1544 & 1546 Four Mile Creek Road, Niagara-On-The-Lake, Ontario

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Hydrogeological Investigation

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Type of Document:
Preliminary

Project Name:
1544 & 1546 Four Mile Creek Road, Niagara-On-The-Lake, Ontario

Project Number:
HAM-24000672-A0

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Date Submitted:
2025-04-07

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1 Introduction

1.1 Project Description

EXP Services Inc. (EXP) was retained by Times Group Corp. to prepare a Hydrogeological Investigation Report associated with the proposed development located at 1544 & 1546 Four Mile Creek Road, Niagara-On-The-Lake, Ontario (hereinafter referred to as the 'Site').

The subject Site is located at 1544 and 1546 Four Mile Creek Road in Niagara-on-the-Lake, Ontario and is bound by Four Mile Creek Road to the east, residential dwellings to the south, reservoir to the west and slope down to the creek to the north. The subject Site is currently occupied by two single detached dwelling, one residential, the other a formerly commercial garage with associated driveway. It is understood that the project will include the construction of a 4-storey residential building and a 2 storey commercial building. Furthermore, the development will consist of one level of underground parking, occupying majority of the Site. The Site location plan is shown in Figure 1.

EXP conducted a Preliminary Geotechnical Investigation in conjunction with this investigation. The pertinent information gathered from the noted investigations is utilized for this report.

1.2 Project Objectives

The main objectives of the Hydrogeological Investigation are as follows:

- Establish the local hydrogeological settings within the Site;
- Provide recommendations on construction and long-term dewatering;
- Assess groundwater quality; and
- Prepare a Hydrogeological Investigation Report.

1.3 Scope of Work

To achieve the investigation objectives, EXP has completed the following scope of work:

- Review available geological and hydrogeological information, source water protection (WHPA, SGRA, HVA) for the Site
- Develop and conduct Single Well Response Tests (SWRT) on six (6) monitoring wells (three new, three from previous investigation) to evaluate hydraulic properties of the saturated soils at the Site
- Collect one (1) groundwater sample for laboratory testing of the Niagara Region Sewer Use By-Law Parameters
- Evaluate the information collected during the field investigation program, including borehole geological information, SWRT results, groundwater level measurements and groundwater water quality
- Evaluated the information collected during the field investigation program, including borehole geological information, Water Well Records (WWR), SWRT results, groundwater level measurements and groundwater water quality;
- Prepared Site plan, cross section, geological mapping and groundwater contour mapping for the Site;
- Provided preliminary recommendations on the requirements for construction and long-term dewatering;

- Provided recommendations on the Ministry of Environment, Conservation and Parks (MECP) Water Taking Permits and Niagara Region Sewer Discharge Agreements (SDA) for the construction and post-construction phases; and,
- Prepared a Hydrogeological Investigation Report

The Hydrogeological Investigation was prepared in accordance with the Ontario Water Resources Act, and Ontario Regulation 387/04. The scope of work outlined above was made to assess dewatering and included a review of Environmental Site Assessments (ESA).

1.4 Review of Previous Reports

The following reports were reviewed as part of this Hydrogeological Investigation:

- EXP Services Inc. (December 6, 2024), Preliminary Geotechnical Investigation, 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, ON, prepared for Mr. Stephen Aghaei.
- Paterson Group (November 17, 2023), Phase I-II Environmental Site Assessment, 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, ON, prepared for Andres Bell Construction Ltd.

Any past and/or future geotechnical, hydrogeological, environmental and risk assessments, and updated development/architectural plans should be provided to update/include in the hydrogeological report which will be used for submission of permits and approvals by the municipalities and agencies. This report was based on information provided by the Client, and it is understood that this information is accurate and complete and EXP can rely on such information and is not responsible for any conclusions derived from this information.

2 Hydrogeological Setting

2.1 Regional Setting

2.1.1 Regional Physiography

The Site is located within a physiographic region named the Iroquois Plain. The physiographic landform is known as the Clay Plains on the southwest portion of the Site, and Sand Plains on the northeast portion of the Site. The Niagara Escarpment lies along the south of the Iroquois Plain (Chapman & Putnam, 2007). The Iroquois Plain was created along the shores of former Lake Iroquois, an ancient glacial lake. The noted Plain primarily consists of shallow water sandy deposits. The topography of the Iroquois Plain is relatively flat with a gradual slope to the south, toward Lake Ontario.

2.1.2 Regional Geology and Hydrogeology

The surficial geology can be described as glaciolacustrine-derived silty to clayey till along the east portion of the Site, and modern alluvial deposits to the west of the Site in the Reservoir and along Four Mile Creek. (Ministry of Northern Development and Mines, 2012). The surficial geology of the Site and surrounding areas is shown on Figure 2C. Groundwater across the area flows northeast, towards Four Mile Creek and Lake Ontario. Local deviation from the groundwater flow pattern may occur in response to changes in topography and/or soils, as well as the presence of surface water features and/or existing subsurface infrastructure. The bedrock formation underlying the Site belongs to the Queenston Formation, consisting of shale, limestone, dolostone, and siltstone. The overburden thickness is approximately 20 m.

2.1.3 Existing Water Well Survey

Water Well Records (WWRs) were compiled from the database maintained by the Ministry of the Environment, Conservation and Parks (MECP) and reviewed to determine the number of water wells documented within a 500-m radius of the Site boundaries. The locations of the MECP WWRs within 500 m of the Site are shown in Figure 3. A summary of the WWR is included in Appendix A.

The MECP WWR database indicates that ten (10) records within a 500 m radius from the Site centroid (Figure 3 and Appendix A). Well distances are calculated relative to the Site centroid, therefore some distances in Appendix A exceed 500 m.

All offSite wells were reportedly identified as monitoring wells/test holes (2), water supply wells (3), abandoned wells (3) and/or listed with unknown use (2).

The Well Identification Number (Well ID No.) of the offSite water supply wells are 3801064, 3801065, and 3801077. These wells are located 258 m to 556 m from the Site centroid. The reported water levels ranged from depths of 2.13 m to 23.47 meters below ground surface (mbgs). Based on the date of installation of the water supply wells (1950 and 2x 1951) and since the area is municipally serviced, it is unlikely that the noted water supply well is still active.

2.2 Site Setting

2.2.1 Site Topography

The Site is in a residential area. The topography is considered relatively flat with a slope down to the Lower Virgil Reservoir to the west and the Four Mile Creek to the north. The surface elevation of the Site ranges between approximately 92.40 to 92.70 meters above sea level (masl).

2.2.2 Local Surface Water Features

The Site is located within the West Lake Ontario Shoreline watershed. No surface water features exist onsite. The nearest surface water feature is Lower Virgil Reservoir, approximately located 40 meters south of the Site boundary. The Virgil Dams were

designed in 1966 with the sole purpose of creating a source of irrigation water for the local fruit growers. Lake Ontario is approximately 4.5 km from the Site boundary to the north.

2.2.3 Local Geology and Hydrogeology

A summary of subsurface soil stratigraphy is provided in the following paragraphs. The soil descriptions are based on the geotechnical investigation report (EXP, December, 2024). They are summarized for the hydrogeological interpretations. As such, the information provided in this section shall not be used for construction design purposes.

The detailed soil profiles encountered in each borehole and the results of moisture content determinations are presented on the attached borehole logs (Appendix B). The soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the Hydrogeological Investigation and shall not be interpreted as exact planes of geological change.

The "Notes on Sample Description" preceding the borehole logs form an integral part of and should be read in conjunction with this report. The following is a brief description of the soil conditions encountered during the investigation.

Based on the results of the geotechnical investigation, the general subsurface soil stratigraphy consists of the following units from top to bottom:

Granular Fill
Boreholes BH-1 and BH-6 were advanced in the gravel driveway and encountered approximately 250 and 450 mm of granular fill. Borehole BH-7 encountered approximately 200 mm of granular fill beneath the surficial topsoil layer. The granular fill typically consisted of crushed limestone.

Topsoil
Surficial topsoil was encountered at Boreholes BH-2, BH-3, BH-4, BH-5, and BH-8. The topsoil was noted to have a thickness of approximately 50 to 150 mm. It is noted that topsoil thicknesses may further vary across the courtyard area.

Fill
A layer of fill was encountered below the surficial topsoil/granular in all boreholes, except for Boreholes BH-2 and BH-3, extending to depths of 0.8 to 9.1 m below grade. The fill consisted of silty clay, gravelly sand, silty sand, or sandy silt; was brown, dark brown, or grey; and was in a moist to wet state, with moisture contents ranging from 5 to 105%. The fill was noted to contain trace organics, trace wood, brick, and asphalt fragments, and deleterious materials.

Silty Clay
Native silty clay was encountered below the fill or topsoil at each of the borehole locations, except for BH-1, extending to the borehole termination at 8.2 to 9.8 m below grade. The silty clay contained trace sand and gravel, was brown, or grey and in a moist to wet state. Moisture contents of the stratum ranged from 10 to 34% and SPT N values ranged from 3 to 37 blows per 305 mm of penetration. Based on estimated undrained shear strengths from pocket penetrometer measurements ranging from 25 kPa to greater than 225 kPa, the stratum is classified as firm to hard in consistency. The silty clay stratum was typically noted to become weaker with depth.

Sandy Silt Till
Native sandy silt till was encountered below the fill in Borehole BH-1, extending to the borehole termination depth of 11.3 m below grade. The sandy silt till contained some clay, trace gravel, was brown, and in a moist state. Moisture contents of the stratum is 10% and SPT N values ranged from 20 to 24 blow per 305 mm of penetration, indicating that the stratum is generally compact.

The borehole and monitoring well locations are shown in Figure 4. The geological cross-section was generated based on the available borehole logs completed as part of the previous and current investigations and is shown in Figure 5 (Cross section A-

A'). The cross section shows a simplified representation of soil conditions and soil deposits may be interconnected differently than represented. Borehole logs used to generate the cross-section are provided in Appendix B.

3 Results

3.1 Monitoring Well Details

The monitoring well network was installed as part of the Geotechnical and Environmental Investigations at the Site. It consists of the following:

- Three (3) shallow overburden monitoring wells (BH/MW 3, BH/MW 4, and BH/MW 7) were installed as part of the current investigation;
- Three (3) shallow overburden monitoring wells (BH/MW 1-23, BH/MW 2-23, and BH/MW 5-23) were installed as part of the previous investigation by Patterson Group;

The diameter of all monitoring wells is 50 mm. Three wells were installed with monument protective casings (stick ups) for current investigations. Previous wells were installed with flush mount protective casings. Borehole logs and monitoring well installation details are provided in Appendix B. The monitoring well locations are shown in Figure 4.

3.2 Water Level Monitoring

As part of the Hydrogeological Investigation, static water levels in the monitoring wells installed outside of the existing building were recorded in two (2) monitoring events: October 25 and November 5, 2024. A summary of all static water level data as it relates to the elevation survey is given in Table 3-1 below.

The groundwater elevation recorded in the intermediate wells ranged from 85.83 masl to 91.93 masl.

Table 3-1: Summary of Measured Groundwater Elevations

Monitoring Well ID	Ground Surface Elevation (masl)	Stick Up (m)	Approximate Full Well Depth – as per BH Log (mbgs)	Depth	25-Oct-24	05-Nov-24
BH3	92.54	0.69	7.60	mbTOP	7.16	7.40
				mbgs	6.47	6.71
				masl	86.07	85.83
BH4	92.60	0.67	7.53	mbTOP	1.47	1.44
				mags	0.80	0.77
				masl	91.80	91.84
BH7	92.43	0.78	7.82	mbTOP	5.81	6.22
				mbgs	5.03	5.44
				masl	87.40	86.99
BH1-23	92.64	0.00	4.66	mbTOP	0.74	0.71
				mags	0.74	0.71
				masl	91.90	**91.93**
BH2-23	92.53	0.00	7.69	mbTOP	2.27	6.26
				mbgs	2.27	6.26
				masl	90.26	86.27
BH5-23	92.72	0.00	7.05	mbTOP	1.57	3.76
				mags	1.57	3.76
				masl	91.15	88.96

A map was created for the Site to show groundwater contours of the water-bearing zone (Figures 6). Accordingly, the groundwater flow direction is interpreted to be north of the Site towards Four Mile Creek.

Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing water levels in the Lower Virgil Reservoir and climate conditions. This may also affect the direction and rate of flow. It is recommended to conduct seasonal groundwater level measurements to provide more information on seasonal groundwater level fluctuations.

3.3 Hydraulic Conductivity Testing

Six (6) Single Well Response Tests (SWRT's) were completed on monitoring wells on November 11, 2024. The tests were completed to estimate the saturated hydraulic conductivity (K) of the soils at the well screen depths utilizing data loggers, preprogramed to take measurement on (time in sec/ half sec/minutes) intervals.

The static water level within each monitoring well was measured prior to the start of testing. In advance of performing SWRTs, each monitoring well underwent development to remove fines introduced into the screens following construction. The development process involved purging of the monitoring wells to induce the flow of fresh formation water through the screen. Each monitoring well was permitted to fully recover prior to performing SWRTs.

Hydraulic conductivity values were calculated from the SWRT and constant rate test data as per Hvorslev's solution included in the Aqtesolv Pro. V.4.5 software package. The semi-log plots for normalized drawdown versus time are included in Appendix C.

A summary of the hydraulic conductivities (K-values) estimated from the SWRTs are provided in Table 3-2.

Table 3-2: Summary of Hydraulic Conductivity Testing

Monitoring Well	Well Depth (mbgs)	Screen Interval (mbgs)		Soil formation Screened	Estimated Hydraulic Conductivity (m/s)
		from	to		
BH3	3.47	5.2	8.2	Silty Clay - some sand	5.1E-10
BH4	3.47	6.7	8.2	Silty Clay - some sand	1.5E-6
BH7	7.82	4.82	7.82	Silty Clay	1.2E-8
BH1-23	4.66	3.16	4.66	Silty Clay - some sand	6.2E-6
BH2-23	7.69	4.69	7.69	Silty Clay	5.1E-9
BH5-23	7.05	5.55	7.05	Silty Clay	3.6E-9
				Highest Estimated K Value	6.2E-6
				Arithmetic Mean of Estimated K values	1.3E-6
				Geometric Mean of Estimated K values	3.2E-8

SWRTs provide K-estimates of the geological formation surrounding the well screens and may not be representative of bulk formation hydraulic conductivity. As shown in Table 3-2, the highest K-value of the tested water-bearing zone is 6.2E-6 m/s, and the arithmetic mean and geometric mean of the K-values are 1.3E-6 m/s and 3.2E-8 m/s respectively.

3.4 Groundwater Quality

To assess the suitability for discharging pumped groundwater into the sewers owned by the Region of Niagara during dewatering activities, one (1) groundwater sample was collected from selected monitoring well (BH4) using a peristaltic pump. Prior to collecting the noted water sample, approximately three (3) standing well volumes of groundwater were purged from the referred well. The sample was collected unfiltered and placed into pre-cleaned laboratory-supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample handling. The

groundwater sample was submitted for analysis to AGAT Laboratory, a CALA certified independent laboratory in Mississauga, Ontario. Analytical results are provided in Appendix D.

No parameters exceeded the Region of Niagara Sanitary and Combined Sewer Discharge Criteria. All reporting detection limits (RDLs) were below the Sewer Use By-Law parameter criteria of Table 1.

For the short-term dewatering system (construction phase), it is anticipated that TSS levels and some other parameters (for example, Total Metals) in the pumped groundwater may become elevated and exceed both, Sanitary and Storm Sewer Use By-Law limits. To control the concentration of TSS and associated metals, it is recommended that a suitable treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system. The specifications of the treatment system will need to be adjusted to the reported water quality results by the treatment contractor/process engineer.

For the long-term dewatering discharge to the sanitary sewer system (post-development phase) and based on the water quality test results, the water is suitable to be discharged without a treatment system.

The water quality results presented in this report may not be representative of the long-term condition of groundwater quality onsite. As such, regular water quality monitoring is recommended for the post-construction phase, as required by the Region of Niagara.

An agreement to discharge into the sewers owned by the Niagara Region will be required prior to releasing dewatering effluent.

The Phase Two Environmental Site Assessment Report(s) by Paterson Group (November 2023) was reviewed for more information on the groundwater quality conditions at the Site. Soil samples were submitted for analysis of a combination of metals, pH, PAHs, BTEX, and PHCs (F1-F4). One of the analyzed samples (BH1-SS3) was found to exceed acceptable Site standards for PHCs. All other results were found to comply with MECP Table 8 standards. Groundwater samples were recovered from the two of the three monitoring wells (BH1-23, and BH5-23) on October 5, 2023. No unusual visual or olfactory observations were noted during the groundwater sampling program. The groundwater samples were submitted to Paracel Laboratories for analysis of VOCs (including BTEX), PAHs, and PHC (F1-F4) parameters. All parameters analyzed were f in compliance with the selected MECP Table 8 standards.

4 Dewatering Assessment

4.1 Dewatering Flow Rate Estimate and Zone of Influence

The Dupuit-Forcheimer equation for radial flow to an excavation through an unconfined aquifer resting on a horizontal impervious surface was used to obtain a flow rate estimate. Dewatering flow rate is expressed as follows:

$$Q_w = \frac{\pi K(H^2 - h^2)}{Ln\left[\frac{R_o}{r_e}\right]}$$

$$r_e = \frac{a+b}{\pi} \qquad R_o = R_{cj} + r_e$$

Where:

Qw = Rate of pumping (m^3/s)
X = Length of excavation (m)
K = Hydraulic conductivity (m/s)
H = Hydraulic head beyond the influence of pumping (static groundwater elevation) (m)
h = Hydraulic head above the base of aquifer in an excavation (m)
R_0 = Radius of influence (m)
R_{cj} = Cooper-Jacob's radius of influence (m)
r_e = Equivalent radius (m)
a = Length of the excavation area (m)
b = Width of the excavation area (m)

It is expected that the initial dewatering rate will be higher to remove groundwater from within the overburden formation. The dewatering rates are expected to decrease once the target water level is achieved in the excavation footprint as groundwater will have been removed, primarily from storage, resulting in lower seepage rates into the excavation.

4.2 Cooper-Jacob's Radius of Influence

The radius of influence (Rcj) for the construction dewatering was calculated based on Cooper-Jacob's equation. This equation is used to predict the distance at which the drawdown resulting from pumping is negligible.

The estimated radius of influence due to pumping is based on Cooper-Jacob's formula as follows:

$$\mathrm{R}_{cj} = \sqrt{2.25KDt/s}$$

Where:

Ro = Cooper-Jacob's radius of influence (m)
D = Aquifer thickness (original saturated thickness) (m)
K = Hydraulic conductivity (m/s)
S = Storage coefficient
t = Duration of pumping (s)

4.3 Stormwater

Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. Therefore, the dewatering rates at the Site should also include removing stormwater from the excavation.

A 25 mm precipitation event was utilized for estimating the stormwater volume. The calculation of the stormwater volume is included in Appendix E.

The estimate of the stormwater volume only accounts for direct precipitation into the excavation. The dimensions of the excavation are considered in the dewatering calculations. Runoff which originated outside of the excavation's footprint is excluded and it should be directed away from the excavation.

During precipitation events greater than 25 mm (ex: 100-year storm), measures should be taken by the contractor to retain stormwater onsite in a safe manner to not exceed the allowable water taking and discharge limits, as necessary. A two (2) and a one hundred (100) year storm event over a 24-hour period are approximately 57.3 and 126.2 mm.

4.4 Results of Dewatering Rate Estimates

4.4.1 Construction Dewatering Rate Estimate

For this assessment, it was assumed that the proposed construction plans include an excavation with shoring extending to the Site boundaries. EXP should be retained to review the assumptions outlined in this section, should the assumed shoring design change.

Short-term (construction) dewatering calculations are presented in Appendix E.

Pits (elevator, sump pits) are assumed to have the same excavation depth and dewatering target as the main excavation; deeper pits may require localized dewatering and revised dewatering estimates.

