2481 Barton Street, Hamilton, Ontario

L8E 2X1

Hydrogeological Investigation

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Type of Document:
Final

Project Name:
2481 Barton Street, Hamilton, Ontario

Project Number:
HAM-00802036-A0

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Date Submitted:
2021-02-03

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1 Introduction

1.1 Project Description

EXP Services Inc. (EXP) was retained by Barton Street Developments Inc. to prepare a Hydrogeological Investigation Report associated with the proposed development located at 2481 Barton Street, Hamilton, Ontario (hereinafter referred to as the 'Site').

The Site is currently occupied by a one storey residential house. It is our understanding that the proposed development plan will consist of a twelve (12) to seventeen (17) storey apartment building with one (1) or two (2) levels of underground parking. The Site location plan is shown on Figure 1.

EXP conducted a 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 Preliminary 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:

- Reviewed available geological and hydrogeological information for the Site;
- Drilled (3) monitoring wells (50 mm dia.) diameter and 8 m deep) as part of the geotechnical investigation;
- Developed and conducted Single Well Response Tests (SWRT) on monitoring wells to assess hydraulic conductivities of the saturated soils at the Site;
- Completed two (2) rounds of groundwater level measurements at all monitoring wells;
- Collected one (1) groundwater sample for analyses of parameters, as listed in the City of Hamilton Sewer Use By-Law;
- 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 plans, cross sections, 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 City of Hamilton 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, Ontario Regulation 387/04, and City of Hamilton. The scope of work outlined above was made to assess dewatering and did not include 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 (2020), Geotechnical Investigation, 2481 Barton St E, Hamilton, ON, prepared for 2454184 Ontario Inc.
- Rubicon Environmental Inc. (2008), Phase II ESA – Environmental Site Assessment, 2481 Barton St E, Stoney Creek, ON, prepared for 2454184 Ontario Inc.

2 Hydrogeological Setting

2.1 Regional Setting

2.1.1 Regional Physiography

The Site is within a physiographic region known as the Iroquois Plain. The physiographic landform is named Sand Plains. The Niagara Escarpment is located approximately 2.5 m south of the Site and separates the Iroquois Plain from the Haldimand Clay Plain, which lies south of escarpment (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 north, toward Lake Ontario.

2.1.2 Regional Geology and Hydrogeology

The surficial geology can be described as fine textured glaciolacustrine deposits consisting of silt and clay, minor sand and gravel, massive to well laminated (Ministry of Northern Development and Mines, 2012). The surficial geology of the Site and surrounding areas is shown on Figure 2.

Based on the available regional geology maps, the bedrock present at the Site can be categorized as shale, limestone, dolostone, siltstone belonging to the Queenston Formation.

Regional groundwater across the area flows North, towards Lake Ontario. Local deviation from the regional 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.

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 on Figure 3. A summary of the WWR is included in Appendix A.

The MECP WWR database recorded seventy (70) records within a 500 m radius from the Site boundary. No water well records are identified onsite (Figure 3 and Appendix A).

The database indicates that the offsite wells are at an approximate distance of seventy (70) m or greater from the Site boundary. All wells were reportedly identified as monitoring and observation wells, test holes, dewatering wells, water supply wells, abandoned and/or listed with unknown use.

The water well with Identification Number (6804705) is the only water supply well identified within the search area, which is located approximately 475 m from the Site boundary. The main purpose of the well was recorded as domestic.

The reported water found depths ranged from 2.4 m to 18.0 meters below ground surface (mbgs).

Based on the date of installation of the water supply well (May 8, 1952) 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 an urban area. The topography is considered relatively flat with a regional gradual north eastern slope towards Lake Ontario.

As indicated on the borehole logs included in Appendix B, the surface elevation of the Site ranges between approximately 85.33 to 85.90 meters above sea level (masl).

2.2.2 Local Surface Water Features

No surface water features exist onsite. The nearest surface water features are Stoney Creek, Redhill Creek and Lake Ontario. Stoney Creek is approximately 0.67 km east, Redhill Creek approximately 1.25 km west and Battlefield Creek approximately 0.85 km south east of the site boundaries. Lake Ontario lies approximately 1.38 kilometers north east of the site boundary.

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, 2020). The soil descriptions 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 this report and should be read in conjunction with it. 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:

2.2.4 Topsoil

Surficial topsoil was encountered at Boreholes BH-01, BH-03, BH-04, BH-07, and BH-08 and was noted to have a thickness ranging from approximately 100 to 175 mm. It is noted that topsoil thicknesses may further vary across the site.

2.2.5 Granular Fill

Boreholes BH-05, BH-09, and BH-10 were advanced in the area of the existing gravel parking lot/driveway and encountered approximately 200 to 600 mm of granular fill. The granular fill consisted of crusher-run limestone.

2.2.6 Fill

A layer of fill was encountered at the ground surface or below the topsoil/granular fill in each of the borehole locations, extending to depths of 0.8 to 2.6 m. The fill consisted of silty clay, sand and gravel, or sandy silt, and was brown, dark brown, greyish brown or grey. The fill was noted to contain rootlets, glass, asphalt, and construction debris. The fill was in a moist to very moist, with moisture contents ranging from 6 to 20%. Trace black organic staining and odour was also noted at Boreholes BH-02, BH-08, and BH-09.

2.2.7 Silty Clay Till

Native silty clay till was encountered in each of the borehole locations, extending to the borehole termination depth or bedrock surface. The silty clay till contained some sand and occasional gravel and was brown, reddish brown, greyish brown, or grey. The stratum was generally in a moist state, becoming damp at depth, with moisture contents ranging from 5 to 23%. Borehole BH-02 was terminated at a depth of 5.8 m below grade due to auger refusal on possible cobbles or boulder within the till.

2.2.8 Bedrock

The weathered shale bedrock surface was encountered at depths ranging from 6.3 to 11.0 m below grade, corresponding to Elev. 79.4 to 74.6 m. The bedrock was not confirmed by coring and was inferred based on drilling observations. However, based on Map 2343, Paleozoic Geology, Grimsby, the bedrock in the site vicinity consists of red shale of the Queenston Formation. The upper portion of the bedrock is typically highly weathered to weathered to a depth of 600 mm to 1.5 m. Hard limestone lenses are common within the shale.

The borehole and monitoring well locations are shown on Figure 4. Geological cross-sections were generated based on the available borehole logs completed as part of the previous and current investigations and shown on Figure 5 (Cross section A-A'). Borehole logs used to generate both cross-sections 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:

- Four (4) shallow overburden monitoring wells (MW 01, MW 02, MW 03 and MW 04) were installed by REI, 2020;
- Three (3) deep bedrock monitoring wells (BHMW 1, BHMW 3, BHMW 9) were installed by EXP, 2020.

The diameter of all monitoring wells is 50 mm. All wells were installed with a flush mount or stick up protective casing. Borehole logs and monitoring well installation details are provided in Appendix B. The monitoring well locations are shown on 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, including November 23rd and 30th, 2020. 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 80.40 masl (5.05 mbgs at MW 01 on November 30, 2020) to 83.77 masl (2.14mbgs at MW 03 on November 30, 2020). The groundwater elevation recorded for the deep wells ranged from 79.96 masl (5.54 mbgs at BHMW 1 on November 30, 2020) to 83.02 masl (2.60 mbgs at BHMW 9 on November 30, 2020.

Table 3-1: Summary of Measured Groundwater Elevations

Monitoring Well ID	Ground Surface Elevation (masl)	Stick Up (m)	Approximate Full Well Depth (mbgs)	Depth	23-Nov-20	30-Nov-20
BHMW 1	85.50	0.44	10.21	mbTOP	4.92	5.98
				mbgs	4.48	5.54
				masl	81.03	79.96
BHMW 3	85.33	0.86	8.89	mbTOP	3.19	3.25
				mbgs	2.33	2.39
				masl	83.01	82.94
BHMW 9	85.62	Flushmount	10.49	mbTOP	-	-
				mbgs	2.89	2.60
				masl	82.73	83.02
MW 01	85.45	0.65	5.32	mbTOP	4.57	5.70
				mbgs	3.92	5.05
				masl	81.53	80.40
MW 02	85.63	Flushmount	4.91	mbTOP	-	-
				mbgs	2.98	4.27

Monitoring Well ID	Ground Surface Elevation (masl)	Stick Up (m)	Approximate Full Well Depth (mbgs)	Depth	23-Nov-20	30-Nov-20
				masl	82.65	81.36
MW 03	85.90	0.75	4.81	mbTOP	3.00	2.89
				mbgs	2.25	2.14
				masl	83.65	83.77
MW 04	85.40	0.85	5.00	mbTOP	4.11	5.25
				mbgs	3.26	4.40
				masl	82.14	81.01

Two (2) maps were created for the Site to show groundwater contours of the shallow and deep water-bearing zones (Figures 6 A and 6 B). Accordingly, the groundwater flow directions in the intermediate and deep zones are interpreted to be north-northwest of the Site, towards Lake Ontario, respectively.

Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing 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

Seven (7) Single Well Response Tests (SWRT's) were completed on monitoring wells BHMW 1, BHMW 3, BHMW 9, MW 01, MW 02, MW 03 and MW 04 on November 23, 2020. The tests were completed to estimate the saturated hydraulic conductivity (K) of the soils at the well screen depths.

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		
BHMW 1	10.21	7.21	10.21	Silty Clay Till to Shale Bedrock	4.8E-9
BHMW 3	8.89	5.89	8.89	Silty Clay Till to Shale Bedrock	1.1E-8
BHMW 9	10.49	7.49	10.49	Silty Clay Till to Shale Bedrock	4.6E-8
MW 01	5.32	2.32	5.32	Clayey Silt	2.6E-9
MW 02	4.91	1.91	4.91	Clayey Silt	3.8E-9

Monitoring Well	Well Depth (mbgs)	Screen Interval (mbgs) from	to	Soil Formation Screened	Estimated Hydraulic Conductivity (m/s)
MW 03	4.81	1.81	4.81	Clayey Silt	8.6E-9
MW 04	5.00	2.00	5.00	Clayey Silt	1.3E-8
				Shallow Highest Estimated K-Value	1.3E-8
				Shallow Geometric Mean of Estimated K-Values	5.8E-9
				Deep Highest Estimated K-Value	4.6E-8
				Deep Geometric Mean of Estimated K-Values	1.3E-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 intermediate water-bearing zone is 1.3E-8 m/s, and the geometric mean K-value is 5.8E-9 m/s. The highest K-value of the deep Silty Clay and bedrock water-bearing zone is 4.6E-8 m/s, and the geometric mean K-value is 1.3E-8 m/s.

3.4 Groundwater Quality

To assess the suitability for discharging pumped groundwater into the sewers owned by the City of Hamilton during dewatering activities, one (1) groundwater sample was collected from monitoring well BHMW 3 on November 30, 2020 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 samples were 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 samples were submitted for analysis to Bureau Veritas Laboratory, a CALA certified independent laboratory in Mississauga, Ontario. Analytical results are provided in Appendix D.

Table 3-3 summarizes exceedance(s) of the Sanitary (Table 1) and Storm (Table 2) Sewer Use By-Law parameters.

When comparing the chemistry of the collected groundwater samples to the Hamilton-Wentworth Sanitary Sewer Discharge Criteria (Table 1), only Dissolved Sulphate (SO4) exceeded Table 1.

When comparing the chemistry of the collected groundwater samples collected to the Hamilton-Wentworth Storm Sewer Discharge Criteria (Table 2), only Total Suspended Solids exceeded Table 2.

Reporting detection limits (RDLs) were below the Sewer Use By-Law parameter criteria of Tables 1 and 2.

Table 3-3: Summary of Analytical Results

Parameter	Units	City of Hamilton **Sanitary and Combined Sewer Discharge Limit (Table 1)**	City of Hamilton **Storm Sewer Discharge Limit (Table 2)**	**Concentration BH/MW 3** November 30, 2020
Total Suspended Solids (TSS)	mg/L	350	15	**34**
Dissolved Sulphate (SO4)	mg/L	1500	-	**2600**

Bold – Exceeds City of Hamilton Storm Sewer Discharge Limit (Table 2).
Bold & underlined – Exceeds City of Hamilton Sanitary and Combined Sewer Discharge Limit (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.

It is noted that the City of Hamilton does not permit any post construction dewatering of the foundation.

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 construction phase, as required by the City.

An agreement to discharge into the sewers owned by the City of Hamilton will be required prior to releasing dewatering effluent.

The Environmental Site Assessment Report(s) shall be reviewed for more information on the groundwater quality conditions at the Site.

4 Construction Dewatering Assessment

The Site is currently occupied by a one storey residential house. It is our understanding that the proposed development plan will consist of a 12 to 17 storey apartment building with one (1) or two (2) levels of underground parking. For the construction dewatering rate assessment, it is assumed that conventional spread and strip footing foundations are constructed on undisturbed silty clay till.

Table 4-1 presents the assumptions used to calculate the dewatering rate for the Site.

Table 4-1 Dewatering Estimate Assumptions

Input Parameter	P1 Assumptions	P2 Assumptions	Unit	Notes
Ground Surface Elevation	85.33 – 85.90		masl	Approximate elevation based on the borehole logs and Site
Groundwater elevation	84.77		masl	The highest recorded groundwater elevation measured across the Site plus 1 meter to account for some seasonal fluctuation
Top of Slab Elevation	81.8	78.3	masl	Assumed approximately 3.5 mbgs per level
Lowest Footing Elevation	80.8	77.3	masl	Assumed to be approximately 1.0 m below the top of slab elevation
Dewatering Target Elevation	79.8	76.3	masl	Assumed to be approximately 1.0 m below the lowest footing elevation
Bottom Elevation of Water-Bearing Zone	74.5		masl	Top of lowest Bedrock Elevation
Excavation Area (Length x Width)	3,036 (66 x 46)		m^2 (m x m)	Approximate area (length x width) of Site for the proposed development based on preliminary Site Plan Design (MASRI O Inc. Architects, 2020.09.02)
Hydraulic Conductivity (K)	4.6E-8		m/s	Highest K-value for overburden

4.1 Dewatering Flow Rate Estimate and Zone of Influence

The Dupuit-Forcheimer equation for steady-state radial flow to the entire 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:

$$Q_w = \pi K(H^2 - hw^2)/Ln(\frac{Ro}{re})$$

Where:

Qw = Rate of pumping (m^3/sec)
K = Hydraulic conductivity (m/sec)
H = Hydraulic head beyond the influence of pumping (static groundwater elevation) (m)
h_w = Hydraulic head above the base of aquifer in an excavation (m)
Ro = Radius of influence (m), Ro = re + Rcj
a = length of excavation (m)
b = width of excavation (m)
re = Effective radius (m) where, re= $(a \times b/\pi)^{0.5}$

It is expected that the initial dewatering rate will be higher in order 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 of Influence

The radius of influence (Rcj) for the construction dewatering was calculated based on Cooper-Jacob 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 formula as follows:

$$R_{cj} = \sqrt{2.25KDt/s}$$

Where:
Ro = Estimated radius of influence (m)
D = Aquifer thickness (original saturated thickness) (m)
K = Hydraulic conductivity (m/sec)
S = Storage coefficient
t = Duration of pumping (s)

Based on Cooper-Jacob's formula and the K-value, the calculated distance of influence (Ro) is provided in Appendix E.

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 15 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 from outside of the excavation's footprint is excluded and it should be directed away from the excavation.

During precipitation events greater than 15 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 56.5 and 124.4 mm, respectively, which would produce 172 and 378 m^3 of water.

4.4 Results of Construction Dewatering Rate Estimate

For this assessment, it was assumed that the proposed construction plans include an excavation without 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. Based on the assumptions provided in this report, the results of the dewatering rate estimate can be summarized as follows:

Table 5.2: Summary of Construction Dewatering Flow Rate

Excavation	Construction Dewatering Rates with safety factor SF (1.5) and stormwater m^3/day	Dewatering Zone of Influence - Rcj (m)	
Level 1 (P1) Full Extent 3,036 m^2 (66 m x 46 m)	65	4	Based on the highest hydraulic conductivity for bedrock and overburden
Level 2 (P2) Full Extent 3,036 m^2 (66 m x 46 m)	70		

This peak dewatering flow rates does 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), if these extend deeper than the dewatering target. Local dewatering is not considered to be part of this assessment. Dewatering estimates should be reviewed once the pit dimensions are available.

All grading around the perimeter of the construction Site should be graded away from the shoring the systems. The dewatering assumptions are based on using a shoring system without open cuts.

The maximum flow rate calculated with a high K-value, provides a conservative estimate to account for higher than expected flow rates during the construction dewatering.

If caisson walls are installed, these should be designed for full hydrostatic pressure for shallow and deep-water levels, without dewatering on the outside. 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 conditions.

The contractor is responsible to ensure that dry conditions are always maintained within the excavation at all costs.

4.5 Construction MECP Water Taking Permit

In accordance with the Ontario Water Resources Act, if the water taking for the construction dewatering is more than 50 m^3/day but less than 400 m^3/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 m^3/day, a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

It is recognized that the maximum flow estimate calculated with a high K-value, provides a conservative estimate to account for higher than expected flow rates during the construction dewatering. Based on the dewatering estimates of approximately 65 and 70 m^3/day for one (P1) or two (P2) levels of underground parking, respectively, an EASR would be required to facilitate

the construction dewatering program of the Site. It should be noted that the EASR would be required mainly to remove stormwater from the excavation.

