Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	MUSKOKA	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

A REPORT TO
BEACHCROFT INVESTMENTS INC. (BALLANTRY HOMES)

A HYDROGEOLOGICAL ASSESSMENT FOR PROPOSED RESIDENTIAL DEVELOPMENT

63 AND 63A TRAFALGAR ROAD
TOWN OF ERIN

REFERENCE NO. 2206-W054

JANUARY 2024
(Revision 1)

DISTRIBUTION

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1.0 EXECUTIVE SUMMARY

Soil Engineers Ltd. has conducted a preliminary hydrogeological assessment for a proposed development site, located at 63 and 63A Trafalgar Road in the Town of Erin. The Preliminary hydrogeological assessment report was issued in February 2.23. The current report is an updated copy of the previously submitted report to revise the estimated short-term dewatering flow rates based on the highest groundwater monitoring data recorded over long-term monitoring program, and provide Threat Assessment for a portion of the Subject Site located within a radius of 100 m away from the future municipal water supply well.

The findings from the current study reveal that beneath the topsoil and ploughed soil horizons, beneath the ground surface, the Subject Site is underlain, predominantly by sand and gravelly sand deposits. Sandy silt to silty sand till or silt deposits were generally contacted in the lower stratigraphy in some of the boreholes. A localized sandy silt deposit was contacted near the ground surface below the ploughed soil in Borehole 6.

The findings of this study confirm that the highest and lowest groundwater levels were measured at El. 441.98 masl and 423.06 masl in BH/MWs 6 and 4 on April 21, 2023 and July 28, 2023, respectively. Additionally, BH/MW 10 remained dry over the monitoring period.

The monitoring wells with sufficient groundwater volumes within them underwent single well response tests (SWRTs) to estimate the hydraulic conductivity at the depths for the monitoring well screens. The results for the SWRT's will be presented in the final hydrogeological assessment report. The single well response tests yielded hydraulic conductivity (K estimate) for the underlying sub-soils for gravelly sand/sandy gravel unit ranges from 5.2×10^{-7} to 5.7×10^{-7} m/s, and the K estimate for the silt and sand unit is 3.6×10^{-6} m/s. The results of the SWRT provide an indication of the yield capacity for the groundwater-bearing subsoil strata at the depths of the monitoring well screens. The above results suggest that the K estimate for the groundwater-bearing subsoils at the depths of the well screen is low to moderate with corresponding low to moderate anticipated groundwater seepage rates into open excavations, below the groundwater table.

Hazen Equation calculated permeability results indicate that the K estimate for the sub-soil units beneath the Subject Site ranges from 5.63×10^{-7} to 1.22×10^{-7} m/sec. The results of the SWRT provide an indication of the yield capacity for the groundwater- bearing subsoil strata primarily above the depths of the monitoring wells screens. The above result suggests that the K estimate for the groundwater-bearing subsoils ranges from low to high with corresponding moderate anticipated groundwater seepage rates into open excavations, below the groundwater table.

The measured groundwater levels at the BH/MWs indicate that shallow groundwater is interpreted to be flowing in southwesterly directions, away from interpreted, localized groundwater high areas, located beneath the northwestern and eastern portions of the Subject Site. Shallow groundwater is interpreted to flow in the direction of the tributary for Credit River that is located southwest of the Subject Site.

Short-term dewatering control is anticipated for the proposed development at the Subject Site. Details are summarized below:

• Lot development: much of the proposed lots including basements will be excavated and constructed above shallow groundwater table. However, dewatering expected for the lots that will be constructed below shallow groundwater table with the maximum anticipated groundwater seepage of 65,000.0 L/day (with safety factor of 1.5), at total flow of 72.200 L/day including storm event.

• Proposes SWMPs: Groundwater seepage of 35,000.0 L/day considering a safety factor of 1.5 is expected for excavation and construction of the proposed SWMP1. Total anticipated flow including storm event reaches 539,000.0 L/day. SWMP2 will be constructed above shallow groundwater level. As such, significant groundwater seepage is not anticipated. However, potential water through storm event with anticipated flow of 489,000.0 L/day should be controlled during construction.

• Underground Services: Proposed underground services will be partially installed below shallow groundwater level. As such, groundwater seepage with a maximum flow rate of 318,000.0 L/day (with safety factor of 1.5), and total flow rate of 322,800.0 L/day is expected.

It is assumed the construction at the Subject Site will be completed over phases. Additionally, since the maximum estimated dewatering flow rate from groundwater source for each proposed development item exceeds 50,000 L/day but is below the 400,000 L/day PTTW threshold limit, the approval for any proposed temporary groundwater-taking for construction is by means of applying for an EASR approval with the MECP.

The estimated zone of influence for any conceptual dewatering wells or dewatering array around excavation footprints could reach maximums of 15.9 m away from the conceptual dewatering array around the servicing trenches. Potential impacts to the nearby structures, natural heritage features and groundwater receptors as summarized below:

• Proposed residential properties located along the southwest limit of the Subject Site, might be located within the conceptual ZoI for dewatering. It is recommended a professional geotechnical engineer is consulted in advance of excavation and construction.

• The existing natural feature located within the Subject Site is located within the upgradient area of the Subject Site. Dewatering is not expected for the area located to the west (northwest of the existing natural feature. The remaining surrounding lands around the natural feature within the Subject Site are located in the down-gradient of the natural feature, where the maximum conceptual ZoI for dewatering reaches 15.39 m away from dewatering array for installation of the proposed underground services. As such, significant impacts with respect to dewatering is not anticipated to the natural features located within the Subject Site. The existing natural features located close to the west and south boundaries of the Subject Site are located outside of the conceptual ZoI for dewatering. Additionally, significant dewatering is not expected as most of the proposed development will be constructed above shallow groundwater table. As such, significant impacts with respect to dewatering is not anticipated to the natural features located outside of the Subject Site.

• A review of the MECP well records confirmed that there are records for water supply wells

that are registered within 500 m of the Subject Site. The water supply well monitoring program is on-going for the residents that has given pression to SEL for well monitoring program. Record review indicates that the water supply wells were installed between 1954 and 2016. Since all of the wells are in the deeper aquafer, as such significant impacts to the water supply records are not expected.

A municipal water supply well is proposed in a property located adjacent to the northwest boundary of the Subject Site. As such potions of the Subject site within a radius of 100.0 m away from the proposed water supply well are located within WHPA-A, where installation of sanitary sewer system, Stormwater Management Facilities (SWMF), and application of road salt is considered as significant threats to the water supply well. As such:

- Sanitary sewer system cannot be installed within the policy area. Policies SWG-13 and SWG-14 should be followed.
- SWMF cannot be constructed within the policy area. A review of the provided plans indicates that SWMP and infiltration trenches are proposed outside of the policy area.
- Application of road salt should be limited and managed to minimize the potential impact to the proposed municipal water supply well. It is recommended the winter maintenance for the neighborhood is mainly comprises mechanical removal of snow, where the application of road salt will be limited. Considering the above approach and extending to the entire Subject Site will minimize the potential impact of road salt to groundwater with respect to the location of the Subject Site within the SGRA and HVA.

2.0 INTRODUCTION

2.1 Project Description

In accordance with the authorization, dated June 15, 2022, from Ms. Uzo Rossouw of Beachcroft Investments Inc., Soil Engineers Ltd. (SEL) has conducted a preliminary hydrogeological assessment for a proposed residential development site, located at 63 and 63A Trafalgar Road in the Town of Erin.

The Preliminary hydrogeological assessment report was issued in February 2023. The current report is an updated copy of the previously submitted report to revise the estimated short-term dewatering flow rates based on the highest groundwater monitoring data recorded over long-term monitoring program, and provide Threat Assessment for a portion of the Subject Site located within a radius of 100 m away from the future municipal water supply well.

The location of the Subject Site is shown on **Drawing No. 1**. Surrounding land use includes; existing residential subdivision to the northwest, farmlands to the northeast, farmlands and Wellington Road 22 to the southeast, and Trafalgar Road and residential properties to the southwest.

Functional Servicing plans (drawing nos. FS-01 and FS-02) and Functional Erosion & Sediment Control plans (drawing nos. FSC-01 and FSC-02), prepared by Urbanworks Engineering Corporation, dated Dec. 19, 2023 were reviewed for the current assessment. Plan review indicates that the proposed development at the Subject Site includes construction of residential houses, 3-storey senior apartment and associated at grade parking lot, low rise senior houses, 2 stormwater management pounds, underground services and roads.

The purpose of this preliminary hydrogeological assessment is to summarize the findings of the field study and the associated groundwater monitoring and testing programs, to provide a description and characterization of the interpreted hydro-stratigraphic setting for the Subject Site and the local surrounding area. In addition, this study provides preliminary recommendations for any construction related dewatering needs, prior to detailed design. The current study provides preliminary recommendations for any construction- related, or permanent foundation drainage needs prior to detailed design.

2.2 Project Objectives

The major objectives of this Hydrogeological Assessment Report are as follows:

1. Establish the local hydrogeological setting for the Subject Site and the local surrounding area;
2. Interpretation of the shallow groundwater flow and runoff patterns;

3. Identify zones of higher groundwater yield as potential sources for any ongoing shallow groundwater seepage;
4. Characterizing the hydraulic conductivity (K) for the shallow groundwater-bearing sub-soil strata;
5. Review of Ontario Water Well Records for the Subject Site and the surrounding areas;
6. Preparation of an interpreted hydrostratigraphic cross-section across the Subject Site and development footprint;
7. Estimation for the anticipated temporary dewatering flows that may be required to lower the groundwater table to facilitate construction, or for any anticipated long-term, permanent, foundation drainage needs, following construction, if required;
8. Describing the groundwater function for the site area, evaluating potential impacts to nearby groundwater receptors within the anticipated zones of influence for any temporary construction dewatering; and development of preliminary estimates for any anticipated dewatering flow rates to facilitate excavation and construction, if required;
9. Provide comments regarding any need to file for an Environmental Activity and Sector Registry (EASR), or to acquire a Permit-To-Take Water (PTTW) as groundwater taking approvals to facilitate a construction dewatering program in support of proposed earthworks for building construction and for installation of the associated underground services;
10. Comment on the feasibility of the site for the implementation of Low Impact Development (LID) stormwater management infrastructure at the developed site to address future storm water management planning for the proposed development.

2.3 **Scope of Work**

The scope of work for the Hydrogeological Study is summarized below:

1. Borehole drilling and installation of eleven (11) monitoring wells within the site's development footprint;
2. Monitoring well development and groundwater level measurements at the eleven (11) installed monitoring wells;
3. Performance of Single Well Response Tests (SWRTs) at the installed monitoring wells to estimate the hydraulic conductivity (K) for the groundwater-bearing subsoil strata at the depths of the monitoring well screens;
4. Describing the geological and hydrogeological setting for the Subject Site and the local surrounding area;
5. Estimating the hydraulic conductivity (K) for the groundwater bearing subsoil strata, based on the SWRT results, and from a review of the soil sample grain size analyses findings;
6. Reviewing and plotting of Ministry of the Environment, Conservation, and Parks (MECP)

water well records within 500 m of the proposed development site;

7. Review of the findings of the previous geotechnical soil investigation study; review of available engineering development plans and profiles for the proposed residential building/housing structures; assessing the preliminary dewatering needs and estimation of any anticipated dewatering flows to lower local groundwater levels to facilitate earthworks and construction, and completing an assessment for any anticipated long-term foundation drainage needs for the completed housing basement/foundation structures;
8. Providing comments regarding any need to register any proposed groundwater-taking through an Environmental Activity and Sector Registry (EASR), or to apply for a Permit-To-Take Water (PTTW) as groundwater taking approvals to facilitate a construction dewatering program;
9. Commenting on the feasibility of the Subject Site soil and groundwater conditions for implementing of LID stormwater management infrastructure to address future stormwater management planning and design for the proposed development.

3.0 METHODOLOGY

3.1 Borehole Advancement and Monitoring Well Installation

Borehole drilling and monitoring well construction were conducted between November 18 and 25, 2022. Eleven (11) boreholes (BHs) were drilled and eleven (11) monitoring wells (MW) were installed within or adjacent to each borehole. The approximated borehole and monitoring well locations are shown on **Drawing No. 2**.

The drilling and monitoring well construction were completed by the licensed water well contractor, DBW, under the full-time supervision of a geotechnical technician from SEL, who also logged the subsoil strata, encountered during borehole advancement, and collected representative samples for soil classification. The boreholes were drilled using continuous flight power auger machine. Selected subsoil samples, retrieved from the borehole drilling program underwent laboratory grain size analysis to confirm the subsoil texture. Detailed descriptions of the encountered subsurface soil and groundwater conditions are presented on the borehole and monitoring well logs Figures 1 to 11, inclusive.

The monitoring wells were constructed, using 50 mm diameter PVC riser pipes and screen sections, which were installed in the open boreholes in accordance with Ontario Regulation (O. Reg.) 903. The monitoring wells were provided with a monument steel protective casing at the ground surface. The details for monitoring well construction are provided on the enclosed Borehole Logs (Figures 1 to 11, inclusive).

The ground surface elevations and horizontal coordinates at the monitoring well locations were determined at the time of the investigation, using a handheld Global Navigation Satellite System survey equipment (Trimble Geoexplorer unit TSC3) which has an accuracy of 0.05± m. The UTM coordinates and ground surface elevations at the borehole/monitoring well locations, together with the summary of the monitoring well installation details, are provided in **Table 3-1**.

Table 3-1- Monitoring Well Installation Details

Well ID	Installation Date	UTM Coordinates		Ground El. (masl)	Borehole Depth (mbgs)	Well Screen Interval (mbgs)	Casing Dia. (mm)
		East (m)	North (m)				
BH/MW 1	November 22, 2022	569441	4848910	439.63	6.7	3.1-6.1	50
BH/MW 2	November 22, 2022	569341	4849156	436.26	6.6	3.1-6.1	50
BH/MW 3	November 24, 2022	569311	4848689	434.05	6.6	3.1-6.1	50
BH/MW 4	November 18, 2022	569583	4848323	427.61	6.6	3.1-6.1	50
BH/MW 5	November 24, 2022	569516	4848679	433.83	6.6	3.1-6.1	50
BH/MW 6	November 21, 2022	569575	4849180	443.49	5.0	1.6-4.6	50
BH/MW 7	November 23, 2022	569667	4848861	442.32	6.6	3.1-6.1	50

Well ID	Installation Date	UTM Coordinates		Ground	Borehole	Well Screen	Casing Dia.
BH/MW 8	November 23, 2022	569294	4848839	434.15	6.6	3.1-6.1	50
BH/MW 9	November 24, 2022	569738	4848573	437.71	4.7	1.6-4.6	50
BH/MW 10	November 25, 2022	569584	4848493	437.92	6.4	3.1-6.1	50
BH/MW 11	November 25, 2022	569862	4848478	435.49	6.6	3.1-6.1	50

Notes: mbgs -- metres below ground surface masl -- metres above sea level

3.2 Groundwater Monitoring

The groundwater levels in the monitoring wells were measured between December 1, 2022 and November 28, 2023, to record the fluctuation of the stabilized groundwater levels beneath the Subject Site, with details discussed in the section 6.3 of the report.

3.3 Mapping of Ontario Water Well Records

SEL received the Ministry of Environment, Conservation and Parks (MECP) Water Well Records (WWRs) for registered wells located on the Subject Site, and within 500 m of the site boundaries (study area). The records indicate that one hundred and forty (140) registered wells are located within the study area relative to the site boundaries. The well locations are shown on **Drawing No. 3**, and the WWRs reviewed for this study are listed in Appendix with a discussion for the review provided in Section 6.2.

3.4 Monitoring Well Development and Single Well Response Tests

Monitoring wells with sufficient groundwater volumes within them will undergo single well response tests (SWRT) to estimate the hydraulic conductivity (K) for saturated subsoil strata at the depths for the monitoring well screens. Monitoring well development involves of the purging and removal of several casing volumes of groundwater from each monitoring well to remove remnants of clay, silt and other debris introduced into the monitoring wells during construction, and to induce the flow of formation groundwater through the monitoring well

The test results from SWRTs will be used to estimate the hydraulic conductivity (K) for groundwater-bearing subsoil strata at the depths of the well screens. The K values estimated from the SWRTs provide an indication of the yield capacity for the groundwater-bearing subsoil strata, and can be used to estimate the flow of groundwater through the groundwater-bearing subsoil strata.

The SWRT involves the placement of a slug of known volume into the monitoring well, below the water table, to displace the groundwater level upward. The rate at which the groundwater level recovers to static conditions (falling head) is tracked using a data logger/ pressure transducer, and/or manually, using an electronic water level tape. The rate at which the groundwater table recovers to static conditions is used to estimate the K value for the groundwater-bearing subsoil strata formation

at the monitoring well screen depth interval. The results of the SWRTs will be presented in the final hydrogeological assessment report.

3.5 **Review Summary of Concurrent Report**

The following, concurrent geotechnical report, prepared by SEL was reviewed in preparation of this hydrogeological study:

"Preliminary Geotechnical Assessment for Proposed Residential Development, Reference No. 2206-S054, dated November 30, 2022.

4.0 REGIONAL AND LOCAL SETTING

4.1 Regional Geology

The Subject Site lies within the Physiographic Region of Southern Ontario known as the Hillsburgh Sandhills and is within a former spillway. The Hillsburgh sandhills are a natural boundary on the southeastern flank of the Dundalk till plain and cover an area of approximately 16,576 hectares. The region is characterised by rough topography, sandy materials and a flat-bottomed swampy valley intersection the moraine. Fine sand is the prevalent soil type. (Chapman and Putnam, 1984).

Review of the surface soil, geological map of Ontario shows that the Subject Site is located partially on the Glaciofluvial ice-contact deposits at the northwest portion and partially on the Glaciofluvial outwash deposits at the southeast portion. The Glaciofluvial ice-contact deposits consist of gravel and sand, minor till, includes esker, kame, end moraine, ice-marginal delta and subaqueous fan deposits. The Glaciofluvial outwash deposits consist of gravel and sand, includes proglacial river and deltaic deposits. **Drawing No. 4**, as reproduced from Ontario Geological Survey (OGS) mapping, illustrates the Quaternary surface soil geology for the Subject Site and surrounding area.

The bedrock underlying the site is comprised of the Middle and Lower Silurian Armabel Formation, which consists of sandstone, shale, dolostone and siltstone. Bedrock was not contacted at the bottom of the boreholes advanced beneath the site. The top of bedrock, beneath the site is at elevations ranging from approximately 408 to 420.5 masl. (www.oakridgeswater.ca).

4.2 Physical Topography

Based on review of the topographic map for the area, and from review of the ground surface elevations at the borehole and monitoring well locations, indicates that the Subject Site is generally descending towards Trafalgar Road. The total elevation relief across the Subject Site is about 15.0 m. **Drawing No. 5** shows the mapped topographical contours for the Subject Site and for the surrounding area.

4.3 Watershed Setting

The Subject Site is located within the Credit River Watershed. The Watershed covers an area of approximately 1,000 km^2 and extends from the Town of Orangeville in the north to the City of Mississauga and Lake Ontario in the south. The watershed covers an area west and northwest of the City of Toronto and includes portions of the Cities of Brampton, Mississauga and Oakville, some of the most densely populated regions in Canada. The main channel of the Credit River is 90 km long and is supported by over 1,500 km of tributary streams and creeks that are organized into 22 subwatersheds. The most significant physiographic feature in the Credit River Watershed is the north-south trending Niagara Escarpment. The Niagara Escarpment subdivides the watershed into

three generalized physiographic regions; the Upper Watershed (i.e. the area west of the Niagara Escarpment); the Niagara Escarpment (Middle); and the Lower Watershed (i.e. the area east of the Niagara Escarpment). The Oak Ridges Moraine, the Orangeville Moraine and the Paris Moraine are also significant physiographic and hydrogeologic features within the watershed.