Based on the assumptions provided in this report, the results of the dewatering rate estimate can be summarized as follows:

Table 4-1 Summary of Construction Dewatering Assumptions and Rate

Input Parameter	South - Native Soil	North - Fill	Units	Notes
Number of Subgrade Levels	One (1) Underground Level		-	
Ground Elevations	92.60		masl	Average elevation of monitoring wells onsite
Top of Slab Elevation	90.40		masl	Assumed to be 3.8 mbgs; Based on Site Section (Icke Brochu, 2024)
Lowest Footing Elevation	88.90		masl	Assumed to be approximately 1.5 m below the top of slab elevation
Excavation Area (Length x Width)	1,890 (42 x 45)	1,890 (42 x 45)	m^2 (m x m)	Approximate area (length x width) of Site for the proposed development
Short Term Dewatering				

Input Parameter	South - Native Soil	North - Fill	Units	Notes
With Safety Factor and Precipitation	51,000	324,000	L/day	Safety factor of 2 and 25 mm of precipitation
With Safety Factor without Precipitation	4,000	276,000	L/day	Safety factor of 2 and without precipitation
Without Safety Factor	49,000	185,000	L/day	Without precipitation
Long Term Dewatering				
With Safety Factor	1,000	70,000	L/day	Safety Factor of 1.5

The peak dewatering flow rates do not account for flow from utility beddings and variations in hydrogeological properties beyond those encountered during this investigation.

Local dewatering may be required for pits (elevator pits, sump pits, raft) and for localized areas with permeable, soft, or wet soil conditions. Local dewatering is not considered to be part of this assessment. However, the contractor should be ready to install additional system to manage such conditions. Dewatering estimates should be reviewed once the pit dimensions are available.

All grading around the perimeter of the excavation should be graded away from the shoring the systems and ramp/Site access to redirect runoff away from excavation.

The dewatering assumptions are based on using a shoring system without open cuts and sloped excavations.

If groundwater cutoff systems (ex: caisson walls, sheet piles) are installed, these should be designed for maximal hydrostatic pressure for shallow and deep water levels, without dewatering on the outer side of the groundwater cutoff. Soldier pile and lagging and caisson wall systems should be designed to account for shallow groundwater conditions and take into consideration that dewatering systems may not provide fully dewatered soil conditions.

If groundwater cutoff systems are used for decreasing long-term dewatering rates, these should be designed as permanent structures to cutoff groundwater inflow in the long-term. All perforations should be sealed permanently (ex: tiebacks, breaches, and cold joints) with no leakages and inspected. Fillers should extend into low permeability deposits (ex: sound bedrock or till) to cutoff groundwater from water bearing zones. Inspections should be conducted to confirm the depth of low permeability deposits along the shoring system and that fillers are keyed into low permeability soil deposits.

All grading around the perimeter of the construction Site should be graded away from the shoring the system.

The contractor is responsible for the design of the dewatering systems (depth of wells, screen length, number of wells, spacing sand pack around screens, prevent soil loss etc.) to ensure that dry conditions are always maintained within the excavation at all costs.

Dewatering should be monitored using dedicated monitoring wells within and around the perimeter of the excavation, and these wells should be monitored using manual measurements and with electronic data loggers; records should be maintained on Site to track dewatering progress. Discharge rates should be monitored using calibrated flow meters and records of dewatering progress, and daily precipitation as per MECP requirements should be maintained.

4.4.2 Post-Construction Dewatering Rate Estimate

It is our understanding that the development plan includes a permanent foundation sub-drain system that will ultimately discharge to the municipal sewer system if conventional footings are installed.

The long-term dewatering was based on the same equations as construction dewatering shown in Section 4.1.

The calculation for the estimated flow to the future sub-drain system (with no cutoff walls) is provided in Appendix E. The dewatering target for the foundation drainage system is taken at 0.5 m below the lowest slab elevation.

The foundation drain analysis provides a flow rate estimate. Once the foundation drain is built, actual flow rate measurements of the sump discharge will be required to confirm the estimated flow rate.

Based on the assumptions provided in this report, the estimated sub-drain discharge volumes are summarized in Appendix F. Seasonal and daily fluctuations are expected. These estimates may be affected by hydrogeological conditions beyond those encountered at this time, fluctuations in groundwater regimes, surrounding Site alterations, and existing and future infrastructures.

Intermittent cycling of sump pumps and seasonal fluctuation in groundwater regimes should be considered for pump specifications. A safety factor was applied to the flow rate to account for water level fluctuations due to seasonal changes.

These estimates assume that pits (elevator and/or sump pits) are made as watertight structures (without drainage), if their depths extend below the dewatering target, as previously stated. The dewatering assumptions are based on using shoring system without open cuts. Open cuts can act as preferential groundwater pathways in the long-term and cause foundation drainage volumes to increase.

The sub-drain rate estimate is based on the assumptions outlined in this report. Any variations in hydrogeological conditions beyond those encountered as part of this investigation may significantly influence the sub-drain discharge volumes.

4.5 MECP Water Taking Permits

4.5.1 Short-Term Discharge Rate (Construction Phase)

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering is more than 50,000 L/day but less than 400,000 L/day, then an online registration in the Environmental Activity and Sector Registry (EASR) with the MECP will be required. If groundwater dewatering rates onsite exceed 400,000 L/day, a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

As of July 1, 2021, an amendment of O. Reg. 63/16 has come into effect and replaced the former subsection 7 (5) such that the EASR water taking limit of 400,000 L/day would apply to groundwater takings of each dewatered work area only, excluding stormwater.

The dewatering estimate including a safety factor is between 50,000 L/day and 400,000 L/day as shown in Table 4-2. The MECP construction dewatering rate excludes the precipitation amount and is the rate used for the permit application. Based on the MECP construction dewatering an EASR will be required to facilitate the construction dewatering program of the Site.

A Discharge Plan (dewatering sketch, sewer discharge agreement) must be developed and applied for any discharges from the Site. Monitoring of both water quantity and water quality must be carried out for the entire duration of the construction dewatering phase. During this phase, the Discharge Plan and the daily water taking records must be available onsite.

The Discharge Plan, hydrogeological investigation report, and geotechnical assessment of settlements must also be available at the construction Site during the entire construction dewatering. EXP should be notified immediately about any changes to the construction dewatering schedule or design, since the EASR will need to be updated to reflect these modifications. Altogether,

the hydrogeological report, EASR, Discharge Plan and geotechnical assessment constitute the Water Taking Plan which needs to be available onsite during the construction dewatering.

4.5.2 Long-Term Discharge Rate (Post Construction Phase)

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering is more than 50,000 L/day, then an application for a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

Based on the dewatering estimate shown in Table 4-3 more than 50,000 L/day, a Category 3 Permit to Take Water (PTTW) will be required to facilitate the post-development phase.

The safety factor for construction (short-term) dewatering is selected larger than for long-term to account for anticipated greater groundwater volumes during initial dewatering. The applied analytical formula is adequate for long-term (steady state) conditions as it omits specific yield and time dependency. When the formula is used for short-term conditions a larger safety factor is recommended to cover a larger initial dewatering rate, which is required to remove stored groundwater. Moreover, a large initial construction dewatering rate is favorable, as it supports reducing the time to reach the dewatering target elevation.

5 Environmental Impact

5.1 Surface Water Features

The Site is located within the West Lake Ontario Shoreline watershed. No surface water features exist onsite. The nearest surface water feature is Lower Virgil Reservoir, approximately located 40 meters south of the Site boundary. The Virgil Dams were designed in 1966 with the sole purpose of creating a source of irrigation water for the local fruit growers. Lake Ontario is approximately 4.5 km from the Site boundary to the north.

Due to the limited extent of zone of influence and the distance to the nearest surface water feature, no detrimental impacts on surface water features are expected during construction activities.

5.2 Groundwater Sources

Well Records from the MECP Water Well Record (WWR) Database were reviewed to determine the presence and number of water supply wells within a 500 m radius of the Site boundaries. Given that no water supply wells exist within the 500 m buffer, no dewatering related impact on water supply wells is expected in the area.

5.3 Geotechnical Considerations

As per the MECP technical requirement for PTTW and EASRs, the geotechnical assessment of the stability of the soils due to water taking (ex: settlement, soil loss, subsidence, etc.) is required. The water taking should not have unacceptable interference on soils and underground structures (foundations, utilities, etc.).

A letter related to geotechnical issues as it pertains to the Site is required to be completed under a separate cover.

5.4 Groundwater Quality

It is our understanding that the potential effluent from the dewatering system during the construction will be released to the municipal sewer system. As such, the quality of groundwater discharge is required to conform the Niagara Region Sewer Use By-Law.

Dewatering (short and long-term) may induce migration of contaminants within the zone of influence and beyond due to changing hydraulic gradients, hydrogeological conditions beyond Site boundaries and preferential pathways in utility beddings etc. The water quality sampling conducted as part of this assessment was performed under static conditions. As a result, monitoring may be required during dewatering activities (short and long-term) to monitor potential migration, and this should be performed more frequently during early dewatering stages.

An agreement to discharge into the sewers owned by the Niagara Region will be required prior to releasing dewatering effluent. The Environmental Site Assessment Report(s) was reviewed for more information on the groundwater quality conditions at the Site.

5.5 Well Decommissioning

In conformance with Regulation 903 of the Ontario Water Resources Act, the installation and eventual decommissioning of any dewatering system wells or monitoring wells must be completed by a licensed well contractor. This will be required for all wells that are no longer in use.

6 Conclusions and Recommendations

Based on the findings of the Hydrogeological Investigation, the following conclusions and recommendations are provided:

- No parameters exceeded the Region of Niagara Sanitary and Combined Sewer Discharge Criteria. All reporting detection limits (RDLs) were below the Sewer Use By-Law parameter criteria of Tables 1 and 2.
- Based on the assumptions outlined in this report, the estimated peak dewatering rate for proposed construction activities is approximately 374,000 L/day. This is the rate which will be required to be discharged to the municipal sewer system.
- The estimated MECP dewatering rate for proposed construction activities is approximately 280,000 L/day. As the dewatering flow rate estimate is below 50,000 L/day, an EASR would not be required to facilitate the construction dewatering program for the Site.
- The construction dewatering and long-term estimate of sub-drain discharge volumes is based on the assumptions outlined in this report. Any variations in hydrogeological conditions beyond those encountered as part of this preliminary investigation may significantly influence the discharge volumes.
- For the short-term dewatering system (construction phase), it is anticipated that TSS levels and some other parameters (for example, Total Metals) in the pumped groundwater may become elevated and exceed both, Sanitary and Storm Sewer Use By-Law limits. To control the concentration of TSS and associated metals, it is recommended that a suitable treatment method be implemented (filtration or decantation facilities and/ or any other applicable treatment system) during construction dewatering activities to discharge to the applicable sewer system. The specifications of the treatment system will need to be adjusted to the reported water quality results by the treatment contractor/process engineer.
- As per the MECP technical requirement for PTTW and EASRs, the geotechnical assessment of the stability of the soils due to water taking (ex: settlement, soil loss, subsidence etc.) is required. The water taking should not have unacceptable interference on soils and underground structures (foundations, utilities etc.). A letter related to geotechnical issues as it pertains to the Site is required to be completed under a separate cover.
- The EASR registration allows construction dewatering discharge of up to 400,000 L/day. A Discharge Plan (dewatering sketch, sewer discharge agreement) must be developed and applied for any discharges from the Site. The Discharge Plan and monitoring for both water quantity and water quality must be carried at the Site during the entire construction dewatering phase. The daily water taking records must be maintained onsite for the entire construction dewatering phase. The EASR, Discharge Plan, hydrogeological investigation report, and geotechnical assessment of settlements must always also be available at the construction Site for the entire construction dewatering. EXP should be notified immediately about any changes to the construction dewatering schedule or design, since EASR will need to be updated to reflect these modifications. The hydrogeological report, EASR, Discharge Plan and geotechnical assessment constitutes the Water Taking Plan which needs to be available onsite for the duration of construction dewatering.
- The long-term flow rate of the foundation sub-drain is estimated to be approximately 71,000 L/day. It is recommended that once the sub-drain system is in place, a flow meter be installed at the sump(s) to record daily discharge volumes during the commissioning stage of the system. Regular maintenance/cleaning of the sub-drain system is recommended to ensure its proper operation.
- Based on the dewatering estimate shown in Table 4-3 more than 50,000 L/day, a Category 3 Permit to Take Water (PTTW) will be required to facilitate the post-development phase.
- For the long-term dewatering discharge to the sanitary sewer system (post-development phase) and based on the water quality test results, the water is suitable to discharge without a treatment system.
- An agreement to discharge into the sewers owned by the Niagara Region will be required prior to releasing dewatering effluent.

- In conformance with Regulation 903 of the Ontario Water Resources Act, the installation and eventual decommissioning of any dewatering system wells or monitoring wells must be completed by a licensed well contractor. This will be required for all wells that are no longer in use.

The conclusions and recommendations provided above should be reviewed in conjunction with the entirety of the report. They assume that the present design concept described throughout the report will proceed to construction. This report is solely intended for the construction and long-term dewatering assessments. Any changes to the design concept may result in a modification to the recommendations provided in this report.

7 Limitations

This report is based on a limited investigation designed to provide information to support an assessment of the current hydrogeological conditions within the study area. The conclusions and recommendations presented within this report reflect Site conditions existing at the time of the assessment. EXP must be contacted immediately, if any unforeseen Site conditions are experienced during construction activities. This will allow EXP to review the new findings and provide appropriate recommendations to allow the construction to proceed in a timely and cost-effective manner.

Our undertaking at EXP, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the geoscience/engineering profession. No other warranty or representation, either expressed or implied, is included or intended in this report.

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

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

Sincerely,

EXP Services Inc.

Nicolas Sabo, B.Sc., M.E.S.
Junior Project Manager
Environmental Services

Reinhard Zapata Blosa, P.Geo., Ph.D.
Senior Hydrogeologist, Hydrogeology
Environmental Services

8 References

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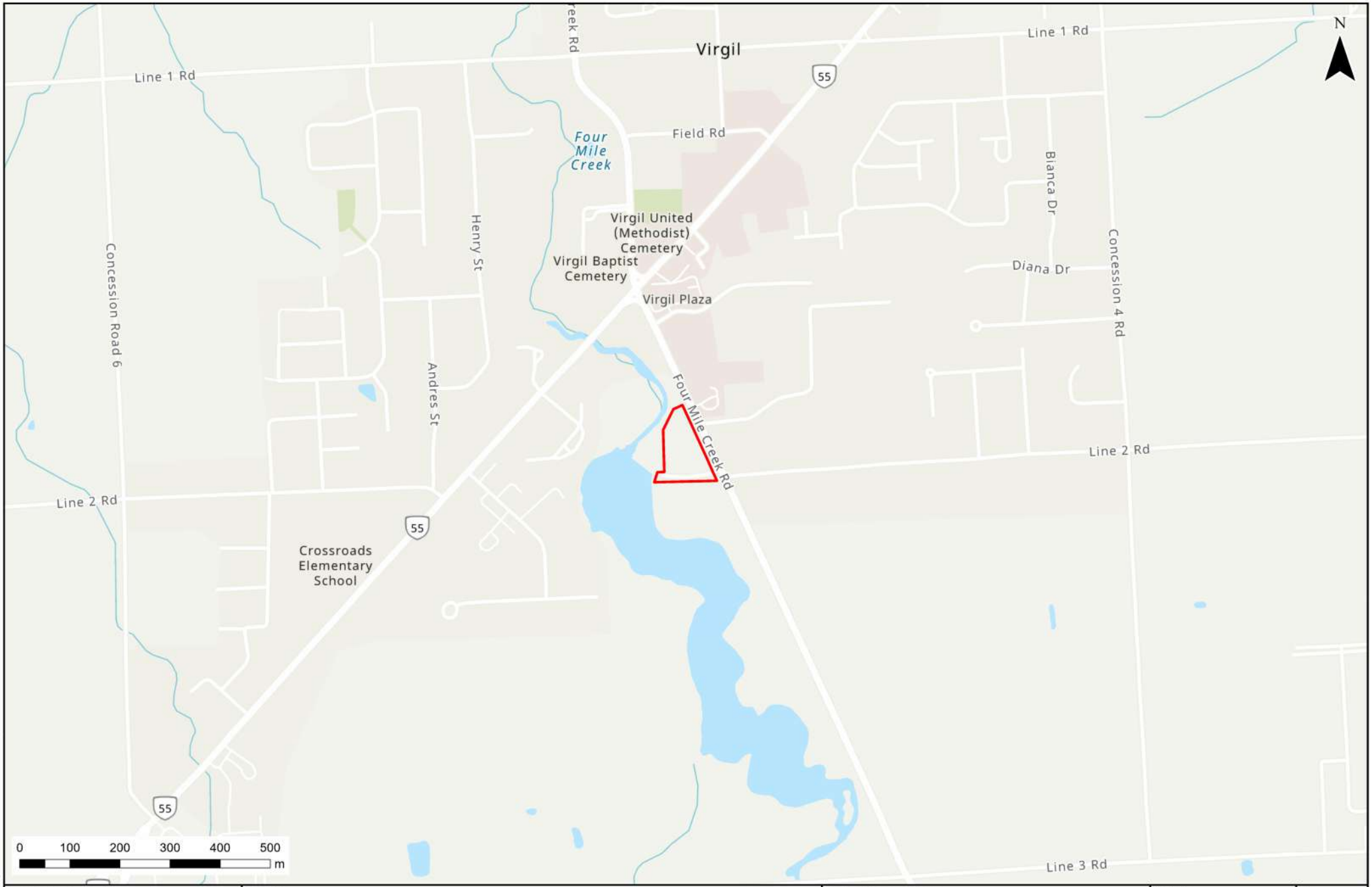
Figures



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LEGEND:
PROPERTY BOUNDARY

TITLE AND LOCATION:

SITE LOCATION PLAN
GEOTECHNICAL INVESTIGATION

1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.:	DWN:
HAM-24000672-A0	K.G.
SCALE: AS NOTED	CHKD: J.G.
DATE: NOVEMBER 2024	FIG. NO.: 1

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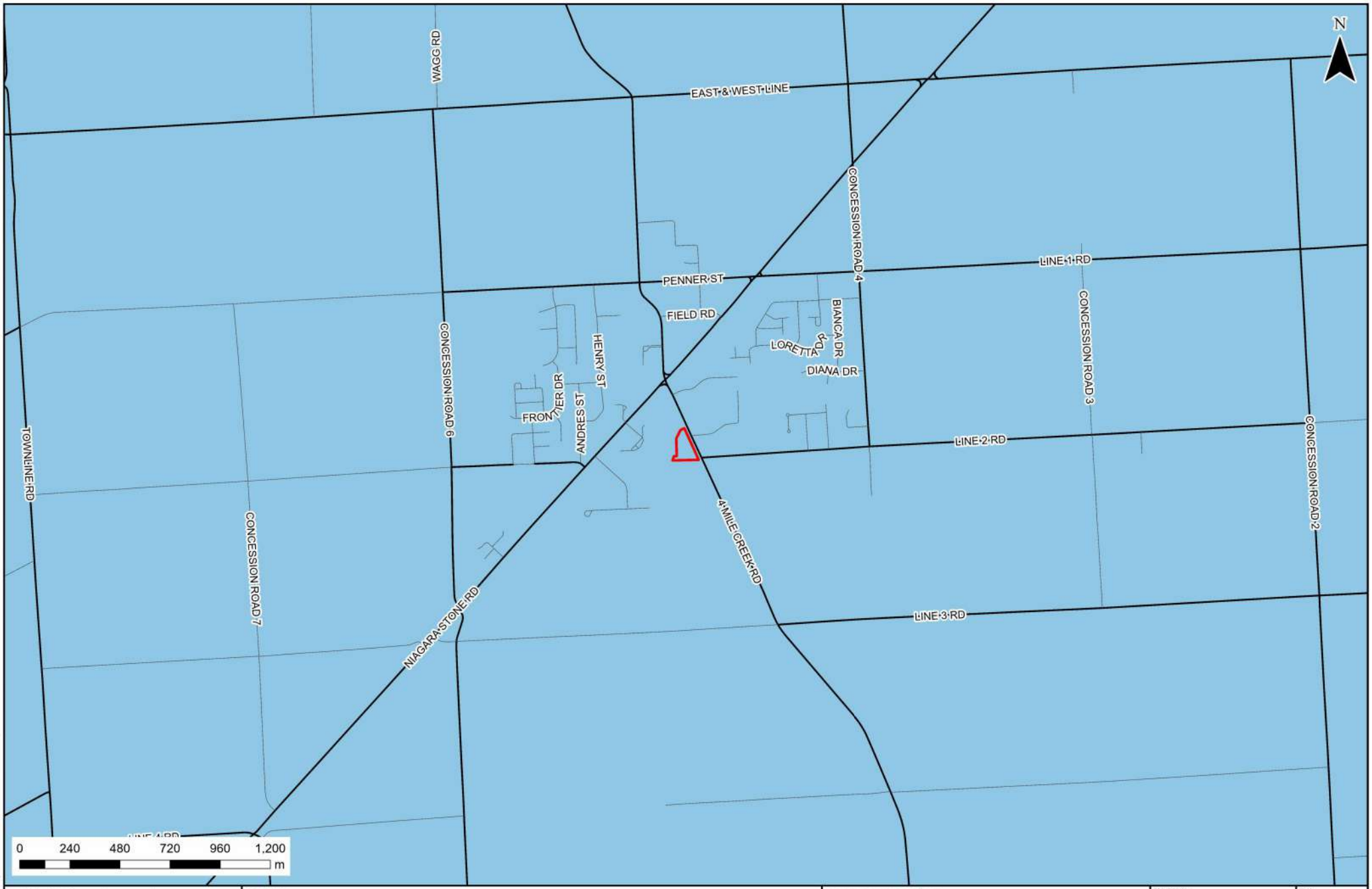