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.

5 Post Construction Foundation Drainage

It is noted that the City of Hamilton does not permit any post construction dewatering of the foundation. As a result, the underground levels will need to be made watertight without any foundation drains (sub-slab and perimeter) and designed for full hydrostatic pressure.

6 Environmental Impact

6.1 Surface Water Features

No surface water features exist onsite. The nearest surface water features are Stoney Creek, Redhill Creek and Lake Ontario. Stoney Creek is approximately 0.67 km east, Redhill Creek approximately 1.25 km west and Battlefield Creek approximately 0.85 km south east of the site boundaries. Lake Ontario lies approximately 1.38 kilometers north east of the site boundary.

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

6.2 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 the dewatering zone of influence is limited, no dewatering related impact is expected on the identified water supply well in the area.

6.3 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.

6.4 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 City of Hamilton Sewer Use By-Law.

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.

It is noted that the City of Hamilton does not permit any post construction dewatering of the foundation. Dewatering (short) 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) to monitor potential migration, and this should be performed more frequently during early dewatering stages.

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 during the construction phase as required by the City. An agreement to discharge into the sewers owned by the City of Hamilton will be required prior to releasing dewatering effluent.

The Environmental Site Assessment Report(s) shall be reviewed for more information on the groundwater quality conditions at the Site.

6.5 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.

7 Conclusions and Recommendations

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

- When comparing the chemistry of the collected groundwater samples to the Hamilton-Wentworth Sanitary Sewer Discharge Criteria (Table 1), only Dissolved Sulphate (SO4) exceeded Table 1.
- When comparing the chemistry of the collected groundwater samples collected to the Hamilton-Wentworth Storm Sewer Discharge Criteria (Table 2), only Total Suspended Solids exceeded Table 2.
- Based on the assumptions outlined in this report, the estimated peak dewatering pumping rate for proposed construction activities is approximately 65 and 70 m^3/day for one (P1) or two (P2) levels of underground parking, respectively. As the dewatering flow rate estimate is between 50 m^3/day and 400 m^3/day, an EASR would be required to facilitate the construction dewatering program for the Site. The EASR would be required mainly to remove stormwater from the excavation.
- It is noted that the City of Hamilton does not permit any post construction foundation. As a result, the underground levels will need to be made watertight without any foundation drains (sub-slab and perimeter) and designed for full hydrostatic pressure.
- The construction dewatering volumes 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 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.
- An agreement to discharge into the sewers owned by the City of Hamilton will be required prior to releasing dewatering effluent.
- The EASR registration allows construction dewatering discharge of up to 400 m^3/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.
- 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.

8 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 Barton Street Developments Inc. 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.

Jay Samarakkody, P. Geo., M.Phil.
Senior Hydrogeologist
Environmental Services

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

Francois Chartier, P. Geo., M. Sc.
Head of Hydrogeology Group
Environmental Services

9 References

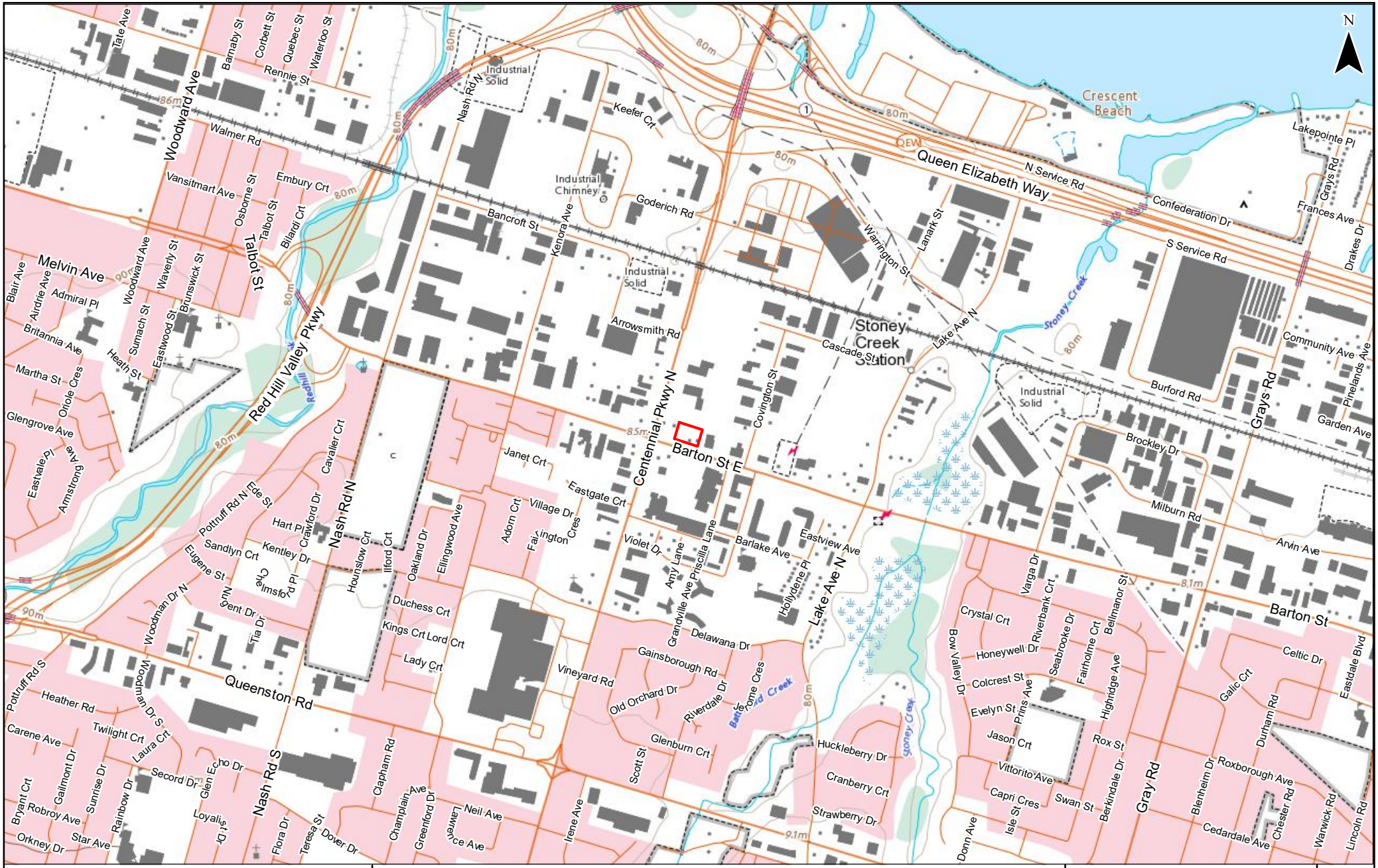
Cashman and Preene (2013) Groundwater Lowering in Construction, 2nd Edition.

Chapman, L.J. and Putnam, D.F. (2007). Physiography of Southern Ontario, 3rd Edition, Ontario Geological Survey.

J.P. Powers, A.B. Corwin, P.C. Schmall and W.E. Kaeck (2007). Construction Dewatering and Groundwater Control, Third Edition.

Ministry of Northern Development and Mines (May, 2012). OGS Earth. Retrieved from http://www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth.

Figures



SCALE:

0 150 300 450 600 750 m

LEGEND:

APPROXIMATE SITE BOUNDARY

SITE LOCATION PLAN

FIGURE: 1

HYDROGEOLOGICAL INVESTIGATION
2481 BARTON STREET
HAMILTON, ONTARIO

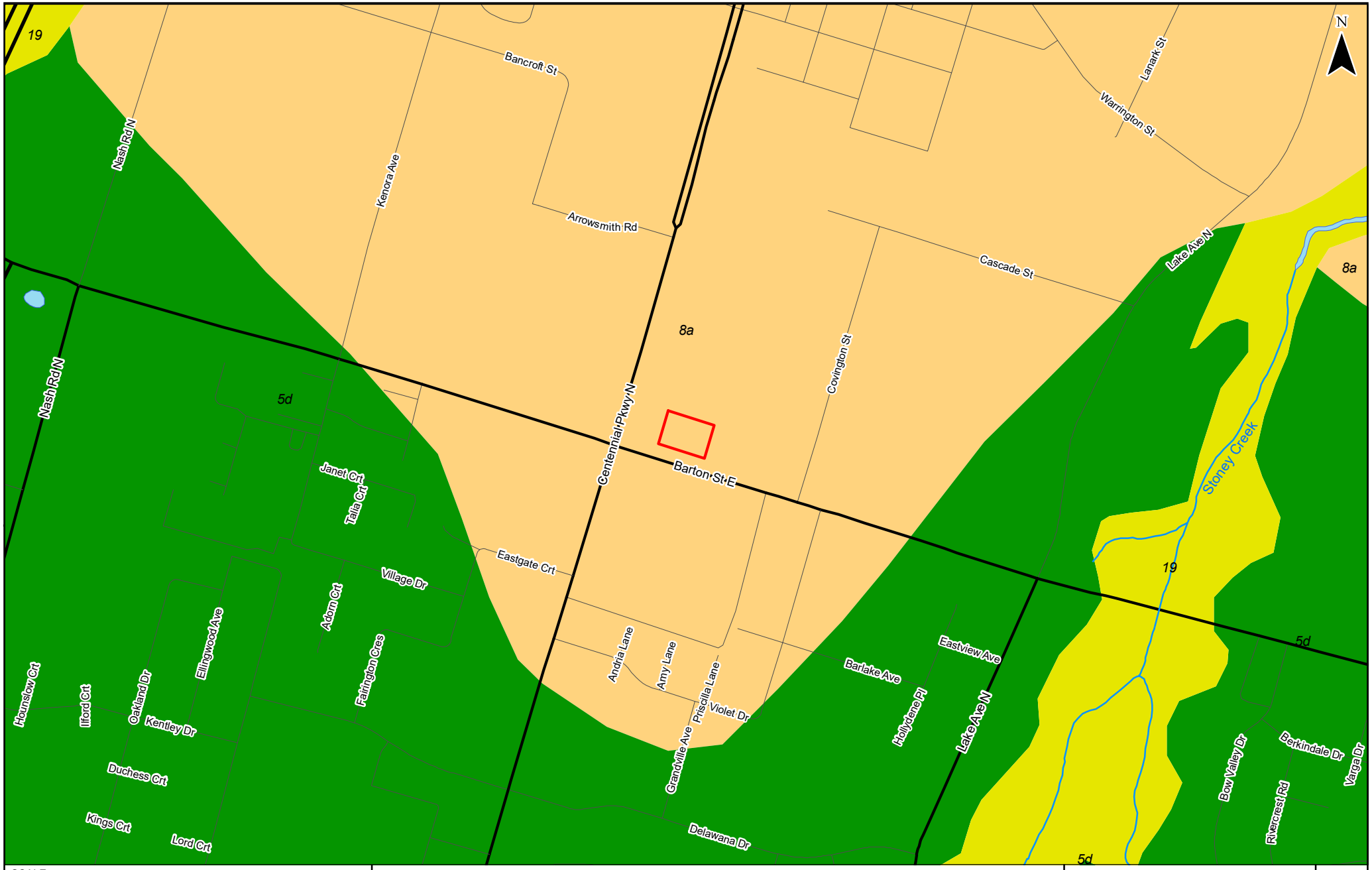
exp.

DRAWN BY: AC

CHECKED BY: CS

PROJECT NUMBER: HAM-00802036-A0

DATE: DECEMBER 2020



SCALE:

0 100 200 300 400 500 m

SOURCE:

BASED ON ONTARIO GEOLOGICAL SURVEY DATA PUBLISHED IN 2010

exp.

DRAWN BY:	CHECKED BY:
AC	CS

LEGEND:

- APPROXIMATE SITE BOUNDARY
- 19: MODERN ALLUVIAL DEPOSITS
- 8A: FINE-TEXTURED GLACIOLACUSTRINE DEPOSITS
- 5D: GLACIOLACUSTRINE-DERIVED SILTY TO CLAYEY TILL

SURFICIAL GEOLOGY

FIGURE: 2

HYDROGEOLOGICAL INVESTIGATION
2481 BARTON STREET
HAMILTON, ONTARIO

PROJECT NUMBER: BRM-00259599-A0

DATE: DECEMBER 2020

SCALE:

0 80 160 240 320 400 m

SOURCE:

BASED ON GOOGLE EARTH IMAGERY DATED 2019,
AVAILABLE WELL RECORD INFORMATION AS OF SEPTEMBER 2019

exp.

DRAWN BY:	CHECKED BY:
AC	CS

LEGEND:

- MONITORING WELL / TEST HOLE
- WATER SUPPLY WELL
- ABANDONED WELL
- UNCLASSIFIED / UNFINISHED WELL
- APPROXIMATE SITE BOUNDARY
- 500 m ZONE

MECP WATER WELL RECORDS MAP

FIGURE: 3

HYDROGEOLOGICAL INVESTIGATION
255 AND 299 BASS PRO MILLS DRIVE
VAUGHAN, ONTARIO

PROJECT NUMBER: HAM-00802036-A0

DATE: DECEMBER 2020

SCALE:

0 6 12 18 24 30 m

LEGEND:

- APPROXIMATE SITE BOUNDARY
- CROSS SECTION AXIS
- BOREHOLE (EXP, 2020)
- BOREHOLE / MONITORING WELL (EXP, 2020)
- BOREHOLE / MONITORING WELL (REI, 2020)

exp.

DRAWN BY:	CHECKED BY:
JA	JS

BOREHOLE / MONITORING WELL LOCATION PLAN

FIGURE: 4

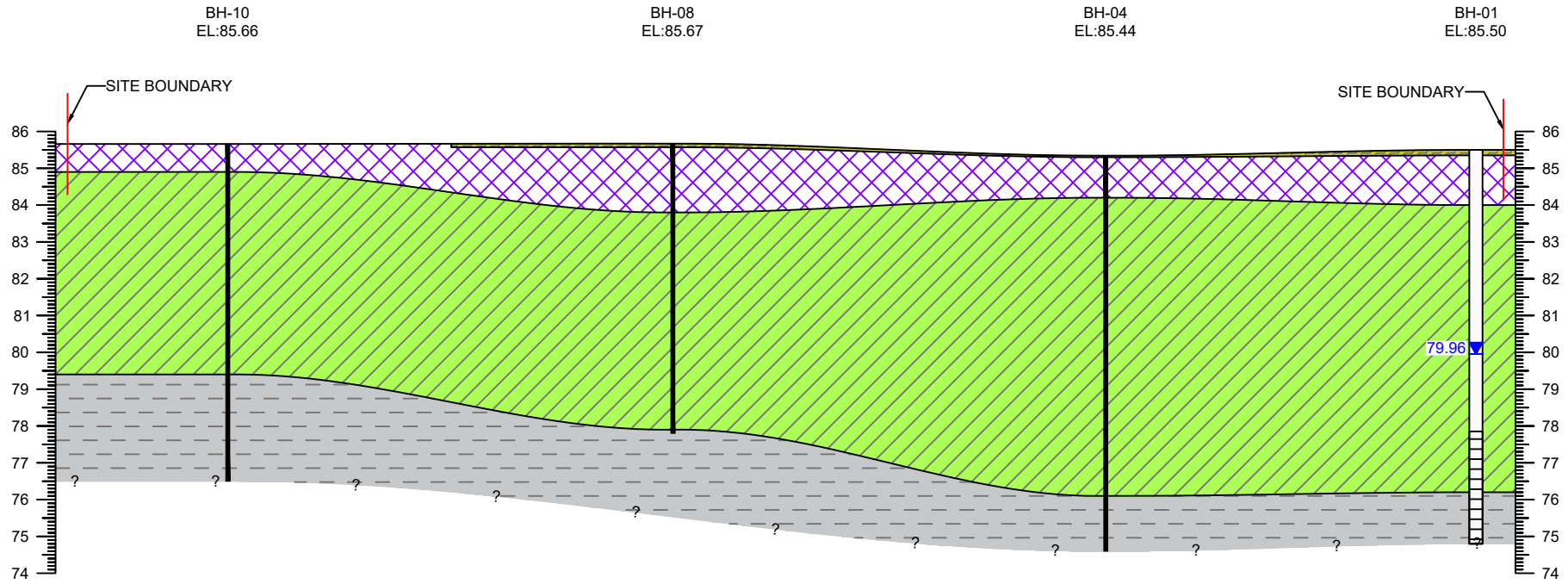
HYDROGEOLOGICAL INVESTIGATION
2481 BARTON STREET EAST
HAMILTON, ONTARIO

PROJECT NUMBER: HAM-00802036-A0

DATE: DECEMBER 2020

A
SOUTHEAST

A'
NORTHWEST



VERTICAL SCALE: AS SHOWN

HORIZONTAL SCALE:

0 5 10 15 20 25 m

EXP Services Inc.
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1595 Clark Boulevard
Brampton, ON L6T 4V1
Canada
www.exp.com

• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

LEGEND:

- TOPSOIL
- FILL
- SILTY CLAY TILL
- SHALE BEDROCK

▼ GROUNDWATER ELEVATION (masl)
AS MEASURED ON NOVEMBER 30, 2020

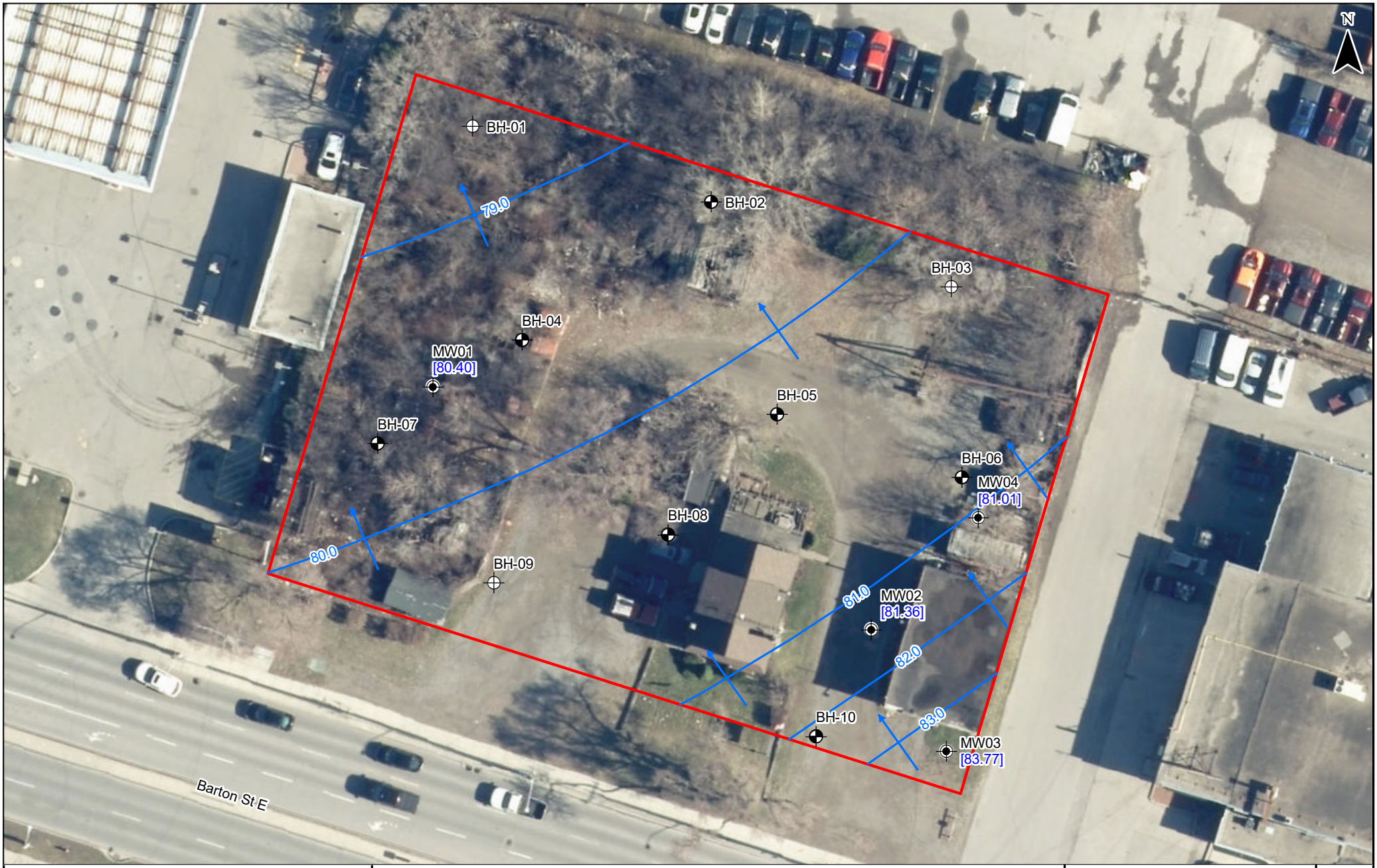
TITLE AND LOCATION:

CROSS SECTION A-A'

HYDROGEOLOGICAL INVESTIGATION
2481 BARTON STREET EAST
HAMILTON, ONTARIO

PROJECT NO.:	DWN.:
HAM-00802036-A0	JA
SCALE:	CK:
AS NOTED	JS
DATE:	FIG. NO.:
DECEMBER 2020	5

F:\00800000\802000\802036-A0 2481 Barton St Hamilton HG\2 - Input\GIS\HAM-00802036-A0.dwg



SCALE:

0 6 12 18 24 30 m

LEGEND:

- APPROXIMATE SITE BOUNDARY
- BOREHOLE (EXP, 2020)
- BOREHOLE / MONITORING WELL (EXP, 2020)
- BOREHOLE / MONITORING WELL (REI, 2020)
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- [XX.XX] GROUNDWATER ELEVATION (masl) AS MEASURED ON NOVEMBER 30, 2020

DRAWN BY:	CHECKED BY:
JA	JS

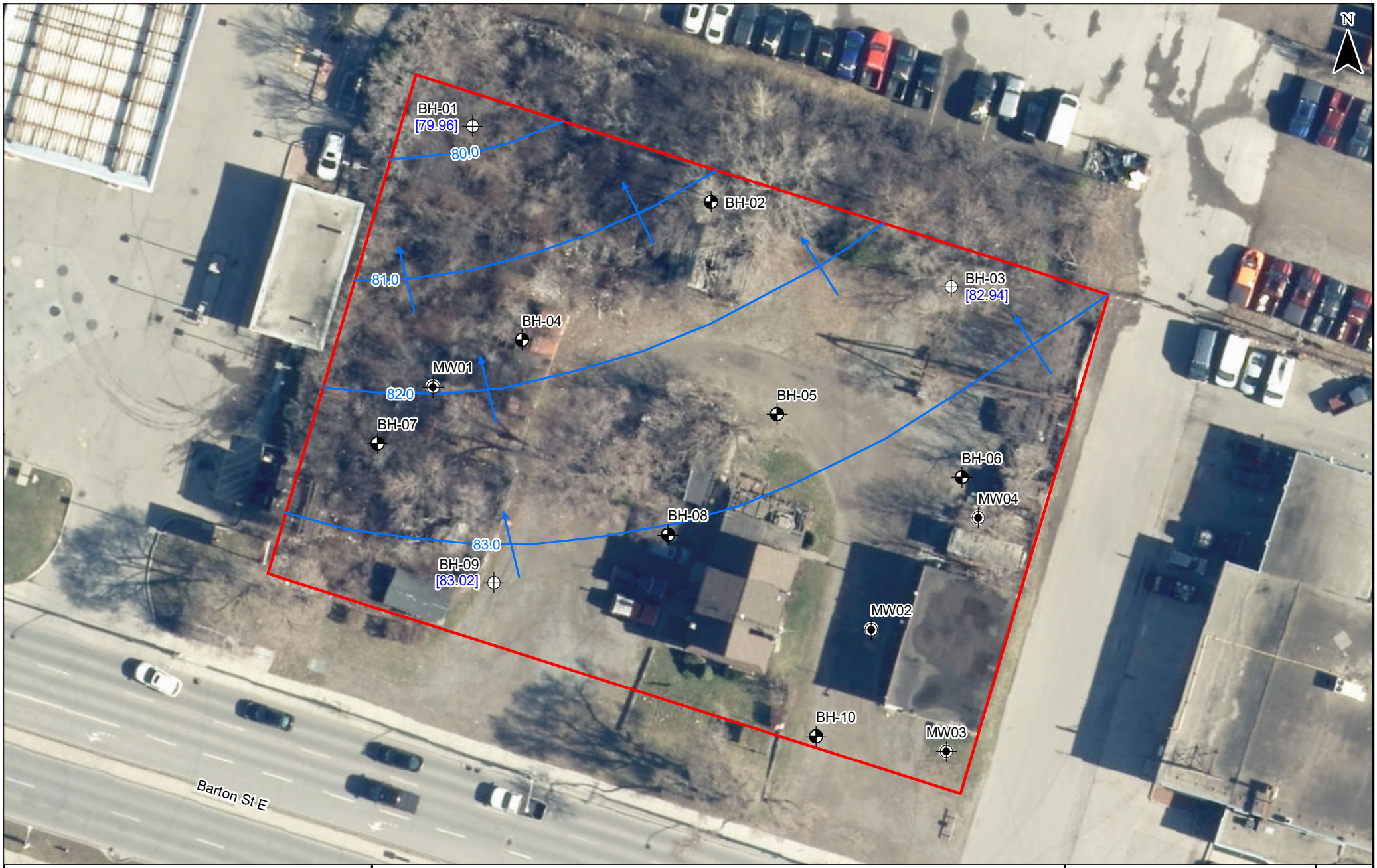
SHALLOW CONTOUR PLAN

FIGURE: 6A

HYDROGEOLOGICAL INVESTIGATION
2481 BARTON STREET EAST
HAMILTON, ONTARIO

PROJECT NUMBER: HAM-00802036-A0

DATE: DECEMBER 2020



SCALE:

0 6 12 18 24 30 m

LEGEND:

- APPROXIMATE SITE BOUNDARY
- BOREHOLE (EXP, 2020)
- BOREHOLE / MONITORING WELL (EXP, 2020)
- BOREHOLE / MONITORING WELL (REI, 2020)
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION
- [XX.XX] GROUNDWATER ELEVATION (masl) AS MEASURED ON NOVEMBER 30, 2020

exp.

DRAWN BY:	CHECKED BY:
JA	JS

BEDROCK CONTOUR PLAN

FIGURE: 6B

HYDROGEOLOGICAL INVESTIGATION
2481 BARTON STREET EAST
HAMILTON, ONTARIO

PROJECT NUMBER: HAM-00802036-A0

DATE: DECEMBER 2020

Appendix A – MECP WWR Summary Table

Appendix A
MECP Water Well Records within 500 m of the Site

Off-Site													
BORE HOLE ID	WELL ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	WELL DEPTH (m bgs)	WATER FOUND (m bgs)	1st USE	2nd USE	FINAL STATUS
10482167	6804706	5/8/1952	601198	4787666	85.2			493	13.7	11.0	Water Supply	Domestic	Water Supply
11761745	7039203	11/30/2006	601097	4787777	85.3	2553 BARTON ST EAST	HAMILTON	359	9.0	4.5	Observation Wells		Observation Wells
1001480709	7101182	9/6/2007	600875	4787810	85.6	258 CENTENNIAL PLWAY N	Hamilton	140	6.0		Other Status	Monitoring	Other Status
1001608624	7106145	5/1/2008	600716	4787613	87.2	200 -210 CENTENNIAL PARKWAY	STONEY CREEK	268	4.6		Observation Wells	Not Used	Observation Wells
1001659070	7108267	3/13/2008	600585	4787667	87.4	200 CENTENIAL PARKWAY 210	STONEY CREEK	270	7.0		Test Hole	Test Hole	Test Hole
1001725127	7109578	9/10/2007	600708	4787733	86.5	730 GUELPH LN		152	4.9		Other Status	Other	Other Status
1001953827	7117879	12/23/2008	600988	4788192	83.8	95 COVINGTON	Hamilton	392	4.6		Test Hole	Test Hole	Test Hole
1002529437	7101182	9/6/2007	600675	4787810	86.1	258 CENTENNIAL PLWAY N	Hamilton	104	6.0	4.5	Other Status	Monitoring	Other Status
1002529445	7101182	9/6/2007	600695	4787734	86.5	258 CENTENNIAL PLWAY N	Hamilton	156	6.0	4.5	Other Status	Monitoring	Other Status
1002529453	7101182	9/6/2007	600686	4787741	86.5	258 CENTENNIAL PLWAY N	Hamilton	153	6.0	4.5	Other Status	Monitoring	Other Status
1002529461	7101182	9/7/2007	600688	4787753	86.4	258 CENTENNIAL PLWAY N	Hamilton	141	6.0	4.5	Other Status	Monitoring	Other Status
1002529469	7101182	9/7/2007	600700	4787733	86.5	258 CENTENNIAL PLWAY N	Hamilton	155	6.0	4.5	Other Status	Monitoring	Other Status
1002529477	7101182	9/7/2007	600712	4787741	86.4	258 CENTENNIAL PLWAY N	Hamilton	144	6.0		Other Status	Monitoring	Other Status
1002952969	7142118	2/24/2010	601076	4788149	83.1	96 COVINGTON ROAD	Hamilton	421	1.8		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1002952971	7142119	2/24/2010	601076	4788149	83.1	96 COVINGTON ROAD	Hamilton	421	2.4		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1002952973	7142120	2/24/2010	601084	4788153	83.1	96 COVINGTON RD.	Hamilton	430	1.7		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1003348636	7152810	10/1/2010	600640	4787979	85.4	257 CENTENNIAL PARKWAY	HAMILTON	151	7.6		Test Hole	Test Hole	Test Hole
1003348638	7152811	10/2/2010	600607	4788017	85.5	257 CENTENNIAL PARKWAY NORTH	HAMILTON	201	7.3		Test Hole	Test Hole	Test Hole
1003348640	7152812	10/1/2010	600583	4787987	85.8	257 CENTENNIAL PARKWAY NORTH	HAMILTON	202	7.3		Test Hole	Test Hole	Test Hole
1003486127	7160430	2/18/2011	601050	4787915	84.9	36 COVINGTON ST	HAMILTON	299	4.2		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1003486129	7160431	2/18/2011	601040	4787917	84.8	36 COVINGTON ST	HAMILTON	289	4.2			Monitoring and Test Hole	
1003486131	7160432	2/18/2011	601009	4787892	84.9	36 CONVINGTON ST	HAMILTON	256	4.2		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1003486133	7160433	2/18/2011	601005	4787914	84.8	36 COVINGTON ST	HAMILTON	254	4.0		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1003581795	7170132	7/14/2011	600794	4788386	80.2	CENTENNIAL PKWY. N	Hamilton	509	5.0		Observation Wells	Test Hole	Observation Wells
1003616390	7173013	10/14/2011	600670	4787800	86.2	220 CENTENNIAL PKWY	Hamilton	114	3.6		Observation Wells		Observation Wells
1003688481	7176258	1/23/2012	600812	4788382	80.5	15M EAST OF CENTENNIAL PKWY. N & 3M N OF CN TRACKS		507	9.2		Observation Wells	Monitoring	Observation Wells
1003688484	7176260	1/19/2012	600765	4788378	80.0	15M WEST OF CENTENNIAL PKWY. N.& 3M S. OF CN TRACK	HAMILTON	500	20.1	18.0	Observation Wells	Monitoring	Observation Wells
1003688508	7176259	1/18/2012	600811	4788364	80.5	15M. E. OF CENTENNIAL PKWY. N.&3M S. OF CN TRACKS	HAMILTON	489	21.3	2.4	Observation Wells	Monitoring	Observation Wells
1004290594	7201370	4/26/2013	600655	4787786	86.3	200 CENTENNIAL PKWY	STONEY CREEK	135	7.0		Observation Wells	Monitoring	Observation Wells
1004830341	7221734	5/21/2014	600766	4788286	80.5	347 CENTENNIAL PARKWAY	Hamilton	408	7.6			Monitoring	
1003424429	7155355	10/18/2010	600724	4787954	84.9	258 CENTENNIAL PARKWAY	Hamilton	81			Abandoned-Other	Not Used	Abandoned-Other
11327418	6814209	3/10/2005	600496	4787497	88.7	155 CENTENNIAL PKWY N	STONEY CREEK	460	7.6		Observation Wells		Observation Wells
1003748494	7161663	6/26/2008	600707	4787635	87.1			248					
1003748503	7161663	6/26/2008	600733	4787613	87.2			266					
1003748512	7161663	6/26/2008	600711	4787593	87.4			289					
1003505603	7161663	6/25/2008	600633	4787747	86.7			178					
1005305129	7237198	11/5/2014	600672	4787826	86.1	220 CENTENNIAL PARKWAY	Hamilton	97	3.9		Observation Wells	Monitoring	Observation Wells
1005305132	7237199	11/5/2014	600689	4787828	85.9	220 CENTENNAIL PARKWAY	Hamilton	82	3.9		Observation Wells	Monitoring	Observation Wells
1005305135	7237200	11/5/2014	600679	4787810	86.1	220 CENTENNIAL PARKWAY	Hamilton	101	3.9		Observation Wells	Monitoring	Observation Wells
1005305138	7237201	11/5/2014	600675	4787795	86.2	220 CENTENNIAL PARKWAY	Hamilton	114	3.9		Observation Wells	Monitoring	Observation Wells
1005305141	7237202	11/5/2014	600661	4787990	85.2	220 CENTENNIAL PARKWAY	Hamilton	145	3.9		Observation Wells	Monitoring	Observation Wells
1005305144	7237203	11/5/2014	600654	4787810	86.3	220 CENTENNIAL PARKWAY	Hamilton	121	3.9		Observation Wells	Monitoring	Observation Wells
1005869471	7256121	10/29/2015	600952	4787918	84.7	35 COVINSTON ST	Hamilton	203	6.1		Observation Wells	Monitoring	Observation Wells
1005939109	7262083	3/20/2016	600475	4787585	88.3	163 CENTENNIAL PARKWAY	HAMILTON	404	6.1		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1005939112	7262084	3/20/2016	600497	4787570	88.3	163 CENTENNIAL PARKWAY	HAMILTON	401	6.1		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1005939115	7262085	3/20/2016	600530	4787613	87.9	163 CENTENNIAL PARKWAY	HAMILTON	347	5.5		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1006060707	7265157	5/19/2016	600697	4787974	85.1	2471 BARTON STREET EAST	HAMILTON	111	6.1			Monitoring and Test Hole	
1006060823	7265045	5/3/2016	600683	4787884	85.8	2471 BARTON STREET EAST	HAMILTON	70	6.1		Monitoring and Test Hole	Monitoring and Test Hole	Monitoring and Test Hole
1006064690	7265183	5/19/2016	600679	4787920	85.5	2471 BARTON STREET EAST	HAMILTON	85	6.1			Monitoring and Test Hole	
1006358747	7281785	1/16/2017	600469	4787771	87.1	2420 BARTON ST	Hamilton	304	7.0		Monitoring and Test Hole	Test Hole	Monitoring and Test Hole
1006358750	7281786	1/16/2017	600485	4787769	87.2	2420 BARTON ST	Hamilton	290	7.6		Monitoring and Test Hole	Test Hole	Monitoring and Test Hole
1006380365	7284608	1/11/2017	600628	4787408	88.8	140 CENTENNIAL PKWY N	Hamilton	487	6.7		Observation Wells	Monitoring	Observation Wells
1006797610	7299234	10/6/2017	600856	4787742	86.1	2520 BARTON ST E	Hamilton	171	13.7		Observation Wells	Monitoring	Observation Wells
1005305126	7237197	11/5/2014	600660	4787790	86.3	220 CENTENNIAL PARKWAY	Hamilton	129			Abandoned-Other		Abandoned-Other
1005793591	7251861	8/4/2015	600787	4788391	80.1	CENTENNIAL PARKWAY		514					
1006498843	7287678	11/9/2016	600530	4787468	88.7	140 CENTENNIAL PKWY N	Hamilton	467			Abandoned-Quality	Test Hole	Abandoned-Quality
1007434523	7331858	9/18/2018	600710	4788055		282 CENTENNIAL PKWY N	Hamilton	182	9.1				