Land use in the Credit Valley Watershed consists primarily of agricultural land (34%) and developed land (30%). The population within the watershed is expected to increase over the coming decades, with much of this growth taking place east of the Escarpment. There are some forest and plantation areas (16%), and aquatic and wetland areas (7%) that are generally located west of, and at the base of, the Escarpment. Groundwater within the Credit River Watershed is important for potable water supply for many residents and it is also a requirement for healthy ecosystems within the watershed. The groundwater system discharges to surface water features such as rivers and streams that support various coldwater and coolwater fish communities, and it also provides streamflow for wastewater assimilation during low streamflow periods. **Drawing No. 6** shows the location of the Subject Site within the Credit River Watershed.

4.4 Local Surface Water and Natural Features

A review of the Ministry of Natural Resource and Forestry (MNRF) database on January 16, 2024 indicates that records of wooded lots are located within the Subject Site. Additionally, two (2) records of wetland features are presented in the Subject Site. Record review indicates that wetland features are not evaluated as per Ontario Wetland Evaluation System (OWES).

Additionally, SEL was provided with Environmental Impact Study (EIS) report completed by Palmer, dated March 10, 2023 and a memorandum prepared by Palmer part of SLR, dated December 22, 2023. A review of the provided reports indicates that there is a record of pounded water, a marsh land and a drainage feature within the existing wooded area located approximately within the northwest portion of the Subject Site.

Records for wetland features evaluated as Provincially Significant Wetlands (PSW), known as West Credit River Wetland Complex, are located approximately 125 m, 200 m and 500 m to the south/southwest, east/northeast and northeast of the Subject Site, respectively. The above mentioned wetland features are associated with bodies of water. Record review indicates that records of watercourses are flowing around the Subject Site, with the closest record located approximately 125 m to the south/southwest of the Subject Site. The locations of the site and the noted natural features are shown on **Drawing No. 7**.

5.0 SOIL LITHOLOGY

The investigation has revealed that beneath the topsoil and ploughed soil at the ground surface, the Subject Site is underlain by predominantly sand and gravelly sand deposits. Sandy silt to silty sand till or silt deposits were generally contacted in the lower stratigraphy in some of the boreholes. A localized sandy silt deposit was contacted near the ground surface below the ploughed soil in Borehole 6. A Key Plan, and the interpreted geological cross-sections along the delineated northwest to southeast, and north to south transects across the Subject Site are presented on **Drawing Nos. 8-1** and **8-2**. **Figures 1-11** presents the borehole logs.

5.1 **Topsoil/Ploughed Soil** (All BH/MWs)

The thickness of the revealed topsoil is approximately 36cm with the ploughed soil extending to depths of 0.5 to 0.9 mbgs. The ploughed soil consists of dark brown sand with occasionally rootlets inclusions. The moisture contents for the retrieved soil samples range from 13.6 to 19.3%. High moisture contents are attributed to the topsoil and organic inclusions.

5.2 **Sand** (All BH/MWs except BH/MWs 6, 8 and 10)

Sand was contacted below the ploughed soil in all boreholes except BH/MWs 6, 8 and 10. It extends to depths ranging from 1.0 to 6.6 mbgs. The relative density varies from very loose to very dense, being generally compact. It is mostly fine to medium grained with occasional gravel inclusions. The moisture contents for the retrieved subsoil samples ranges from 4.2 to 11.4%, indicating moist to very moist conditions. The colour remains brown. Grain size analysis on one sample from BH/MW 7 at 4.8 mbgs indicates the estimated permeability is 10^{-3} m/sec, and the gradations are plotted on **Figure 12**.

5.3 **Gravelly Sand/Sandy Gravel** (All BH/MWs except BH/MWs 7 and 11)

Gravelly sand/sandy gravel deposits were encountered in the lower soil stratigraphy below the sand or sandy silt layer. The relative density varies from compact to very dense. The soil colour remains brown and occasionally cobbles and boulders are included. The moisture contents for the retrieved subsoil samples ranges from 2.6 to 12.4%, indicating damp to saturated conditions. The saturated samples were found at lower depth generally 5 mbgs. Grain size analysis on one sample from BH/MW 1 at 3.3 mbgs indicates the estimated permeability is 10^{-3} m/sec and the gradations are plotted on **Figure 13**.

5.4 **Silty Sand Till/Sandy Silt Till** (BH/MWs 4 and 5)

Silty sand to sandy silt till deposit was contacted locally at the bottom of BH/MWs 4 and 5 below gravel sand deposit. The relative density is dense to very dense. It contains some gravel, a trace of

clay and occasionally cobbles and boulders. The silty sand till becomes grey at 4.5 mbgs in BH/MWs 4. Grain size analyses were performed on one (1) subsoil samples, and the gradations are plotted on **Figure 14**.

5.5 **Sandy Silt/Silt** (BH/MWs 6, 8 and 11)

A layer of sandy silt was encountered in the upper zone of BH/MW 6, extending to a depth of 2.2m. Silt deposit was found at the bottom of BH/MWs 8 and 11. The sandy silt is compact, moist and remains brown. The silt is dense to very dense and becomes grey at 6.4 mbgs in BH/MW 11.

6.0 GROUNDWATER STUDY

6.1 Review Summary of Concurrent Report

A review of the findings from the concurrent geotechnical soil investigation report (SEL Reference No. 2206-S054) has disclosed that beneath a layer of topsoil/ploughed soil, the Subject Site is underlain by predominantly sand and gravelly sand deposits. Sandy silt to silty sand sill or silt was contacted in the lower stratigraphy in some of the boreholes. A local sandy silt deposit was encountered near the ground surface below the ploughed soil in BH/MW 6.

6.2 Review of Ontario Water Well Records

The Ministry of the Environment, Conservation and Parks (MECP) water well records for the Subject Site, and for the properties within a 500 m radius of the boundaries of the Subject Site (study area) were reviewed.

The records indicate that one hundred and forty (140) well records are located within the study area relative to the site boundaries. The locations of these well records, based on the UTM coordinates provided by the records, are shown on **Drawing No. 3**. Details of the MECP water well records that were reviewed are provided in Appendix.

A review of the final status and of the well records within the study area reveals that ninety-six (96) are registered as water supply wells, two (2) are registered as test hole wells, one (1) is registered as having other status, ten (10) are registered as observation wells, three (3) are registered as monitoring and test hole wells, two (2) are registered as abandoned-supply wells, twenty-one (21) are registered as abandoned-other wells, and five (5) wells are registered as having unknown statuses.

A review of the first use of the well records reveals that five (5) are registered as test hole wells, seven (7) are registered as public wells, six (6) are registered as not used, one (1) is registered as a municipal well, eight (8) are registered as monitoring wells, one (1) is registered as a livestock well, eighty-two (82) are registered as domestic wells, two (2) are registered as commercial wells, and twenty-eight (28) wells are registered as having unknown statuses. Details are presented in **Appendix A**.

Should there be any water supply wells discovered during the site grading operations, we recommend that they be properly decommissioned in accordance with the Ontario Water resources Act, Regulation 903.

6.3 Groundwater Monitoring

The groundwater levels in the monitoring wells were measured, manually and monthly basis from

December 1, 2022 to November 28, 2023. A review of the findings indicates that the highest and lowest groundwater levels were measured at El. 441.98 masl and 423.06 masl in BH/MWs 6 and 4 on April 21, 2023 and July 28, 2023, respectively. Additionally, BH/MW 10 remained dry over the monitoring period. Details of the groundwater monitoring data are presented in **Appendix B**.

6.4 Shallow Groundwater Flow Pattern

The shallow groundwater flow pattern beneath the Subject Site were interpreted from the highest groundwater level measurements, recorded at all of the BH/MWs locations on May 25, 2023. The groundwater levels for wells which were reported being dry, were interpreted to be at the bottom elevation of the monitoring well. The measured groundwater levels at the BH/MWs records indicate that it is interpreted to flow in a southwesterly direction, away from interpreted, localized higher groundwater areas. Shallow groundwater is interpreted to flow in the direction of the tributary for Credit River that is located southwest of the Subject Site. The interpreted shallow groundwater flow pattern for the Subject Site area is illustrated on **Drawing No. 9**.

6.5 Single Well Response Test Analysis

BH/MWs 4, 6 and 11 underwent single well response tests (SWRTs) to assess the hydraulic conductivity (K) for saturated subsoil strata at the depths for the monitoring well screens. The SWRT could not be performed on BH/MW 2 as the groundwater levels were consistently below the depths of the monitoring well during every monitoring event performed over the initial study period. Furthermore, the SWRT could not be performed on BH/MWs 1, 3, 5, 7, 8, 9 and 10 due to insufficient groundwater volume within the monitoring wells. The results of the SWRTs are presented in Appendix 'B', with a summary of the findings shown in **Table 6-1**.

Table 6-1 - Summary of SWRT Results

Well ID	Ground El. (masl)	Monitoring Well Depth (mbgs)	Borehole Depth (mbgs)	Screen Interval (mbgs)	Screen Sub-Soil Strata	Hydraulic Conductivity (K) (m/sec)
BH/MW 4	427.61	6.1	6.4	30.-6.1	Gravelly Sand	5.2×10^{-7}
BH/MW 6	443.49	4.6	5.0	1.5-4.6	Sandy Gravel	5.7×10^{-7}
BH/MW 11	435.49	6.1	6.6	3.0-6.1	Silt and Sand	3.6×10^{-6}

Notes: mbgs -- metres below ground surface masl -- metres above sea level

As shown in **Table 6-1**, the estimated K for the underlying sub-soils for gravelly sand/sandy gravel unit ranges from 5.2×10^{-7} to 5.7×10^{-7} m/s, and the K estimate for the silt and sand unit is 3.6×10^{-6} m/s. The results for the SWRT provide an indication of the yield capacity for the shallow groundwater-bearing sub-soil strata at the depths of the monitoring well screens. The above results suggest that the hydraulic conductivity for the groundwater-bearing subsoils at the depths of the well screens is low to moderate, with corresponding low to moderate groundwater seepage rates being anticipated into open excavations, below the shallow groundwater table. Details are presented in **Appendix C**.

6.6 Assessment of Hydraulic Conductivity Based on the Hazen Equation

The Hazen Equation method was adopted to estimate the hydraulic conductivity (K) for different subsoil layers which may contain groundwater during the seasonal high-water period.

The Hazen equation relies on the interrelationship between hydraulic conductivity and effective grain size, d_{10}, in the soil media. This empirical relation predicts a power-law relation with K, as follows:

$$K = Ad_{10}^2$$

where;

d_{10}: Value of the soil grain size gradation curve as determined by sieve analysis whereby 10% by weight of the soil particles are finer and 90% by weight of the soil particles are coarser.

A: Coefficient; it is equal to 1 when K in cm/sec and d_{10} is in mm

The Hazen Equation K estimation method provides an indication for the yield capacity for groundwater-bearing subsoil strata at the depths where the soil samples that underwent grain size analyses were collected. The calculated results indicate that the K estimate for the sub-soil units beneath the Subject Site ranges from 1.22×10^{-7} to 5.63×10^{-7} m/sec. The results of the Hazen method, determined K estimates are provided in **Table 6-2** below. The K estimates determined from the Hazen Method suggests moderate hydraulic conductivity (K) estimates for the groundwater bearing sub-soil layers beneath the Subject Site.

Table 6-2 - Summary of Hazen Equation K Estimates

Well ID	Sample Depth (mbgs)	Sample El. (masl)	Description of Soil Strata	D_{10} (mm)	Hydraulic Conductivity (K) (m/sec)
BH/MW 1	5.0	434.60	Silty Sand Till, some gravel to gravelly and a trace of clay	0.0075	5.63×10^{-7}
BH/MW 5	6.3	427.5	Sandy Silt Till, traces of gravel and clay	0.0035	1.22×10^{-7}

Notes:
mbgs -- metres below ground surface
masl -- metres above sea level

7.0 GROUNDWATER CONTROL DURING CONSTRUCTION

The estimated hydraulic conductivity (K) for the screened subsoil strata comprised mainly of sand, gravelly sand/sandy gravel, silty sand to sandy silt till, sandy silt and silt, suggests that the groundwater seepage rates into open excavations below the groundwater table will be moderate. To provide safe, dry and stable subsoil conditions for proposed earthworks and excavations, for construction of the proposed stormwater management, underground housing foundation structures and for the associated underground services, the groundwater table may need to be lowered in advance of, or during construction, in which temporary limited groundwater control may be required. The preliminary estimates for construction dewatering flows required to locally lower the groundwater table, based on the K test estimates, are discussed in the following sections.

7.1 Groundwater Construction Dewatering Rates

Functional servicing plans (drawing nos. FS-01 and FS-02) and Functional Erosion & Sediment Control Plans (drawing nos. FSC-01 and FSC-02), prepared by Urbanworks Engineering Corporation, dated Dec. 19, 2023 were reviewed for the current assessment. Plan review indicates that the proposed development at the Subject Site includes construction of residential houses, 3-storey senior apartment and associated at grade parking lot, low rise senior houses, 2 stormwater management pounds, underground services and roads.

Considering available information from subsurface investigation (soil and groundwater level), existing topography of the Subject Site, and elevations provided in the reviewed drawings, potential needs for short-term dewatering was calculated. The entire Subject Site, where the details were available, was divided into nine (9) dewatering areas and dewatering needs were assessed for each area. Dewatering calculations are presented in **Appendix C**. **Drawing No. 10** presents the dewatering areas. Details for construction of proposed 3-storey senior apartment and associated at grade parking lot, low rise senior houses are not available at the time of preparation of the current report. As such, potential dewatering needs were not assessed for the above noted portions. The following sections presents the methodology and dewatering needs assessment:

Methodology - Groundwater Flow Rate Estimate: The pumping rate calculation for the construction for the proposed development was performed based on the assumption with each excavation acting as trench considering the dimensions of the proposed excavation boxes. The calculation was based on the equations provided by Powers et al. (2007). For the purposes of this analysis, steady state flow into an open excavation is assumed. Additionally, the equations of radial flow have the following assumptions:

- Ideal aquifer conditions (homogeneous, isotropic, uniform thickness and has infinite areal extent)
- Fully penetrating pumping well
- Only lateral flow to the pumping well

The following equations were used for open trenches and is based on unconfined aquifer conditions (Powers et. al., 2007).

$$Q = \frac{\pi K (H^2 - h^2)}{\ln(R_0 / r_s)} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

Where:

Q = Anticipated pumping Rate (m3/day)
K = Hydraulic Conductivity (m/day)
H = Distance from the static water level to the bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)

R_o = Distance from a point of greatest drawdown to a point where there is zero drawdown (radius of influence) (m)
r_s = Distance to the wellpoints from the centre of the trench, assumed to be half of the trench width (m) for Trench base calculation and Radius of Excavation for Single Well Equation.
X = Trench Length (m)
L = Distance from a line source to the trench, Ro (m)/2

The calculated pumping rate was multiplied by a factor of safety of 1.5 to account for uncertainties and natural variability in the range of hydraulic conductivity. The dewatering calculations can be found in **Appendix VII**.

An estimate of the Zone of Influence (ZOI) for dewatering in unconfined aquifers can be calculated using the following equation (Bear, 1979):

$$R_0 = 2.45\sqrt{\frac{HK}{S_y}}t$$

where,

R_o = Zone of Influence (m), beyond which there is negligible drawdown
H = Distance from initial static water level to bottom of saturated aquifer (m)
Sy = Specific yield of the aquifer formation
t = Time, in seconds, required to draw the static groundwater level to the desired level (assumed to be equivalent to 14 days)
K = Hydraulic Conductivity (m/s)

Assumptions: Following groundwater flow rates were estimated assuming a geomean hydraulic conductivity of 1.02 x 10^{-6} m/sec. estimated in the monitoring wells within the sandy gravel, gravelly sand and, sand and silt units.

Following assumptions were considered to estimate short-term dewatering needs:

- Lowering groundwater level 1.0 m below the proposed/assumed base of excavation/invert elevation.
- Additional 1.0 m was considered as a thickness of the liner for proposed SWMPs.

- To estimate the invert elevations of the proposed sewer alignment using the provided obvert elevations, 0.3 m was assumed as the diameter of the pipes.
- Basement slabs were assumed 3.0 m below the approximate proposed grading level.

Short-Term Dewatering-Dewatering Area 1: The highest groundwater level measured in BH/MW2 was considered to assess the potential groundwater control for excavation and construction of the proposed houses and installation of the proposed underground sewer system. A review of the above mentioned plans indicates that obvert elevation for the proposed deepest manholes and sewer alignments are located above shallow groundwater level 430.25 masl (measured at BH/MW2). Assuming 0.3 m as a diameter of the sewer alignment, proposed invert elevations are still located above the highest measured groundwater table. As such, groundwater seepage is not anticipated for Dewatering Area 1. However, potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. As such, potential collected water considering an open active trench with dimensions of 50 m x 2.0 m; and an open excavation box for construction of the basements with dimensions of 8.0 X 30.0 m reaches 3,000.0 L/day and 7,200.0 L/day, respectively. **Table 7-1** presents the details:

Table 7-1 - Dewatering needs for Dewatering Area 1

Dewatering Item	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
Underground service (50 x 2 m)	0.0	3,000.0	3,000.0
Lot Basement (30 x 8 m)	0.0	7,200.0	7,200.0

*S,F. Safety Factor

Since the excavation and construction in the Dewatering Area 1, will be completed above shallow groundwater level, Zone of Influence (ZoI) for dewatering is not anticipated.

Short-Term Dewatering-Dewatering Area 2: The highest groundwater level measured in BH/MW3 was considered to assess the potential needs for groundwater control for excavation and construction of the proposed houses, installation of the proposed underground sewer system and construction of the SWMP 1. Plan review indicates that proposed SWMP1 is located below shallow groundwater level 428.81 masl (measured at BH/MW3). Additionally, potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. **Table 7-2** presents the details:

Table 7-2- Dewatering needs for Dewatering Area 2

Dewatering Item	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
Proposed MHs (2.0 x 50.0 m)	0.0	3,000.0	3,000.0
Lot Basements (30 x 8 m)-Per Lot	0.0	7,200.0	7,200.0
SWMP 1 (100 x 168 m)	35,000.0	504,000.0	539,000.0

*S,F. Safety Factor

The maximum ZoI for dewatering in Dewatering Area 2 reaches 9.0 m away from dewatering area for construction od the proposed SWM pond.

Short-Term Dewatering-Dewatering Area 3: The highest groundwater level measured in BH/MW1 was considered to assess the potential needs for groundwater control for excavation and construction of the proposed houses, and installation of the proposed underground sewer system. Plan review indicates that the proposed deepest manholes and sewer alignments are located below shallow groundwater level 435.79 masl (measured at BH/MW1). Proposed basements for the lots are also partially located below shallow groundwater table. As such, groundwater seepage is anticipated. Additionally, potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. **Table 7-3** presents the details:

Table 7-3- Dewatering needs for Dewatering Area 3

Dewatering Item	Invert El. (Base of Excavation) (masl)	The Highest Groundwater Level (masl)	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
MH.11A-MH.26A (Length: 270 m)	432.53	435.79	226,000.0	16,200	242,200.0
MH.26A-MH.44A (Length: 135)	431.52	435.79	159,000.0	8,100	167,100.0
MH.26A-MH.40A (Length: 80 m)	434.45	435.79	30,000.0	4,800.0	34,800.0
MH.28A-MH.7A (Length 135 m)	431.09	435.79	178,000.0	8,100.0	186,100.0
MH.25A-MH.8A (135 m)	430.82	435.79	191,000.0	8,100.0	199,100
Lots (8.0 x 30)	433.82	435.79	23,000.0	7,200	30,200.0

*S,F. Safety Factor

Assuming an open and active dewatering trench with a length of 50 m, anticipated groundwater seepage with a safety factor of 1.5, and storm event reach 42,000.0 L/day and 3,000.0 L/day for MH.11A-MH.26A; 59,000.0 L/day and 3,000.0 L/day for MH.26A-MH.44A, 66,000 L/day and 3,000.0 L/day for MH.28A-MH.7A, and 70,000.0 L/day and 3,000.0 L/day for MH.25A-MH.8A respectively.