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LEGEND:

- PROPERTY BOUNDARY
- 41, IROQUOIS PLAIN

TITLE AND LOCATION:

GEOTECHNICAL INVESTIGATION
PHYSIOGRAPHIC REGIONS

1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.: HAM-24000672-A0	DWN: K.G.
SCALE: AS NOTED	CHKD: J.G.
DATE: NOVEMBER 2024	FIG. NO.: 2A

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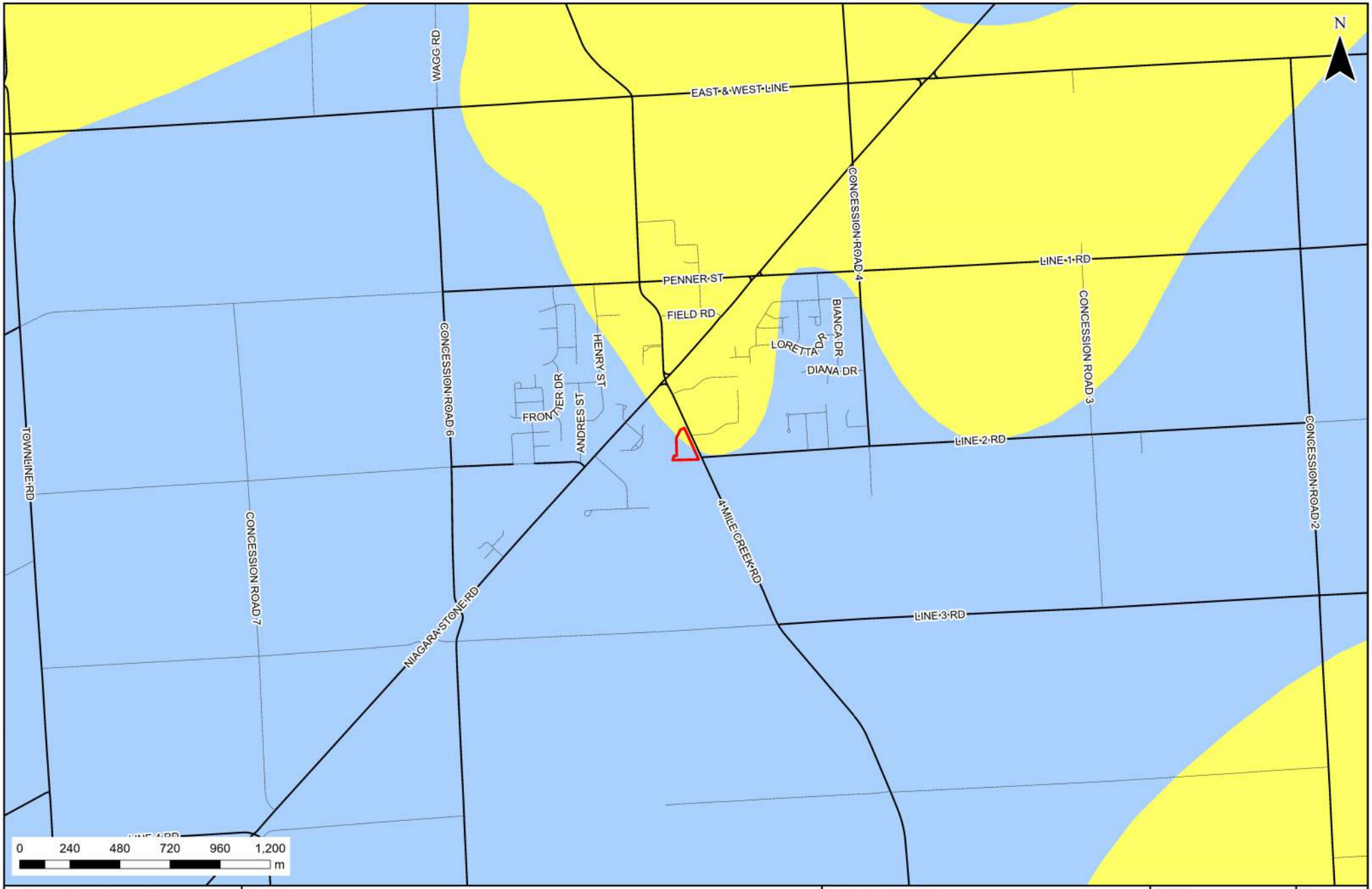

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LEGEND:

- PROPERTY BOUNDARY
- 12: Clay Plains
- 11: Sand Plains

TITLE AND LOCATION:

GEOTECHNICAL INVESTIGATION
PHYSIOGRAPHIC LANDFORMS

1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.: HAM-24000672-A0	DWN: K.G.
SCALE: AS NOTED	CHKD: J.G.
DATE: NOVEMBER 2024	FIG. NO.: 2B

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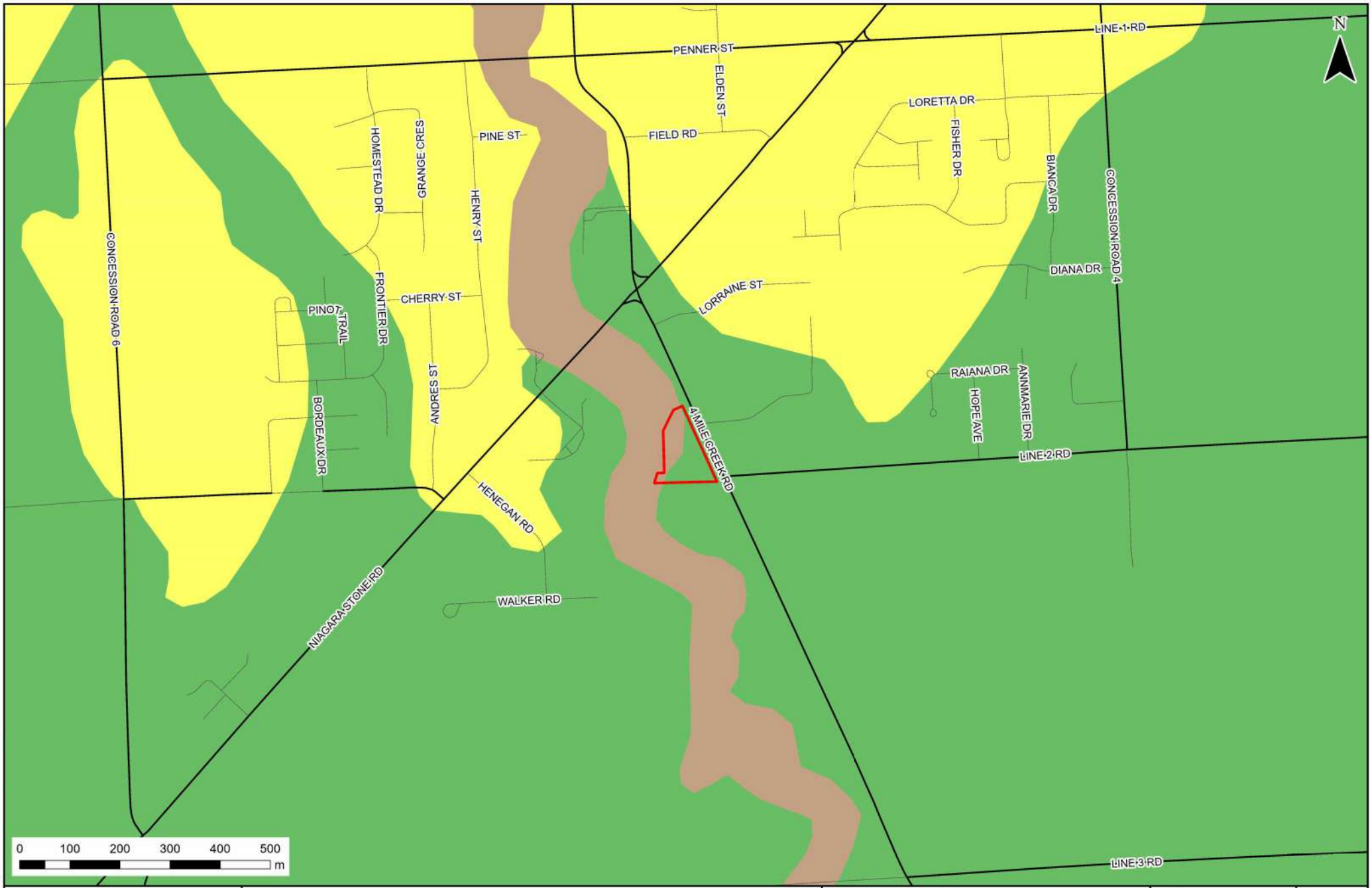

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LEGEND:

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- 5D: GLACIOLACUSTRINE-DERIVED SILTY TO CLAYEY TILL
- 9: COARSE-TEXTURED GLACIOLACUSTRINE DEPOSITS
- 19: MODERN ALLUVIAL DEPOSITS

TITLE AND LOCATION:

GEOTECHNICAL INVESTIGATION
SURFICIAL GEOLOGY

1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.:	DWN:
HAM-24000672-A0	K.G.
SCALE: AS NOTED	CHKD: J.G.
DATE: NOVEMBER 2024	FIG. NO.: 2C

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LEGEND:

- PROPERTY BOUNDARY
- 55a

TITLE AND LOCATION:

GEOTECHNICAL INVESTIGATION
BEDROCK GEOLOGY

1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.: HAM-24000672-A0	DWN: K.G.
SCALE: AS NOTED	CHKD: J.G.
DATE: NOVEMBER 2024	FIG. NO.: 2D

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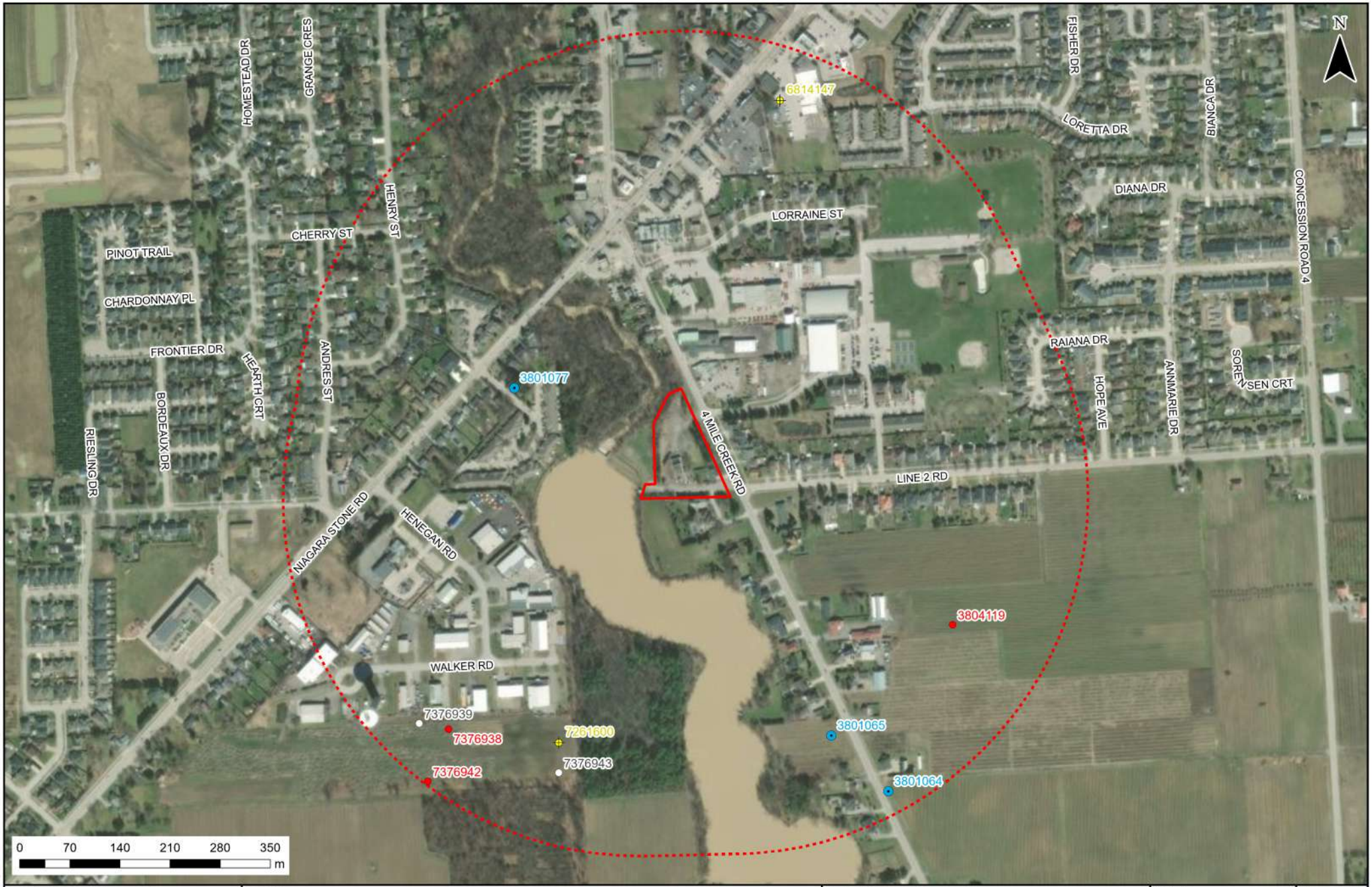

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LEGEND:

- PROPERTY BOUNDARY
- UNCLASSIFIED/UNFINISHED WELL
- ABANDONED-OTHER
- OBSERVATION WELLS; TEST HOLE
- WATER SUPPLY

TITLE AND LOCATION:

MECP WATER WELL
RECORDS MAP
GEOTECHNICAL INVESTIGATION
1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.: HAM-24000672-A0	DWN: K.G.
SCALE: AS NOTED	CHKD: J.G.
DATE: NOVEMBER 2024	FIG. NO.: 3

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LEGEND:

- PROPERTY BOUNDARY
- BOREHOLE LOCATION (EXP, 2024)
- MONITORING WELL LOCATION (PATTERSON GR. 2023)
- MONITORING WELL LOCATION (EXP, 2024)
- CROSS SECTION LINE

TITLE AND LOCATION:

BOREHOLE, MONITORING WELL LOCATION PLAN
GEOTECHNICAL INVESTIGATION
1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.: HAM-24000672-A0	DWN: K.G.
SCALE: AS NOTED	CHKD: J.G.
DATE: NOVEMBER 2024	FIG. NO.: 4

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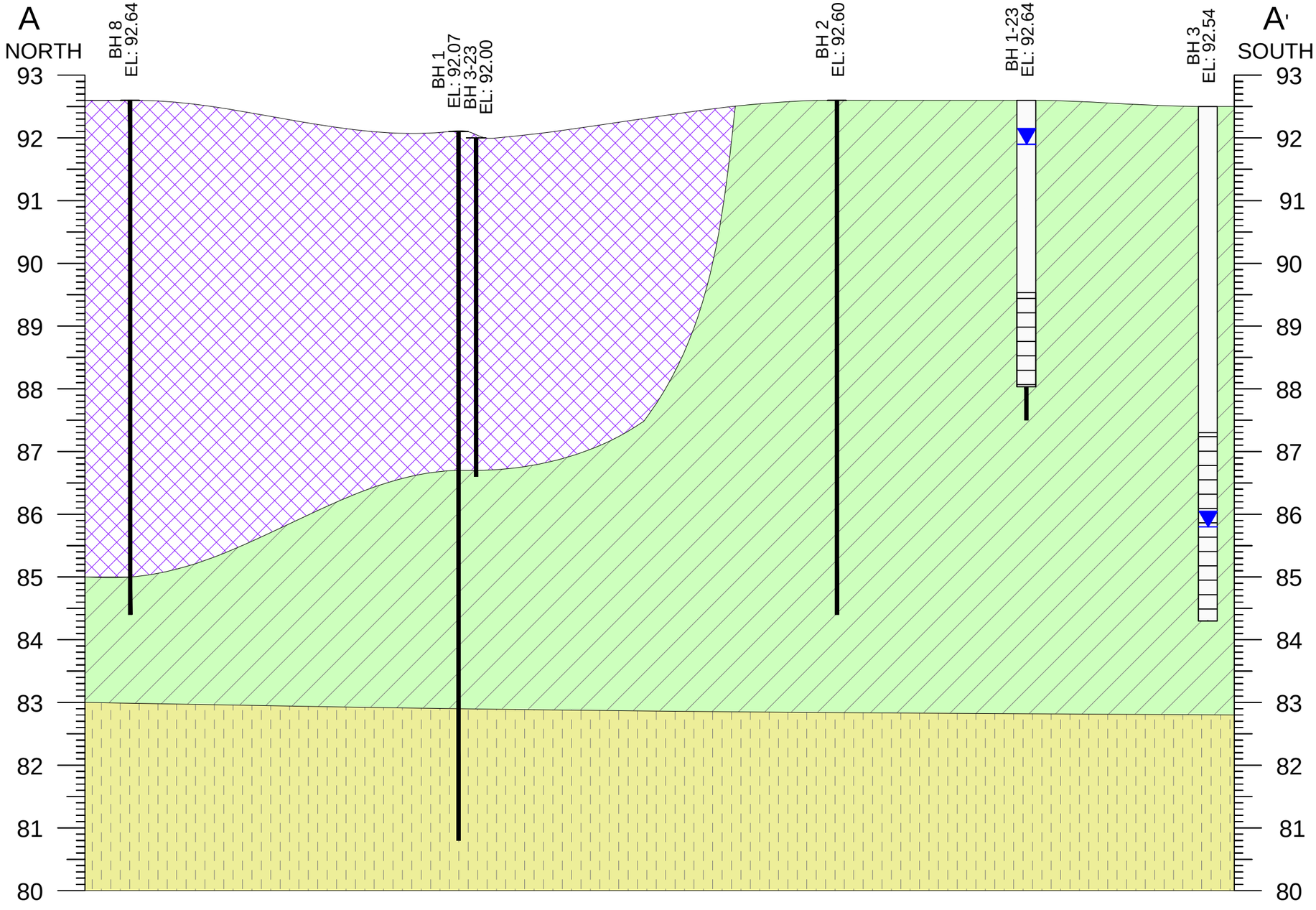

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LEGEND:

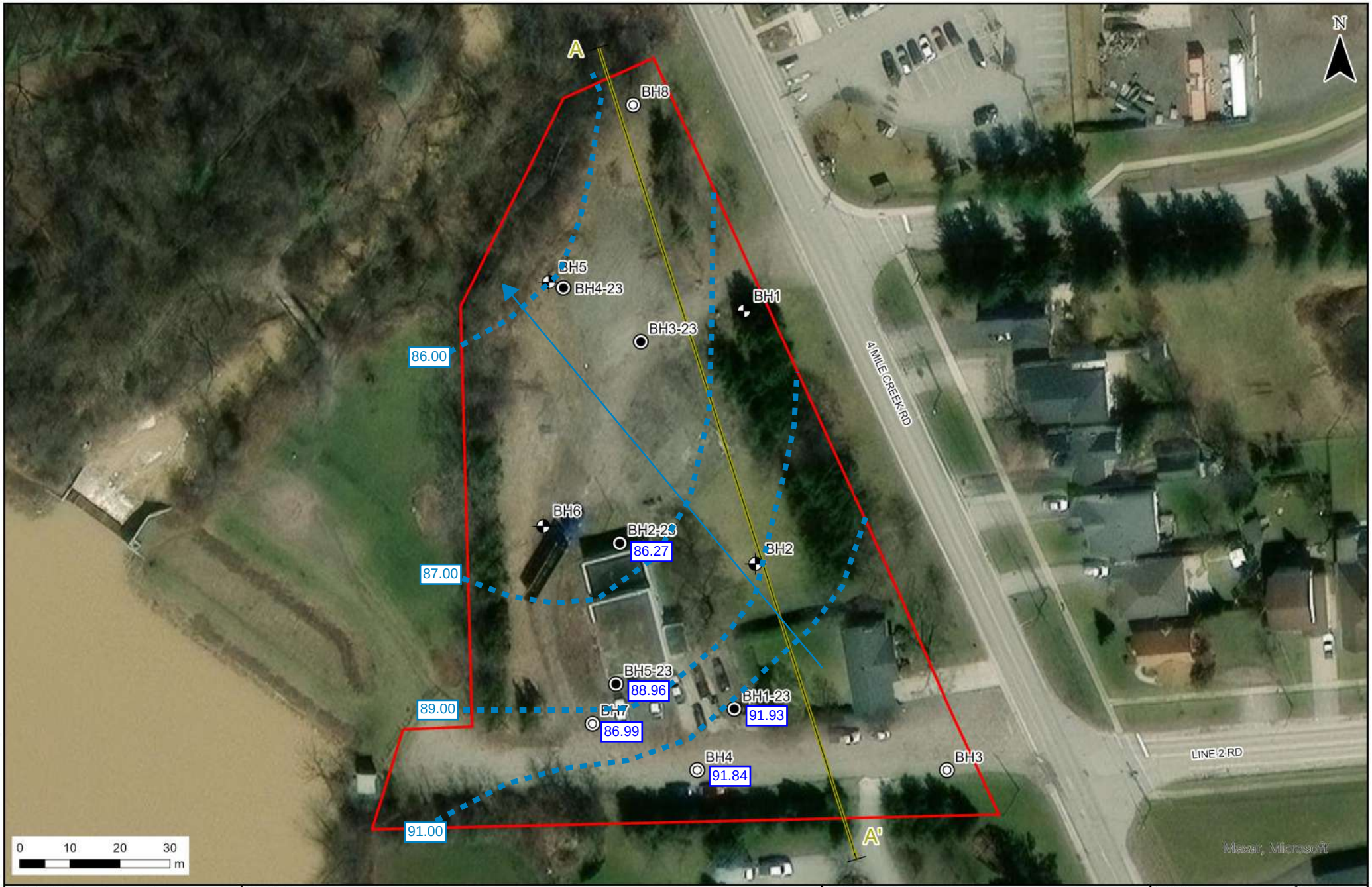
- FILL
- SILTY CLAY
- SANDY SILT TILL
- GROUNDWATER ELEVATION ON NOVEMBER 5, 2024

TITLE AND LOCATION:

CROSS SECTION A-A'

1544 & 1546 FOUR MILE CREEK ROAD,
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.:	DWN.:
HAM-24000672-A0	NS
SCALE:	CK:
AS NOTED	RZ
DATE:	FIG. NO.:
JANUARY 2025	5



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LEGEND:

- PROPERTY BOUNDARY
- BOREHOLE LOCATION (EXP, 2024)
- MONITORING WELL LOCATION (PATTERSON GR. 2023)
- MONITORING WELL LOCATION (EXP, 2024)
- CROSS SECTION LINE
- 86.99 GROUNDWATER ELEVATION (masl) AS MEASURED ON NOVEMBER 5, 2024

TITLE AND LOCATION:

GROUNDWATER CONTOUR PLAN GEOTECHNICAL INVESTIGATION

1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA-ON-THE-LAKE, ONTARIO

PROJECT NO.: HAM-24000672-A0	DWN: K.G.
SCALE: AS NOTED	CHKD: J.G.
DATE: NOVEMBER 2024	FIG. NO.: 6

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Appendix A – MECP WWR Summary Table

Off-Site															
BORE_HOLE_ID	WELL_ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	LOCATION ACCURACY	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	CONSTRUCTION METHOD	WELL DEPTH (m bgs)	WATER FOUND (m bgs)	CASING DIAMETER (cm)	1st USE	2nd USE	FINAL STATUS
10238848	3801064	1950-06-05	652821	4786301	93.3603973	unknown UTM			556	Cable Tool	23.5	23.46850014	15.24	Domestic		Water Supply
10238849	3801065	1951-07-09	652741	4786379	92.9657974	unknown UTM			449	Cable Tool	21.89999962	21.33499908	15.24	Domestic		Water Supply
10238861	3801077	1951-06-18	652298	4786865	92.8816986	unknown UTM			258	Cable Tool	16.79999924	16.76320076	15.24	Domestic		Water Supply
10545576	3804119	2003-09-05	652911	4786534	93.3300018	Lot centroid			444	Not Known	0	0	0	Not Used		Abandoned-Other
11179960	6814147	2004-09-15	652669	4787267	92.1212997	on Water Well Record	1551 NIAGARA STONE ROAD	VIRGIL	501	Boring	6.599999905	3	5	Not Used		Test Hole
1005933389	7261600	2016-02-03	652360	4786369	92.5789032	on Water Well Record	1313 NIAGARA STONE RD.	NIAGARA ON THE LAKE	451	Auger	7.599999905	0	2.54	Monitoring		Observation Wells
1008570886	7376939	2020-10-30	652165	4786396	92.2646027	on Water Well Record	1313 NIAGARA STONE RD	Niagara-on-the-Lake	540		0	2.133500099	0			
1008570895	7376942	2020-10-30	652177	4786315	92.4897003	on Water Well Record	1313 NIAGARA STONE RD	Niagara-on-the-Lake	593		0	4.266990185	0			Abandoned-Other
1008570898	7376943	2020-10-30	652360	4786327	92.8995972	on Water Well Record			490		0	4.266990185	0			
1008570883	7376938	2020-10-30	652206	4786388	92.4870987	on Water Well Record	1315 NIAGARA STONE ROAD	Niagara-on-the-Lake	518		0	0	0			Abandoned-Other

Appendix B – Borehole Logs

Log of Borehole BH-1

Project No. HAM-24000672-A0 Drawing No. 3

Project: Proposed Mixed-Use Development Sheet No. 1 of 1

Location: 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, Ontario

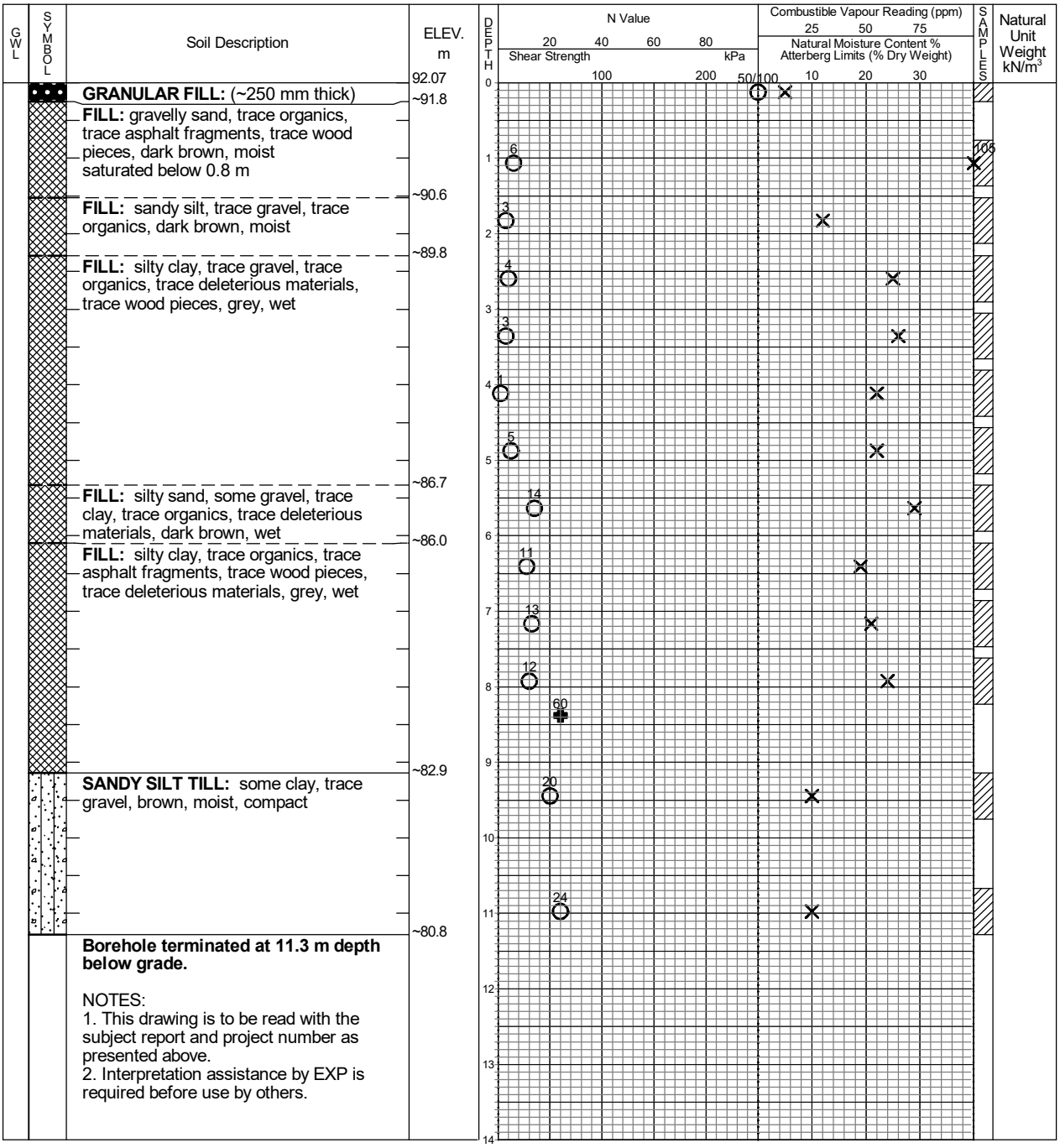
Date Drilled: September 25, 2024

Drill Type: D-50 Track Mount. Solid Stem.

Datum: Geodetic

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

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	7.6	7.3

Log of Borehole BH-2

Project No. HAM-24000672-A0 Drawing No. 4

Project: Proposed Mixed-Use Development Sheet No. 1 of 1

Location: 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, Ontario

Date Drilled: September 24, 2024

Drill Type: D-50 Track Mount. Solid Stem.

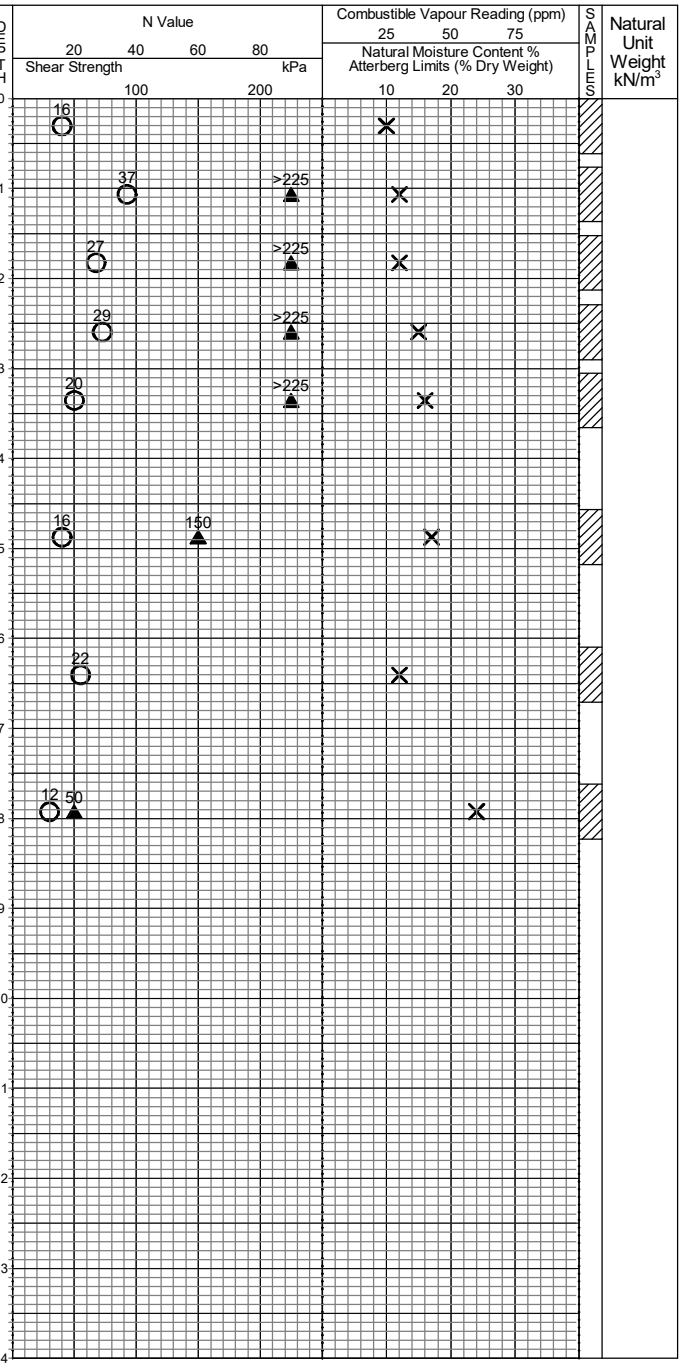
Datum: Geodetic

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

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m
	92.60
TOPSOIL: (~50 mm thick)	~92.6
SILTY CLAY: trace sand, trace gravel, brown, moist, hard	
very stiff below 4.5 m	
very moist silty sand layer at 6.1 m	
grey, very moist and stiff below 7.6 m	
	~84.4
Borehole terminated at 8.2 m depth below grade.	

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.



LAGWGLJFHAM-EXP BHLOGS 1541 FMC CR.GPJ NEW.GDT 11/1/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	open

Log of Borehole BH-3

Project No. HAM-24000672-A0 Drawing No. 5

Project: Proposed Mixed-Use Development Sheet No. 1 of 1

Location: 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, Ontario

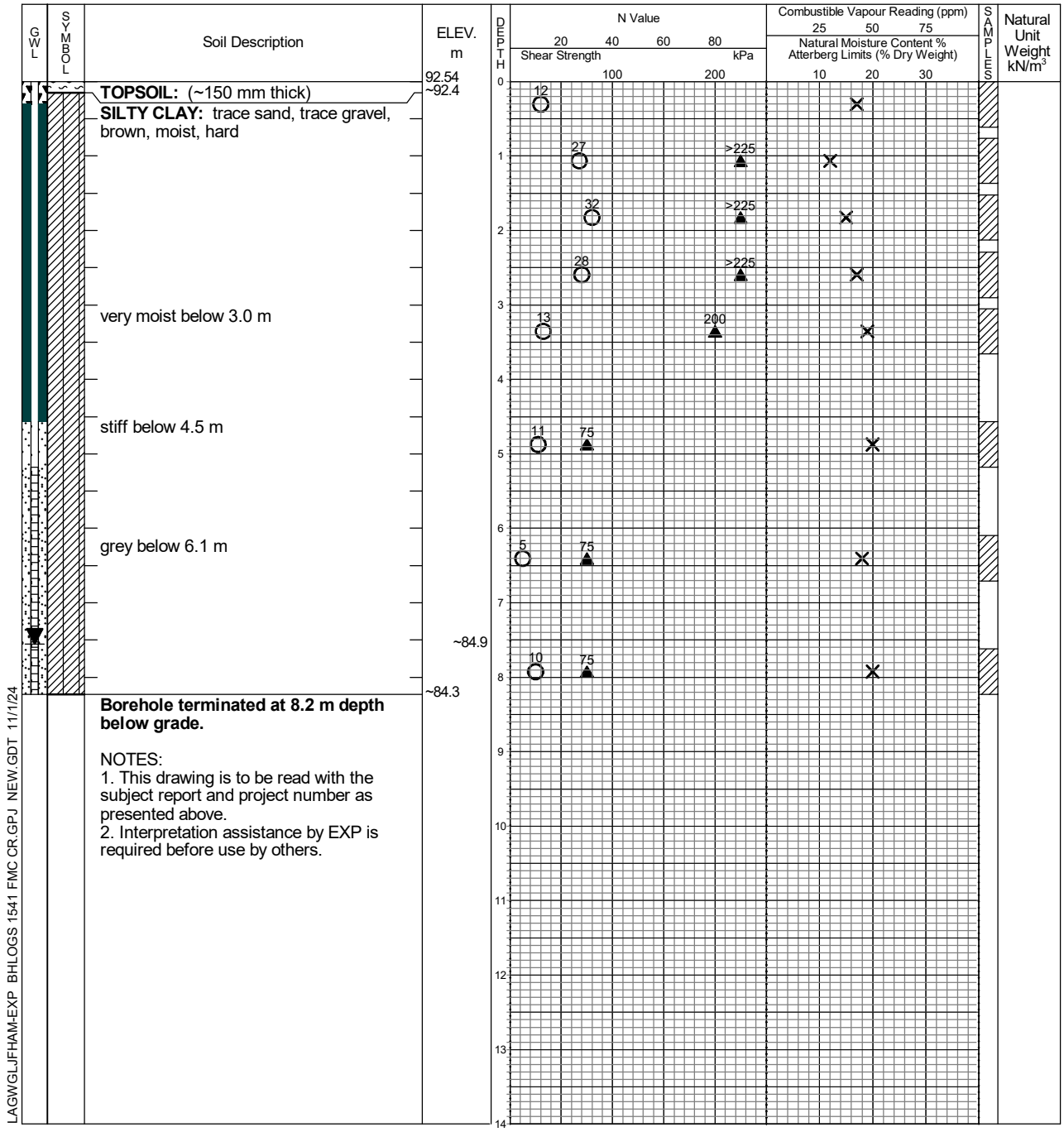
Date Drilled: September 26, 2024

Drill Type: D-50 Track Mount. Solid Stem.

Datum: Geodetic

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

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGLJFHAM-EXP BHLOGS 1541 FMC CR.GPJ NEW.GDT 11/1/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	open
October 24, 2024	7.6	-

Log of Borehole BH-4

Project No. HAM-24000672-A0 Drawing No. 6

Project: Proposed Mixed-Use Development Sheet No. 1 of 1

Location: 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, Ontario

Date Drilled: September 24, 2024

Drill Type: D-50 Track Mount. Solid Stem.