Appendix A
MECP Water Well Records within 500 m of the Site

Off-Site													
BORE HOLE ID	WELL ID	DATE	EAST83	NORTH83	ELEVATION (m ASL)	STREET	CITY	DISTANCE FROM SITE CENTROID (m)	WELL DEPTH (m bgs)	WATER FOUND (m bgs)	1st USE	2nd USE	FINAL STATUS
1003485750	7160354	5/3/2010	600380	4787901	86.6			374					
1003707144	7178735	7/20/2011	600627	4788048	85.2			211					
1004716245	7217050	12/2/2013	601025	4787958	84.6			283					
1004801559	7221343	3/25/2014	600975	4787941	84.6			231					
1004917208	7223570	6/10/2014	600695	4788157	82.9			284					
1004924592	7223758	10/4/2013	601054	4787951	84.7			309					
1006236022	7270712	8/18/2015	601087	4787927	84.9			337					
1006278708	7273971	1/12/2016	600985	4787964	84.5			247					
1006375746	7284092	1/19/2017	601031	4787933	84.8			283					
1006503813	7287638	11/2/2016	600543	4787473	88.6			457					
1006504424	7287648	11/9/2016	600541	4787477	88.6			454					
1006504574	7287655	5/12/2017	601176	4787893	84.9			423					
1007004447	7307678	1/11/2018	600677	4788381				508					

Appendix B – Borehole Logs

Log of Borehole BH-01

Project No. HAM-00802036-A0 Drawing No. 3

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

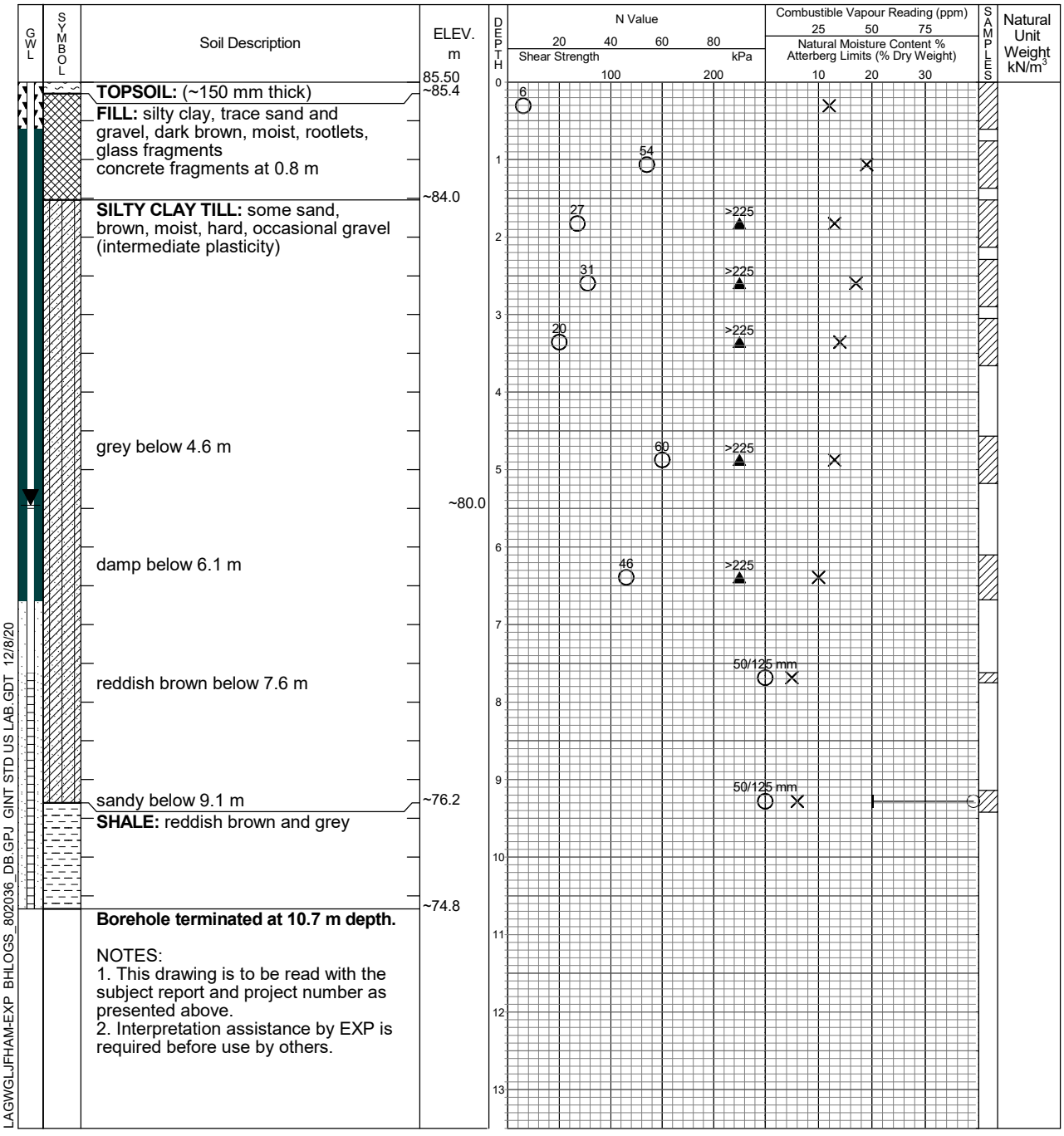
Date Drilled: November 10, 2020

Drill Type: CME-55 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



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_802036_DB.GPJ GINT STD US LAB.GDT 12/8/20

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	10.7
November 23, 2020	4.5	N/A
November 30, 2020	5.5	N/A

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

Log of Borehole BH-02

Project No. HAM-00802036-A0 | Drawing No. 4

Project: Proposed Mid-Rise Apartment Building | Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

Date Drilled: November 10, 2020

Drill Type: CME-55 Track Mount. Solid Stem

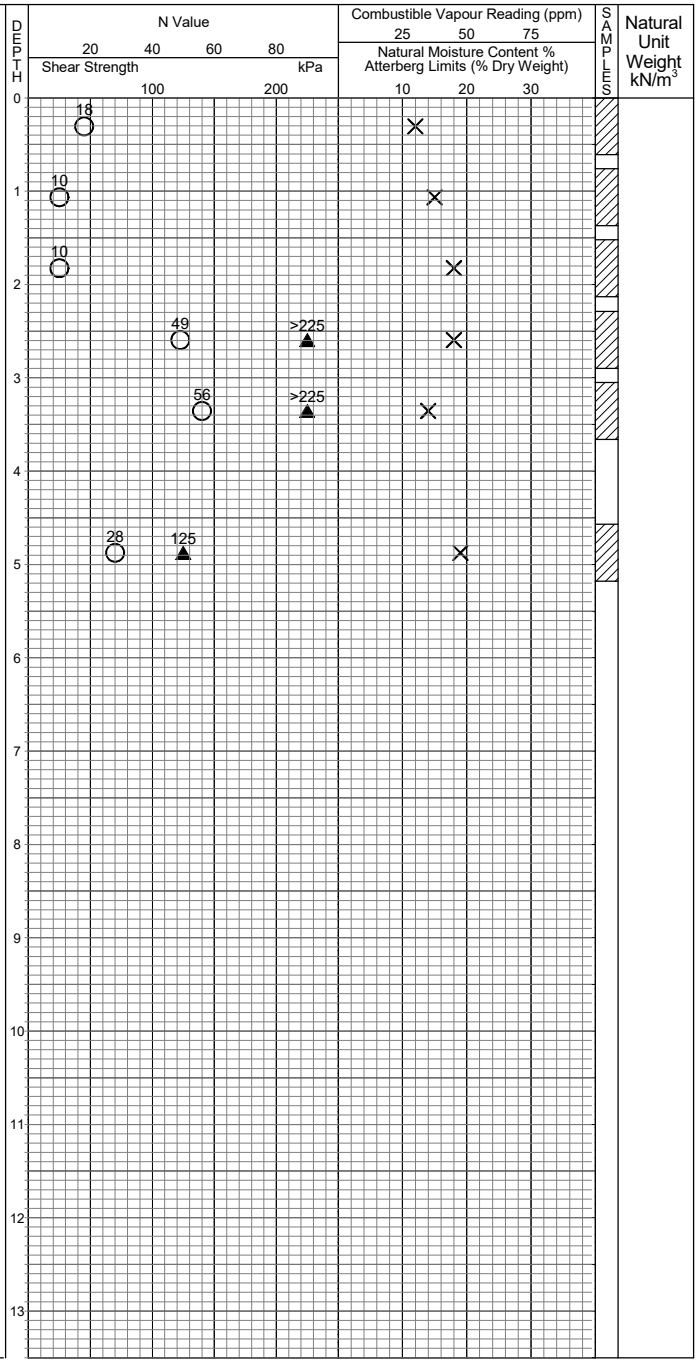
Datum: Geodetic

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
			85.26
		FILL: silty clay, some sand and gravel, dark brown, moist, rootlets, brick fragments	
			~84.2
		FILL: sandy silt, some clay, brown, very moist, trace black organic staining and odour	
			~83.0
		SILTY CLAY TILL: some sand, brown, moist, hard, occasional gravel	
		grey, very stiff below 4.6 m	
			~79.5
		Borehole terminated at 5.8 m depth due to auger refusal on obstruction.	

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.



Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	5.8

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

Log of Borehole BH-03

Project No. HAM-00802036-A0 Drawing No. 5

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

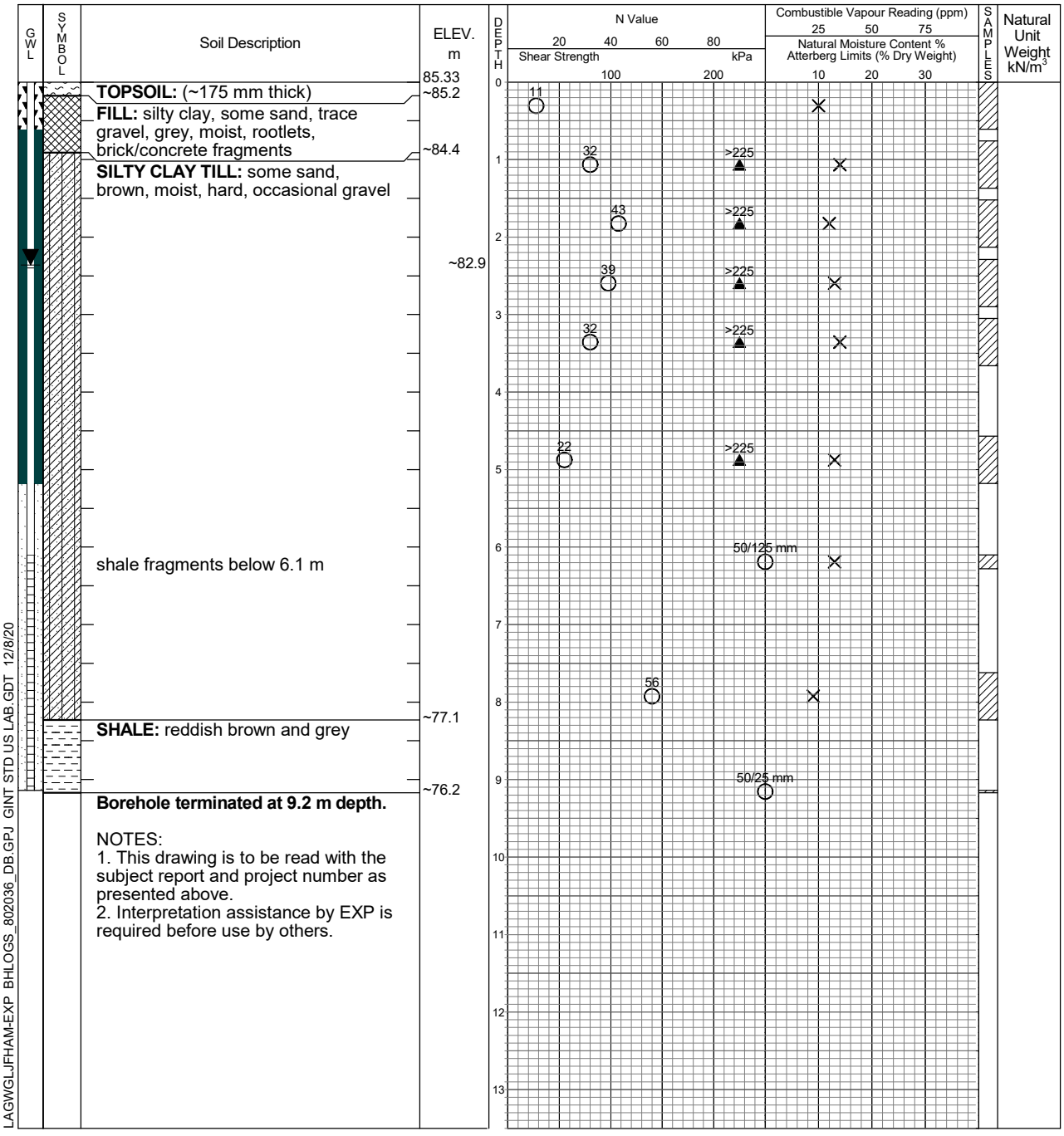
Date Drilled: November 9, 2020

Drill Type: CME-55 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



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.

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	9.2
November 23, 2020	2.3	N/A
November 30, 2020	2.4	N/A

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

Log of Borehole BH-04

Project No. HAM-00802036-A0 Drawing No. 6

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

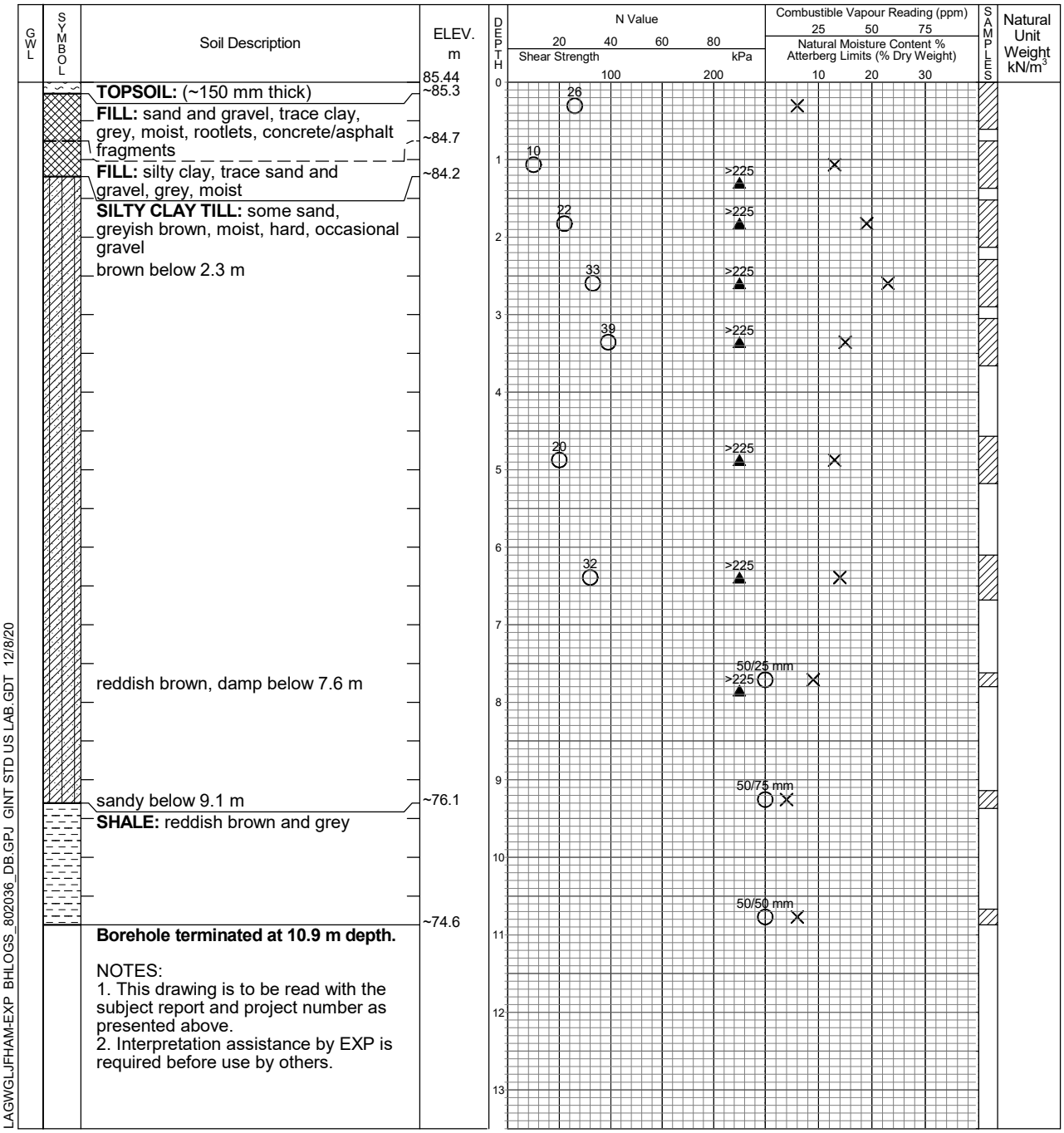
Date Drilled: November 10, 2020

Drill Type: CME-55 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



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.