The maximum ZoI for dewatering in Dewatering Area 3 reaches 15.2 m away from dewatering area for construction od the proposed underground services.

Short-Term Dewatering-Dewatering Area 4: The highest groundwater level measured in BH/MW6 was considered to assess the potential needs for groundwater control for excavation and construction of the proposed houses, and installation of the proposed underground sewer system. A review of the provided plans indicates that the proposed deepest manholes and sewer alignments are located below shallow groundwater level 441.98 masl (measured at BH/MW6). Additionally proposed basements for the lots are partially located below shallow groundwater table. Additionally, potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. **Table 7-4** presents the details:

Table 7-4- Dewatering needs for Dewatering Area 4

Dewatering Item	Invert El. (Base of Excavation) (masl)	The Highest Groundwater Level (masl)	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
MH.33A-MH.37A (Length: 90 m)	437.36	441.98	103,000.0	5,400.0	108,400.0
MH.37A-MH.35A (Length: 85)	4.37.36	441.98	98,000.0	5,100.0	103,100.0
MH.37A-MH.40A (Length: 80 m)	435.68	441.98	318,000.0	4,800.0	322,800.0
Lots (8.0 x 30)	441.67 – 436.94	441.98	4,000.0 – 65,000.0	7,200.0	11,200.0 – 72,200.0

*S,F. Safety Factor

The maximum ZoI for dewatering in Dewatering Area 4 reaches 15.9 m away from dewatering area for construction od the proposed underground services.

Short-Term Dewatering-Dewatering Area 5: The highest groundwater level measured in BH/MW7 was considered to assess the potential needs for groundwater control for excavation and construction and installation of the proposed underground sewer system. Plan review indicates that obvert elevation for the proposed deepest manholes and sewer alignments are partially located below shallow groundwater level 436.23 masl (measured at BH/MW7). Proposed basements for the lots are located above shallow groundwater table.

Potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. **Table 7-5** presents the details:

Table 7-5- Dewatering needs for Dewatering Area 5

Dewatering Item	Invert El. (Base of Excavation) (masl)	The Highest Groundwater Level (masl)	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
MH.40A-MH.41A (67 m length below groundwater level)	434.0	436.23	103,000.0	9,000.0	112,000.0
Lot Basements (30 x 8 m)-Per Lot	Above shallow groundwater level	436.23	0.0	7,200.0	7,200.0

*S,F. Safety Factor

The maximum ZoI for dewatering in Dewatering Area 5 reaches 12.6 m away from dewatering array for installation of proposed underground services.

Short-Term Dewatering-Dewatering Area 6: The highest groundwater level measured in BH/MW5 was considered to assess the potential needs for groundwater control for excavation and construction of the proposed houses and installation of the proposed underground sewer system. A review of the plans indicates that obvert elevation for the proposed deepest manholes and sewer alignments and lot basements are located above shallow groundwater level 431.64 masl (measured at BH/MW5). Potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. **Table 7-6**

presents the details:

Table 7-6- Dewatering needs for Dewatering Area 6

Dewatering Item	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
Underground service (50 x 2 m)	0.0	3,000.0	3,000.0
Lot Basement (30 x 8 m)	0.0	7,200.0	7,200.0

*S,F. Safety Factor

Since the excavation and construction in the Dewatering Area 6, will be completed above shallow groundwater level, Zone of Influence (ZoI) for dewatering is not anticipated.

Short-Term Dewatering-Dewatering Area 7: The highest groundwater level measured in BH/MW9 was considered to assess the potential needs for groundwater control for excavation and construction of the proposed houses and installation of the proposed underground sewer system. Plan review indicates that obvert elevation for the proposed deepest manholes and sewer alignments are partially located below shallow groundwater level 433.83 masl (measured at BH/MW9). Proposed basements for the lots are located above shallow groundwater table.

Potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. **Table 7-7** presents the details:

Table 7-7- Dewatering needs for Dewatering Area 7

Dewatering Item	Invert El. (Base of Excavation) (masl)	The Highest Groundwater Level (masl)	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
MH.62A-MH.68A (80 m length)	431.44	433.83	51,000.0	4,800.0	55,800.0
MH.67A-MH.68A (80 m length)	431.44	433.83	51,000.0	4,800.0	55,800.0
Lot Basements (30 x 8 m)-Per Lot	Above shallow groundwater level	433.83	0.0	7,200.0	7,200.0

*S,F. Safety Factor

The maximum ZoI for dewatering in Dewatering Area 7 reaches 11.3 m away from dewatering array for installation of proposed underground services.

Short-Term Dewatering-Dewatering Area 8: The highest groundwater level measured in BH/MW11 was considered to assess the potential needs for groundwater control for excavation and construction of the proposed houses and installation of the proposed underground sewer system. A review of the provided plans indicates that obvert elevation for the proposed deepest manholes and sewer alignments are partially located below shallow groundwater level 432.72 masl (measured at BH/MW11). Proposed basements for the lots are also partially located above shallow groundwater table.

Potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. **Table 7-8** presents the details:

Table 7-8- Dewatering needs for Dewatering Area 8

Dewatering Item	Invert El. (Base of Excavation) (masl)	The Highest Groundwater Level (masl)	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
MH.88A-MH.89A (70 m length)	451.23	432.72	26,000.0	4,200.0	30,200.0
MH.89A-MH.95A (140 m length)	430.31	432.72	80,000.0	8,400.0	88,400.0
Lot Basements (30 x 8 m)-Per Lot	431.75	432.72	Up to 11,000.0	7,200.0	18,200.0

*S,F. Safety Factor

Assuming an open and active dewatering trench with a length of 50 m, anticipated groundwater seepage with a safety factor of 1.5, and storm event reach 28,600.0 L/day and 3,000.0 L/day for MH89A-MH95A.

The maximum ZoI for dewatering in Dewatering Area 8 reaches 11.2 m away from dewatering array for installation of proposed underground services.

Short-Term Dewatering-Dewatering Area 9: The highest groundwater level measured in BH/MW4 was considered to assess the potential needs for groundwater control for excavation and construction of the proposed houses, installation of the proposed underground sewer system and construction of the SWMP 1. Plan review indicates that invert elevation for proposed SWMP2 is located below shallow groundwater level 424.14 masl (measured at BH/MW4). Potential collected water during storm event should be managed. 31 mm rainfall depth considering 2-year storm event over a 3-hour period per day is considered for the current assessment. **Table 7-9** presents the details:

Table 7-9- Dewatering needs for Dewatering Area 9

Dewatering Item	Invert El. (Base of Excavation) (masl)	The Highest Groundwater Level (masl)	Groundwater Seepage (S.F. 1.5)* (L/day)	Storm Event (L/day)	Total Dewatering Flow (L/day)
MH.19A-MH.MH-19 (215 m)	423.08	424.14	125,000.0	12,500.0	137,500.0
Lot Basements (30 x 8 m)-Per Lot	430.45	424.14	0.0	7,200.0	7,200.0
SWMP 2 (100 x 160 m)	426.5	424.14	0.0	480,000.0	480,000.0

*S,F. Safety Factor

Assuming an open and active dewatering trench with a length of 50 m, anticipated groundwater seepage with a safety factor of 1.5, and storm event reach 29,000.0 L/day and 3,000.0 L/day for MH.91A-MH.H.MH19, respectively.

The maximum ZoI for dewatering in Dewatering Area 2 reaches 14.5 m away from dewatering array for construction of proposed underground services.

7.2 **Permit Requirements**

Proposed construction details are not available for review at the time of preparation of the current report. However, the anticipated short-term dewatering flow rate considering an active excavation

trench with a length of 50.0 m, indicates that the anticipated groundwater seepage will remain below upper MECP EASR threshold of 400,000.0 L/day. Additionally, anticipated groundwater seepage for construction of the proposed SWMPs reaches up to 310,000.0 L/day considering a safety factor of 1.5, which is below upper MECP EASR threshold of 400,000.0 L/day. As such, filing an EASR with MECP is required. Applying for PTTW with MECP is not required if the excavation and construction completed over phases.

7.3 **Potential Dewatering Impacts and Mitigation Plan**

Short-Term Discharge Water Quality: The dewatering system must be appropriately filtered in order to prevent the pumping of fines during the dewatering activities.

Groundwater quality should be assessed in advance of construction, compared to the applicable sewer use by-law.

Ground Settlement: The maximum conceptual ZOI for dewatering reaches 15.9 m away from the dewatering area. Proposed residential properties located along the southwest limit of the Subject Site, might be located within the conceptual ZoI for dewatering. It is recommended a professional geotechnical engineer is consulted in advance of excavation and construction.

Surface Water, Wetlands and Areas of Natural Significance: Record review indicates that a records of wooded lots and wetland feature are located within the northwest portion of the Subject Site. A review of the provided EIS report confirms that there is a record of pounded water, a marsh land and a drainage feature within the existing wooded area that is located in the northwest portion of the Subject Site.

The above mentioned natural features are located adjacent to Dewatering Areas 1, 3 and 4. Proposed lots' basements and the underground services within Dewatering Area 1 will be excavated and constructed above shallow groundwater table. However, short-term dewatering is expected for Dewatering Areas 3 and 4. A review of the conceptual ZoI for dewatering indicates that the anticipated ZoI reaches 15.2 and 15.9 m away from dewatering area for Dewatering Areas 3 and 4, respectively. A review of the interpreted shallow groundwater flow pattern indicates that shallow groundwater flows southwesterly direction, towards a tributary of the Credit River. As such, significant impacts with respect to dewatering is not anticipated to the natural features located within the Subject Site.

Available data from local investigation, regional topography map for the Subject Site and its vicinity as well as interpreted shallow groundwater flow pattern were reviewed to understand the connection between groundwater beneath the Subject Site and the nearby tributary. A review of the findings indicates that a portion of the tributary of Credit River, located along the west/northwest boundary of the Subject Site, is not located within the downgradient of the Subject Site (the nearest point). Additionally, considering the available data, it cannot be confirmed that tributary is being recharged by groundwater adjacent to the Subject Site. Furthermore, a review of the groundwater flow pattern indicates that groundwater flows in a southwesterly direction.

A portion of the tributary of Credit River and associated wetland features (PSW) and wooded lots are located along the southwest boundary of the Subject Site. Considering conceptual ZoI for dewatering, nearby natural features are located outside of the ZoI for dewatering. Additionally, significant dewatering is not expected as most of the proposed development will be constructed above shallow groundwater table. As such, significant impacts with respect to dewatering is not anticipated to the natural features located outside of the Subject Site.

Water Supply Wells and Zone of Influence: A review of the MECP well records confirmed that there are records for water supply wells that are registered within 500 m of the Subject Site. The water supply well monitoring program is on-going for the residents that has given pression to SEL for well monitoring program. Record review indicates that the water supply wells were installed between 1954 and 2016. Since all of the wells are in the deeper aquafer, as such significant impacts to the water supply records are not expected.

8.0 DRINKING WATER THREAT DISCLOSURE REPORT AND MANAGEMENT PLAN

It is understood that a municipal water supply well is proposed in a property located adjacent to the northwest boundary of the Subject Site. As such, a drinking water threat disclosure report and mitigation plan is required for the Subject Site.

SEL contacted Wellington Source Protection Office with respect to the details of the proposed municipal water supply well as well as the required report to address the potential impact of the proposed development to the proposed water supply well. Following sections presents the findings and the mitigation plan.

Below listed documents were reviewed for preparation of the current report:

- Appendix C: Guidance Documents, provided by Wellington Source Water Protection;
- Appendix A: CTC Policies; and,
- Memorandum provided by Wellington Source Water Protection, dated July 20, 2023.

8.1 Identification or Disclosure of Drinking Water Threat

A review of the memorandum dated July 20, 2023 indicates that the Subject Site is partially located within Wellhead Protection Area A (WHPA-A) for the proposed municipal water supply well. WHPA-A represents an area located within a radius of 100 m from the municipal well. Details of the proposed water supply well and the plans showing the extension of the WHPA-B, WHPA-C and WHPA-D are not available for review at the time of preparation of the current report. However, it is anticipated that potions of the Subject Site will locate within the above mentioned WHPAs, where the travel time ranges between 2 to 25 years. A review of the memorandum indicates that the anticipated vulnerability scores will range between 2 (low) and up to 10 (high).

Additionally, the reviewed memorandum states that the Subject Site is located within designated areas known as Significant Groundwater Recharge Area (SGRA) and a Highly Vulnerable Aquifer (HVA).

Following activities or developments within the designated WHPAs are considered drinking water threat:

- Considering the vulnerability score of 10 for WHPA-A and WHPA-B, operation or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage including sanitary sewers and pipes (Policy SWG-13 and SWG-14) is considered a significant Drinking Water Threat.

- Stormwater Management facilities (SWMF), their discharge, including infiltration and ponds are prohibited in the future WHPA-A (SWG-11 and SWG-12).

- Handling or storage of the chemicals of concern, apart from salt, (SAL-10)

8.2 **Proposed Management Program**

Considering the identified drinking water threats, following approaches are recommended to mitigate potential impact of the proposed development within the above noted policy area:

Sanitary Sewer: Proposing the sanitary sewers and associated infrastructure within the designated area with vulnerability score 10 is prohibited. Where sanitary sewers and related pipes are proposed in an area where the activity is, or would be, a significant drinking water threat, the Environmental Compliance Approval that governs the activity shall be reviewed or established to ensure appropriate terms and conditions are included so that the activity ceases to be, or does not become, a significant drinking water threat. High construction standards should be proposed to design the sanitary system and the sanitary system should be inspected and monitored for any potential spill (SWG13 and SWG-14).

SWMF: Discharge, including infiltration, from a stormwater management facility shall be prohibited into an area where the discharge would be a significant drinking water threat (WHPA-A) (SWG-11). A review of the Functional servicing plans (drawing nos. FS-01 and FS-02) and Functional Erosion & Sediment Control Plans (drawing nos. FSC-01 and FSC-02), prepared by Urbanworks Engineering Corporation, dated Dec. 19, 2023 indicates that SWMF are not proposed within WHPA-A. As such, significant concerns and impacts to the proposed water supply well are not anticipated with respect to the SWMF for the proposed development. Additionally, since infiltration facilities are not proposed within the designated area, significant concerns are not anticipated with respect to the location of this potion of the Subject Site within the SGRA and HVA.

Road Salt: Road salt would be a moderate to low drinking water threat. As such, a salt management plan should be proposed for the portions of the proposed development located within the policy areas. Following sections presents the risk management and associated mitigation plans:

- *Risk Management Plan:* In order to prepare risk management and mitigation plan and to conduct a risk management analysis, the Toronto Region Conservation Authority's (TRCA) Risk Management Measures Catalogue for applying, handling and storage of road salt was reviewed (http://www.trcagauging.ca/RmmCatalogue/QualityThreat.aspx). Findings of the review are summarized as below:
    - Optimizing road salt application efficiency: This measure reduces the negative environmental impacts of salt applications by delivering the correct amount of road salt at the right place and at the right time.
    - Implementing road design that minimizes salt application, de-icing, and snow storage requirements: An increase in the roadway and bridge designers' awareness of techniques, configurations, and design parameters will reduce the amount of snow and ice accumulation, which can lead to reduced salt application.

The threat associated with the application of road salt can be managed through optimization of road salt application efficiency. This could be accomplished by retaining a contractor who is certified by Smart About Salt® and trained in the practices identified in the Transportation Association of Canada (TAC) Synthesis of Best Management Practices for Road Salt Management (TAC, 2013). Practices of road salt management to be considered so as to reduce the amount of salt needed and minimize associated groundwater and surface water impacts include (TAC, 2013):

- The 4 R's of snow and ice control:
    1. Right Material: the right material will depend on the conditions being treated. In situations where the pavement temperature is extremely cold, chemicals with lower working temperatures and sand/salt mixtures may be warranted.
    2. Right Amount: The right amount of material is dependent upon the type of slippery condition being treated, the amount of residual chemical on the pavement surface, the expected pavement temperature and the amount of precipitation that is expected.
    3. Right Place: Placement of materials is important to keeping it in the right place to be effective rather than wasted to the environment. Proper material placement requires the right equipment and skilled operators.
    4. Right Timing: The timing of salt placement is important to minimizing waste and maximizing chemical effectiveness. There are times when the pavement temperature is, and is expected to remain, above freezing and therefore may not warrant salt application. Proactive anti-icing is key to achieving safer conditions quickly with less salt.

To reduce the application of road salt following approaches are recommended:

- The mechanical removal of snow from the treatment area prior to the application of a freeze point depressant (e.g., salt) to minimize the amount of material needed, and the potential for dilution and re-freeze.
- The application of freeze point depressants after plowing only when pavement temperatures are below freezing and the remaining snow/ice that could not be removed by mechanical means presents a hazard.
- The use of liquid rather than solid salt in the right conditions to speed up the melting process.
- The understanding that salt should not be used to promote rapid melting of stockpiled snow.
- Application of a Road Salt Alternative – Calcium Magnesium Acetate: Calcium Magnesium Acetate has a low environmental impact but can contribute to biochemical oxygen demand (BOD). It also has a high purchase cost relative to NaCl. In addition, Potassium Acetate (KA) is often used as a base for commercial chloride-free liquid de-icer formulations as a road salt alternative, having low corrosion, relatively high

performance, and a low environmental impact. The above risk management and risk mitigation measures should be considered for the proposed development.

- *Monitoring and Mitigation Plan*: As mentioned previously, the risk associated with the application of road salt was determined to be moderate to low. The local surficial soil beneath the Subject Site is primarily comprised of sand. However, the ground surface, where the salt will be applied, is expected to have an asphalt or paved. As such, it was determined that there is no significant downward pathway into the underlying municipal aquifer.

Considering all above and the proposed development scheme consisting of residential development that will be privately owned, local roads, walkways and driveways, it is recommended the winter maintenance for the neighbourhood is mainly comprises mechanical removal of snow, where the application of road salt will be limited. Considering the above approach and extending to the entire Subject Site will minimize the potential impact of road salt to groundwater with respect to the location of the Subject Site within the SGRA and HVA.

9.0 CONCLUSIONS

2. The Subject Site lies within the Physiographic Region of Southern Ontario known as the Hillsburgh Sandhills and is within a former spillway.
3. Based on review of the surface geological map of Ontario, the Subject Site is underlain by the Glaciofluvial ice-contact deposits at the northwest portion and the Glaciofluvial outwash deposits within the southeast portion. The Glaciofluvial ice-contact deposits consist of gravel and sand, includes esker, kame, end moraine, ice-marginal delta and subaqueous fan deposits. The Glaciofluvial outwash deposits consist of gravel and sand, includes also proglacial river and deltaic deposits.
4. The Subject Site is located within the Credit River Watershed.
5. A review of the topography map for the area, and from review of the ground surface elevations at the borehole and monitoring well locations, indicates that the Subject Site is generally descending to the southwest, towards Trafalgar Road.
6. The findings from the current study reveal that beneath the topsoil and ploughed soil horizons, beneath the ground surface, the Subject Site is underlain, predominantly by sand and gravelly sand deposits. Sandy silt to silty sand till or silt deposits were generally contacted in the lower stratigraphy in some of the boreholes. A localized sandy silt deposit was contacted near the ground surface below the ploughed soil in Borehole 6.
7. The findings of this study confirm that the highest and lowest groundwater levels were measured at El. 441.98 masl and 423.06 masl in BH/MWs 6 and 4 on April 21, 2023 and July 28, 2023, respectively. Additionally, BH/MW 10 remained dry over the monitoring period.
8. The monitoring wells with sufficient groundwater volumes within them underwent single well response tests (SWRTs) to estimate the hydraulic conductivity at the depths for the monitoring well screens. The results for the SWRT's will be presented in the final hydrogeological assessment report. The single well response tests yielded hydraulic conductivity (K estimate) for the underlying sub-soils for gravelly sand/sandy gravel unit ranges from 5.2×10^{-7} to 5.7×10^{-7} m/s, and the K estimate for the silt and sand unit is 3.6×10^{-6} m/s. The results of the SWRT provide an indication of the yield capacity for the groundwater-bearing subsoil strata at the depths of the monitoring well screens. The above results suggest that the K estimate for the groundwater-bearing subsoils at the depths of the well screen is low to moderate with corresponding low to moderate anticipated groundwater seepage rates into open excavations, below the groundwater table.
9. Hazen Equation calculated permeability results indicate that the K estimate for the sub-soil units beneath the Subject Site ranges from 5.63×10^{-7} to 1.22×10^{-7} m/sec. The results of the SWRT provide an indication of the yield capacity for the groundwater- bearing subsoil strata primarily above the depths of the monitoring wells screens. The above result suggests that the K estimate for the groundwater-bearing subsoils ranges from low to high with corresponding moderate anticipated groundwater seepage rates into open excavations, below the groundwater table.