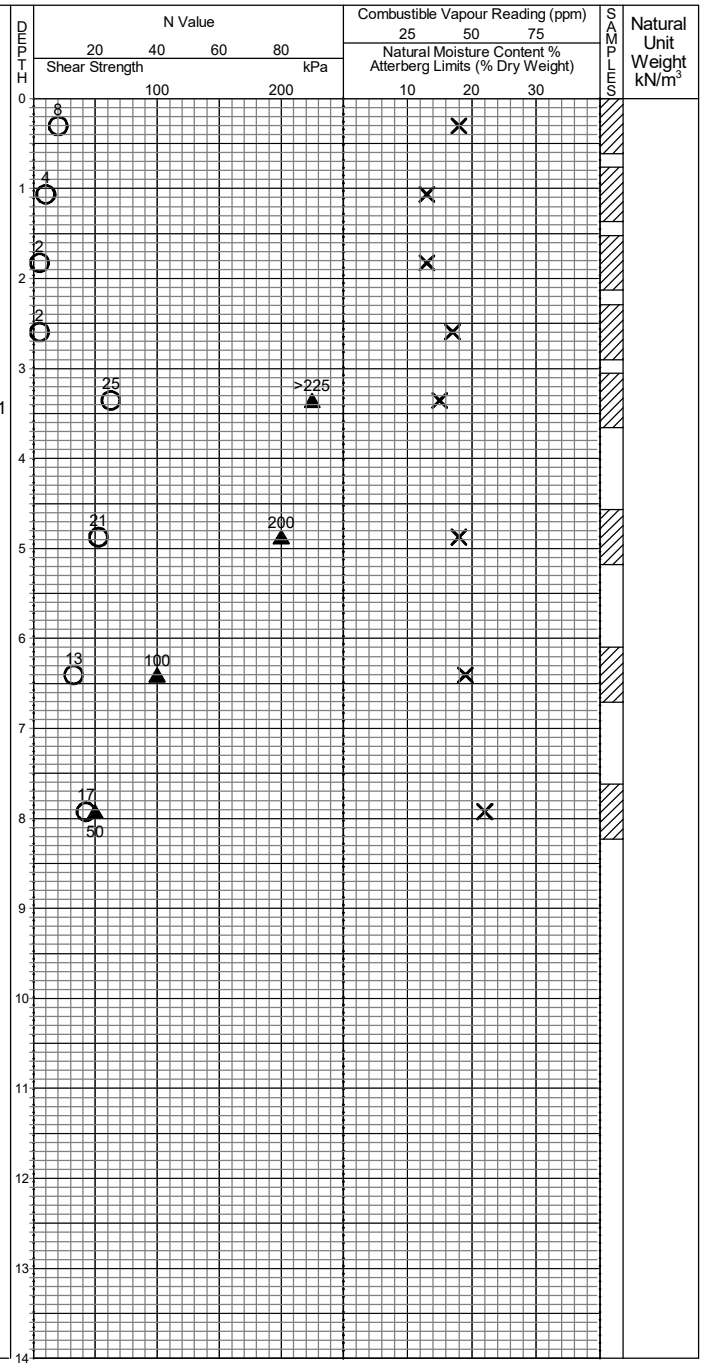
Datum: Geodetic

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

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m
			92.60
		TOPSOIL: (~100 mm thick)	~92.5
		FILL: silty sand, trace clay, trace organics, dark brown, wet	
			~89.6
▽		**SILTY CLAY:** trace sand, trace gravel, grey, moist, hard	~89.1
		very moist and very stiff below 4.5 m	
		stiff below 6.0 m	
			~84.4
		Borehole terminated at 8.2 m depth below grade.	

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.



LAGWGLJFHAM-EXP BHLOGS 1541 FMC CR.GPJ NEW.GDT 11/1/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	1.2
October 24, 2024	3.5	-

Log of Borehole BH-5

Project No. HAM-24000672-A0 Drawing No. 7

Project: Proposed Mixed-Use Development Sheet No. 1 of 1

Location: 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, Ontario

Date Drilled: September 25, 2024

Drill Type: D-50 Track Mount. Solid Stem.

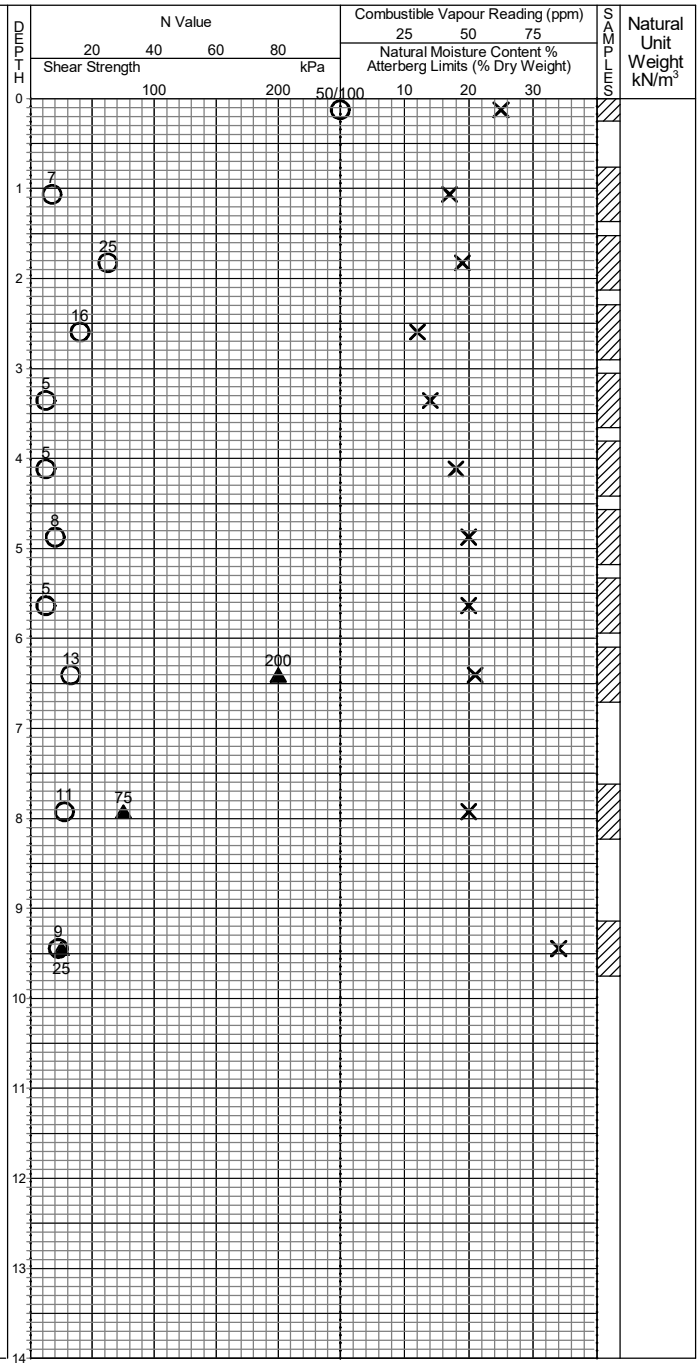
Datum: Geodetic

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

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m
	91.68
TOPSOIL: (~50 mm thick)	~91.6
FILL: silty sand, trace gravel, trace asphalt fragments, black, wet	~90.9
FILL: sandy silt, some clay, trace gravel, trace deleterious materials, dark brown, wet	~90.2
FILL: silty clay, trace sand, trace gravel, trace organics, trace asphalt fragments, brown, moist	
	~86.4
FILL: silty sand, some clay, trace organics, brown and grey, wet	~85.6
SILTY CLAY: trace sand, trace gravel, brown, very moist, hard	
grey and stiff below 7.6 m	
wet and firm below 9.1 m	~81.9
Borehole terminated at 9.8 m depth below grade.	

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.



LAGWGLJFHAM-EXP BHLOGS 1541 FMC CR.GPJ NEW.GDT 11/1/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	6.1	6.7

Log of Borehole BH-6

Project No. HAM-24000672-A0 Drawing No. 8

Project: Proposed Mixed-Use Development Sheet No. 1 of 1

Location: 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, Ontario

Date Drilled: September 25, 2024

Drill Type: D-50 Track Mount. Solid Stem.

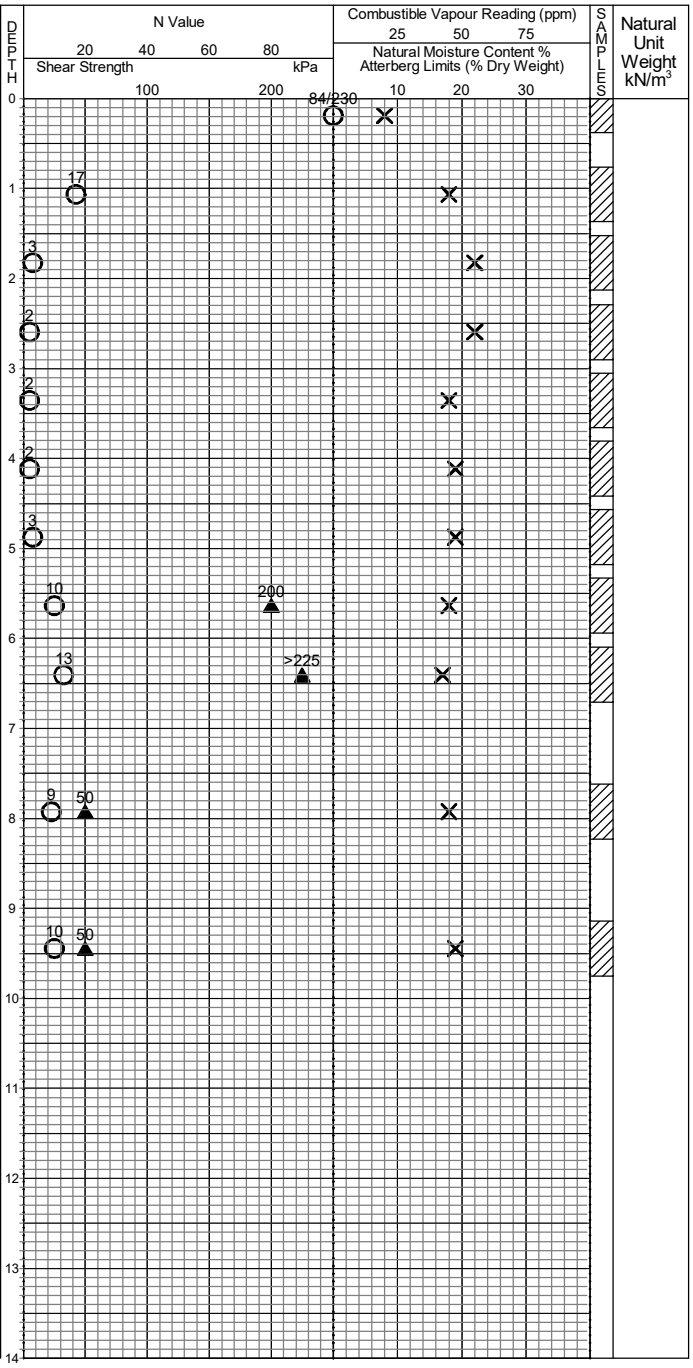
Datum: Geodetic

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

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m
GRANULAR FILL: (~450 mm thick)	92.12
	~91.7
FILL: gravelly sand, trace asphalt fragments, brown, moist	~91.4
FILL: silty clay, trace sand, trace gravel, trace plastic fragments, brown, moist	~90.6
FILL: sandy silt, some clay, brown, wet	~89.8
FILL: silty clay, some sand, trace gravel, trace organics, dark brown, very moist	
SILTY CLAY: trace sand, trace gravel, brown, very moist, hard	~86.8
grey and stiff below 7.6 m	
Borehole terminated at 9.8 m depth below grade.	~82.4

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.



LAGWGLJFHAM-EXP BHLOGS 1541 FMC CR.GPJ NEW.GDT 11/1/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	open

Log of Borehole BH-7

Project No. HAM-24000672-A0 Drawing No. 9

Project: Proposed Mixed-Use Development Sheet No. 1 of 1

Location: 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, Ontario

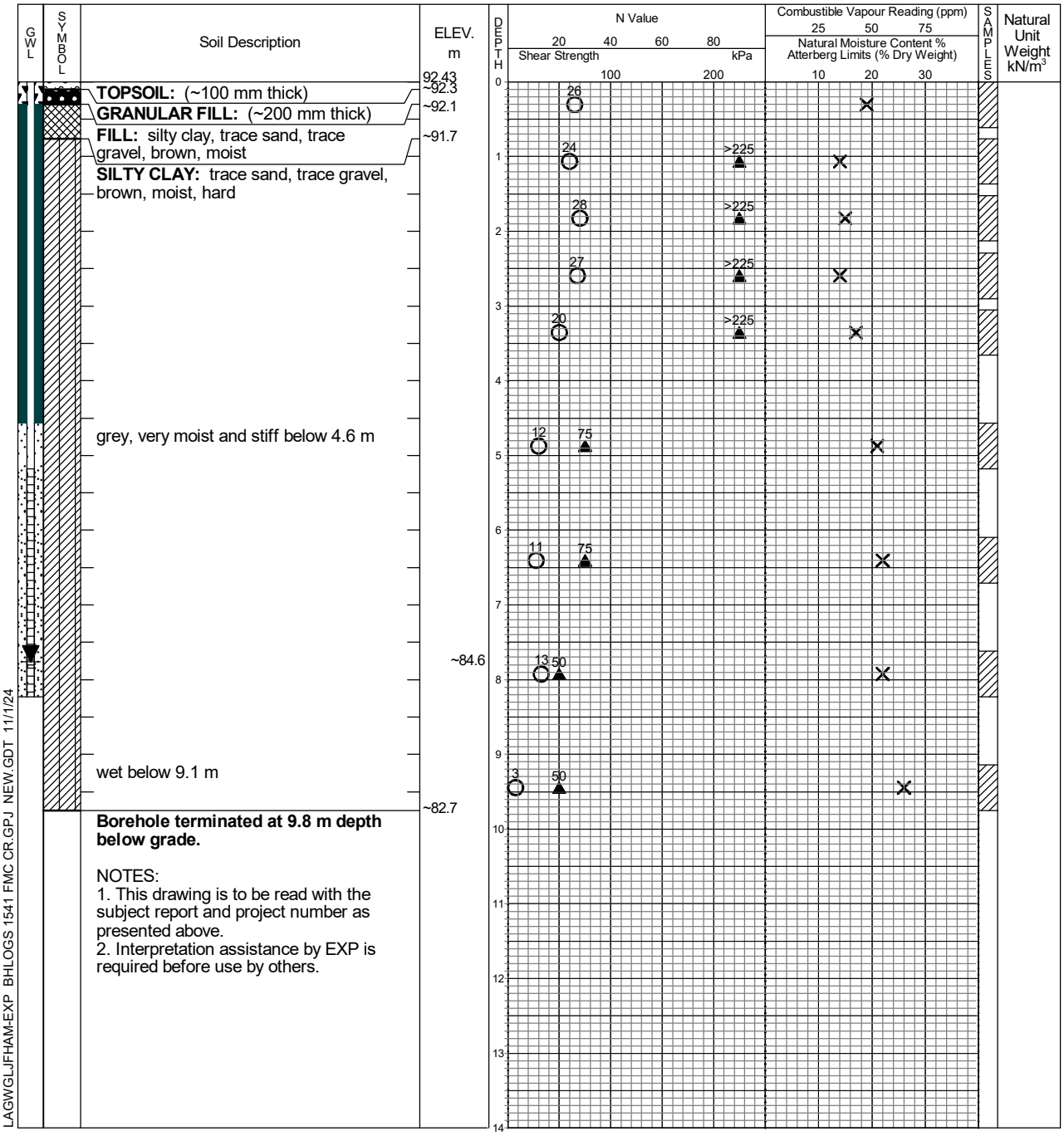
Date Drilled: September 24, 2024

Drill Type: D-50 Track Mount. Solid Stem.

Datum: Geodetic

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

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	open
October 24, 2024	7.8	-

Log of Borehole BH-8

Project No. HAM-24000672-A0 | Drawing No. 10

Project: Proposed Mixed-Use Development | Sheet No. 1 of 1

Location: 1544 & 1546 Four Mile Creek Road, Niagara-on-the-Lake, Ontario

Date Drilled: September 26, 2024

Drill Type: D-50 Track Mount. Solid Stem.

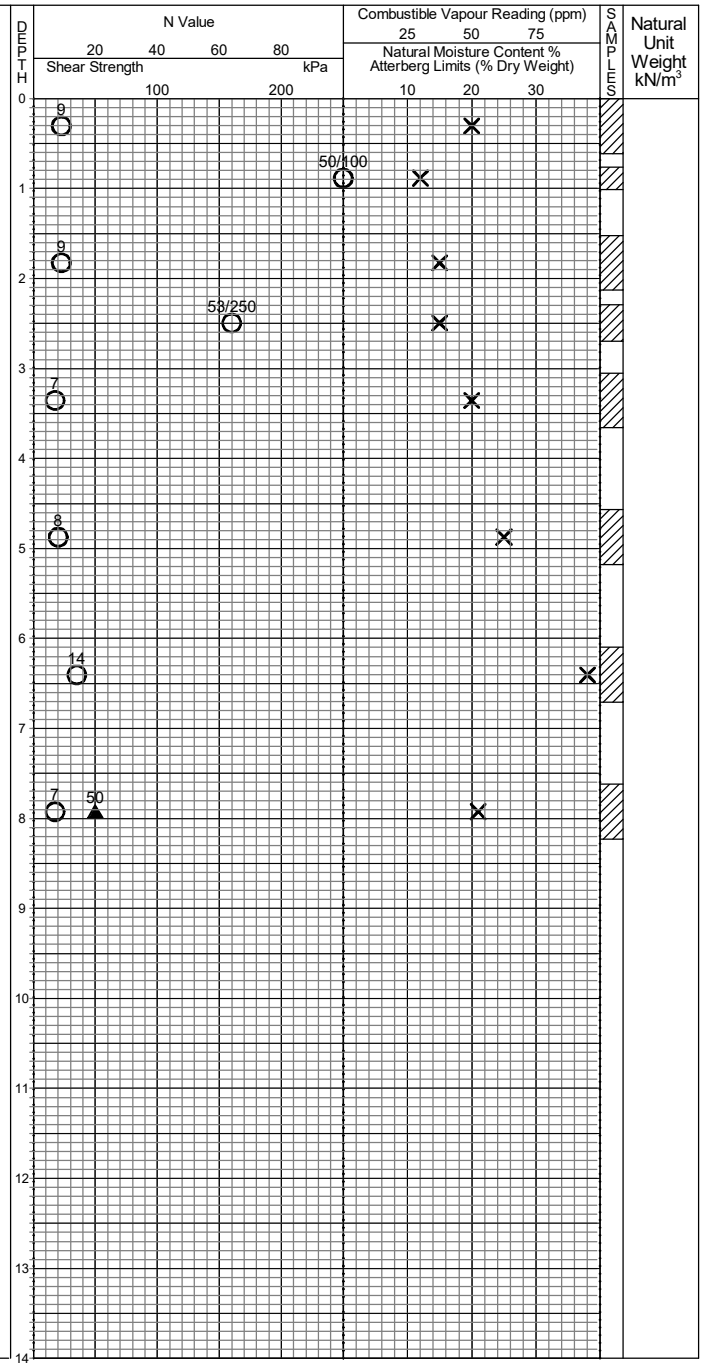
Datum: Geodetic

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

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m
			92.64
		TOPSOIL: (~130 mm thick)	~92.5
		FILL: silty clay, trace sand, trace gravel, brown, moist	~91.9
		FILL: gravelly sand, trace silt, trace brick fragments, brown, moist	~91.1
		FILL: silty clay, some gravel, trace sand, trace organics, trace asphalt fragments, dark brown, moist	
		wet below 6.1 m	
			~85.0
		SILTY CLAY: trace sand, trace gravel, grey, very moist, stiff	~84.4
		Borehole terminated at 8.2 m depth below grade.	

NOTES:
1. This drawing is to be read with the subject report and project number as presented above.
2. Interpretation assistance by EXP is required before use by others.