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	10.1

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

Log of Borehole BH-05

Project No. HAM-00802036-A0 Drawing No. 7

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

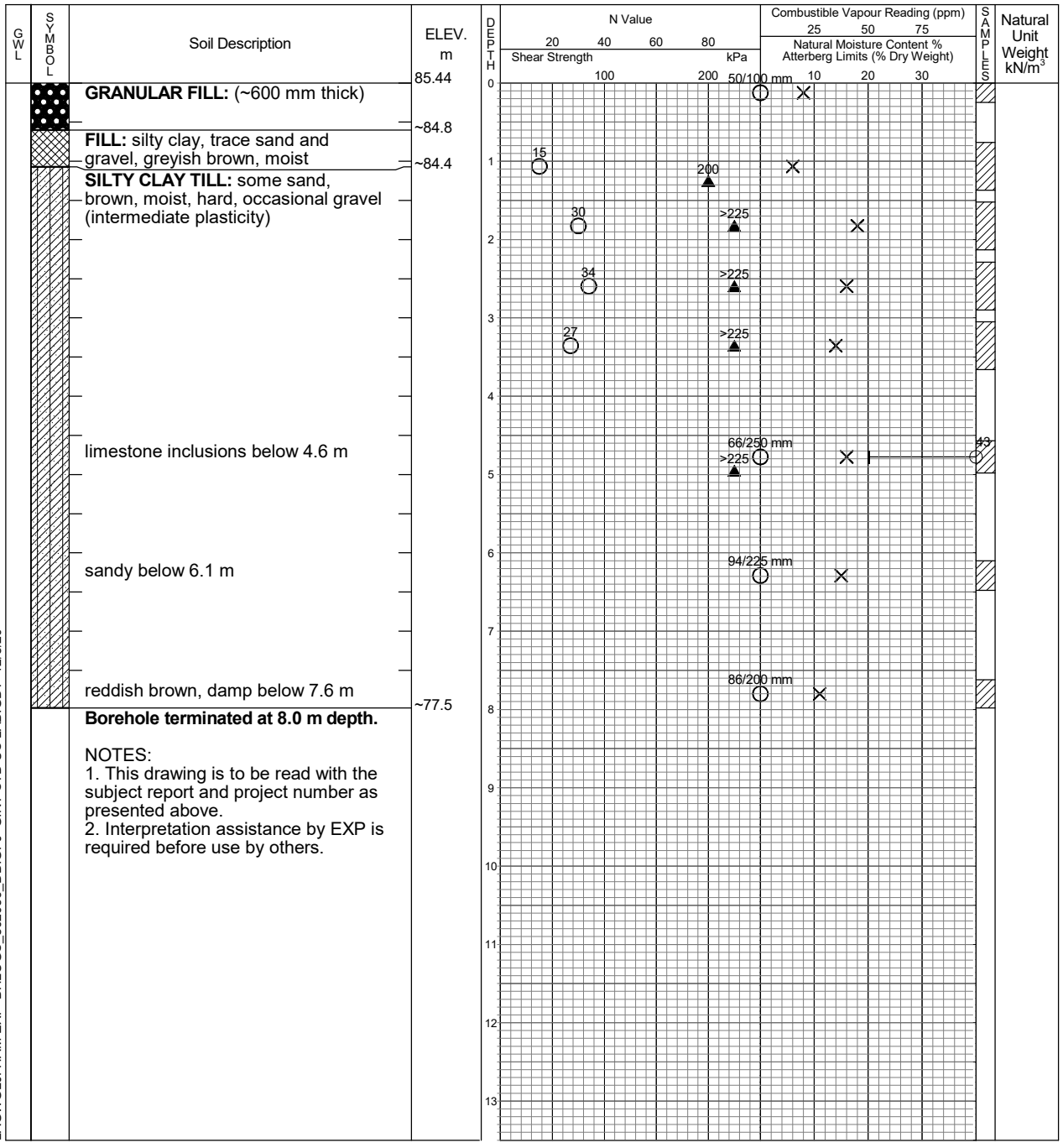
Date Drilled: November 11, 2020

Drill Type: CME-55 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



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.

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	7.3

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

Log of Borehole BH-06

Project No. HAM-00802036-A0 Drawing No. 8

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

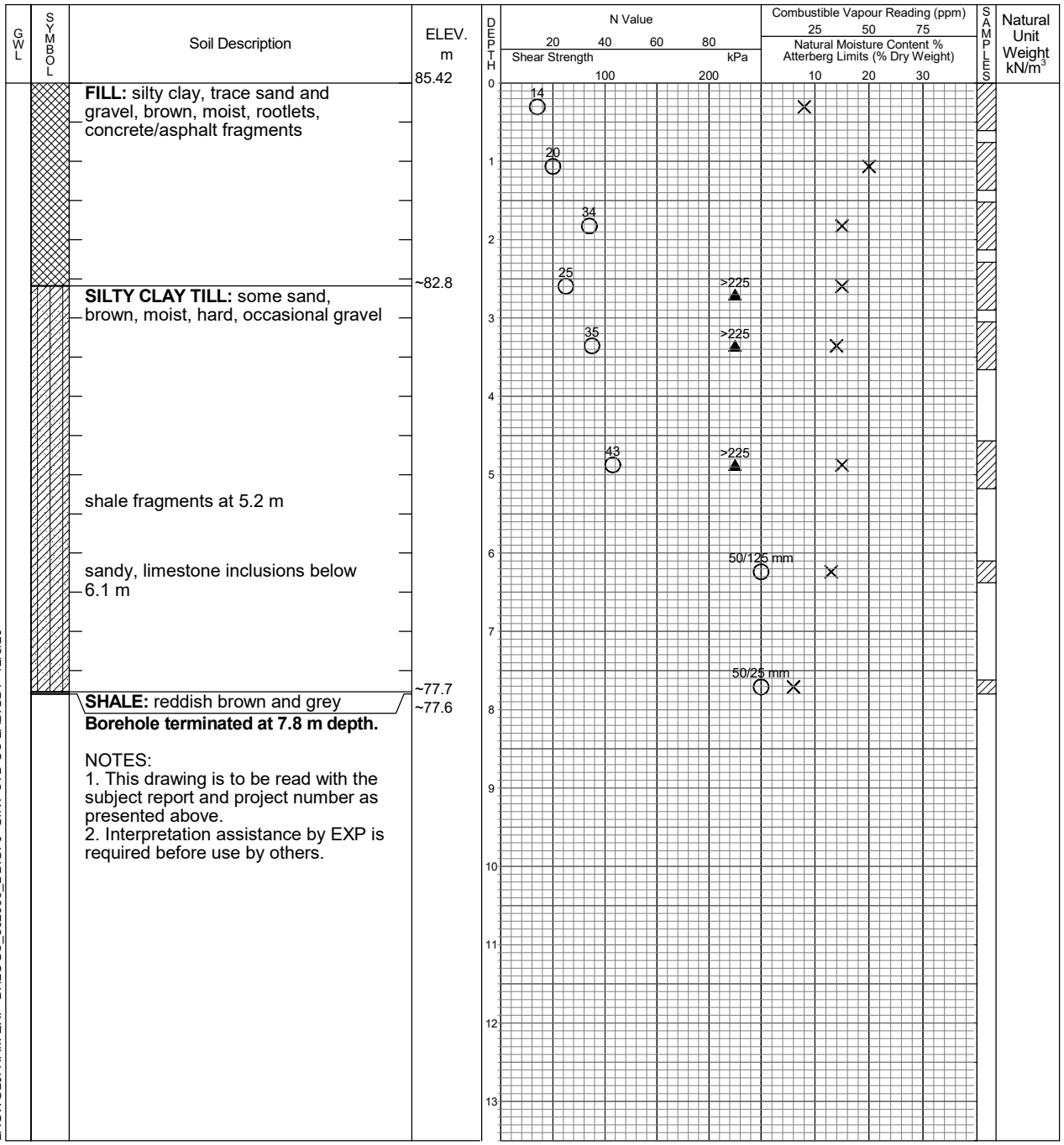
Date Drilled: November 9, 2020

Drill Type: CME-55 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



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.

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	7.8

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

Log of Borehole BH-07

Project No. HAM-00802036-A0 Drawing No. 9

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

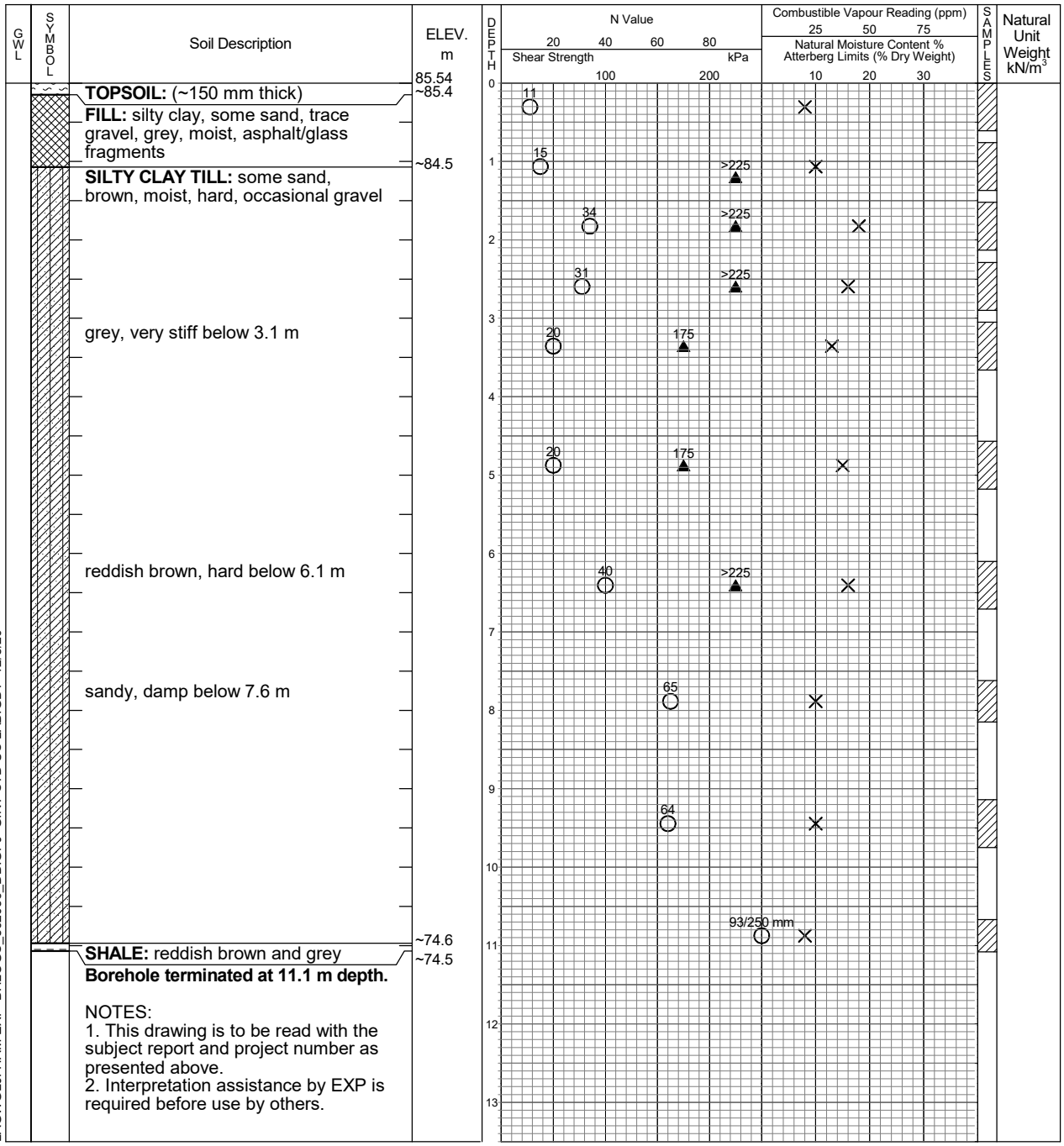
Date Drilled: November 11, 2020

Drill Type: CME-55 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



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.

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	10.5

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

Log of Borehole BH-08

Project No. HAM-00802036-A0 Drawing No. 10

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

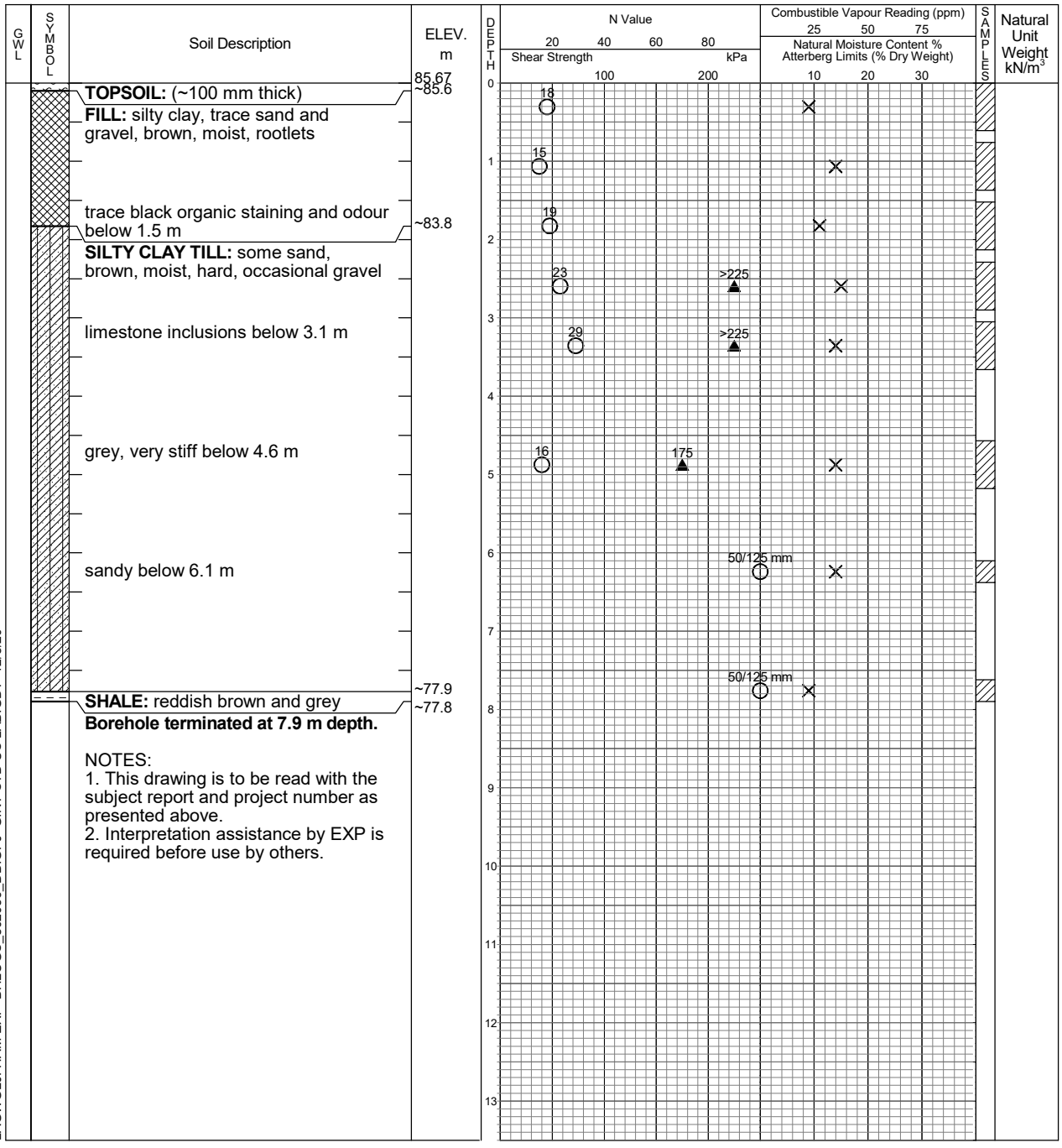
Date Drilled: November 11, 2020

Drill Type: CME-55 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



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.