10. The measured groundwater levels at the BH/MWs indicate that shallow groundwater is interpreted to be flowing in southwesterly directions, away from interpreted, localized groundwater high areas, located beneath the northwestern and eastern portions of the Subject Site. Shallow groundwater is interpreted to flow in the direction of the tributary for Credit River that is located southwest of the Subject Site.

11. Short-term dewatering control is anticipated for the proposed development at the Subject Site. Details are summarized below:

    • Lot development: much of the proposed lots including basements will be excavated and constructed above shallow groundwater table. However, dewatering expected for the lots that will be constructed below shallow groundwater table with the maximum anticipated groundwater seepage of 65,000.0 L/day (with safety factor of 1.5), at total flow of 72.200 L/day including storm event.

    • Proposes SWMPs: Groundwater seepage of 35,000.0 L/day considering a safety factor of 1.5 is expected for excavation and construction of the proposed SWMP1. Total anticipated flow including storm event reaches 539,000.0 L/day. SWMP2 will be constructed above shallow groundwater level. As such, significant groundwater seepage is not anticipated. However, potential water through storm event with anticipated flow of 489,000.0 L/day should be controlled during construction.

    • Underground Services: Proposed underground services will be partially installed below shallow groundwater level. As such, groundwater seepage with a maximum flow rate of 318,000.0 L/day (with safety factor of 1.5), and total flow rate of 322,800.0 L/day is expected.

12. It is assumed the construction at the Subject Site will be completed over phases. Additionally, since the maximum estimated dewatering flow rate from groundwater source for each proposed development item exceeds 50,000 L/day but is below the 400,000 L/day PTTW threshold limit, the approval for any proposed temporary groundwater-taking for construction is by means of applying for an EASR approval with the MECP.

13. The estimated zone of influence for any conceptual dewatering wells or dewatering array around excavation footprints could reach maximums of 15.9 m away from the conceptual dewatering array around the servicing trenches. Potential impacts to the nearby structures, natural heritage features and groundwater receptors as summarized below:

    • Proposed residential properties located along the southwest limit of the Subject Site, might be located within the conceptual ZoI for dewatering. It is recommended a professional geotechnical engineer is consulted in advance of excavation and construction.

    • The existing natural feature located within the Subject Site is located within the upgradient area of the Subject Site. Dewatering is not expected for the area located to the west (northwest of the existing natural feature. The remaining surrounding lands around the natural feature within the Subject Site are located in the down-gradient of the natural feature, where the maximum conceptual ZoI for dewatering reaches 15.39 m away from dewatering array for installation of the proposed underground services. As such, significant impacts with respect to

dewatering is not anticipated to the natural features located within the Subject Site. The existing natural features located close to the west and south boundaries of the Subject Site are located outside of the conceptual ZoI for dewatering. Additionally, significant dewatering is not expected as most of the proposed development will be constructed above shallow groundwater table. As such, significant impacts with respect to dewatering is not anticipated to the natural features located outside of the Subject Site.

• A review of the MECP well records confirmed that there are records for water supply wells that are registered within 500 m of the Subject Site. The water supply well monitoring program is on-going for the residents that has given pression to SEL for well monitoring program. Record review indicates that the water supply wells were installed between 1954 and 2016. Since all of the wells are in the deeper aquafer, as such significant impacts to the water supply records are not expected.

14. A municipal water supply well is proposed in a property located adjacent to the northwest boundary of the Subject Site. As such potions of the Subject site within a radius of 100.0 m away from the proposed water supply well are located within WHPA-A, where installation of sanitary sewer system, Stormwater Management Facilities (SWMF), and application of road salt is considered as significant threats to the water supply well. As such:

    • Sanitary sewer system cannot be installed within the policy area. Policies SWG-13 and SWG-14 should be followed.

    • SWMF cannot be constructed within the policy area. A review of the provided plans indicates that SWMP and infiltration trenches are proposed outside of the policy area.

    • Application of road salt should be limited and managed to minimize the potential impact to the proposed municipal water supply well. It is recommended the winter maintenance for the neighbourhood is mainly comprises mechanical removal of snow, where the application of road salt will be limited. Considering the above approach and extending to the entire Subject Site will minimize the potential impact of road salt to groundwater with respect to the location of the Subject Site within the SGRA and HVA.

We trust the above satisfies your present requirements. Should you have any further queries, please feel free to contact this office.

Yours Truly,
SOIL ENGINEERS LTD.

Tarek Agha, B. Eng., EIT.

Narjes Alijani, M.Sc., P.Geo.
TA/NA

10.0 REFERENCES

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Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

FIGURES 1 to 14

BOREHOLE LOGS/MONITORING WELL LOGS
AND
GRAIN SIZE ANALYSIS

REFERENCE NO. 2206-W054

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS Auger sample
CS Chunk sample
DO Drive open (split spoon)
DS Denison type sample
FS Foil sample
RC Rock core (with size and percentage recovery)
ST Slotted tube
TO Thin-walled, open
TP Thin-walled, piston
WS Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—●—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

WH Sampler advanced by static weight
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
NP No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0 Field vane test in borehole; the number denotes the sensitivity to remoulding

△ Laboratory vane test

☐ Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres
1lb = 0.454 kg
1 inch = 25.4 mm
1ksf = 47.88 kPa

JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 1** **FIGURE NO.:** 1

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 23, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
439.6	Ground Surface							
0.0	**36 cm Topsoil**				0			
	PLOUGHED SOIL	1	DO	9			14	
439.1	Dark brown sand, occ. rootlets							
0.5	Brown, dense to very dense							
	GRAVELLY SAND	2	DO	37	1		4	
	occ. cobbles and boulders							
		3	DO	58			4	
					2			
		4	DO	50/10			3	
		5	DO	50/15	3		5	
					4			
		6	DO	50/15			5	
434.1					5			
5.5	Brown, very dense							
	SILT				6			
	fine grained	7	DO	56			19	
433.0					7			
6.6	**END OF BOREHOLE**							
	Installed 50 mm Ø monitoring well to 6.2 m				8			
	completed with 3.1 m screen							
	Sand backfill from 2.4 to 6.2 m				9			
	Bentonite seal from 0.0 m to 2.4 m							
	Provided with a monument casing				10			

Dry on Dec 01, 2022
W.L. @ El. 433.46 m on Jan 05, 2023

Soil Engineers Ltd.

JOB NO.: 2206-W054 # LOG OF BOREHOLE: BH/MW 2 **FIGURE NO.:** 2

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 22, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
436.3	Ground Surface							
0.0	**36 cm Topsoil**	1	DO	6	0		14	
	PLOUGHED SOIL Dark brown sand, occ. rootlets							
435.6 / 0.7	Brown, loose	2	DO	5	1		6	
	SAND fine to medium grained	3	DO	7	2		9	
433.9 / 2.4	Brown, dense to very dense	4	DO	45			5	
	GRAVELLY SAND occ. cobbles and boulders	5	DO	50/15	3		4	
		6	DO	50/15	4		5	
		7	DO	60	5		3	
429.7 / 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.2 m completed with 3.1 m screen Sand backfill from 2.4 to 6.2 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing				6 7 8 9 10			Dry on Dec 01, 2022 Dry on Jan 05, 2023

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JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 3** **FIGURE NO.:** 3

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 24, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
434.1	Ground Surface							
0.0	**36 cm Topsoil**	1	DO	7	0		18	
	PLOUGHED SOIL Dark brown sand, occ. rootlets							
433.4								
0.7	Brown, compact	2	DO	12	1		10	
	SAND fine to medium grained							
432.7								
1.4	Brown, dense to very dense	3	DO	60	2		3	
	GRAVELLY SAND occ. cobbles and boulders wet below 5.5 m	4	DO	52			3	
		5	DO	39	3		3	
		6	DO	50/15	4		2	
		7	DO	54	5		10	
427.4					6			
6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.2 m completed with 3.1 m screen Sand backfill from 2.4 to 6.2 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing				7			
					8			
					9			
					10			

W.L. @ El. 428.17 m on Dec 01, 2022
W.L. @ El. 428.21 m on Jan 05, 2023

Soil Engineers Ltd.

JOB NO.: 2206-W054 # LOG OF BOREHOLE: BH/MW 4 **FIGURE NO.:** 4

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 18, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
427.6	Ground Surface							
0.0	**36 cm Topsoil**	1	DO	12	0		16	
427.1 / 0.5	**PLOUGHED SOIL** Dark brown sand, occ. rootlets; Brown, compact							
426.6 / 1.0	**SAND** fine to medium grained; Brown, very dense	2	DO	50/15	1			
	GRAVELLY SAND occ. cobbles and boulders	3	DO	72	2		4	
		4	DO	50/10				
		5	DO	88	3		5	
423.9 / 3.7	Very dense to dense	6	DO	50	4		8	
	SILTY SAND TILL some gravel to gravelly, a trace of clay, occ. cobbles and boulders — — brown / grey	7	DO	66	5		6	
		8	DO	35	6		7	
421.0 / 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.2 m completed with 3.1 m screen. Sand backfill from 2.4 to 6.2 m. Bentonite seal from 0.0 m to 2.4 m. Provided with a monument casing	9	DO	36	7		8	
					8			
					9			
					10			

W.L. @ El. 423.70 m on Dec 01, 2022
W.L. @ El. 423.76 m on Jan 05, 2023

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JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 5** **FIGURE NO.:** 5

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 24, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
433.8	Ground Surface							
0.0	**36 cm Topsoil**				0			
	PLOUGHED SOIL Dark brown sand, occ. rootlets	1	DO	4			16	
433.1								
0.7	Brown, compact							
	SAND fine grained some silt	2	DO	7	1		5	
		3	DO	4	2		6	
		4	DO	21			5	
		5	DO	27	3		11	
429.7					4			
4.1	Brown, dense							
	GRAVELLY SAND occ. cobbles and boulders	6	DO	42	5		9	
428.2								
5.6	Brown, dense				6			
	SANDY SILT TILL traces of gravel and clay occ. cobbles and boulders	7	DO	40			19	
427.2								
6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.2 m completed with 3.1 m screen Sand backfill from 2.4 to 6.2 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing				7 8 9 10			W.L. @ El. 428.89 m on Dec 01, 2022 W.L. @ El. 428.93 m on Jan 05, 2023

JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 6** **FIGURE NO.:** 6

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 21, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
443.5	Ground Surface							
0.0	**36 cm Topsoil**				0			
	PLOUGHED SOIL Dark brown sand, occ. rootlets	1	DO	10			14	
442.8								
0.7	Brown, compact							
	SANDY SILT some gravel	2	DO	12	1		11	
		3	DO	10			12	
441.3					2			
2.2	Brown, compact to very dense							
	SANDY GRAVEL occ. cobbles and boulders	4	DO	25			12	
		5	DO	38	3		11	
		6	DO	24	4		12	
		7	DO	50/28			8	
438.5					5			
5.0	**END OF BOREHOLE**							
	Installed 50 mm Ø monitoring well to 4.6 m completed with 3.1 m screen Sand backfill from 0.9 to 4.6 m Bentonite seal from 0.0 m to 0.9 m Provided with a monument casing				6			
					7			
					8			
					9			
					10			

W.L. @ El. 440.32 m on Dec 01, 2022
W.L. @ El. 440.74 m on Jan 05, 2023

Soil Engineers Ltd.

JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 7** **FIGURE NO.:** 7

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 23, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
442.3	Ground Surface							
0.0	**36 cm Topsoil**	1	DO	6	0		13	
	PLOUGHED SOIL Dark brown sand, occ. rootlets							
441.6 / 0.7	Brown, very loose to very dense	2	DO	3	1		12	
	SAND fine to well graded a trace to some gravel	3	DO	18	2		3	
		4	DO	48	3		3	
		5	DO	34			3	
		6	DO	50/23	5		3	
		7	DO	45	6		3	
435.7 / 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.2 m completed with 3.1 m screen Sand backfill from 2.4 to 6.2 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing				7 8 9 10			Dry on Dec 01, 2022 W.L. @ El. 436.12 m on Jan 05, 2023

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JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 8** **FIGURE NO.:** 8

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 22, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
434.1	Ground Surface							
0.0	**36 cm Topsoil**				0			
	PLOUGHED SOIL Dark brown sand, occ. rootlets	1	DO	4			17	
433.4								
0.7	Brown, compact							
	SAND fine to medium grained	2	DO	17	1		7	
432.6								
1.5	Brown, dense to very dense	3	DO	50/28			7	
	GRAVELLY SAND occ. cobbles and boulders wet below 5.1 m				2			
		4	DO	26			4	
		5	DO	46	3		6	
		6	DO	22	4		3	
		7	DO	50/15			4	
		8	DO	42	5		12	
		9	DO	32	6		12	
427.4								
6.7	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing				7 8 9 10			W.L. @ El. 428.32 m on Dec 01, 2022 W.L. @ El. 428.36 m on Jan 05, 2023

Soil Engineers Ltd.

JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 9** **FIGURE NO.:** 9

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 24, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
437.7	Ground Surface							
0.0	**36 cm Topsoil**				0			
	PLOUGHED SOIL Dark brown sand, occ. rootlets	1	DO	5			19	
437.0 / 0.7	Brown, compact							
	SAND fine to medium grained	2	DO	4	1		15	
435.9 / 1.8	Brown, dense to very dense	3	DO	31			9	
	GRAVELLY SAND occ. cobbles and boulders				2			
		4	DO	50/15			3	
					3			
		5	DO	50/10			5	
					4			
433.0		6	DO	50/3			5	
4.7	**END OF BOREHOLE**				5			
	Installed 50 mm Ø monitoring well to 4.4 m completed with 3.1 m screen Sand backfill from 0.9 to 4.3 m Bentonite seal from 0.0 m to 0.9 m Provided with a monument casing				6			
					7			
					8			
					9			
					10			

Dry on Dec 01, 2022
Dry on Jan 05, 2023

Soil Engineers Ltd.

JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 10** **FIGURE NO.:** 10

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 25, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
437.9	Ground Surface							
0.0	**36 cm Topsoil**				0			
	PLOUGHED SOIL Dark brown sand, occ. rootlets	1	DO	11			16	
437.0		2	DO	50/5	1		16	
0.9	Brown, dense to very dense							
	GRAVELLY SAND occ. cobbles and boulders	3	DO	50/15			4	
					2			
		4	DO	34			4	
		5	DO	38	3		2	
					4			
		6	DO	50/15			3	
					5			
					6			
431.5		7	DO	50/10			3	
6.4	**END OF BOREHOLE**				7			
	Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing				8			
					9			
					10			

Dry on Dec 01, 2022
Dry on Jan 05, 2023

Soil Engineers Ltd.

JOB NO.: 2206-W054 **LOG OF BOREHOLE: BH/MW 11** **FIGURE NO.:** 11

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Flight Auger

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 25, 2022

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
435.5	Ground Surface							
0.0	**36 cm Topsoil**	1	DO	12	0		12	
	PLOUGHED SOIL Dark brown sand, occ. rootlets							
434.8								
0.7	Brown, dense to very dense	2	DO	40	1		5	
	SAND well graded trace to some gravel	3	DO	74	2		6	
		4	DO	62			2	
		5	DO	46	3		4	
431.4					4			
4.1	Dense							
	SILT fine grained occ. clay seams	6	DO	38	5		25	
	— — brown grey	7	DO	38	6		22	
428.9								
6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing				7 8 9 10			W.L. @ El. 431.64 m on Dec 01, 2022 W.L. @ El. 431.61 m on Jan 05, 2023

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

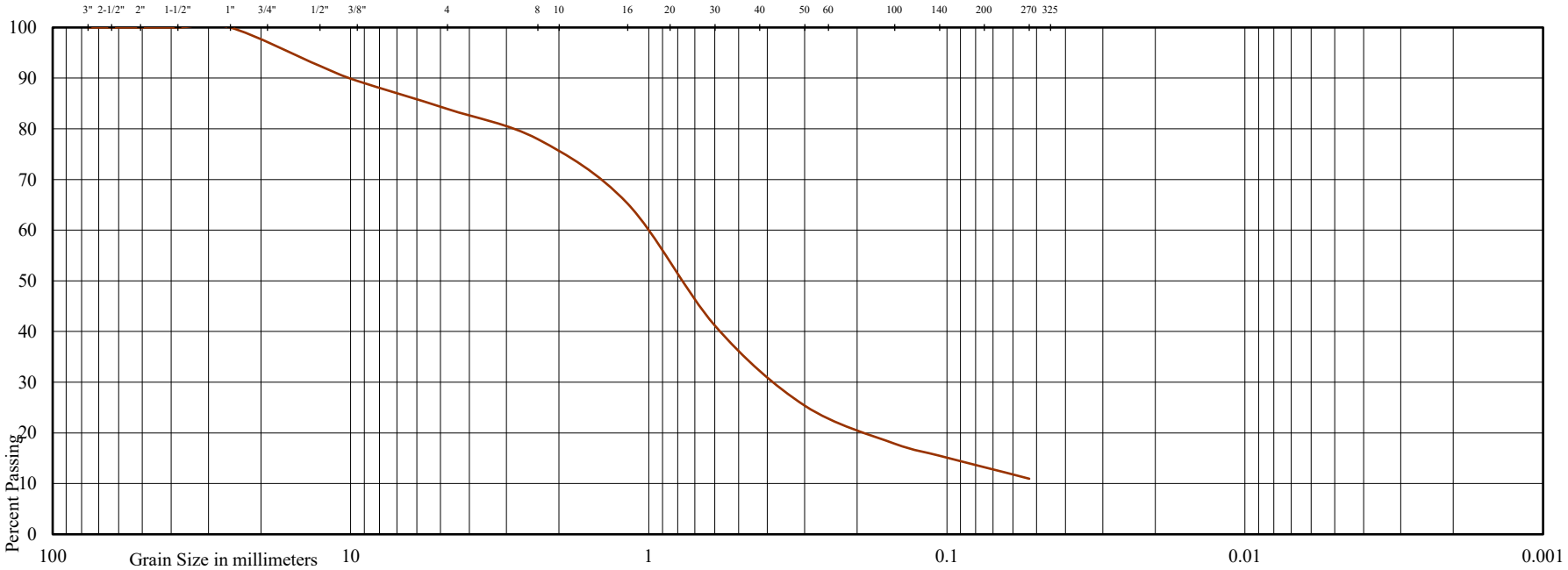
Reference No: 2206-S054

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Somewhere

Location: Someplace

Borehole No: 7

Sample No: 6

Depth (m): 4.8

Elevation (m):

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = 10^{-3}

Classification of Sample [& Group Symbol]:	FINE TO MEDIUM SAND some silt and gravel, a trace of coarse sand