LAGWGLJFHAM-EXP BHLOGS 1541 FMC CR.GPJ NEW.GDT 11/1/24

EXP Services Inc.
Hamilton, Ontario
Telephone: 905.573.4000
Facsimile: 905.573.9693

Time	Water Level (m)	Depth to Cave (m)
on completion	3.0	open

SOIL PROFILE AND TEST DATA

PHASE II - ENVIRONMENTAL SITE ASSESSMENT

1544 & 1546 Four Mile Creek Rd., Niagara on the Lake

DATUM: Geodetic **EASTING:** 4786739.603 **NORTHING:** 652548.79 **ELEVATION:**

PROJECT: Phase II - Environmental Site Assessment

BORINGS BY: CME 55 Low Clearance Power Auger

REMARKS:

DATE: September 25, 2023

FILE NO. TE0108

HOLE NO. BH 1-23

SAMPLE DESCRIPTION	STRATA PLOT	Sample No.	SAMPLE % RECOVERY	N VALUE or RQD	ANALYTICAL TESTS	DEPTH (m)	PID (ppm) 0 16.67 33.33 50	Gas Tech (ppm) 0 50 100 150 200	Monitoring Well Construction
GroundSurface EL 92.64 m									
FILL: Brown silty sand, some gravel		SS1	40	7		0	1.5		
0.69 m EL 91.95 m									
FILL: Brown silty sand with gravel and cobbles		SS2	0	6		1	3.0		
		SS3	20	4		2	0.4		
		SS4	40	7			0.1		
2.97 m EL 89.67 m						3			
Brown SILTY CLAY, some sand and gravel		SS5	60	30			0		
		SS6	50	22		4	0.1		
4.5 m EL 88.14 m									
Grey SILTY CLAY		SS7	40	21		5	0		
5.18 m EL 87.46 m									
End Borehole						6			
(GWL @ 0.97m - Oct. 5, 2023)						7			
						8			
						9			

SOIL PROFILE AND TEST DATA

PHASE II - ENVIRONMENTAL SITE ASSESSMENT

1544 & 1546 Four Mile Creek Rd., Niagara on the Lake

DATUM: Geodetic **EASTING:** 4786769.073 **NORTHING:** 652525.207 **ELEVATION:** 92.53

PROJECT: Phase II - Environmental Site Assessment

BORINGS BY: CME 55 Low Clearance Power Auger

REMARKS:

DATE: September 25, 2023

FILE NO. TE0108

HOLE NO. BH 2-23

SAMPLE DESCRIPTION	STRATA PLOT	Sample No.	SAMPLE % RECOVERY	N VALUE or RQD	ANALYTICAL TESTS	DEPTH (m)	PID (ppm) 0 16.67 33.33 50	Gas Tech (ppm) 0 50 100 150 200	Monitoring Well Construction
GroundSurface EL 92.53 m									
TOPSOIL 0.15 m EL 92.38 m		SS1	40	6		0	0		
Loose, brown SILTY SAND with clay 0.69 m EL 91.84 m		SS2	60	8		1	0		
Brown SILTY CLAY with sand, some gravel		SS3	60	7		2	0.1		
- grey-brown by 2.2m depth		SS4	20	13		3	0.1		
		SS5	80	18		4	0		
		SS6	0	22		5	0		
		SS7	40	14		6	0		
		SS8	75	14		7	0		
5.87 m EL 86.66 m						8	0		
Grey SILTY CLAY		SS9	75	9		9			
		SS10	100	8					
7.47 m EL 85.06 m									
End of Borehole									
(BH dry - Oct. 5, 2023)									

SOIL PROFILE AND TEST DATA

PHASE II - ENVIRONMENTAL SITE ASSESSMENT

1544 & 1546 Four Mile Creek Rd., Niagara on the Lake

DATUM: Geodetic **EASTING:** 4786796.147 **NORTHING:** 652535.184 **ELEVATION:** 92

PROJECT: Phase II - Environmental Site Assessment

BORINGS BY: CME 55 Low Clearance Power Auger

REMARKS:

DATE: September 25, 2023

FILE NO. TE0108

HOLE NO. BH 3-23

SAMPLE DESCRIPTION	STRATA PLOT	Sample No.	SAMPLE % RECOVERY	N VALUE or RQD	ANALYTICAL TESTS	DEPTH (m)	PID (ppm) 0 16.67 33.33 50	Gas Tech (ppm) 0 50 100 150 200	Monitoring Well Construction
GroundSurface EL 92 m									
Gravel Pad 0.15 m EL 91.85 m		SS1	20	9		0	0.2		
FILL: Brown silty sand with gravel and cobbles 0.69 m EL 91.31 m		SS2	20	5		1	0.1		
FILL: Black silty sand with clay and gravel 1.45 m EL 90.55 m		SS3	20	3		2	0.3		
		SS4	80	5			1.7		
FILL: Grey-brown silty clay with gravel, some slag		SS5	60	5		3	0.2		
		SS6	80	7		4	0.1		
		SS7	100	6		5	0		
5.26 m EL 86.74 m									
Grey SILTY CLAY, some sand and gravel		SS8	80	6			0		
5.94 m EL 86.06 m						6			
End Borehole						7			
						8			
						9			

SOIL PROFILE AND TEST DATA

PHASE II - ENVIRONMENTAL SITE ASSESSMENT

1544 & 1546 Four Mile Creek Rd., Niagara on the Lake

DATUM: Geodetic **EASTING:** 4786796.854 **NORTHING:** 652523.733 **ELEVATION:** 91.88

PROJECT: Phase II - Environmental Site Assessment

BORINGS BY: CME 55 Low Clearance Power Auger

REMARKS:

DATE: September 25, 2023

FILE NO. TE0108

HOLE NO. BH 4-23

SAMPLE DESCRIPTION	STRATA PLOT	Sample No.	SAMPLE % RECOVERY	N VALUE or RQD	ANALYTICAL TESTS	DEPTH (m)	PID (ppm) 0 16.67 33.33 50	Gas Tech (ppm) 0 50 100 150 200	Monitoring Well Construction
GroundSurface EL 91.88 m									
Gravel pad 0.18 m EL 91.7 m		AU1				0	3.1		
FILL: Black silty sand with gravel and wood 0.69 m EL 91.19 m									
FILL: Black to brown silty sand with clay and gravel 1.37 m EL 90.51 m		SS2	60	13		1	1.6		
		SS3	20	4		2	1.4		
FILL: Black to grey-brown silty clay with gravel, sand and debris		SS4	50	2		3	1.1		
		SS5	80	4			1.0		
4.11 m EL 87.77 m		SS6	60	5		4	1.2		
Grey SILTY CLAY		SS7	100	7		5	0		
5.18 m EL 86.7 m End Borehole						6			
						7			
						8			
						9			

SOIL PROFILE AND TEST DATA

PHASE II - ENVIRONMENTAL SITE ASSESSMENT

1544 & 1546 Four Mile Creek Rd., Niagara on the Lake

DATUM: Geodetic **EASTING:** 4786742.05 **NORTHING:** 652525.601 **ELEVATION:** 92.72

PROJECT: Phase II - Environmental Site Assessment

BORINGS BY: CME 55 Low Clearance Power Auger

REMARKS:

DATE: September 25, 2023

FILE NO. TE0108

HOLE NO. BH 5-23

SAMPLE DESCRIPTION	STRATA PLOT	Sample No.	SAMPLE % RECOVERY	N VALUE or RQD	ANALYTICAL TESTS	DEPTH (m)	PID (ppm) 0 16.67 33.33 50	Gas Tech (ppm) 0 50 100 150 200	Monitoring Well Construction
GroundSurface EL 92.72 m									
FILL: Brown silty sand with gravel, wood 0.2 m EL 92.52 m		SS1	40	12		0	0.6		
FILL: Brown silty sand 0.69 m EL 92.03 m		SS2	50	17		1	0		
FILL: Brown silty clay with gravel and sand 1.45 m EL 91.27 m		SS3	60	30		2	0.1		
Brown SILTY CLAY with gravel, some sand		SS4	80	22		3	0		
- grey by 5.2m depth		SS5	80	21		4	0		
		SS6	100	24		5	0		
		SS7	100	15		6	0		
		SS8	80	9		7	0		
		SS9	100	9		8	0.1		
6.71 m EL 86.01 m						9			
End Borehole (GWL @ 6.19m - Oct. 5, 2023)									

1579 FOUR MILE CREEK ROAD
COMMERCIAL
(ANTIQUES ON CREEK)

1573 FOUR MILE CREEK ROAD
COMMERCIAL
(RESTAURANT BRICKS & BARLEY)

AREANA RD

1561 FOUR MILE CREEK ROAD RESIDENTIAL

1557 FOUR MILE CREEK ROAD RESIDENTIAL

1553 FOUR MILE CREEK ROAD RESIDENTIAL

1549 FOUR MILE CREEK ROAD RESIDENTIAL

1545 FOUR MILE CREEK ROAD RESIDENTIAL

1541 FOUR MILE CREEK ROAD RESIDENTIAL

LINE2 ROAD

1533 FOUR MILE CREEK ROAD
RESIDENTIAL

1527 FOUR MILE CREEK
ROAD
RESIDENTIAL

FOUR MILE CREEK ROAD

1586 FOUR MILE CREEK ROAD RESIDENTIAL

1582 FOUR MILE CREEK ROAD RESIDENTIAL

1544 AND 1546 FOUR MILE CREEK ROAD
COMMERCIAL
(SOUTH SHORE YACHTS)

RESIDENTIAL

TREED AREA

LANDSCAPED

LANDSCAPED

GRAVEL

GRAVEL

BH 3-23
92.00

TP 6-21

TP 5-21

TP 7-21

TP 4-21

TP 8-21

BH 1-23
92.64
(91.67)

TP 11-21

TP 1-21

BH 4-23
91.88

TP 9-21

TP 10-21

TP 3-21

BH 2-23
92.53

BH 5-23
92.72
(86.53)

TP 2-21

1526 FOUR MILE CREEK ROAD
RESIDENTIAL

1536 FOUR MILE CREEK ROAD
RESIDENTIAL

VACANT/ TREED AREA

LOWER VIRGIL RESEVOIR

LEGEND:

- BOREHOLE LOCATION
- BOREHOLE WITH MONITORING WELL LOCATION
- TEST PIT LOCATION BY ENGLOBE (SEPTEMBER, 2021)
- 92.64 GROUND SURFACE ELEVATION (m)
- (91.67) GROUNDWATER SURFACE ELEVATION (m)

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:1000

0 10 20 30 40 50m 75m

POTENTIALLY CONTAMINATING ACTIVITIES :

ID #	PCA ID	ADDRESS	DESCRIPTION
1	28	ON-SITE	GASOLINE AND ASSOCIATED PRODUCTS IN FIXED TANKS - TWO FORMER UNDERGROUND STORAGE TANKS
2	30	ON-SITE	IMPORTATION OF FILL OF UNKNOWN QUALITY- APPROXIMATE AREA
3	27	ON-SITE	GARAGES AND MAINTENANCE OF MARINE VEHICLES

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

ANDRES BELL CONSTRUCTION LTD.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
1544 AND 1546 FOUR MILE CREEK ROAD
NIAGARA ON THE LAKE, ONTARIO

Title:

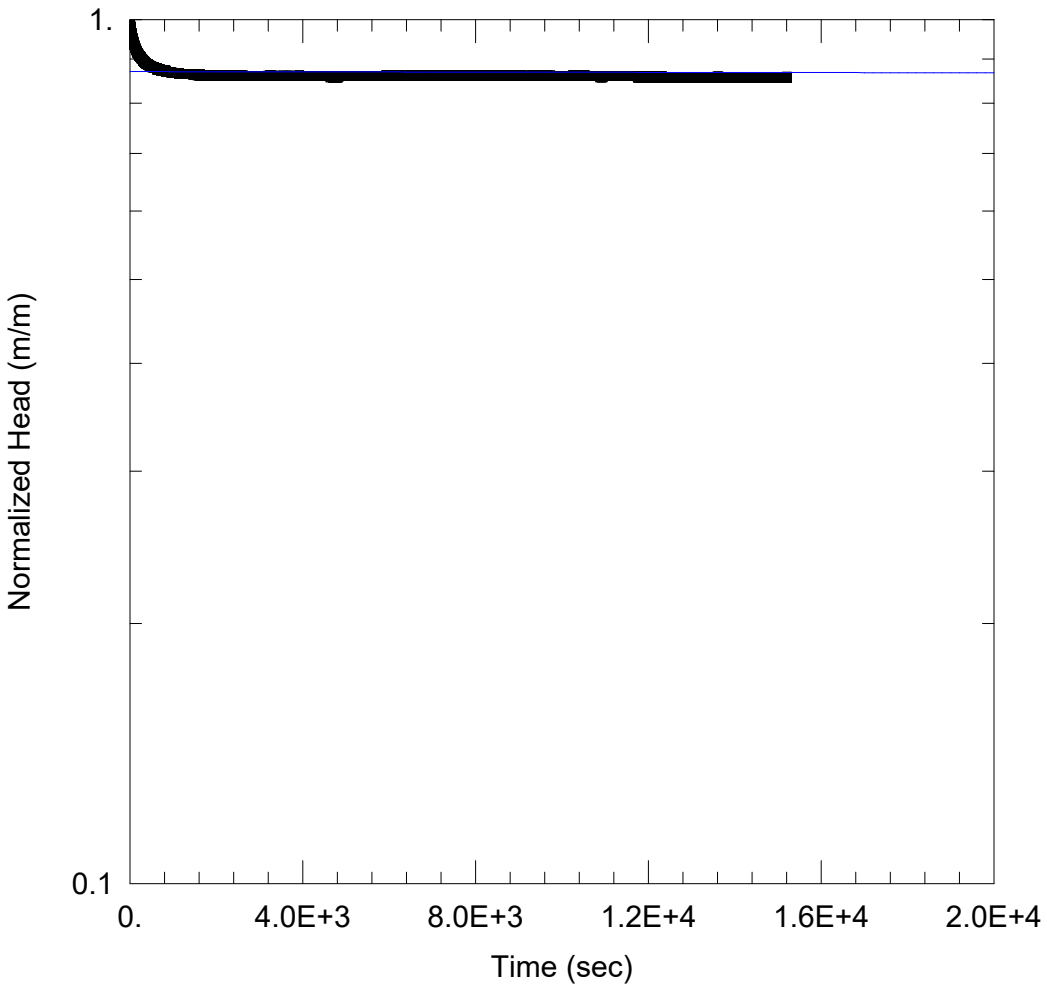
TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 10/2023
Drawn by: GK	Report No.: TE0108-1
Checked by: CB	Dwg. No.: TE0108-1
Approved by: MSD	Revision No.:

11x17

p:\autocad drawings\environmental\te01xx\te0108\te0108-1 test hole location plan.dwg

Appendix C – SWRT Procedures and Results



RISING HEAD SWRT - BH3

Data Set: C:\Users\AlexanderR\OneDrive - EXP\Desktop\SWRT Outputs\BH 3.aqt
Date: 01/15/25 Time: 12:16:11

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Stephen Aghaei
Project: HAM-24000672-A0
Location: 1544 & 1546 Four Mile Creek Rd
Test Well: BH3
Test Date: November 25, 2024

AQUIFER DATA

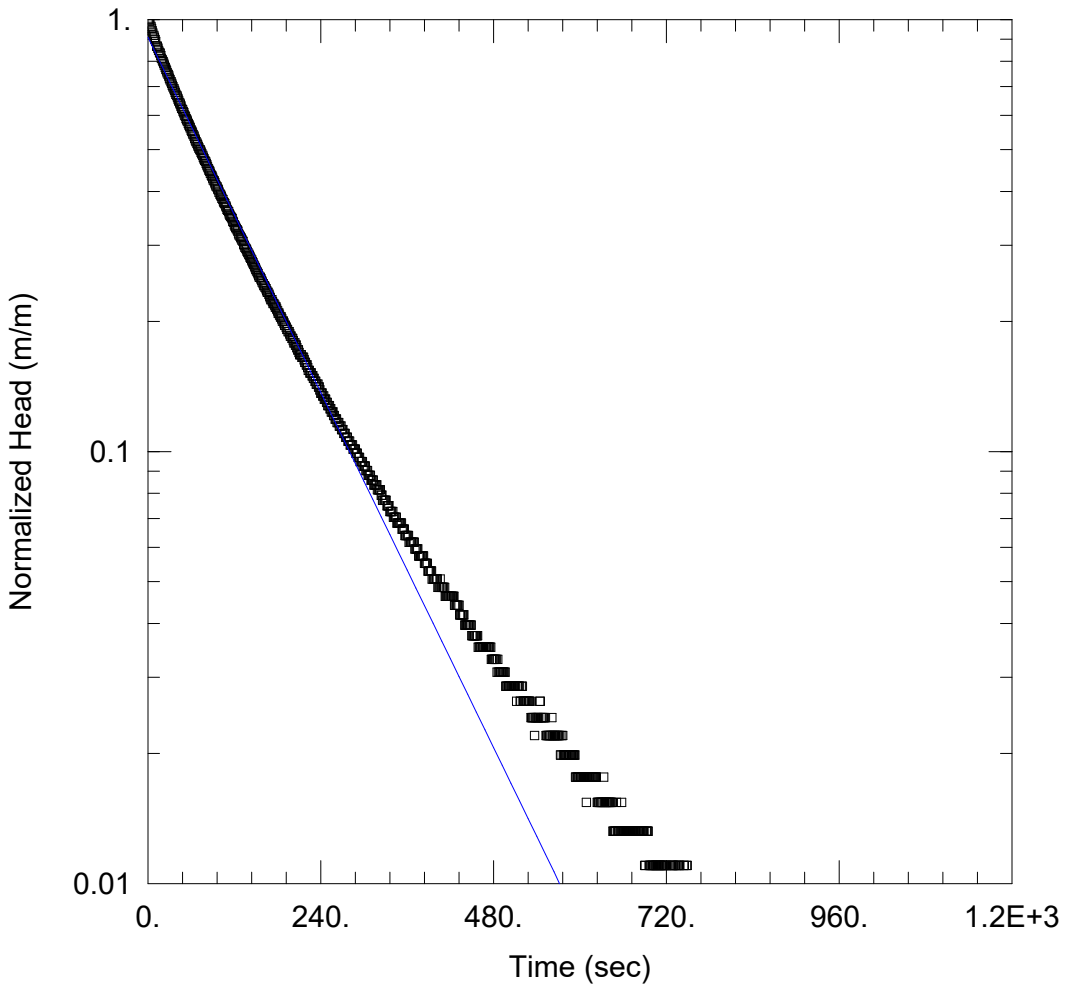
Saturated Thickness: 0.54 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH3)

Initial Displacement: 1.131 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 0.54 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.054E-10 m/sec
y0 = 0.9844 m



RISING HEAD SWRT - BH1-23

Data Set: E:\...\BH1-23.aqt
Date: 11/11/24 Time: 16:13:09

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Stephen Aghaei
Project: HAM-24000672-A0
Location: 1544 & 1546 Four Mile Creek Rd
Test Well: BH1-23
Test Date: November 5 2024

AQUIFER DATA

Saturated Thickness: 3.85 m Anisotropy Ratio (Kz/Kr): 1.