Time	Water Level (m)	Depth to Cave (m)
on completion	no free water	7.5

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

Log of Borehole BH-09

Project No. HAM-00802036-A0 Drawing No. 11

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

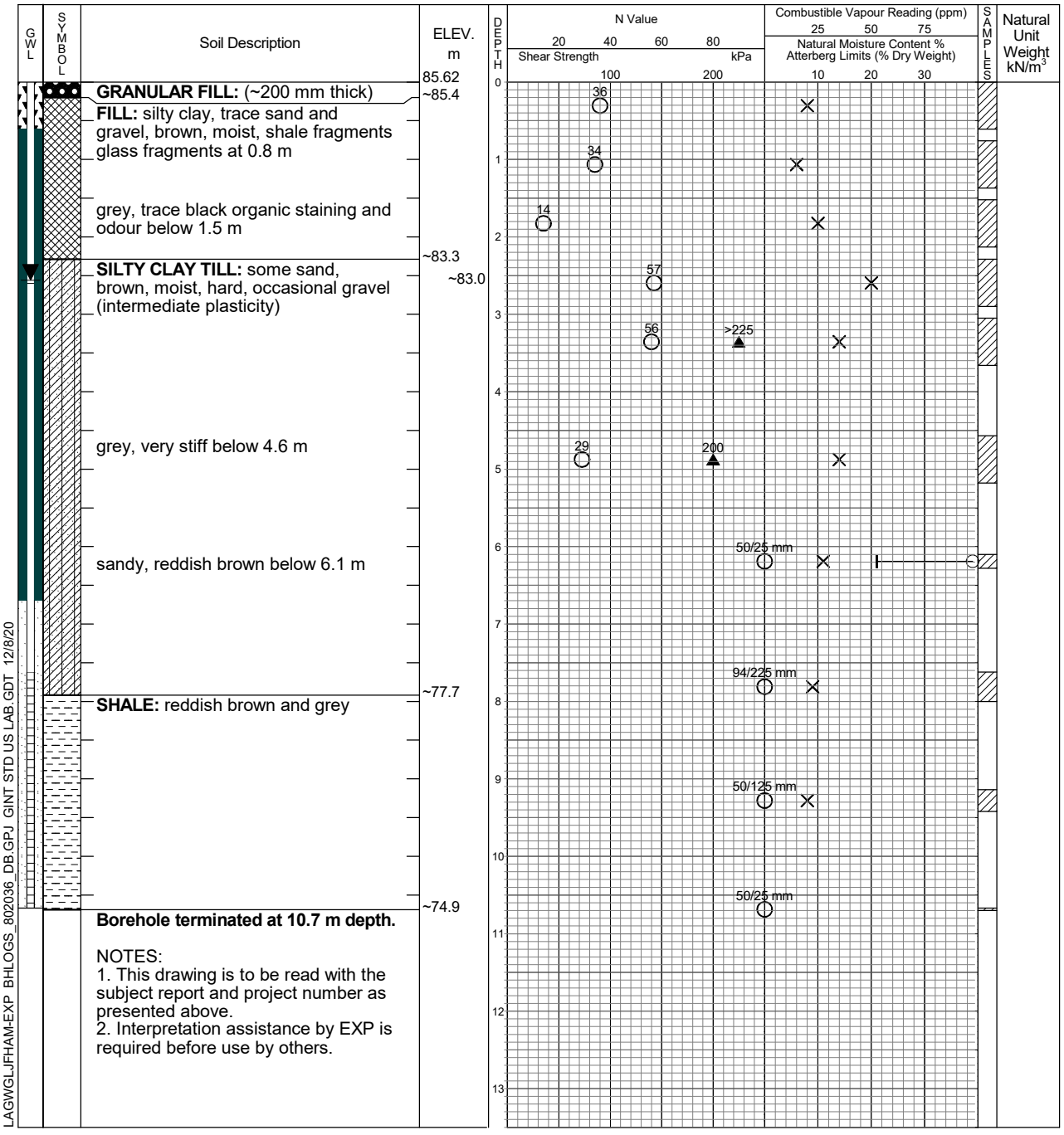
Date Drilled: November 11, 2020

Drill Type: CME-55 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



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_802036_DB.GPJ GINT STD US LAB.GDT 12/8/20

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

Time	Water Level (m)	Depth to Cave (m)
on completion	10.2	10.5
November 23, 2020	2.9	N/A
November 30, 2020	2.6	N/A

Log of Borehole BH-10

Project No. HAM-00802036-A0 Drawing No. 12

Project: Proposed Mid-Rise Apartment Building Sheet No. 1 of 1

Location: 2481 Barton Street E, Hamilton, ON

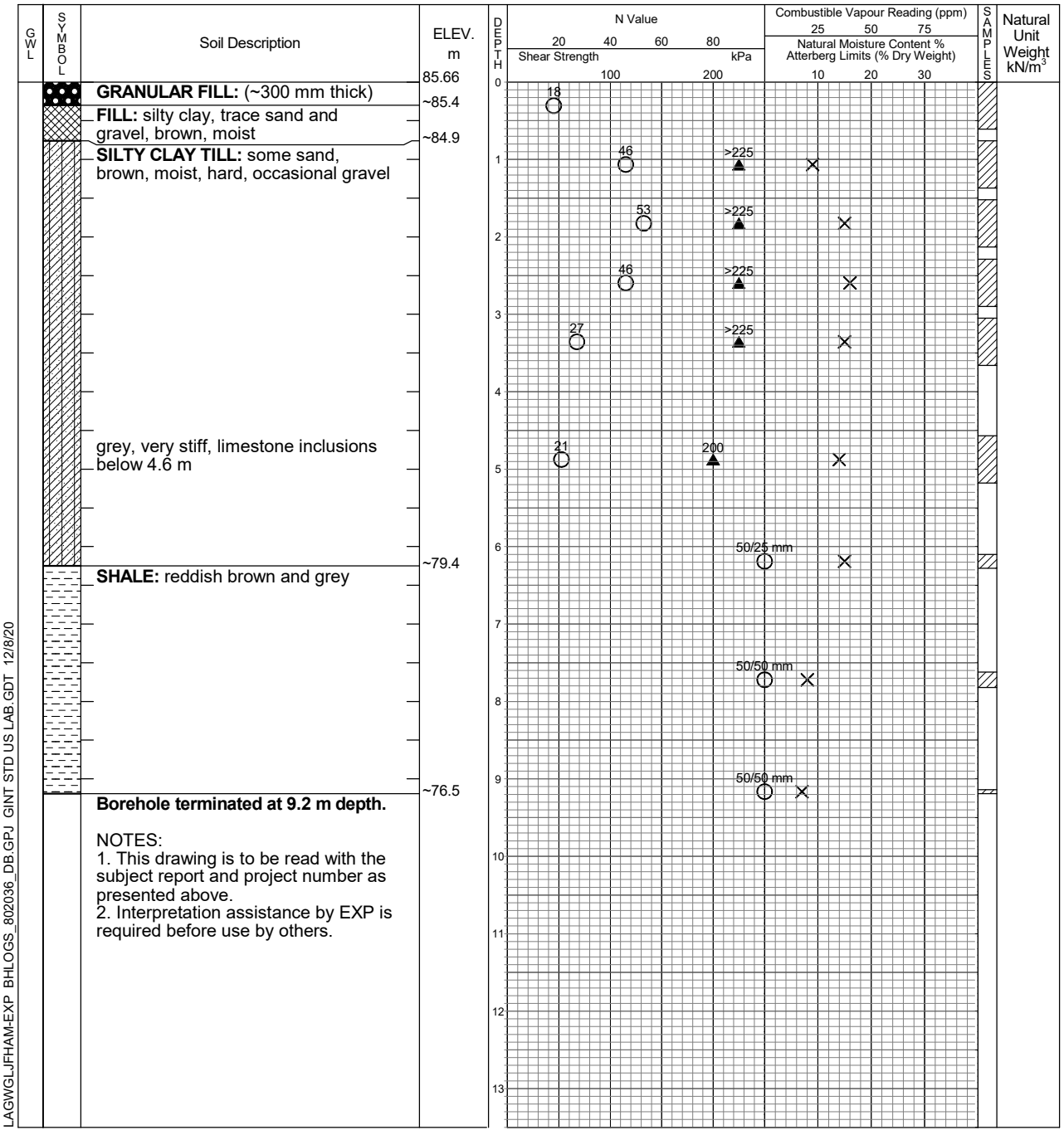
Date Drilled: November 9, 2020

Drill Type: CME-55 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



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.

Time	Water Level (m)	Depth to Cave (m)
on completion	8.9	9.2

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

Project No: R60315.1

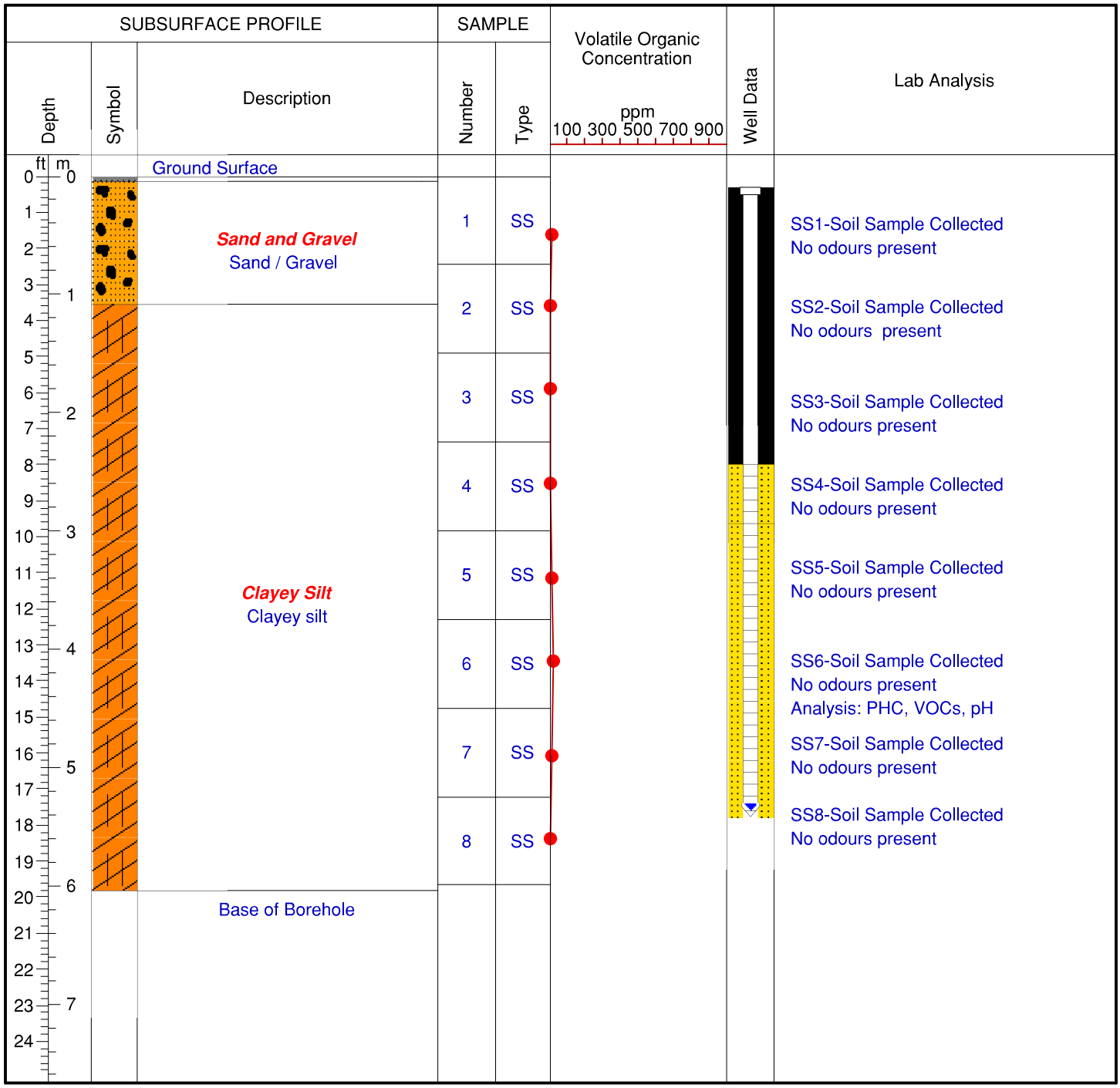
Log of: BH1/MW01

Project: Phase II ESA

Client: 2454184 Ontario Inc.

Location: 2481 Barton St E, Stoney Creek

Logged by: PDR



Drill Method: Auger / Split Spoon Sampler

Drill Date: August 25, 2020

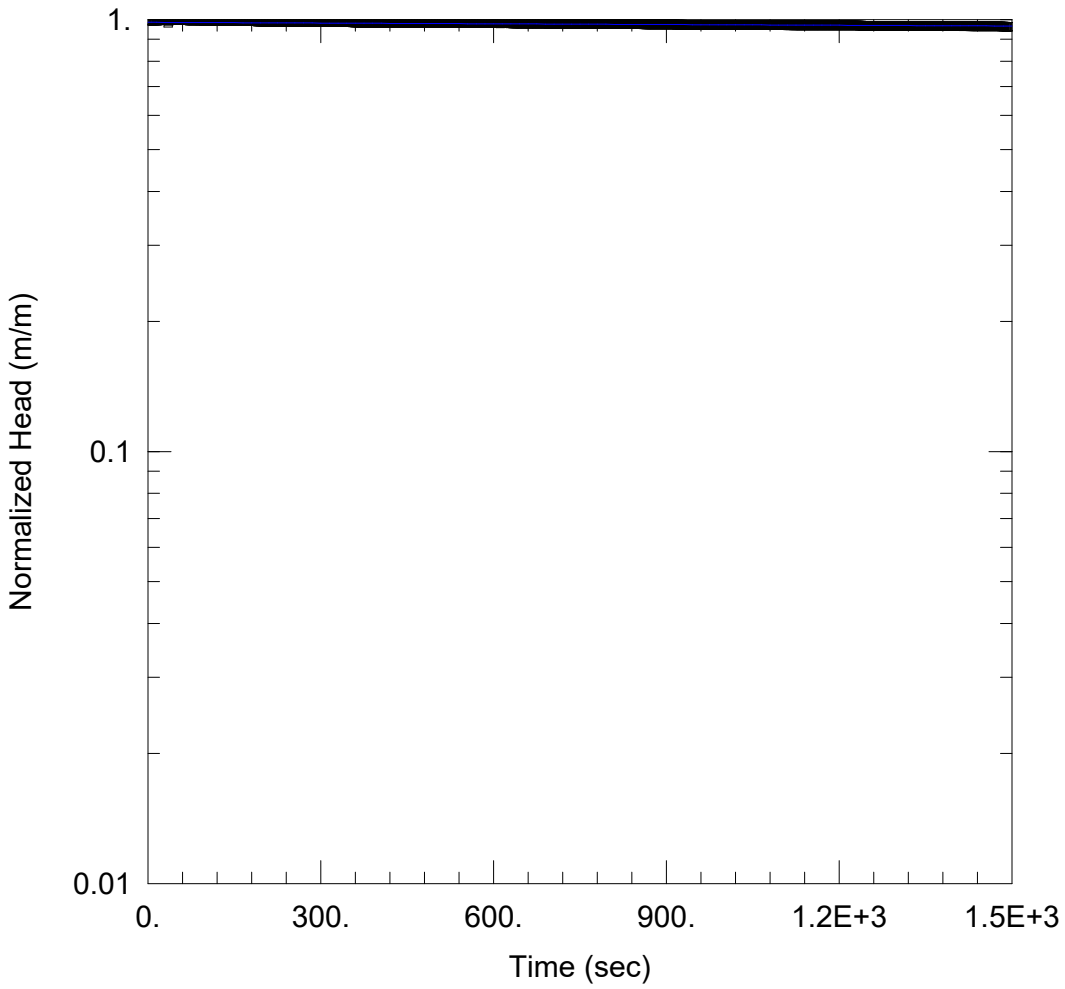
Drilled By: Rubicon Environmental (2008) Inc.

Datum: Local

Hole Size: 6"

Sheet: 1 of 1

Appendix C – SWRT Procedures and Results



SWRT - RISING HEAD - BHMW 1

Data Set: \...\BHMW 1.aqt
Date: 12/07/20 Time: 13:29:18

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Victoria Park Community Homes
Project: HAM-00802036-A0
Location: 2481 Baron St, Hamilton, ON
Test Well: BHMW 1
Test Date: November 23, 2020

AQUIFER DATA

Saturated Thickness: 5.735 m Anisotropy Ratio (Kz/Kr): 1.

