LIGHT-COLOURED
LYRD	LAYERED
MARL	MARL
MGRD	MEDIUM-GRAINED
MGVL	MEDIUM GRAVEL
MRBL	MARBLE
MSND	MEDIUM SAND
MUCK	MUCK
OBDN	OVERBURDEN
PCKD	PACKED
PEAT	PEAT
PGVL	PEA GRAVEL
PORS	POROUS
PRDG	PREVIOUSLY DUG

Code	Description
PRDR	PREV. DRILLED
QRTZ	QUARTZITE
QTZ	QUARTZ
ROCK	ROCK
SAND	SAND
SHLE	SHALE
SHLY	SHALY
SHRP	SHARP
SHST	SCHIST
SILT	SILT
SLTE	SLATE
SLTY	SILTY
SNDS	SANDSTONE
SNDY	SANDYSOAPSTONE
SOFT	SOFT
SPST	SOAPSTONE
STKY	STICKY
STNS	STONES
STNY	STONEY
THIK	THICK
THIN	THIN
TILL	TILL
UNKN	UNKNOWN
VERY	VERY
WBRG	WATER-BEARING
WDFR	WOOD

Code	Description
WTHD	WEATHERED

Notes (Cont'd):

Table 2. Core Colour

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

Table 3. Well Use

Code	Description
DO	Domestic
ST	Livestock
IR	Irrigation
IN	Industrial
CO	Commercial
MN	Municipal
PS	Public
AC	Cooling and A/C
NU	Not Used
OT	Other
TH	Test Hole
DE	Dewatering
MO	Monitoring
MT	Monitoring TestHole

Table 4. Water Detail

Code	Description
FR	Fresh
SA	Salty
SU	Sulphur
MN	Mineral
Uk	Unknown
GS	Gas
IR	Iron