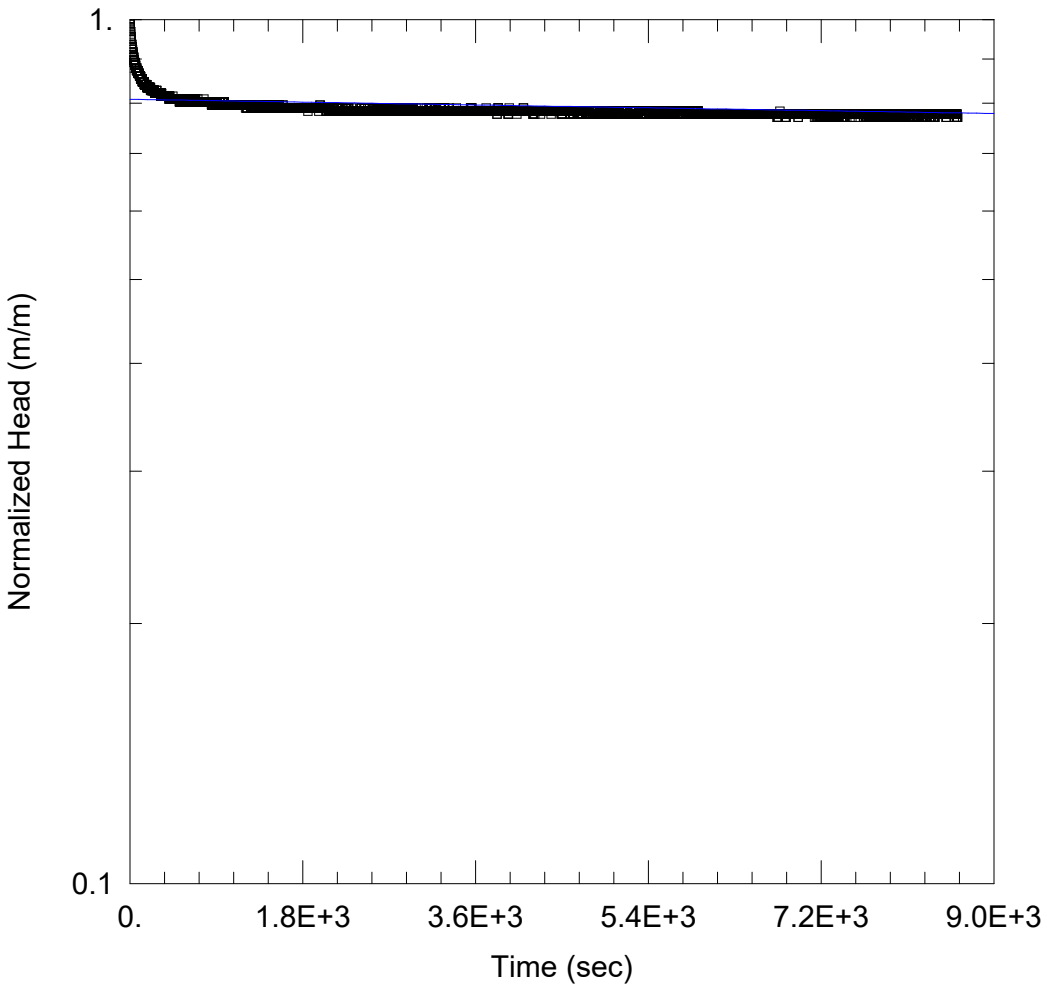
WELL DATA (BH1-23)

Initial Displacement: 1.362 m
Total Well Penetration Depth: 3.85 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.85 m
Screen Length: 1.5 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 6.231E-6 m/sec y0 = 1.238 m



RISING HEAD SWRT - BH2-23

Data Set: E:\...\BH2-23.aqt
Date: 11/11/24 Time: 16:15:32

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Stephen Aghaei
Project: HAM-24000672-A0
Location: 1544 & 1546 Four Mile Creek Rd
Test Well: BH2-23
Test Date: November 5 2024

AQUIFER DATA

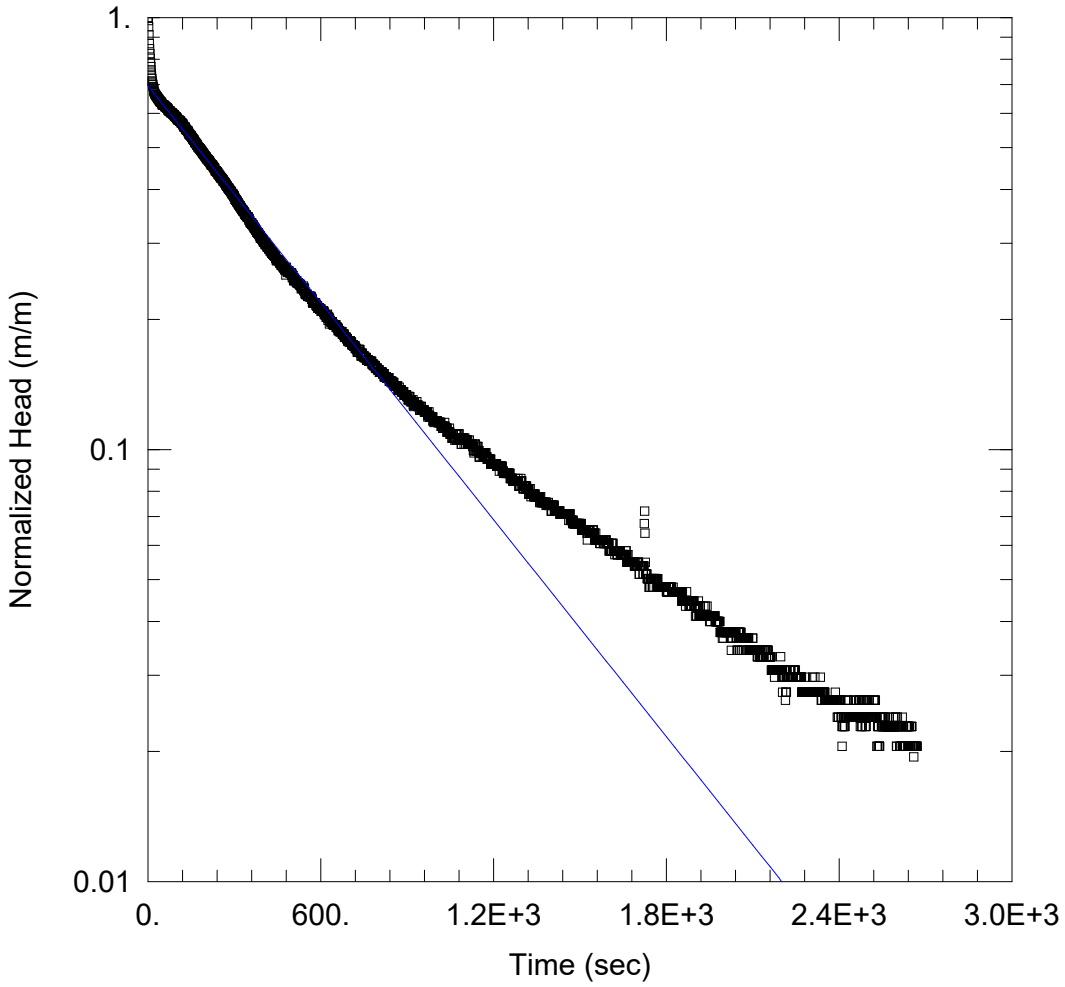
Saturated Thickness: 1.41 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH2-23)

Initial Displacement: 0.471 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 1.41 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.109E-9 m/sec
y0 = 0.3808 m



FALLING HEAD SWRT - BH4

Data Set: E:\HAM\HAM-24000672-A0\50 Input\51 - Field Notes\field work\SWRT\Working File\BH4.aqt
Date: 11/11/24 Time: 16:09:13

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Stephen Aghaei
Project: HAM-24000672-A0
Location: 1544 & 1546 Four Mile Creek Rd
Test Well: BH4
Test Date: November 5 2024

AQUIFER DATA

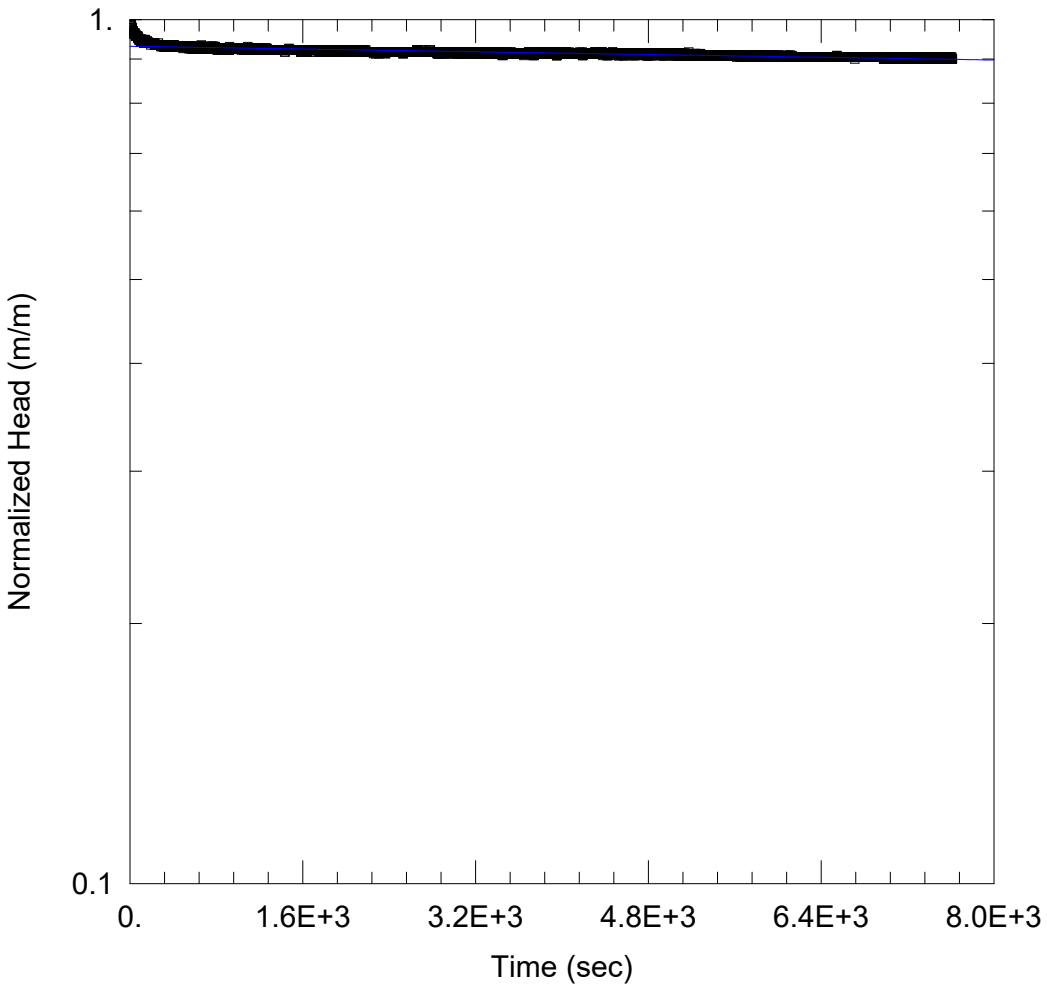
Saturated Thickness: 2.745 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH4)

Initial Displacement: 0.875 m
Total Well Penetration Depth: 2.745 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.745 m
Screen Length: 1.5 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.522E-6 m/sec
y0 = 0.6075 m



RISING HEAD SWRT - BH5-23

Data Set: E:\...\BH5-23.aqt
Date: 11/11/24 Time: 16:17:09

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Stephen Aghaei
Project: HAM-24000672-A0
Location: 1544 & 1546 Four Mile Creek Rd
Test Well: BH5-23
Test Date: November 5 2024

AQUIFER DATA

Saturated Thickness: 3.27 m Anisotropy Ratio (Kz/Kr): 1.

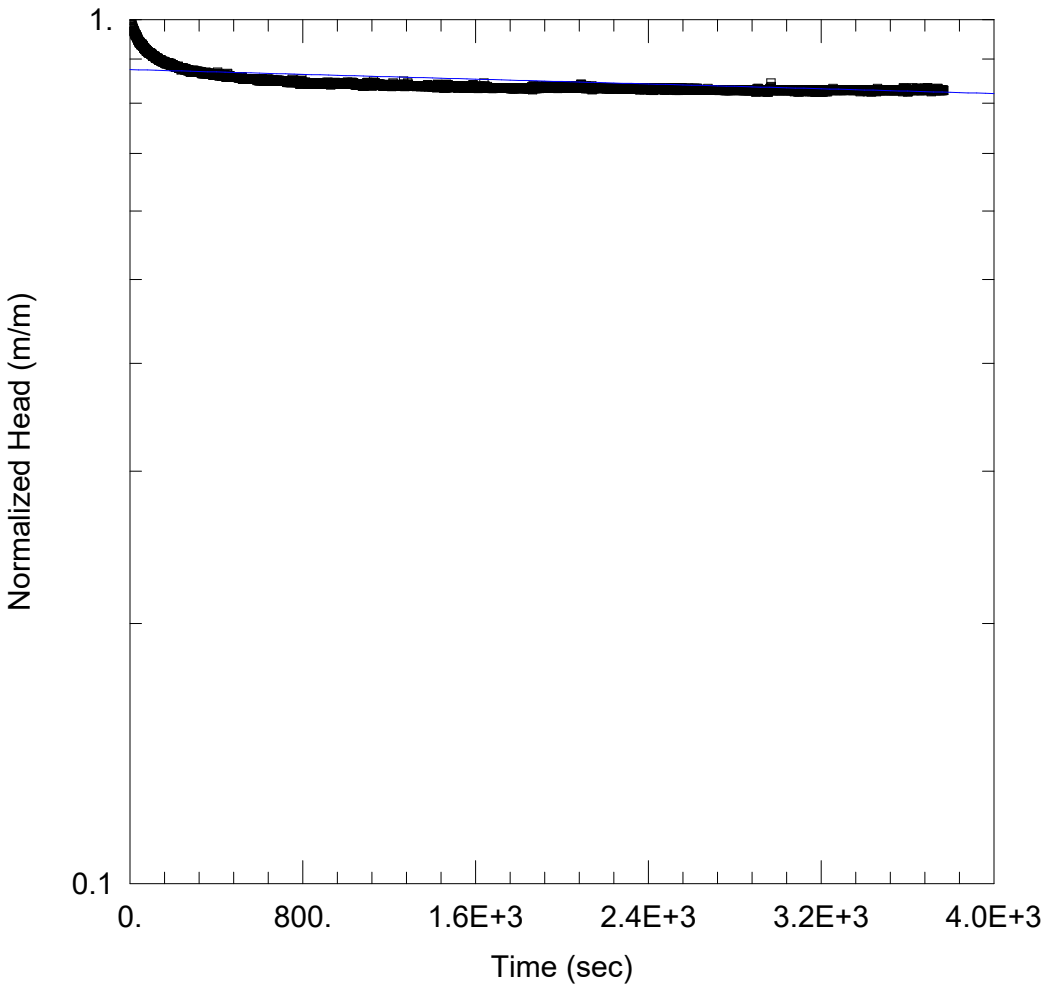
WELL DATA (BH5-23)

Initial Displacement: 0.69 m
Total Well Penetration Depth: 3.27 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.27 m
Screen Length: 1.5 m
Well Radius: 0.0762 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 3.607E-9 m/sec y0 = 0.6425 m



RISING HEAD SWRT - BH7

Data Set: E:\HAM\HAM-24000672-A0\50 Input\51 - Field Notes\field work\SWRT\Working File\BH7.aqt
Date: 11/11/24 Time: 16:11:18

PROJECT INFORMATION

Company: EXP Services Inc.
Client: Stephen Aghaei
Project: HAM-24000672-A0
Location: 1544 & 1546 Four Mile Creek Rd
Test Well: BH7
Test Date: November 5 2024

AQUIFER DATA

Saturated Thickness: 2.37 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH7)

Initial Displacement: 0.733 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.37 m
Screen Length: 3. m
Well Radius: 0.0762 m

SOLUTION

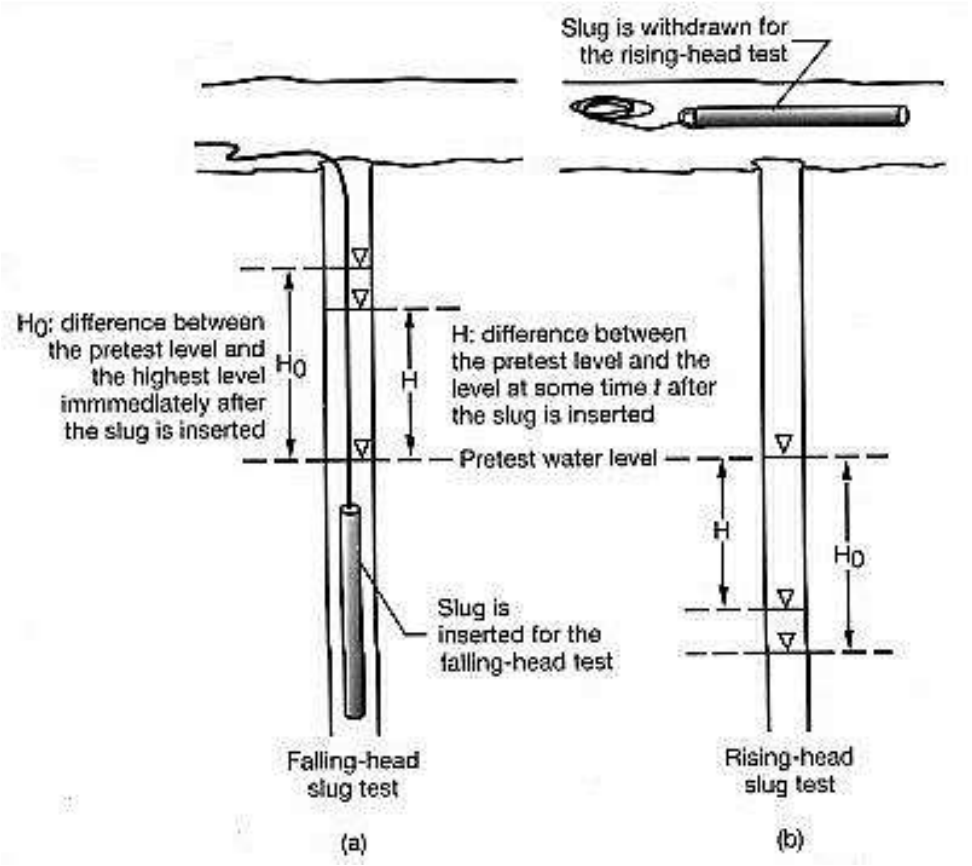
Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.153E-8 m/sec
y0 = 0.6416 m

Single Well Response Test Procedure

A Single Well Response Test (SWRT), also known as a bail test or a slug test, is conducted in order to determine the saturated hydraulic conductivity (K) of an aquifer. The method of the SWRT is to characterize the change of groundwater level in a well or borehole over time.

In order to ensure consistency and repeatability, all **exp** employees are to follow the procedure outlined in this document when conducting SWRTs.

The figure below depicts a schematic of a slug and bail test and the respective water level changes.



Initials ___

Slug Test Procedure

Equipment Required

- Copy of a signed health and safety plan
- Copy of the work program
- PPE as required by Site-Specific HASP
- Copy of the monitoring well location plan/site plan
- Waterproof pen and bound field note book
- SWRT field data Entry form
- Disposable gloves
- Duct tape
- Deionized water
- Alconox (phosphate free detergent)
- Spray bottles
- Electronic water level meter and spare batteries
- Solid PVC or stainless steel slug of known volume or clean water
- String (nylon)
- Water pressure transducer (data logger) and baro-logger
- Watch or stop watch with second hand
- Plastic sheeting

Testing Procedure

1. Remove cap from well and collect static water level
2. Remove waterra tubing/bailer and place in garbage bag. Record static water level measurement again.
3. Lower the slug into the well and record the dynamic water level.
4. Record the drawdown (for the slug test) at set five (5) second intervals for the first five (5) minutes, then reduce to every one (1) minute.
5. Continue recording the drawdown until 95% recovery is reached. To calculate this value: Find the difference between the dynamic water level and the static water level, then multiply by 95% (.95). Add the resulting value to the dynamic water level.

   (Static Water Level – Dynamic Water Level).95 + Static Water Level = 95% Recovery Value
6. Once complete, replace the waterra tubing/bailer and re-secure the well cap.

Note: If the well is deep, more than one slug may be inserted by attaching the slugs to a series.

Slugs must be washed with methanol, then lab grade soap, and then rinsed with de-ionized water after each use.

Based on the recorded observations, the hydraulic conductivity (in m/s) of the aquifer will be determined. In order to determine the hydraulic conductivity; the well diameter, radius of the borehole and length of the screen will also be required.