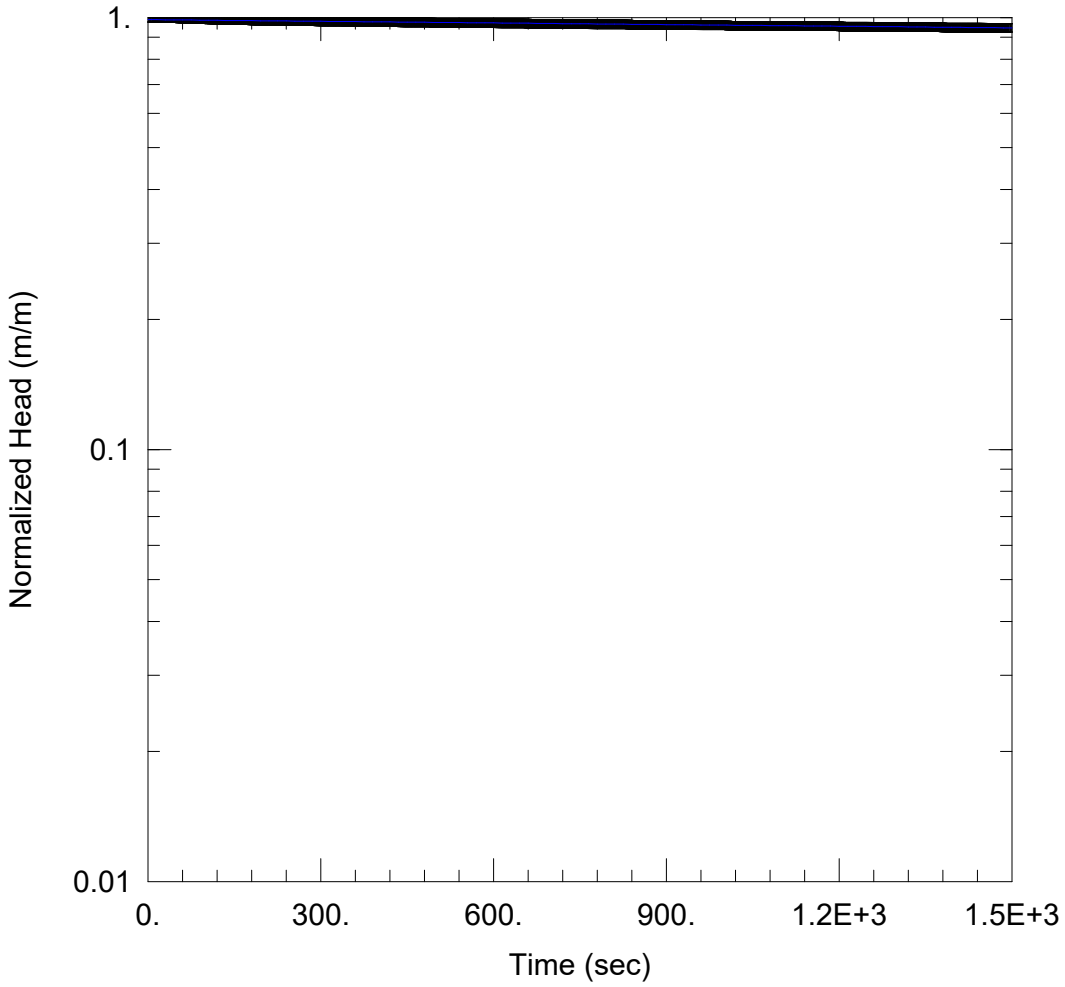
WELL DATA (BHMW 1)

Initial Displacement: 2.67 m
Static Water Column Height: 5.735 m
Total Well Penetration Depth: 5.735 m
Screen Length: 3. m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 4.75E-9 m/sec
y0 = 2.63 m



SWRT - RISING HEAD - BHMW 3

Data Set: C:\Users\simonc\Documents\SWRT_active jobs\2481 baron-swrt\BH 3.aqt
Date: 12/07/20 Time: 12:01:29

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Victoria Park Community Homes
Project: HAM-00802036-A0
Location: 2481 Baron St, Hamilton, ON
Test Well: BHMW 3
Test Date: November 23, 2020

AQUIFER DATA

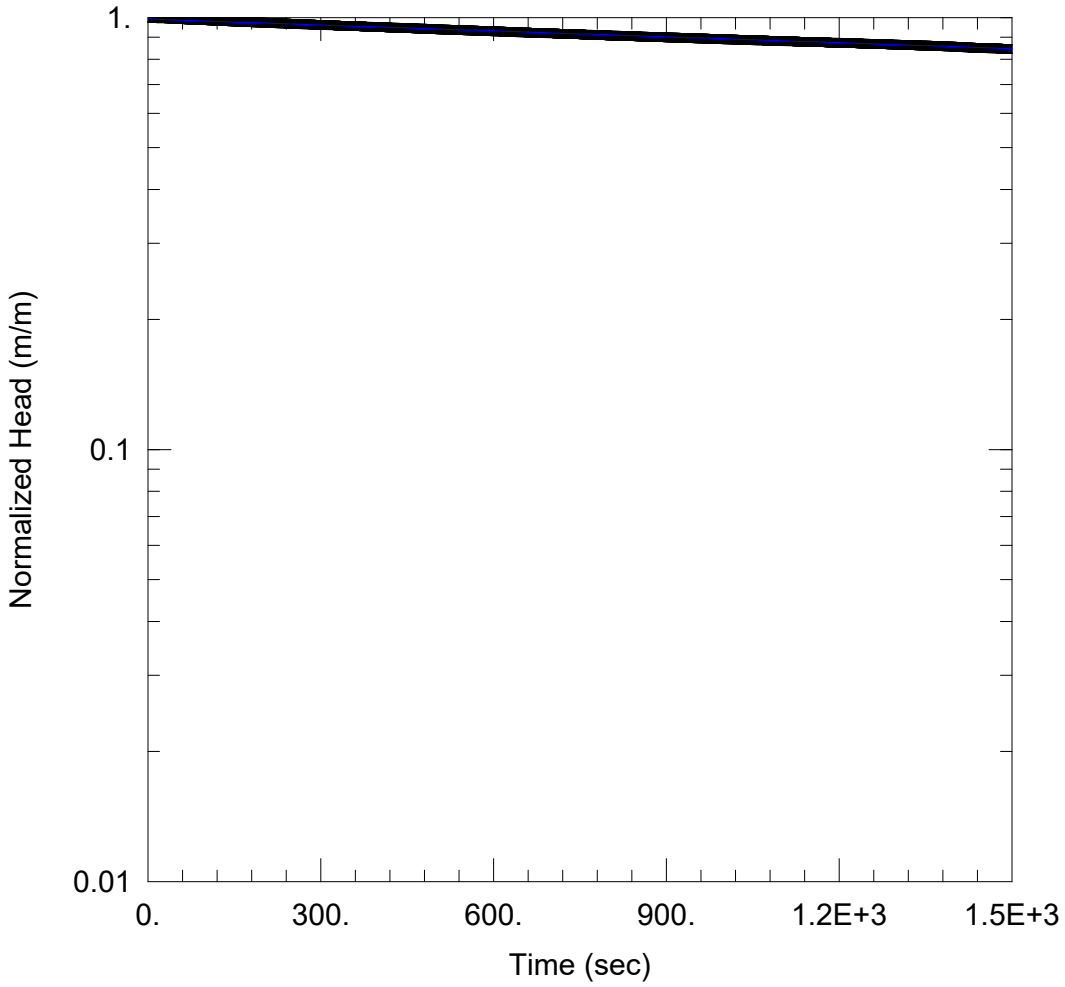
Saturated Thickness: 6.565 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 3)

Initial Displacement: 6.393 m Static Water Column Height: 6.565 m
Total Well Penetration Depth: 6.565 m Screen Length: 3. m
Casing Radius: 0.0254 m Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 1.06E-8 m/sec y0 = 6.32 m



SWRT - RISING HEAD - BHMW 9

Data Set: C:\Users\simonc\Documents\SWRT_active jobs\2481 baron-swrt\BHMW 9.aqt
Date: 12/07/20 Time: 12:04:26

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Victoria Park Community Homes
Project: HAM-00802036-A0
Location: 2481 Baron St, Hamilton, ON
Test Well: BHMW 9
Test Date: November 23, 2020

AQUIFER DATA

Saturated Thickness: 7.6 m Anisotropy Ratio (Kz/Kr): 1.

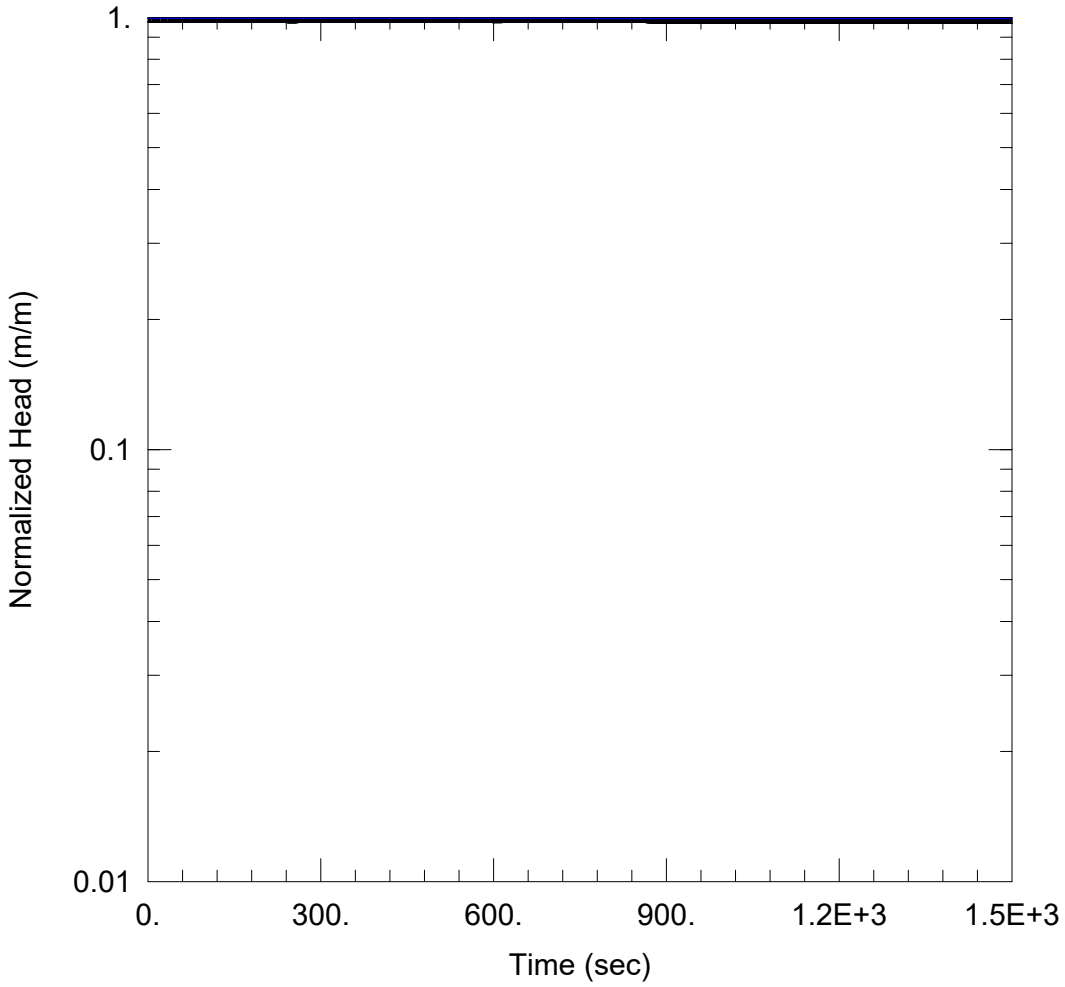
WELL DATA (BHMW 9)

Initial Displacement: 7.308 m Static Water Column Height: 7.6 m
Total Well Penetration Depth: 7.6 m Screen Length: 3. m
Casing Radius: 0.0254 m Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 4.6E-8 m/sec y0 = 7.247 m



SWRT - RISING HEAD - MW 01

Data Set: C:\Users\simonc\Documents\SWRT_active jobs\2481 baron-swrt\MW 01.aqt
Date: 12/07/20 Time: 12:48:56

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Victoria Park Community Homes
Project: HAM-00802036-A0
Location: 2481 Baron St, Hamilton, ON
Test Well: MW 01
Test Date: November 23, 2020

AQUIFER DATA

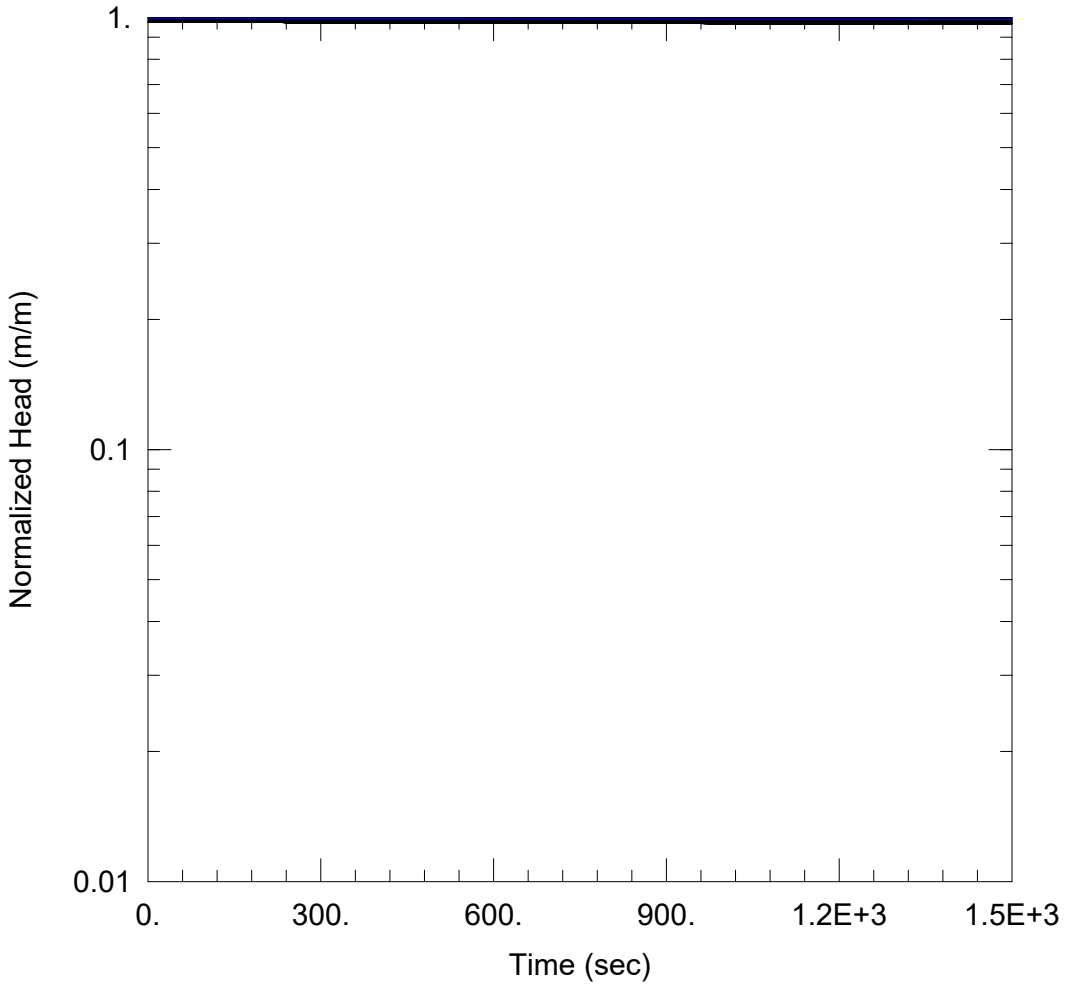
Saturated Thickness: 1.4 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW 01)

Initial Displacement: 1.341 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 1.4 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 2.55E-9 m/sec
y0 = 1.336 m



SWRT - RISING HEAD - MW 02

Data Set: C:\Users\simonc\Documents\SWRT_active jobs\2481 baron-swrt\MW 02.aqt
Date: 12/07/20 Time: 13:21:39

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Victoria Park Community Homes
Project: HAM-00802036-A0
Location: 2481 Baron St, Hamilton, ON
Test Well: MW 02
Test Date: November 23, 2020

AQUIFER DATA

Saturated Thickness: 1.93 m Anisotropy Ratio (Kz/Kr): 1.