Figure: 12

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

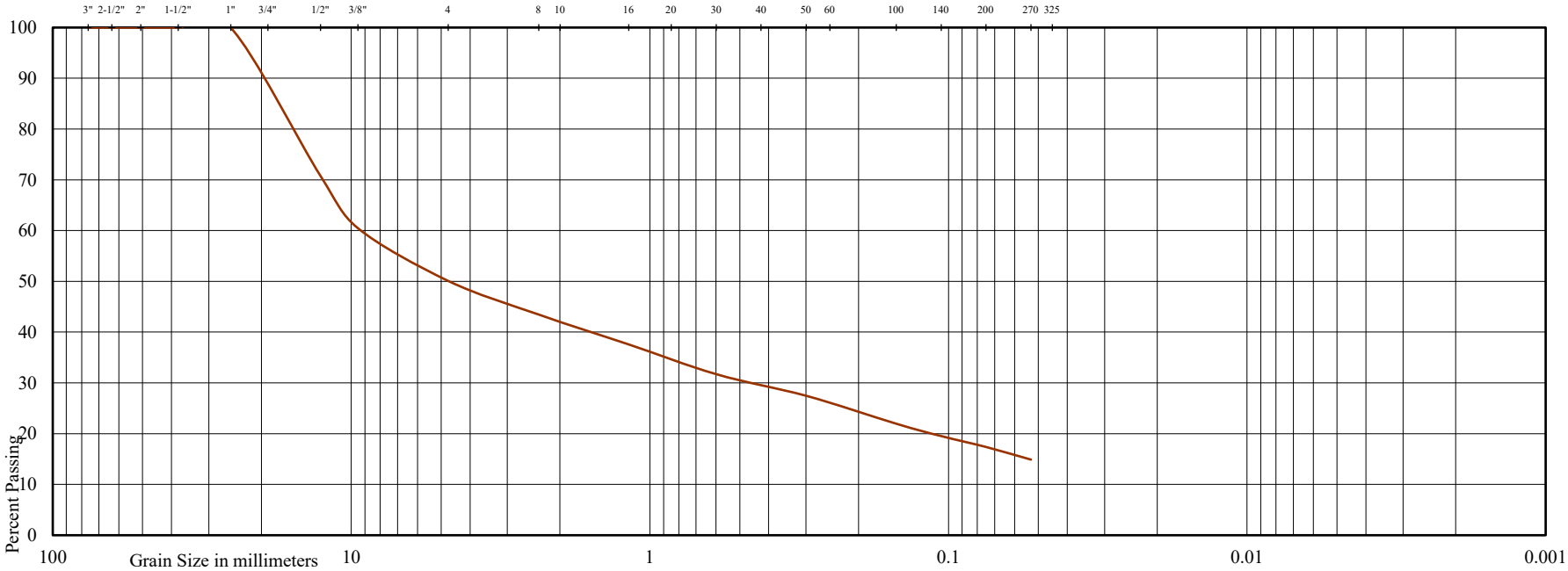
Reference No: 2206-S054

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Somewhere

Location: Someplace

Borehole No: 1

Sample No: 5

Depth (m): 3.3

Elevation (m):

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = 10^{-3}

Classification of Sample [& Group Symbol]:	SANDY GRAVEL some silt

Figure: 13

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

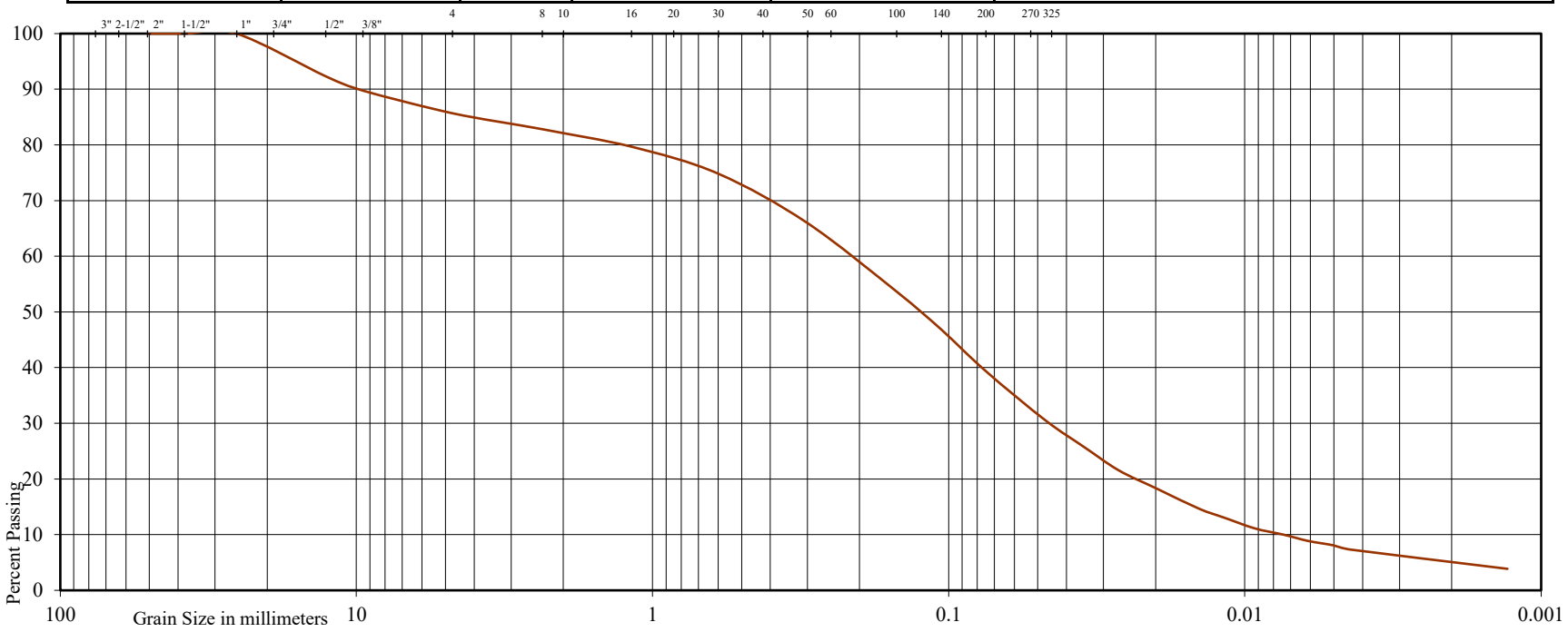
Reference No: 2206-S054

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: JOB NAME

Location: JOB LOCATION

Borehole No: 5

Sample No: 4

Depth (m): 4.5

Elevation (m):

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = 10^{-4}

Classification of Sample [& Group Symbol]: SILTY SAND, TILL

some gravel, a trace of clay

Figure: 14

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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

DRAWINGS 1 to 8

REFERENCE NO. 2206-W054

N

Legend

- Approximate Boundary of Subject Site
- Waterbody
- Road
- Railway
- Watercourse

Soil Engineers Ltd.

Title: Site Location Plan

Project:

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

Date: December 21, 2022

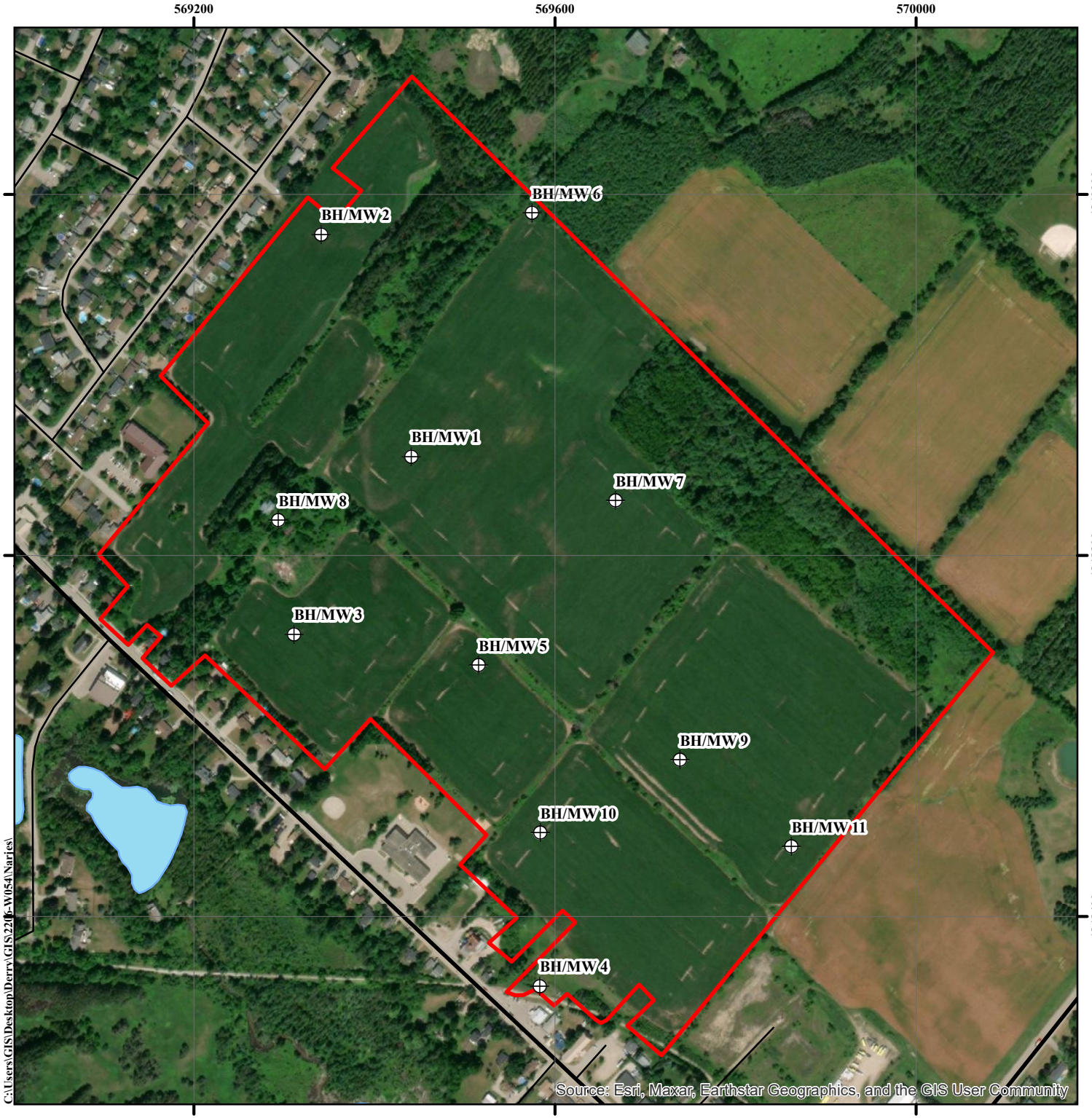
Scale:

0 50 100 200 300 400 500
Metres

Drawing No. 1

D:\GIS\2206-W054\

Source: Ontario Ministry of Natural Resources and Forestry



N

Legend

- Borehole with Monitoring Well
- Property
- Major Road
- Local Road
- Waterbody

Soil Engineers Ltd.

Borehole and Monitoring Well Location Plan

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

Date: January 22, 2024

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 2

N

Legend

- Property
- 500 Metres From Subject Site Boundary
- Major Road
- Local Road
- Waterbody
- Watercourse
- Unknown
- Abandoned-Other
- Abandoned-Supply
- Monitoring and Test Hole
- Observation Wells
- Other Status
- Test Hole
- Water Supply

Soil Engineers Ltd.

Title: MECP Well Location Plan

Project:

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

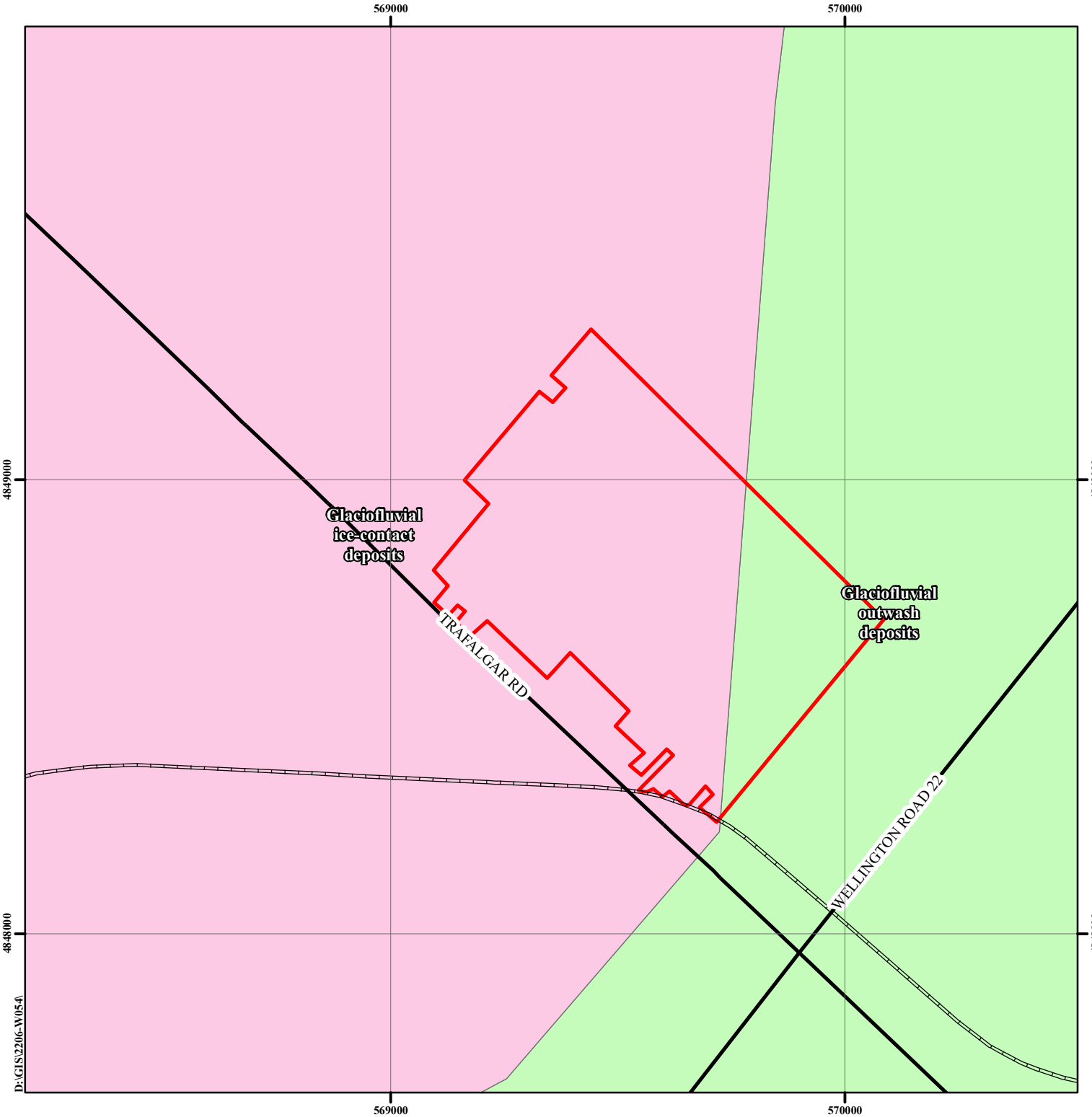
Date: January 17, 2024

Scale:

0 55 110 220 330 440 550

Metres

Drawing No. 3



N

Legend

- Approximate Boundary of Subject Site
- Glaciofluvial ice-contact deposits
  Material: gravel and sand, minor till, includes esker, kame, end moraine, ice-marginal delta and subaqueous fan deposits
- Glaciofluvial outwash deposits
  Material: gravel and sand, includes proglacial river and deltaic deposits
- Major Road
- Railway

Soil Engineers Ltd.

Title: Quarternary and Surface Geology Map

Project:

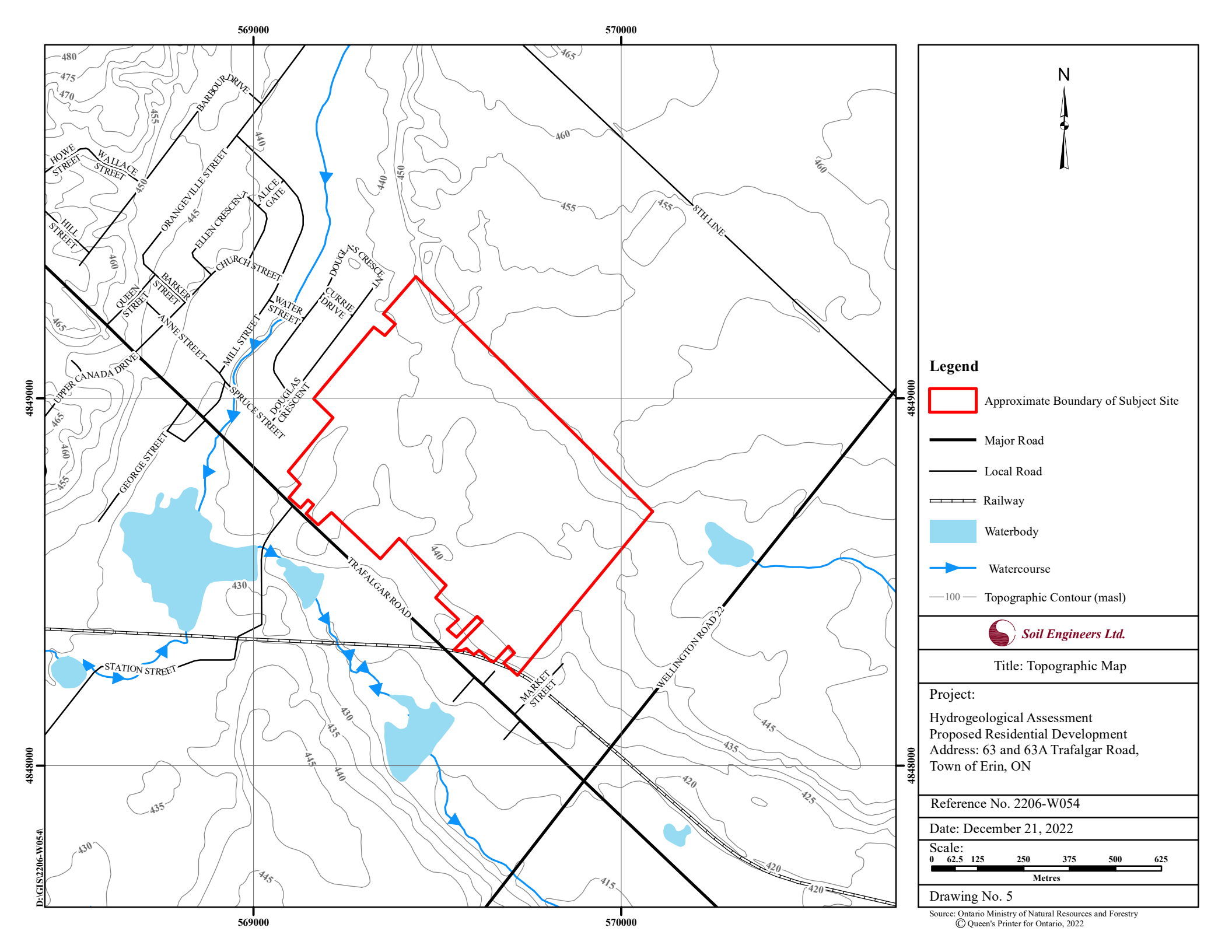
Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

Date: December 21, 2022

Scale:
0 80 160 240 320 400
Metres

Drawing No. 4



N

Legend

- Approximate Boundary of Subject Site
- Major Road
- Local Road
- Railway
- Waterbody
- Watercourse
- 100 Topographic Contour (masl)

Soil Engineers Ltd.