Bail Test Procedure

Equipment Required

- 20 L (5 gal) Graduated pail
- Stop watch or watch with seconds
- Garbage bags
- Water level meter
- Field sheets/log book
- Latex Gloves
- Bailer and Rope

Procedure

1. Remove cap from well and collect static water level.
2. If using a **bailer**:
    a. Affix the rope to the bailer.
    b. Remove the waterra tubing and place in garbage bag
    c. Record static water level measurement again.
    d. Record how much water was removed by either counting the number of full bailers or emptying removed water into a container.
    e. Quickly lower the bailer into the well and remove.
    f. Continue this process until the water level will reduce no further.
    g. Record the dynamic water level.
3. If using **waterra** to bail the water:
    a. Pump the water into graduated bucket until the water level will reduce no further.
    b. Record how much water has been removed.
    c. Record the dynamic water level.
4. Record the recovery at set five (5) second intervals for the first (5) minutes, then reduce to every one (1) minute.
5. Continue recording the drawdown/recovery until 95% recovery is reached.
6. Once complete, replace any waterra tubing that may have been removed from the well and re-secure the well cap.

Appendix D – Laboratory's Certificates of Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: EXP SERVICES INC
1266 SOUTH SERVICE ROAD, SUITE C1-1
STONEY CREEK , ON L8E 5R9
(905) 573-4000
ATTENTION TO: Edwin Chessell
PROJECT: 1544 Four Mile Creek
AGAT WORK ORDER: 24H217799
TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist
WATER ANALYSIS REVIEWED BY: Yris Verastegui, Inorganic Team Lead
DATE REPORTED: Nov 13, 2024
PAGES (INCLUDING COVER): 8
VERSION*: 2

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

Notes

VERSION 2:Version 2 supersedes work order 24H217799 , Version 1, issued November 12, 2024. Complete.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 24H217799

PROJECT: 1544 Four Mile Creek

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Edwin Chessell

SAMPLING SITE:Niagara on the Lake

SAMPLED BY:

Niagara Sanitary - Organics

DATE RECEIVED: 2024-11-06 **DATE REPORTED: 2024-11-13**

		SAMPLE DESCRIPTION:		BH4
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2024-11-05 14:33
Parameter	**Unit**	**G / S**	**RDL**	**6296793**
Oil and Grease (animal/vegetable) in water	mg/L	150	0.5	<0.5
Oil and Grease (mineral) in water	mg/L	15	0.5	<0.5
Methylene Chloride	mg/L	0.21	0.0003	<0.0003
Chloroform	mg/L	0.04	0.0002	<0.0002
Benzene	mg/L	0.01	0.0002	<0.0002
Trichloroethylene	mg/L	0.05	0.0002	<0.0002
Toluene	mg/L	0.2	0.0002	<0.0002
Tetrachloroethylene	mg/L	0.05	0.0001	<0.0001
Ethylbenzene	mg/L	0.16	0.0001	0.0040
1,1,2,2-Tetrachloroethane	mg/L	0.04	0.0001	<0.0001
1,4-Dichlorobenzene	mg/L	0.08	0.0001	<0.0001
1,2-Dichlorobenzene	mg/L	0.05	0.0001	<0.0001
o-Xylene	mg/L	0.52	0.0002	0.0003
Surrogate	**Unit**	**Acceptable Limits**		
Toluene-d8	% Recovery	50-140		116
4-Bromofluorobenzene	% Recovery	50-140		102

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Limits for Sanitary and Combined Sewer Discharge - The Regional Municipality of Niagara - By-Law No. 27-2014
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

6296793 Oil and Grease animal/vegetable is a calculated parameter. The calculated value is the difference between Total O&G and Mineral O&G.
Xylenes total is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: N Popnikolof

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 24H217799

PROJECT: 1544 Four Mile Creek

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Edwin Chessell

SAMPLING SITE:Niagara on the Lake

SAMPLED BY:

Niagara Sanitary Sewer Use By-law - Inorganics

DATE RECEIVED: 2024-11-06

DATE REPORTED: 2024-11-13

				SAMPLE DESCRIPTION:	**BH4**
				SAMPLE TYPE:	**Water**
				DATE SAMPLED:	**2024-11-05 14:33**
Parameter	**Unit**	**G / S: A**	**G / S: B**	**RDL**	**6296793**
pH	pH Units	6.0-11.0	6.5-8.5	NA	7.83
BOD (5)	mg/L	300		2	3[<A]
Total Suspended Solids	mg/L	350		10	46[<A]
Fluoride	mg/L	10		0.05	2.77[<A]
Sulphate	mg/L	1500		0.10	88.6[<A]
Total Phosphorus	mg/L	10		0.02	0.23[<A]
Total Kjeldahl Nitrogen	mg/L	100		0.10	0.50[<A]
Phenols	mg/L	1		0.001	<0.001
Cyanide, SAD	mg/L	1		0.002	<0.002
Sulphide	mg/L	1		0.01	<0.01
Total Antimony	mg/L	5		0.003	<0.003
Total Arsenic	mg/L	1		0.003	0.011[<A]
Total Cadmium	mg/L	0.7		0.0001	<0.0001
Total Chromium	mg/L	3		0.003	<0.003
Total Cobalt	mg/L	5		0.0005	0.0013[<A]
Total Copper	mg/L	3		0.002	0.005[<A]
Total Lead	mg/L	1		0.0005	0.0024[<A]
Total Mercury	mg/L	0.01		0.0002	<0.0002
Total Molybdenum	mg/L	5		0.002	0.003[<A]
Total Nickel	mg/L	2		0.003	0.006[<A]
Total Selenium	mg/L	1		0.002	<0.002
Total Silver	mg/L	5		0.0001	<0.0001
Total Tin	mg/L	5		0.002	<0.002
Total Zinc	mg/L	3		0.020	<0.020

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Limits for Sanitary and Combined Sewer Discharge - The Regional Municipality of Niagara - By-Law No. 27-2014, B Refers to Niagra Storm Sewer
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: Iris Verástegui

AGAT Laboratories

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Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24H217799

PROJECT: 1544 Four Mile Creek

ATTENTION TO: Edwin Chessell

SAMPLING SITE:Niagara on the Lake

SAMPLED BY:

Trace Organics Analysis

RPT Date: Nov 13, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Niagara Sanitary - Organics															
Oil and Grease (animal/vegetable) in water	6273906		< 0.5	< 0.5	NA	< 0.5	96%	70%	130%	104%	70%	130%	100%	70%	130%
Oil and Grease (mineral) in water	6273906		< 0.5	< 0.5	NA	< 0.5	90%	70%	130%	95%	70%	130%	93%	70%	130%
Methylene Chloride	6292600		<0.0003	<0.0003	NA	< 0.0003	77%	50%	140%	68%	60%	130%	105%	50%	140%
Chloroform	6292600		<0.0002	<0.0002	NA	< 0.0002	99%	50%	140%	92%	60%	130%	98%	50%	140%
Benzene	6292600		<0.0002	<0.0002	NA	< 0.0002	111%	50%	140%	88%	60%	130%	99%	50%	140%
Trichloroethylene	6292600		<0.0002	<0.0002	NA	< 0.0002	115%	50%	140%	87%	60%	130%	102%	50%	140%
Toluene	6292600		<0.0002	<0.0002	NA	< 0.0002	109%	50%	140%	92%	60%	130%	107%	50%	140%
Tetrachloroethylene	6292600		<0.0001	<0.0001	NA	< 0.0001	95%	60%	130%	72%	60%	130%	100%	60%	130%
Ethylbenzene	6292600		<0.0001	<0.0001	NA	< 0.0001	114%	50%	140%	82%	60%	130%	93%	50%	140%
1,1,2,2-Tetrachloroethane	6292600		<0.0001	<0.0001	NA	< 0.0001	103%	50%	140%	74%	60%	130%	88%	50%	140%
1,4-Dichlorobenzene	6292600		<0.0001	<0.0001	NA	< 0.0001	112%	50%	140%	91%	60%	130%	98%	50%	140%
1,2-Dichlorobenzene	6292600		<0.0001	<0.0001	NA	< 0.0001	118%	50%	140%	89%	60%	130%	98%	50%	140%
o-Xylene	6292600		<0.0002	<0.0002	NA	< 0.0002	119%	50%	140%	93%	60%	130%	104%	50%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: N Popowkof

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Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24H217799

PROJECT: 1544 Four Mile Creek

ATTENTION TO: Edwin Chessell

SAMPLING SITE:Niagara on the Lake

SAMPLED BY:

Water Analysis

RPT Date: Nov 13, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Niagara Sanitary Sewer Use By-law - Inorganics															
pH	6292891		7.91	7.95	0.5%	NA	100%	90%	110%						
BOD (5)	6303569		<2	<2	NA	< 2	101%	75%	125%						
Total Suspended Solids	6296832		11	11	NA	< 10	100%	80%	120%						
Fluoride	6296336		<0.05	<0.05	NA	< 0.05	96%	70%	130%	99%	80%	120%	93%	70%	130%
Sulphate	6296336		17.8	17.4	2.3%	< 0.10	94%	70%	130%	96%	80%	120%	91%	70%	130%
Total Phosphorus	6282486		<0.02	<0.02	NA	< 0.02	102%	70%	130%	101%	80%	120%	94%	70%	130%
Total Kjeldahl Nitrogen	6301902		30800	30800	0.0%	< 0.10	105%	70%	130%	94%	80%	120%	NA	70%	130%
Phenols	6290412		0.010	0.010	0.0%	< 0.001	101%	90%	110%	98%	90%	110%	118%	80%	120%
Cyanide, SAD	6288133		<0.002	<0.002	NA	< 0.002	90%	70%	130%	100%	80%	120%	110%	70%	130%
Sulphide	6303483		<0.01	<0.01	NA	< 0.01	99%	90%	110%	103%	90%	110%	101%	80%	120%
Total Antimony	6292891		<0.003	<0.003	NA	< 0.003	102%	70%	130%	101%	80%	120%	107%	70%	130%
Total Arsenic	6292891		<0.003	<0.003	NA	< 0.003	92%	70%	130%	100%	80%	120%	107%	70%	130%
Total Cadmium	6292891		<0.0001	<0.0001	NA	< 0.0001	101%	70%	130%	103%	80%	120%	106%	70%	130%
Total Chromium	6292891		<0.003	<0.003	NA	< 0.003	98%	70%	130%	102%	80%	120%	102%	70%	130%
Total Cobalt	6292891		<0.0005	<0.0005	NA	< 0.0005	99%	70%	130%	99%	80%	120%	100%	70%	130%
Total Copper	6292891		<0.002	0.002	NA	< 0.002	101%	70%	130%	99%	80%	120%	98%	70%	130%
Total Lead	6292891		<0.0005	<0.0005	NA	< 0.0005	90%	70%	130%	90%	80%	120%	91%	70%	130%
Total Mercury	6306159		<0.0002	<0.0002	NA	< 0.0002	99%	70%	130%	97%	80%	120%	94%	70%	130%
Total Molybdenum	6292891		0.004	0.005	NA	< 0.002	103%	70%	130%	104%	80%	120%	109%	70%	130%
Total Nickel	6292891		0.009	0.008	NA	< 0.003	99%	70%	130%	96%	80%	120%	98%	70%	130%
Total Selenium	6292891		<0.002	<0.002	NA	< 0.002	103%	70%	130%	99%	80%	120%	107%	70%	130%
Total Silver	6292891		<0.0001	<0.0001	NA	< 0.0001	100%	70%	130%	100%	80%	120%	101%	70%	130%
Total Tin	6292891		<0.002	<0.002	NA	< 0.002	101%	70%	130%	104%	80%	120%	106%	70%	130%
Total Zinc	6292891		<0.020	<0.020	NA	< 0.020	101%	70%	130%	98%	80%	120%	105%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate NA: results are under 5X the RDL and will not be calculated.
Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.

Certified By: Iris Verástegui

AGAT Laboratories

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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24H217799

PROJECT: 1544 Four Mile Creek

ATTENTION TO: Edwin Chessell

SAMPLING SITE:Niagara on the Lake

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Oil and Grease (animal/vegetable) in water	VOL-91-5011	EPA SW-846 3510C & 8015B	BALANCE
Oil and Grease (mineral) in water	VOL-91-5011	EPA SW-846 3510C & 8015B	BALANCE
Methylene Chloride	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Chloroform	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Benzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Trichloroethylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Toluene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
o-Xylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Toluene-d8	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS

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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24H217799

PROJECT: 1544 Four Mile Creek

ATTENTION TO: Edwin Chessell

SAMPLING SITE:Niagara on the Lake

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
pH	INOR-93-6000	modified from SM 4500-H+ B	PC TITRATE
BOD (5)	INOR-93-6006	Modified from SM 5210 B	DO METER
Total Suspended Solids	INOR-93-6028	modified from EPA 1684,ON MOECC E3139,SM 2540C,D	BALANCE
Fluoride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Total Phosphorus	INOR-93-6022	modified from SM 4500-P B and SM 4500-P E	SPECTROPHOTOMETER
Total Kjeldahl Nitrogen	INOR-93-6048	modified from EPA 351.2 and SM 4500-NORG D	LACHAT FIA
Phenols	INOR-93-6072	mod from SM 510C, EPA 420.2, ISO 3696, ASTM D1193	SEGMENTED FLOW ANALYSIS
Cyanide, SAD	INOR-93-6051	modified from MOECC E3015; SM 4500-CN- A, B, & C	SEGMENTED FLOW ANALYSIS
Sulphide	INOR-93-6054	modified from SM 4500 S2- D	SPECTROPHOTOMETER
Total Antimony	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Arsenic	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cadmium	MET -93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Chromium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cobalt	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Copper	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Lead	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Mercury	MET-93-6100	modified from EPA 245.2 and SM 3112 B	CVAAS
Total Molybdenum	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Nickel	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Selenium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Silver	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Tin	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Zinc	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

AGAT Laboratories

Have feedback? Scan here for a quick survey!

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: EXP Services Inc
Contact: edwin.Chussell@exp.com
Address: 1266 S. Service RD
Hamilton
Phone: Fax:
Reports to be sent to:
1. Email: Nicolas.Sabo@exp.com
2. Email: Edwin.Chussell@exp.com

Project Information:

Project: 1544 Four Mile Creek
Site Location: Niagara on the Lake
Sampled By: EC
AGAT Quote #: PO: HAM-24000672-A0
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☐ No ☒
Company: EXP Services Inc
Contact: AP@exp.com
Address: 1595 Clark Blvd Brampton
Email: AP@exp.com

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Regulation 406
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
☐ Regulation 558
☐ CCME

☒ Sewer Use ☒ Sanitary ☒ Storm
Niagara Region
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a Record of Site Condition (RSC)? ☒ Yes ☐ No

Report Guideline on Certificate of Analysis ☒ Yes ☐ No

Legal Sample ☐

Sample Matrix Legend

GW	Ground Water	SD	Sediment
O	Oil	SW	Surface Water
P	Paint	R	Rock/Shale
S	Soil		

Laboratory Use Only

Work Order #: 24H217799
Cooler Quantity: MD COOLER
Arrival Temperatures: 6.1 | 6.2 | 6.3
Depot Temperatures: 15.9 | 16.0 | 16.7
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: LOOSE ICE

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*
For 'Same Day' analysis, please contact your AGAT CSR

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y/N)	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	VOC	PAHs	PCBs: Aroclors ☐	O. Reg 406: Regulation 406 Characterization Package pH, Metals, BTEX, F1-F4	O. Reg 406: EC, SAR	O. Reg 406: Regulation 406 SPLP Rainwater Leach mSPLP: ☐ Metals ☐ VOCs ☐ SVOCs ☐ OC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ BteP ☐ PCBs	O. Reg 558: Corrosivity: ☐ Moisture ☐ Sulphide	Niagara Region Sanitary Sewer	Niagara Region Storm Sewer	Use by law			Potentially Hazardous or High Concentration (Y/N)
1. BH4	24/11/5	2:33 AM/PM	15	GW		NO													X			N
2.		AM/PM																				
3.		AM/PM																				
4.		AM/PM																				
5.		AM/PM																				
6.		AM/PM																				
7.		AM/PM																				
8.		AM/PM																				
9.		AM/PM																				
10.		AM/PM																				
11.		AM/PM																				

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Edwin Chussell	24/11/5	4:45pm	DTAC	NOV 5/24	4:45pm
DTAC	Nov 6/24	3pm		Nov 6/24	15:50

Page ____ of ____

N: T-163860

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

Appendix E – Construction and Post-Construction Flow Rate Calculations

APPENDIX E: Dewatering Flow Rates

1544 Four Mile Creek
HAM-24000672-A0

Table E-1: Construction and Post Construction Dewatering Assessments

Parameters	Symbols	Unit	Construction		Post-Construction	
			South - Native Soil	North - Fill	South - Native Soil	North - Fill
Number of Underground Level		-	**1**	**1**	**1**	**1**
Ground Elevation	-	mASL	**92.60**	**92.60**	**92.60**	**92.60**
Highest Groundwater Elevation	-	mASL	**92.93**	**92.93**	**92.93**	**92.93**
Lowest Top Slab Elevation	-	mASL	**90.40**	**90.40**	**90.40**	**90.40**
Lowest Foundation Invert Elevation	-	mASL	**88.90**	**88.90**	-	-
Height of Static Water Table Above the Base Aquifer	**H**	m	9.43	9.43	9.43	9.43
Dewatering Target Elevation	-	mASL	87.90	87.90	89.90	89.90
Height of Target Water Level Above the Base Aquifer	$\mathbf{h_w}$	m	4.40	4.40	6.40	6.40
Drawdown	**s**	m	5.03	5.03	3.03	3.03
Dupuit Check (> 45%)		m	47%	47%	68%	68%
Base of Aquifer / Water Bearing Zone	-	mASL	**83.50**	**83.50**	**83.50**	**83.50**
Hydraulic Conductivity	**K**	m/s	**1.2E-08**	**6.2E-06**	**1.2E-08**	**6.2E-06**
Length of Excavation	-	m	**42.00**	**42.00**	**42.00**	**42.00**
Width of Excavation	-	m	**45.00**	**45.00**	**45.00**	**45.00**
Equivalent Radius (equivalent perimeter)	$\mathbf{r_e}$	m	27.69	27.69	27.69	27.69
Method to Calculate Radius of Influence	-	-	**Cooper-Jacob**	**Cooper-Jacob**	**Cooper-Jacob**	**Cooper-Jacob**
Time (days)			**30.00**	**30.00**	**365.00**	**365.00**
Time (seconds)	**t**	s	2,592,000	2,592,000	31,536,000	31,536,000
Specific Yield	**Sy**		**0.05**	**0.25**	**0.05**	**0.25**
Cooper-Jacob's Radius of Influence	**Rcj**	m	3.63	36.93	12.67	128.82
Radius of Influence	**Ro**	m	31.33	64.62	40.37	156.51
Dewatering Flow Rate (unconfined radial flow)	**Q**	m^3/day	**1.84**	**138.15**	**0.41**	**46.61**
Factor of Safety	**fs**	-	2.00	2.00	1.50	1.50
Dewatering Flow Rate (multiplied by factor of safety)	**Q.fs**	m^3/day	**4**	**276**	**1**	**70**
Precipitation Event	-	mm/day	25	25	-	-
Volume from Precipitation (25 mm)	-	m^3/day	47	47	-	-
Total Volume (L/day) **with Safety Factor** (with precipitation)	-	m^3/day	**51**	**324**	**-**	**-**
Total Volume (L/day) **without Safety Factor** (with precipitation)	-	m^3/day	**49**	**185**	**-**	**-**

Precipitation Event 2 year storm (~57 mm)	-	m^3/day	107.73
Precipitation Event 100 year storm (~125 mm)	-	m^3/day	236.25

Notes:
mASL - meters above sea level

Analytical Solution for Estimating Radial Flow from an Unconfined Aquifer to a Fully-Penetrating Excavation

$$Q_w = \frac{\pi K(H^2 - h^2)}{Ln\,[\frac{R_o}{r_e}]}$$ (Based on the Dupuit-Forcheimer Equation)

$$r_e = \frac{a+b}{\pi} \qquad R_o = \mathrm{R}_{cj} = \sqrt{2.25KDt/S}$$

Where:

Q_w = Flow rate per unit length of excavation (m^3/s)
K = Hydraulic conductivity (m/s)
H = Height of static water table above base of water-bearing zone (m)
h_w = Height of target water level above the base of water-bearing zone (m)
Rcj=Cooper Jacob Radius of Influence (m)
R_o=Radius of influence (m)
re=Equivalent perimeter (m)