Title: Topographic Map

Project:

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

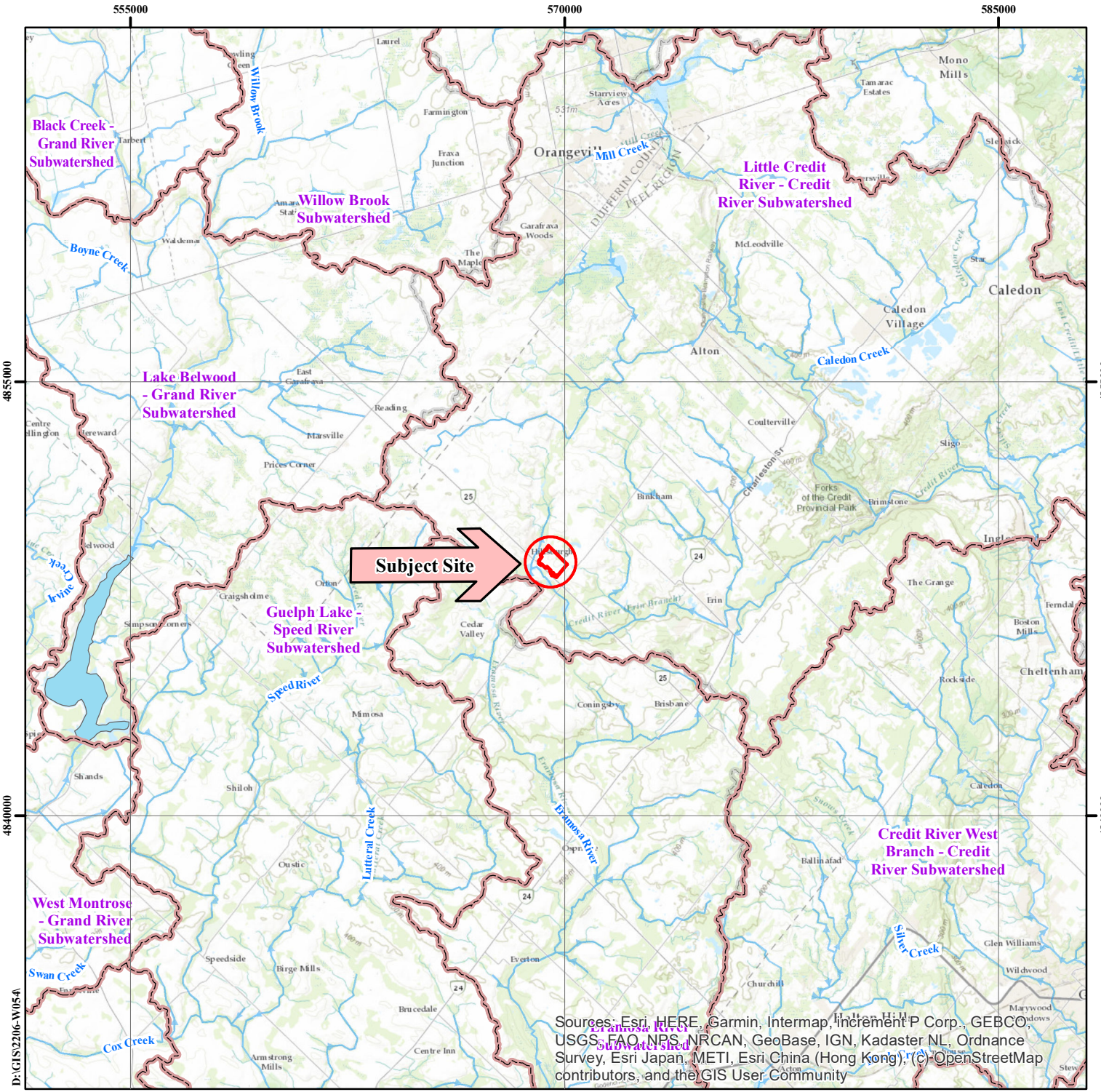
Date: December 21, 2022

Scale:

0 62.5 125 250 375 500 625
Metres

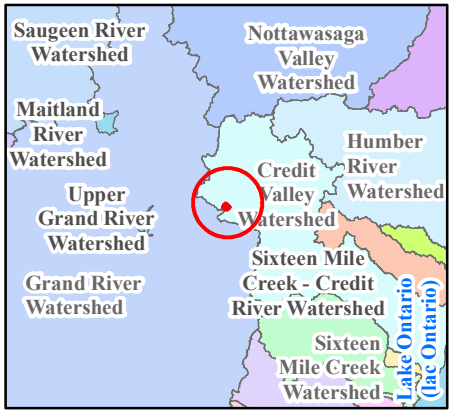
Drawing No. 5

Source: Ontario Ministry of Natural Resources and Forestry



N

Watershed:



Legend

- Approximate Boundary of the Subject Site
- Watershed Boundaries
- Waterbody
- Watercourse
- Expressway/Major Road

Soil Engineers Ltd.

Title: Watershed and Subwatershed Map

Project:

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

Date: December 21, 2022

Scale:

0 2,100 4,200 6,300 8,400 10,500

Metres

Drawing No. 6

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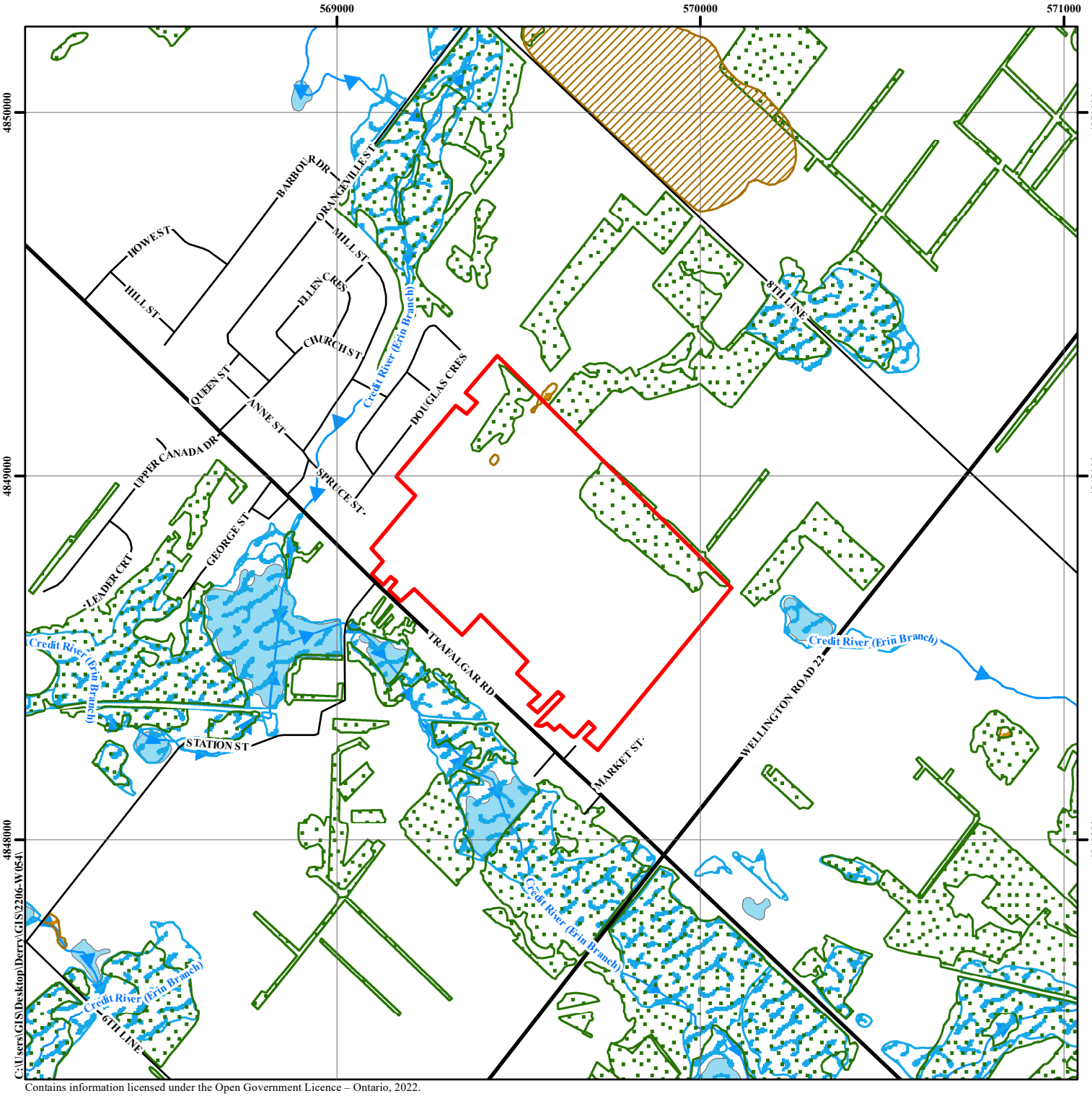
This mapping was produced by SEL and should be used for information purposes only.
Data sources used in its production are of varying quality and accuracy and all boundaries should be considered approximate.



N

Legend

- Approximate Boundary of Subject Site
- Area of Natural and Scientific Interest (ANSI)
- Wetland (classified as Provincial)
- Wetland (Not evaluated per OWES)
- Wooded Area
- Waterbody
- Watercourse
- Major Road
- Local Road

Soil Engineers Ltd.

Title: Natural Features and Protection Area Plan

Project:

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

Date: December 21, 2022

Scale:

0 100 200 300 400 500

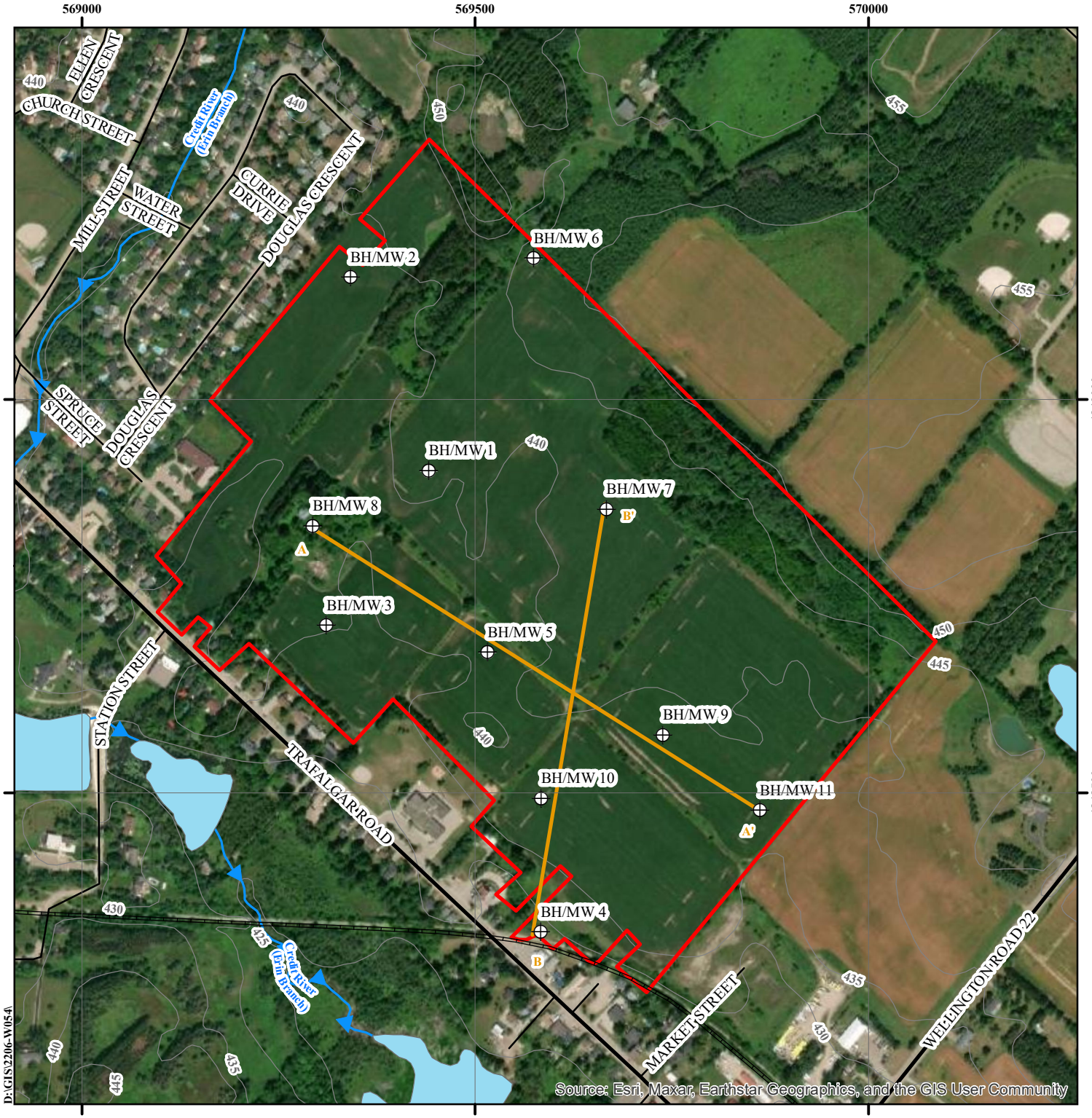
Metres

Drawing No. 7

C:\Users\GIS\Desktop\Derry\GIS\2206-W054\

Source: Ontario Ministry of Natural Resources and Forestry

OWES: Ontario Wetland Evaluation System



N

Legend

- Approximate Boundary of Subject Site
- Borehole with Monitoring Well
- Waterbody
- Watercourse
- Major Road
- Local Road
- Railway
- A A' Cross-Section Direction
- 100 Topographic Contour (masl)

Soil Engineers Ltd.

Title: Cross-Section Key Plan

Project:

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

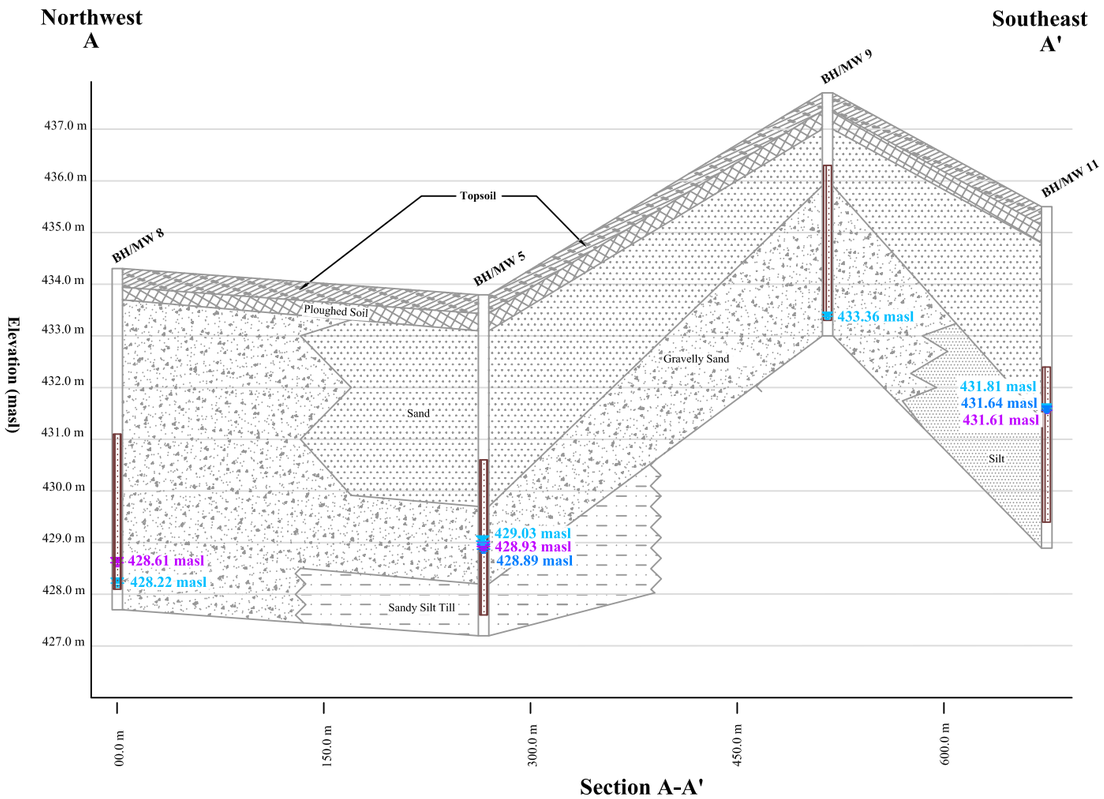
Reference No. 2206-W054

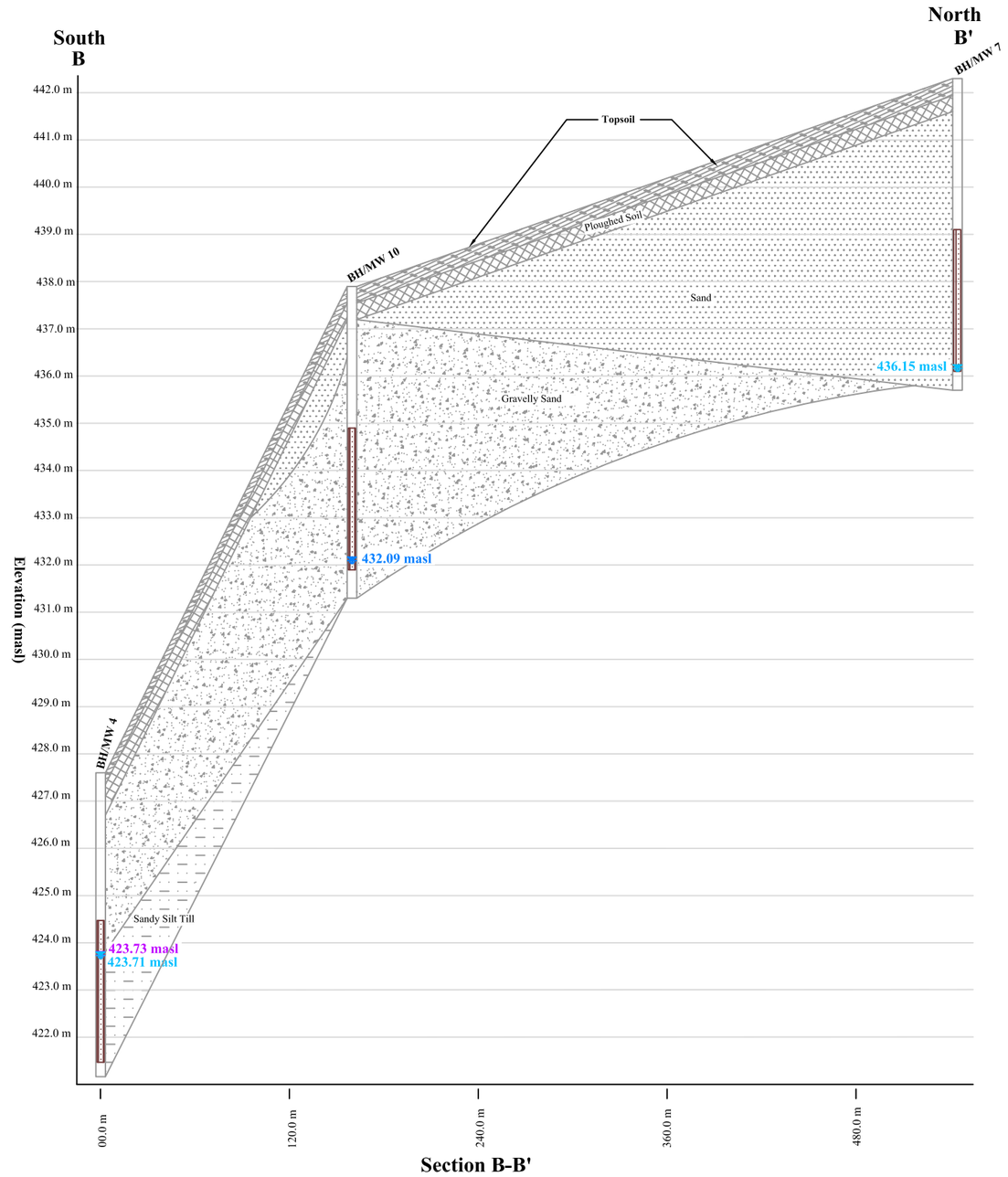
Date: December 21, 2022

Scale:

0 35 70 140 210 280 350
Metres

Drawing No. 8-1





Topsoil
Ploughed Soil
Gravelly Sand
Silt
Fine to Medium Sand
Sandy Silt Till
3.0 m Screen

Water Table on December 01, 2022
Water Table on January 05, 2023
Water Table on February 08, 2023

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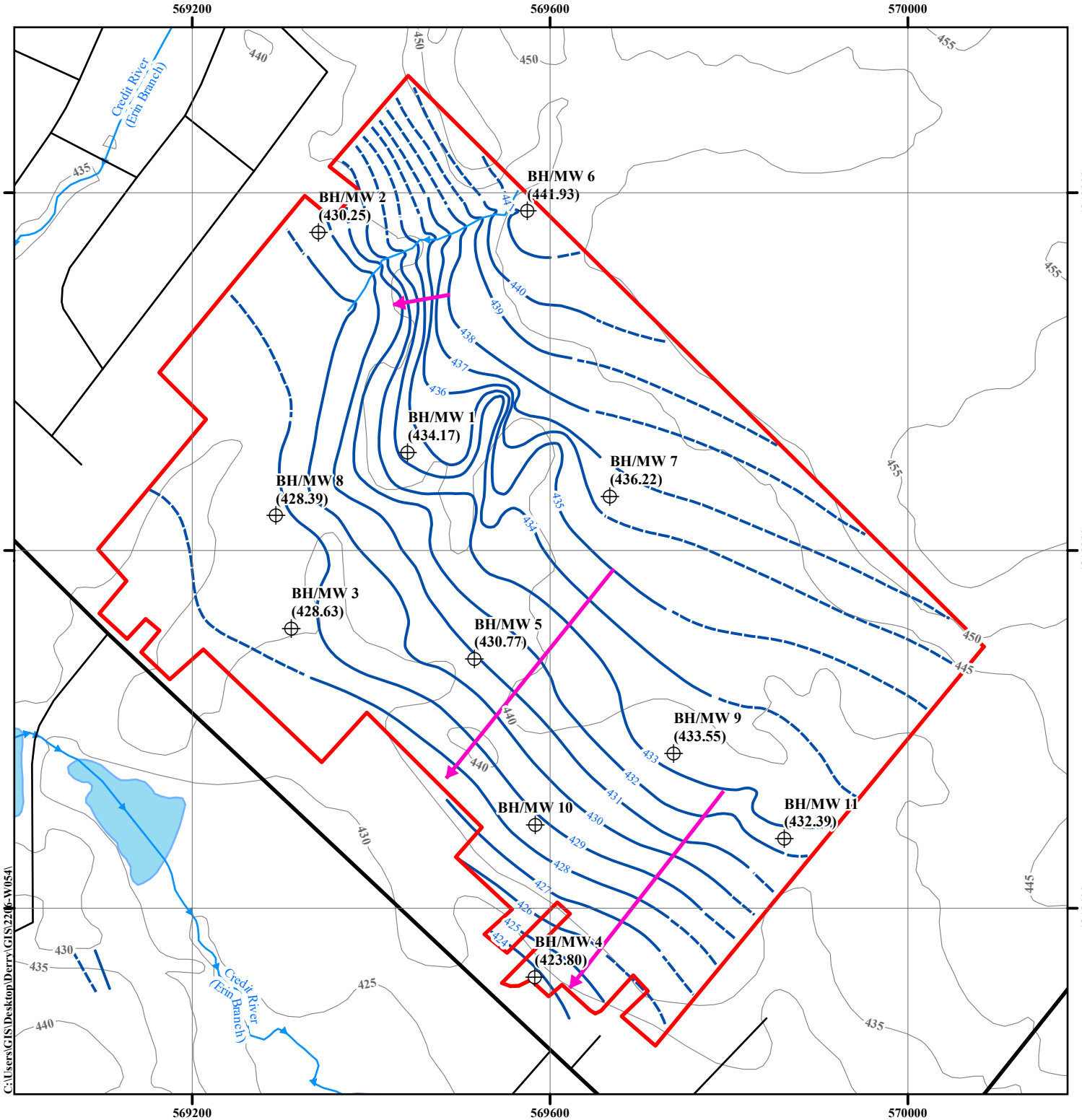
Title: Geological Cross-Section (A-A' and B-B')

Project: Hydrogeological Assessment
Proposed Residential Development
63 and 63A Trafalgar Road, Town of Erin, Ontario

Reference No:	Date:	Scale: V	Scale: H	Drawing No.
2206-W054	January, 2024	1:100	1:2500	8-2



N

Legend

- Borehole with Monitoring Well
- Property
- Major Road
- Local Road
- Watercourse
- Waterbody
- Ontario - 5 m
- Interpreted Shallow Groundwater Elevation Contour
- Inferred Shallow Groundwater Elevation Contour
- Interpreted Shallow Groundwater Flow Direction
- (441.93) Shallow Groundwater Level Measured on May 25, 2023

Soil Engineers Ltd.

Shallow Groundwater
Flow Pattern Plan

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

Date: January 22, 2024

Scale:
0 30 60 120 180 240 300
Metres

Drawing No. 9

568800 569100 569400 569700 570000 570300

4849300 4849000 4848700 4848400

CHURCH STREET
MILL STREET
WATER STREET
CURRIE DRIVE
DOUGLAS CRESCENT
ANNE STREET
SPRUCE STREET
8TH LINE
TRAFALGAR ROAD
STATION STREET
MARKET STREET
WELLINGTON ROAD 22

N

References: Ontario Ministry of Natural Resources and Forestry
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Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Dewatering Area 1
- Dewatering Area 2
- Dewatering Area 3
- Dewatering Area 4
- Dewatering Area 5
- Dewatering Area 6
- Dewatering Area 7
- Dewatering Area 8
- Dewatering Area 9
- Major Road
- Local Road

Soil Engineers Ltd.

Conceptual Dewatering Area Plan

Hydrogeological Assessment
Proposed Residential Development
Address: 63 and 63A Trafalgar Road,
Town of Erin, ON

Reference No. 2206-W054

Date: January 23, 2024

Scale:
0 25 50 100 150 200 250
Metres

Drawing No. 10

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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

APPENDIX 'A'

MECP WATER WELL RECORDS SUMMARY

REFERENCE NO. 2206-W054

MECP Well Records Summary

WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
				Final Status	First Use				
1	6700712	Cable Tool	39.6	Water Supply	Domestic	9.1	-	-	1966-03-21
2	6700713	Cable Tool	22.9	Water Supply	Domestic	7.6	-	-	1966-08-05
3	6700740	Cable Tool	42.7	Water Supply	Domestic	12.2	-	-	1958-08-04
4	6700741	Cable Tool	25.9	Water Supply	Commercial	4.3	-	-	1960-05-20
5	6700742	Cable Tool	29.9	Water Supply	Public	6.1	-	-	1961-03-21
6	6700746	Cable Tool	30.5	Water Supply	Public	4.6	-	-	1958-07-22
7	6703077	Cable Tool	32.0	Water Supply	Domestic	8.8	-	-	1968-04-05
8	6703149	Cable Tool	37.2	Water Supply	Public	4.6	-	-	1968-11-06
9	6703357	Cable Tool	46.3	Water Supply	Domestic	16.2	-	-	1969-03-19
10	6703518	Rotary (Convent.)	59.4	Water Supply	Domestic	9.4	-	-	1969-08-20
11	6703528	Rotary (Convent.)	54.9	Water Supply	Domestic	7.6	-	-	1969-08-05
12	6704716	Rotary (Convent.)	45.7	Water Supply	Domestic	2.4	-	-	1973-05-11
13	6704171	Rotary (Convent.)	25.9	Water Supply	Domestic	3.7	-	-	1972-01-14
14	6704175	Rotary (Convent.)	42.7	Water Supply	Domestic	6.7	-	-	1971-12-22
15	6704176	Rotary (Convent.)	42.7	Water Supply	Domestic	6.7	-	-	1971-12-24
16	6704542	Rotary (Convent.)	24.4	Water Supply	Public	5.8	-	-	1973-01-03
17	6704913	Rotary (Convent.)	74.7	Water Supply	Livestock	4.6	-	-	1973-10-25
18	6705146	Rotary (Convent.)	24.4	Water Supply	Domestic	2.4	-	-	1974-04-16
19	6705148	Rotary (Convent.)	18.3	Water Supply	Domestic	0.9	-	-	1974-06-21
20	6705612	Rotary (Convent.)	41.1	Water Supply	Domestic	7.0	-	-	1974-10-10
21	6705647	Rotary (Convent.)	47.5	Water Supply	Domestic	22.3	-	-	1975-03-21
22	6706041	Rotary (Convent.)	15.8	Water Supply	Domestic	3.0	-	-	1975-07-03
23	6706286	Rotary (Convent.)	32.0	Water Supply	Domestic	3.0	-	-	1976-07-08
24	6706583	Rotary (Convent.)	20.7	Water Supply	Domestic	5.5	-	-	1977-05-17
25	6706911	Rotary (Convent.)	21.3	Water Supply	Domestic	7.3	-	-	1978-08-30
26	6707143	Rotary (Convent.)	25.0	Water Supply	Domestic	4.6	-	-	1979-04-26
27	6707144	Rotary (Convent.)	26.5	Water Supply	Domestic	4.9	-	-	1979-05-01
28	6707156	Rotary (Convent.)	29.6	Water Supply	Domestic	5.5	-	-	1979-04-25
29	6707351	Rotary (Convent.)	33.8	Water Supply	Domestic	22.9	-	-	1980-07-14
30	6707358	Rotary (Convent.)	32.9	Water Supply	Domestic	3.7	-	-	1980-04-18
31	6707559	Rotary (Convent.)	47.2	Water Supply	Commercial	5.2	-	-	1981-12-09
32	6707861	Rotary (Convent.)	36.6	Water Supply	Domestic	2.4	-	-	1983-05-12
33	6708080	Rotary (Convent.)	31.1	Water Supply	Domestic	1.8	-	-	1983-11-07
34	6708174	Rotary (Convent.)	22.9	Water Supply	Domestic	2.1	-	-	1984-04-18
35	6708346	Rotary (Convent.)	35.4	Water Supply	Domestic	4.3	-	-	1985-07-24
36	6708365	Rotary (Convent.)	34.1	Water Supply	Domestic	3.0	-	-	1985-12-24
37	6708396	Rotary (Convent.)	50.3	Water Supply	Domestic	5.2	-	-	1985-05-16
38	6708616	Rotary (Convent.)	29.6	Water Supply	Domestic	8.8	-	-	1986-12-01
39	6708808	Rotary (Convent.)	53.3	Water Supply	Domestic	8.8	-	-	1986-12-31

WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
				Final Status	First Use				
40	6708819	Rotary (Convent.)	21.3	Water Supply	Domestic	7.6	-	-	1987-05-21
41	6709050	Rotary (Convent.)	57.0	Water Supply	Domestic	5.5	-	-	1987-11-30
42	6709065	Rotary (Convent.)	53.0	Water Supply	Domestic	24.7	-	-	1987-10-23
43	6709156	Rotary (Convent.)	51.8	Water Supply	Domestic	7.6	-	-	1988-01-12
44	6709157	Rotary (Convent.)	30.2	Water Supply	Domestic	7.6	-	-	1987-12-09
45	6709212	Rotary (Convent.)	45.1	Water Supply	Domestic	11.6	-	-	1987-08-20
46	6709530	Rotary (Convent.)	30.5	Water Supply	Domestic	9.1	-	-	1988-09-15
47	6709532	Rotary (Convent.)	23.5	Water Supply	Domestic	8.5	-	-	1988-09-16
48	6709533	Rotary (Convent.)	22.9	Water Supply	Domestic	8.8	-	-	1988-09-14
49	6709578	Rotary (Convent.)	49.7	Water Supply	Domestic	7.0	-	-	1988-12-15
50	6709595	Rotary (Convent.)	21.3	Water Supply	Domestic	0.3	-	-	1988-10-25
51	6709602	Rotary (Convent.)	23.2	Water Supply	Domestic	2.4	-	-	1988-08-17
52	6709605	Rotary (Convent.)	21.3	Water Supply	Domestic	0.3	-	-	1988-09-06
53	6709886	Rotary (Convent.)	22.9	Water Supply	Domestic	4.9	-	-	1989-07-22
54	6710148	Rotary (Convent.)	61.0	Water Supply	Public	5.5	-	-	1989-05-13
55	6710156	Rotary (Convent.)	42.7	Water Supply	Domestic	27.4	-	-	1989-10-31
56	6710235	Rotary (Convent.)	32.0	Water Supply	Domestic	2.7	-	-	1989-07-27
57	6710548	Rotary (Convent.)	26.2	Water Supply	Domestic	4.3	-	-	1990-10-19
58	6710809	Rotary (Convent.)	34.1	Water Supply	Domestic	6.7	-	-	1991-05-24
59	6711058	Rotary (Convent.)	21.3	Water Supply	Domestic	-	-	-	1992-11-19
60	6711075	Rotary (Convent.)	57.0	Water Supply	Domestic	4.3	-	-	1992-10-30
61	6711348	Rotary (Convent.)	48.8	Water Supply	Domestic	12.2	-	-	1993-10-19
62	6711507	Rotary (Convent.)	76.2	Water Supply	Public	29.0	-	-	1994-07-27
63	6712031	Rotary (Convent.)	57.9	Water Supply	Municipal	1.8	-	-	1996-05-01
64	6712455	Not Known	-	Abandoned-Other	Not Used	-	-	-	1995-11-20
65	6712833	Rotary (Convent.)	24.4	Water Supply	Domestic	4.3	-	-	1998-10-06
66	6713227	Rotary (Convent.)	24.4	Water Supply	Domestic	5.2	-	-	1999-08-19
67	6713603	Rotary (Convent.)	29.6	Water Supply	Domestic	3.0	-	-	2000-11-22
68	6713762	Rotary (Convent.)	21.3	Water Supply	Domestic	3.0	-	-	2001-07-09
69	6713886	Rotary (Convent.)	42.7	Water Supply	Domestic	21.6	-	-	2001-09-24
70	6713887	Rotary (Convent.)	29.0	Water Supply	Domestic	8.5	-	-	2001-10-04
71	6713888	Rotary (Convent.)	30.8	Water Supply	Domestic	5.5	-	-	2001-10-03
72	6713900	Rotary (Convent.)	38.1	Water Supply	Domestic	4.3	-	-	2001-10-25
73	6714187	Rotary (Convent.)	19.8	Water Supply	Domestic	4.6	-	-	2002-09-07
74	6714235	Rotary (Convent.)	42.1	Water Supply	Domestic	6.7	-	-	2002-10-17
75	6714664	Not Known	-	Abandoned-Other	Not Used	-	-	-	2003-09-29
76	6714839	Other Method	14.3	Observation Wells	Not Used	-	11.3	12.8	2003-05-15
77	6714944	-	-	Abandoned-Other	-	-	-	-	2004-06-22
78	6715166	-	-	Abandoned-Other	-	-	-	-	2004-12-10

WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
				Final Status	First Use				
79	6715250	Other Method	4.3	Abandoned-Other	-	-	2.7	4.3	2005-02-10
80	6715394	Rotary (Convent.)	30.5	Water Supply	Domestic	5.2	-	-	2005-07-04
81	6715503	-	-	Abandoned-Other	-	-	-	-	2005-09-02
82	6715772	Rotary (Convent.)	30.5	Water Supply	Domestic	6.1	-	-	2006-06-15
83	6715910	Rotary (Convent.)	30.5	Water Supply	Domestic	7.0	-	-	2006-09-06
84	6715969	Other Method	13.7	Observation Wells	-	-	12.2	13.7	2006-09-12
85	7050905	Rotary (Convent.)	30.5	Water Supply	Domestic	5.2	-	-	2007-10-01
86	7104643	-	-	Water Supply	-	-	-	-	2008-03-18
87	7105350	-	-	Abandoned-Other	-	-	-	-	2008-05-05
88	7113491	Cable Tool	27.7	Water Supply	-	3.4	-	-	2008-05-07
89	7118031	Rotary (Convent.)	44.8	Water Supply	Domestic	7.0	-	-	2008-09-25
90	7125694	Other Method	25.0	Water Supply	Domestic	5.2	-	-	2009-06-02
91	7127280	-	-	Abandoned-Other	-	-	-	-	2009-06-02
92	7127282	Rotary (Convent.)	25.0	Water Supply	Domestic	2.7	-	-	2009-06-09
93	7135171	Rotary (Convent.)	19.8	Water Supply	Domestic	2.4	-	-	2009-10-10
94	7139080	-	-	Abandoned-Other	Not Used	-	-	-	2008-08-14
95	7139081	-	-	-	Not Used	-	-	-	2009-08-14
96	7153541	Rotary (Convent.)	20.7	Water Supply	Domestic	3.7	-	-	2010-08-08
97	7160498	Rotary (Air)	18.3	Water Supply	Domestic	3.7	-	-	2011-02-23
98	7165335	-	-	Abandoned-Other	Not Used	-	-	-	2011-06-13
99	7174984	-	-	Abandoned-Other	-	-	-	-	2011-11-12
100	7179274	-	-	-	-	-	-	-	2012-01-31
101	7181812	Rotary (Convent.)	-	Other Status	-	3.2	-	-	2012-05-09
102	7191665	-	-	Abandoned-Other	-	-	-	-	2012-09-25
103	7194971	-	-	Abandoned-Other	-	-	-	-	2012-11-06
104	7197600	-	-	Abandoned-Other	-	-	-	-	2012-12-20
105	7201338	-	-	Abandoned-Other	-	-	-	-	2013-04-25
106	7201342	Rotary (Convent.)	-	Abandoned-Other	Domestic	-	-	-	2013-04-25
107	7204348	Rotary (Convent.)	31.1	Water Supply	Domestic	6.4	-	-	2013-06-05
108	7221287	Air Percussion	25.3	Water Supply	Domestic	5.5	-	-	2014-05-20
109	7221467	-	6.0	Abandoned-Other	-	-	-	-	2014-04-22
110	7221469	Other Method	-	Abandoned-Other	-	-	-	-	2014-04-22
111	7221471	Other Method	38.5	Abandoned-Other	-	6.7	-	-	2014-04-28
112	7264117	-	-	-	-	-	-	-	2016-05-29
113	7266474	Other Method	23.5	-	-	6.4	-	-	2016-04-11
114	7279241	Rotary (Convent.)	55.5	Water Supply	Domestic	15.8	-	-	2016-11-02
115	7279242	Rotary (Convent.)	25.0	Water Supply	Domestic	7.9	-	-	2016-11-01
116	7282682	-	-	Abandoned-Supply	-	-	-	-	2016-12-14
117	7287957	-	-	Abandoned-Supply	-	-	-	-	2017-05-17

WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Static Water Level (m)**	Top of Screen Depth (m)**	Bottom of Screen Depth (m)**	Date Completed
				Final Status	First Use				
118	7292103	Other Method	61.0	Water Supply	Public	21.3	-	-	2017-07-17
119	7292603	Rotary (Convent.)	44.8	Water Supply	Domestic	21.3	-	-	2017-07-12
120	7292608	Rotary (Convent.)	49.4	Water Supply	Domestic	23.2	-	-	2017-06-19
121	7300378	Boring	4.6	Test Hole	Test Hole	-	3.0	4.6	2017-11-16
122	7304150	Boring	4.6	Monitoring and Test Hole	Test Hole	-	3.0	4.6	2017-11-02
123	7304151	Boring	4.6	Monitoring and Test Hole	Test Hole	-	3.0	4.6	2017-11-02
124	7304154	Boring	7.6	Monitoring and Test Hole	Test Hole	-	6.1	7.6	2017-11-03
125	7305135	Boring	4.6	Observation Wells	Monitoring	-	3.0	4.6	2017-11-29
126	7305136	Boring	5.5	Observation Wells	Monitoring	-	4.0	5.5	2017-11-24
127	7305137	Boring	4.6	Observation Wells	Monitoring	-	3.0	4.6	2017-11-24
128	7305138	Boring	4.6	Observation Wells	Monitoring	-	3.0	4.6	2017-11-24
129	7325517	Driving	7.6	Observation Wells	Monitoring	-	4.5	7.6	2018-11-20
130	7326108	Rotary (Convent.)	97.5	Test Hole	Test Hole	11.3	-	-	2018-12-06
131	7346374	Cable Tool	12.5	Water Supply	Domestic	2.4	-	-	2019-10-28
132	7346759	Auger	3.7	Observation Wells	Monitoring	-	2.2	3.7	2019-10-04
133	7346760	Auger	3.7	Observation Wells	Monitoring	-	2.2	3.7	2019-10-04
134	7352921	Other Method	7.6	Observation Wells	Monitoring	-	9.1	10.7	2019-11-06
135	7352922	Rotary (Convent.)	91.4	Water Supply	-	-	-	-	2020-01-13
136	7352923	-	-	Water Supply	-	-	79.2	85.3	2020-01-13
137	7357193	-	-	Abandoned-Other	-	-	-	-	2020-04-20
138	7357194	-	-	Abandoned-Other	-	-	-	-	2020-04-20
139	7372412	-	-	-	-	-	-	-	2020-10-07
140	7373295	-	-	-	-	-	-	-	2019-06-21

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CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

APPENDIX 'B'

GROUNDWATER MONITORING DATA

REFERENCE NO. 2206-W054

Long-Term Groundwater Level Monitoring Data

BH/MW ID	Unit	Ground Surface El	01-Dec-22	05-Jan-23	08-Feb-23	30-Mar-23	21-Apr-23	25-May-23	26-Jun-23	28-Jul-23	21-Aug-23	28-Sep-23	25-Oct-23	28-Nov-23
BH/MW 1	mbgs		3.91	5.47	5.84	5.35	5.35	5.53	5.76	5.79	5.80	5.81	5.82	5.83
	masl	439.70	435.79	434.23	433.86	434.35	434.35	434.17	433.94	433.91	433.90	433.89	433.88	433.87
BH/MW 2	mbgs		Dry	DRY	DRY	DRY	6.08	6.05	6.05	6.09	6.09	6.10	6.09	6.10
	masl	436.30	DRY	DRY	DRY	DRY	430.22	430.25	430.25	430.21	430.21	430.20	430.21	430.20
BH/MW 3	mbgs		5.88	5.84	5.85	5.41	5.39	5.57	5.82	5.97	5.83	5.84	5.86	5.87
	masl	434.20	428.32	428.36	428.35	428.79	428.81	428.63	428.38	428.23	428.37	428.36	428.34	428.33
BH/MW 4	mbgs		DRY	3.88	3.90	4.23	3.56	3.90	3.79	4.64	3.60	3.62	3.64	3.63
	masl	427.70	DRY	423.82	423.80	423.47	424.14	423.80	423.91	**423.06**	424.10	424.08	424.06	424.07
BH/MW 5	mbgs		4.94	4.90	4.80	2.88	2.26	3.13	4.03	4.26	4.28	4.29	4.29	4.30
	masl	433.90	428.96	429.00	429.10	431.02	431.64	430.77	429.87	429.64	429.62	429.61	429.61	429.60
BH/MW 6	mbgs		3.17	2.75	2.96	1.61	1.52	1.57	1.93	2.12	2.38	2.40	2.42	2.44
	masl	443.50	440.33	440.75	440.54	441.89	**441.98**	441.93	441.57	441.38	441.12	441.10	441.08	441.06
BH/MW 7	mbgs		DRY	DRY	6.17	6.17	DRY	6.18	6.18	6.22	6.17	6.18	6.18	6.19
	masl	442.40	DRY	DRY	436.23	436.23	DRY	436.22	436.22	436.18	436.23	436.22	436.22	436.21
BH/MW 8	mbgs		Dry	5.54	5.93	5.85	5.92	5.91	5.94	5.92	5.94	5.95	5.95	5.96
	masl	434.30	Dry	428.76	428.37	428.45	428.38	428.39	428.36	428.38	428.36	428.35	428.35	428.34
BH/MW 9	mbgs		DRY	DRY	4.35	3.90	3.87	4.15	4.17	4.18	4.18	4.20	4.22	4.21
	masl	437.70	DRY	DRY	433.35	433.80	433.83	433.55	433.53	433.52	433.52	433.50	433.48	433.49
BH/MW 10	mbgs		5.83	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	masl	437.90	432.07	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
BH/MW 11	mbgs		3.85	3.88	3.68	2.96	2.88	3.21	3.45	3.57	3.57	3.58	3.59	3.61
	masl	435.60	431.75	431.72	431.92	432.64	432.72	432.39	432.15	432.03	432.03	432.02	432.01	431.99

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90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

APPENDIX 'C'

SINGLE WELL RESPONSE TEST RESULTS

REFERENCE NO. 2206-W054

Falling Head Test (Slug Test)

Test Date:		05-Jan-23	
Piezometer/Well No.:		BH/MW 4	
Ground level:		427.61	m
Screen top level:		424.51	m
Screen bottom level:		421.51	m
Test El. (at midpoint of screen):		423.01	m
Test depth (at midpoint of screen):		4.6	m
Screen length	L=	3.1	m
Diameter of undisturbed portion o	2R=	0.22	m
Standpipe diameter	2r=	0.05	m
Initial unbalanced head	Ho=	-0.0513	m
Initial water depth		3.88	m
Aquifer material:		**Gravelly Sand**	

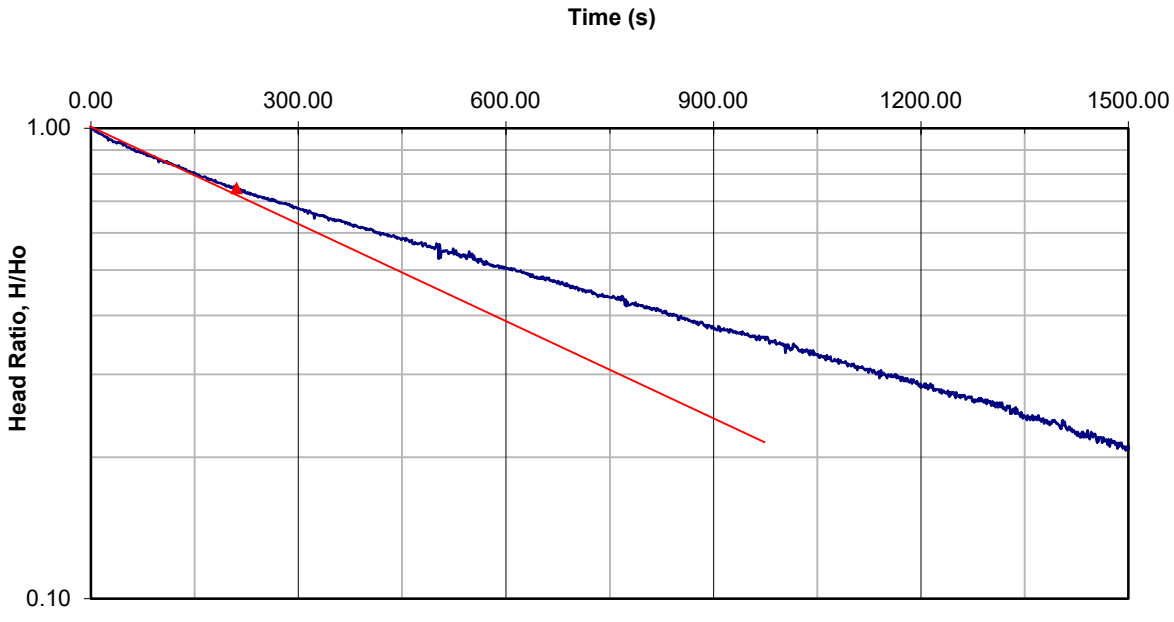
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.83401$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.00155954$

K= **5.2E-05** cm/s

5.2E-07 m/s



Falling Head Test (Slug Test)

Test Date:		05-Jan-23	
Piezometer/Well No.:		BH/MW 6	
Ground level:		443.49	m
Screen top level:		441.89	m
Screen bottom level:		438.89	m
Test El. (at midpoint of screen):		440.39	m
Test depth (at midpoint of screen):		3.1	m
Screen length	L=	3.1	m
Diameter of undisturbed portion o	2R=	0.22	m
Standpipe diameter	2r=	0.05	m
Initial unbalanced head	Ho=	-0.0614	m
Initial water depth		2.75	m
Aquifer material:		**Sandy Silt and Sandy Gravel**	

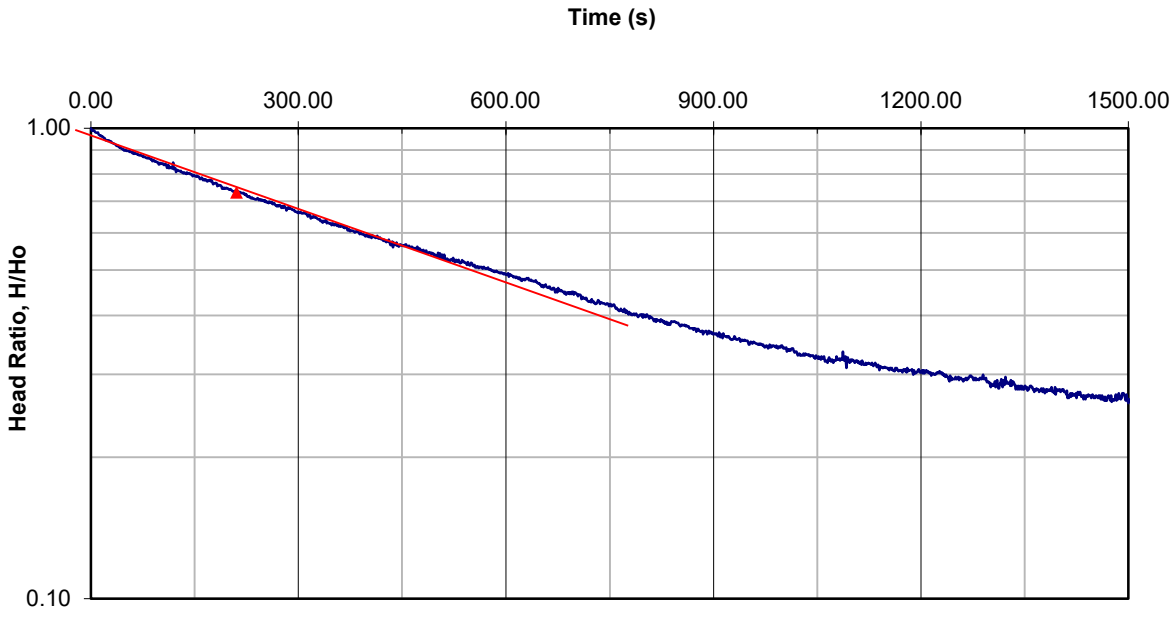
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.83401$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.00169306$

K= **5.7E-05** cm/s

5.7E-07 m/s



Falling Head Test (Slug Test)

Test Date:		05-Jan-23	
Piezometer/Well No.:		BH/MW 11	
Ground level:		435.49	m
Screen top level:		432.39	m
Screen bottom level:		429.39	m
Test El. (at midpoint of screen):		430.89	m
Test depth (at midpoint of screen):		4.6	m
Screen length	L=	3.1	m
Diameter of undisturbed portion (	2R=	0.22	m
Standpipe diameter	2r=	0.05	m
Initial unbalanced head	Ho=	-0.081	m
Initial water depth		3.88	m
Aquifer material:		**Sand and Silt**	

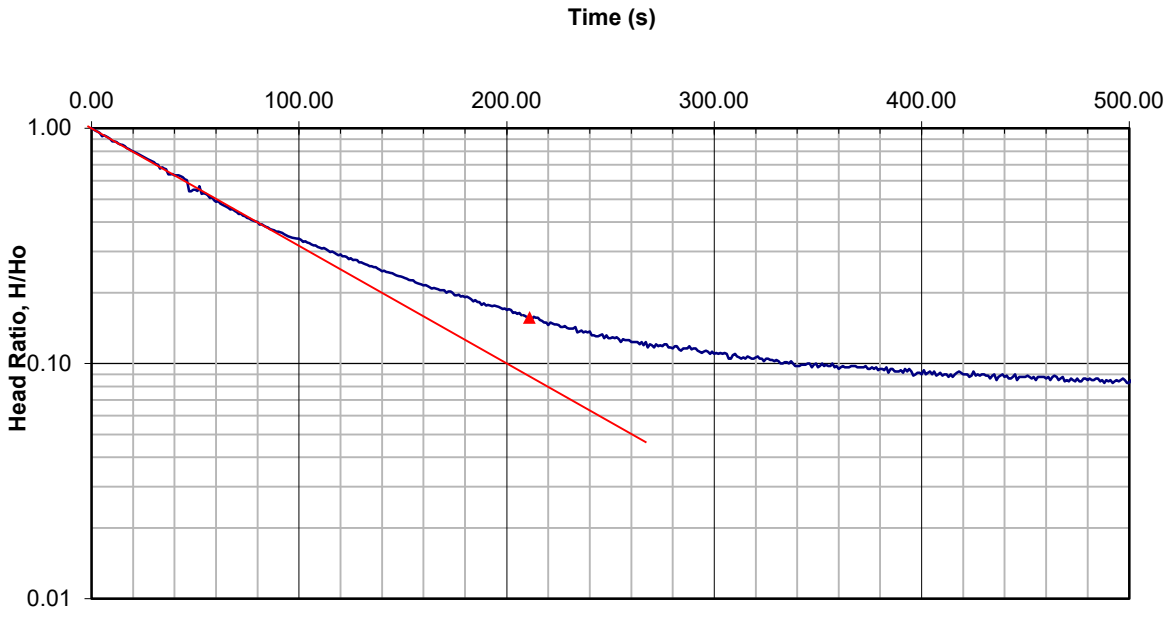
Shape factor $F = \frac{2 \times 3.14 \times L}{\ln(L/R)} = 5.83401$ m

Permeability $K = \frac{3.14 \times r2}{F \times (t2 - t1)} \times \ln(H1/H2)$ (Bouwer and Rice Method)

$\frac{\ln(H1/H2)}{(t2 - t1)} = 0.0111357$

K= **3.7E-04** cm/s

3.7E-06 m/s



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BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

APPENDIX 'D'

SHORT_TERM DEWATERING FLOW RATE CALCULATION

REFERENCE NO. 2206-W054

Dewatering Calculations 63 and 63A Trafalgar Rd, Erin-Services

Dewatering Rate Formula for an Unconfined Aquifer (Powers et al., 2007):

$$Q = \frac{\pi K (H^2 - h^2)}{\ln(R_0 / r_s)} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

Where:

- Q = Anticipated pumping rate (m^3/day)
- K = Hydraulic Conductivity (m/day)
- H = Initial Hight of static groundwater level to bottom of the saturated aquifer (m)
- h = Depth of water in the well while pumping (m)
- R_0 = Distance from a point of greatest drawdown to a point where there is no drawdown (Radius of influence) (m)
- r_s = Distance to the wellpoints from the centre of the trench (m), assumed to be half of the trench width
- x = Trench Length (m)
- L = Distance from a line source to the trench, R_o (m)/2

Radius of Influence Formula (Bear, 1979):

$$R_0 = 2.45\sqrt{\frac{HK}{S_y}}\,t$$

Where:

- R_0 = Radius of Influence (m), beyond which there is negligible drawdown
- 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)

Dewatering Area	Units	Area 3					Area 4			Area 5	Area 7		Area 8		Area 9
Manholes		MH.11A-MH.26A	MH.26A-MH.44A	MH.26A-MH.40A	MH.28A-MH.7A	MH.25A-MH.8A	MH.33A-MH.37A	MH.37A-MH.35A	MH.37A-MH.40A	MH.40A-MH41A	MH.62A-MH.68A	MH.68A-MH.67A	MH.88A-MH.89A	MH.89A-MH.95A	MH.91A-MH.H-MH-19
Q s.f. 1.5	**m^3/day**	226	159	30	178	191	103	98	318	103	51	51	26	80	125
Q	**m^3/day**	151	106	20	119	127	69	65	212	69	34	34	17	53	84
K	**m/day**	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
H	**m**	6.8	8.3	3.9	9.0	9.4	7.7	7.7	10.2	6.4	5.5	5.5	3.7	5.1	8.5
h	**m**	2.6	3.1	1.6	3.3	3.4	2.1	2.1	2.9	3.2	2.1	2.1	1.2	1.6	6.4
R_0	**m**	13.0	14.3	9.9	14.9	15.2	13.8	13.8	15.9	12.6	11.7	11.7	9.5	11.2	14.5
Trench width (b)	**m**	2	2	2	2	2	2	2	2	2	2	2	2	2	2
r_s	**m**	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
x (a)	**m**	270.0	135.0	80.0	135.0	135.0	90.0	85.0	190.0	150.0	80.0	80.0	70.0	140.0	215.0
L	**m**	6.5	7.2	4.9	7.4	7.6	6.9	6.9	7.9	6.3	5.8	5.8	4.8	5.6	7.2
	a/b	135.0	67.5	40.0	67.5	67.5	45.0	42.5	95.0	75.0	40.0	40.0	35.0	70.0	107.5

Parameter	Units	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
R_0	**m**	13.0	14.3	9.9	14.9	15.2	13.8	13.8	15.9	12.6	11.7	11.7	9.5	11.2	14.5
H	**m**	6.8	8.3	3.9	9.0	9.4	7.7	7.7	10.2	6.4	5.5	5.5	3.7	5.1	8.5
K	**m/s**	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06
S_y (Johnson,1967)		0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
t	**s**	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600	1209600

Dewatering Calculations 63 and 63A Trafalgar Rd, Erin-Lots and SWMP 2

Dewatering Rate Formula for an Unconfined Aquifer (Powers et al., 2007):

$$Q = \frac{\pi K (H^2 - h^2)}{\ln(R_0 / r_s)} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

Where:

Q = Anticipated pumping rate (m^3/day)
K = Hydraulic Conductivity (m/day)
H = Initial Hight of static groundwater level to bottom of the saturated aquifer (m)
h = Depth of water in the well while pumping (m)
R_0 = Distance from a point of greatest drawdown to a point where there is no drawdown (Radius of influence) (m)
r_s = Distance to the wellpoints from the centre of the trench (m), assumed to be half of the trench width
x = Trench Length (m)
L = Distance from a line source to the trench, R_o (m)/2

Dewatering Area	Units	Area 2	Area 3	Area 4		Area 8
Lots/SWMP		SWMP 1	Lots	Lots	Lots	Max
Q s.f. 1.5	**m^3/day**	35	23	4	65	11
Q	**m^3/day**	23	15	3	43	7
K	**m/day**	0.09	0.09	0.09	0.09	0.09
H	**m**	3.3	4.9	1.2	9.5	2.9
h	**m**	1.9	1.9	-0.1	3.5	0.9
R_0	**m**	9.0	11.0	5.5	15.4	8.5
Trench width (b)	**m**	100	8	8	8	8
r_s	**m**	50.0	4.0	4.0	4.0	4.0
x (a)	**m**	168.0	30.0	30.0	30.0	30.0
L	**m**	4.5	5.5	2.7	7.7	4.2
	a/b	1.7	3.8	3.8	3.8	3.8

Radius of Influence Formula (Bear, 1979):

$$R_0 = 2.45\sqrt{\frac{HK}{S_y}}t$$

Where:

R_0 = Radius of Influence (m), beyond which there is negligible drawdown
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	Units	Value	Value	Value	Value	Value
R_0	**m**	9.0	11.0	5.5	15.4	8.5
H	**m**	3.3	4.9	1.2	9.5	2.9
K	**m/s**	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06
S_y (Johnson,1967)		0.30	0.30	0.30	0.30	0.30
t	**s**	1209600	1209600	1209600	1209600	1209600