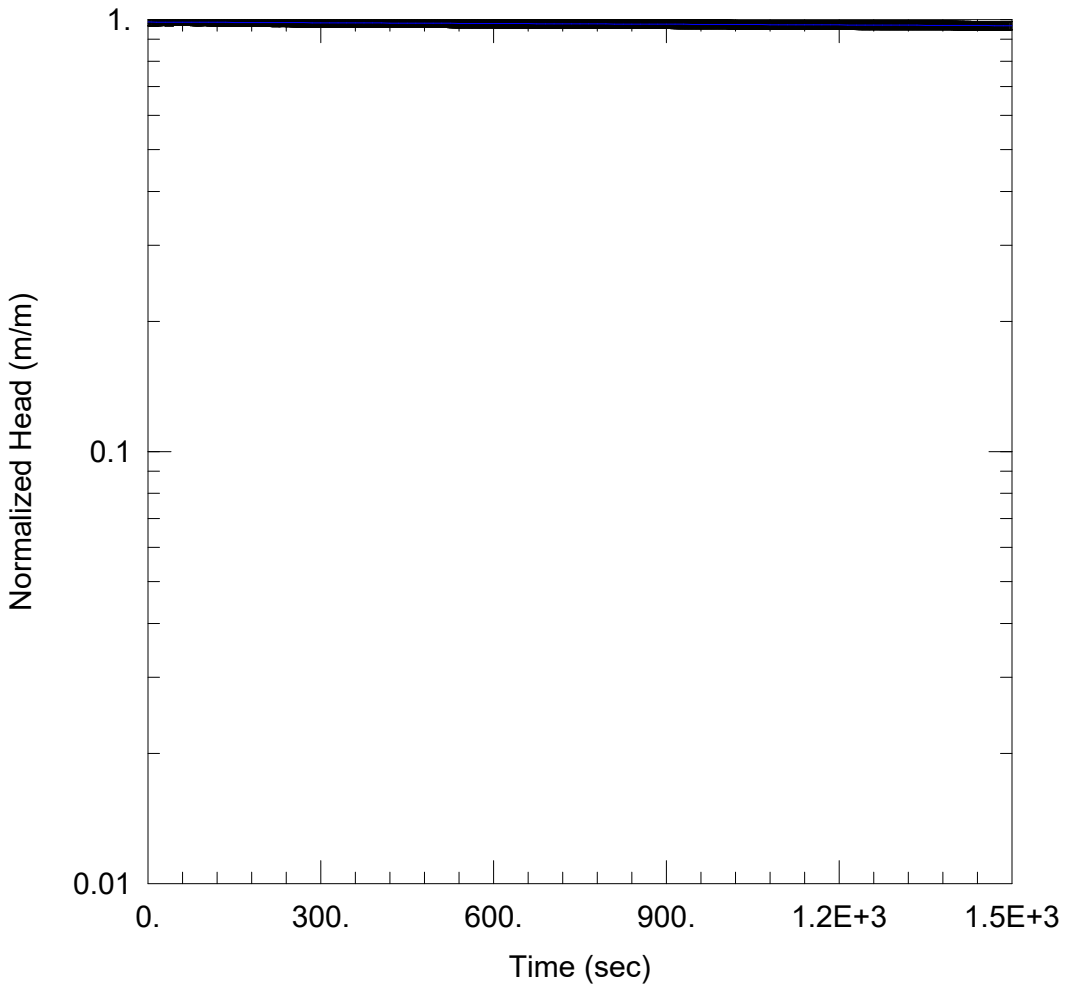
WELL DATA (MW 02)

Initial Displacement: 2.907 m Static Water Column Height: 1.93 m
Total Well Penetration Depth: 3. m Screen Length: 3. m
Casing Radius: 0.0254 m Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 3.8E-9 m/sec y0 = 2.894 m



SWRT - RISING HEAD - MW 03

Data Set: C:\Users\simonc\Documents\SWRT_active jobs\2481 baron-swrt\MW 03.aqt
Date: 12/07/20 Time: 12:45:40

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Victoria Park Community Homes
Project: HAM-00802036-A0
Location: 2481 Baron St, Hamilton, ON
Test Well: MW 03
Test Date: November 23, 2020

AQUIFER DATA

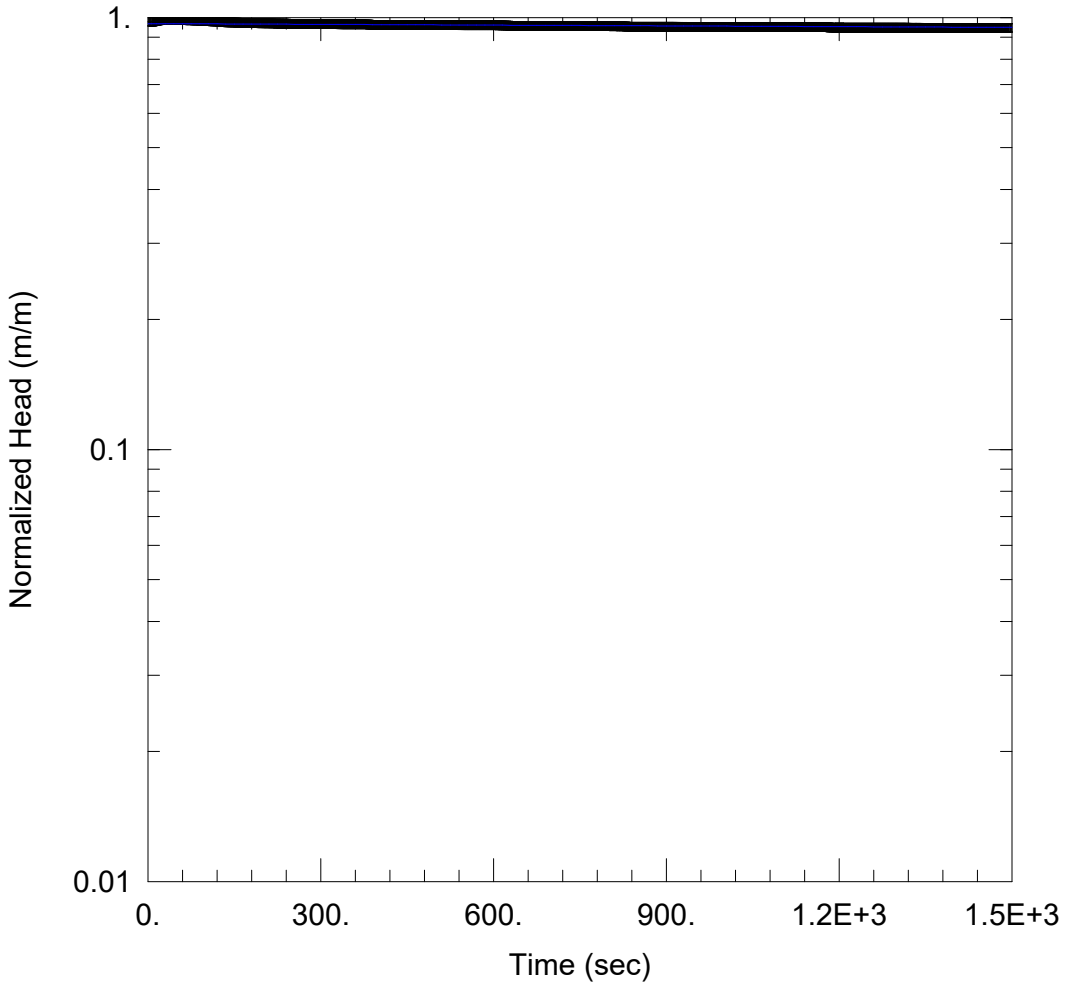
Saturated Thickness: 2.56 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW 03)

Initial Displacement: 2.379 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.56 m
Screen Length: 3. m
Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 8.56E-9 m/sec
y0 = 2.347 m



SWRT - RISING HEAD - MW 04

Data Set: C:\Users\simonc\Documents\SWRT_active jobs\2481 baron-swrt\MW 04.aqt
Date: 12/07/20 Time: 12:08:04

PROJECT INFORMATION

Company: Exp Services Inc.
Client: Victoria Park Community Homes
Project: HAM-00802036-A0
Location: 2481 Baron St, Hamilton, ON
Test Well: MW 04
Test Date: November 23, 2020

AQUIFER DATA

Saturated Thickness: 1.74 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW 04)

Initial Displacement: 1.662 m Static Water Column Height: 1.74 m
Total Well Penetration Depth: 3. m Screen Length: 3. m
Casing Radius: 0.0254 m Well Radius: 0.1016 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

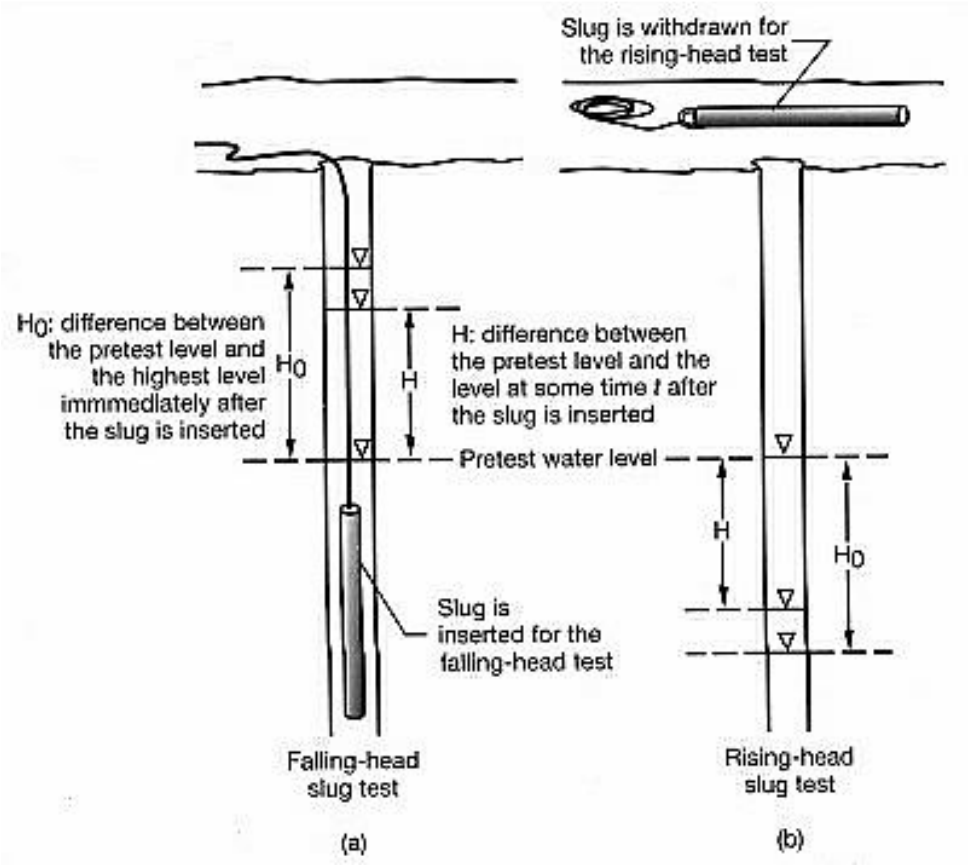
K = 1.33E-8 m/sec y0 = 1.609 m

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

Your P.O. #: Env-brm
Your Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your C.O.C. #: 802940-01-01

Attention: Jay Samarakkody

exp Services Inc
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2020/12/07
Report #: R6439279
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0V7932
Received: 2020/11/30, 14:50

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sewer Use By-Law Semivolatile Organics	1	2020/12/01	2020/12/01	CAM SOP 00301	EPA 8270 m
Carbonaceous BOD	1	2020/12/01	2020/12/06	CAM SOP-00427	SM 23 5210B m
Chloride by Automated Colourimetry	1	N/A	2020/12/02	CAM SOP-00463	SM 23 4500-Cl E m
Total Cyanide	1	2020/12/02	2020/12/03	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2020/12/02	2020/12/02	CAM SOP-00449	SM 23 4500-F C m
Mercury in Water by CVAA	1	2020/12/03	2020/12/03	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by Axial ICP	1	2020/12/03	2020/12/04	CAM SOP-00408	EPA 6010D m
Animal and Vegetable Oil and Grease	1	N/A	2020/12/03	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2020/12/03	2020/12/03	CAM SOP-00326	EPA1664B m,SM5520B m
OC Pesticides (Selected) & PCB (1)	1	2020/12/02	2020/12/04	CAM SOP-00307	EPA 8081A/8082B m
OC Pesticides Summed Parameters	1	N/A	2020/12/02	CAM SOP-00307	EPA 8081A/8082B m
pH	1	2020/12/02	2020/12/02	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2020/12/02	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2020/12/02	CAM SOP-00464	EPA 375.4 m
Total Kjeldahl Nitrogen in Water	1	2020/12/02	2020/12/03	CAM SOP-00938	OMOE E3516 m
Total PAHs (Hamilton, Ottawa S.U.B.) (2)	1	N/A	2020/12/02	CAM SOP - 00301	
Mineral/Synthetic O & G (TPH Heavy Oil) (3)	1	2020/12/03	2020/12/03	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	1	2020/12/01	2020/12/02	CAM SOP-00428	SM 23 2540D m
Volatile Organic Compounds in Water	1	N/A	2020/12/02	CAM SOP-00228	EPA 8260C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and

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Your P.O. #: Env-brm
Your Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your C.O.C. #: 802940-01-01

Attention: Jay Samarakkody

exp Services Inc
1595 Clark Blvd
Brampton, ON
CANADA L6T 4V1

Report Date: 2020/12/07
Report #: R6439279
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0V7932
Received: 2020/11/30, 14:50

use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Chlordane (Total) = Alpha Chlordane + Gamma Chlordane
(2) Total PAHs include only those PAHs specified in the sewer use by-by-law.
(3) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bvlabs.com
Phone# (519)652-9444
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C0V7932
Report Date: 2020/12/07

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

HAMILTON SANITARY SEWER BYLAW (14-090)

BV Labs ID				OHE576			OHE576		
Sampling Date				2020/11/30 13:30			2020/11/30 13:30		
COC Number				802940-01-01			802940-01-01		
	UNITS	Criteria	Criteria-2	BH 3	RDL	QC Batch	BH 3 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Total Animal/Vegetable Oil and Grease	mg/L	150	10	ND	0.50	7083167			
Inorganics									
Total Carbonaceous BOD	mg/L	300	-	6	2	7084962			
Fluoride (F-)	mg/L	10	-	0.33	0.10	7087239			
Total Kjeldahl Nitrogen (TKN)	mg/L	100	-	3.0	0.10	7088653	3.2	0.10	7088653
pH	pH	5.5:9.5	5.5:9.5	7.70		7087241			
Phenols-4AAP	mg/L	1	0.02	ND	0.0010	7087149			
Total Suspended Solids	mg/L	350	15	**34**	10	7085212			
Dissolved Sulphate (SO4)	mg/L	1500	-	**2600**	10	7085467			
Total Cyanide (CN)	mg/L	2	-	ND	0.0050	7087265			
Dissolved Chloride (Cl-)	mg/L	1500	-	1200	15	7085465			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	-	-	ND	0.50	7090522			
Total Oil & Grease Mineral/Synthetic	mg/L	15	-	ND	0.50	7090534			
Metals									
Total Aluminum (Al)	mg/L	50	-	0.2	0.1	7090042			
Total Antimony (Sb)	mg/L	5	-	ND	0.02	7090042			
Total Arsenic (As)	mg/L	1	-	ND	0.01	7090042			
Total Bismuth (Bi)	mg/L	5	-	ND	0.05	7090042			
Total Cadmium (Cd)	mg/L	0.7	1	ND	0.002	7090042			
Total Chromium (Cr)	mg/L	5	1	ND	0.01	7090042			
Total Cobalt (Co)	mg/L	5	-	ND	0.002	7090042			
Total Copper (Cu)	mg/L	2	1	ND	0.01	7090042			
Total Iron (Fe)	mg/L	50	-	0.60	0.02	7090042			
Total Lead (Pb)	mg/L	2	1	ND	0.01	7090042			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Hamilton-Wentworth Sanitary Sewer Discharges.
Criteria-2: Hamilton-Wentworth Storm Sewer Discharge.
ND = Not detected

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BV Labs Job #: C0V7932
Report Date: 2020/12/07

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

HAMILTON SANITARY SEWER BYLAW (14-090)

BV Labs ID				OHE576			OHE576		
Sampling Date				2020/11/30 13:30			2020/11/30 13:30		
COC Number				802940-01-01			802940-01-01		
	UNITS	Criteria	Criteria-2	BH 3	RDL	QC Batch	BH 3 Lab-Dup	RDL	QC Batch
Total Manganese (Mn)	mg/L	5	-	0.49	0.001	7090042			
Mercury (Hg)	mg/L	0.01	-	ND	0.00010	7089481			
Total Molybdenum (Mo)	mg/L	1	-	0.018	0.005	7090042			
Total Nickel (Ni)	mg/L	2	1	ND	0.005	7090042			
Total Phosphorus (P)	mg/L	10	10	ND	0.05	7090042			
Total Selenium (Se)	mg/L	1	-	ND	0.02	7090042			
Total Silver (Ag)	mg/L	5	-	ND	0.01	7090042			
Total Tin (Sn)	mg/L	5	-	ND	0.02	7090042			
Total Titanium (Ti)	mg/L	5	-	ND	0.005	7090042			
Total Vanadium (V)	mg/L	5	-	ND	0.005	7090042			
Total Zinc (Zn)	mg/L	3	3	0.007	0.005	7090042			
Semivolatile Organics									
Di-N-butyl phthalate	ug/L	80	-	ND	2	7084666			
Bis(2-ethylhexyl)phthalate	ug/L	12	-	ND	2	7084666			
3,3'-Dichlorobenzidine	ug/L	2	-	ND	0.8	7084666			
Pentachlorophenol	ug/L	5	-	ND	1	7084666			
Phenanthrene	ug/L	5	-	ND	0.2	7084666			
Anthracene	ug/L	5	-	ND	0.2	7084666			
Fluoranthene	ug/L	5	-	ND	0.2	7084666			
Pyrene	ug/L	5	-	ND	0.2	7084666			
Benzo(a)anthracene	ug/L	5	-	ND	0.2	7084666			
Chrysene	ug/L	5	-	ND	0.2	7084666			
Benzo(b/j)fluoranthene	ug/L	-	-	ND	0.2	7084666			
Benzo(k)fluoranthene	ug/L	5	-	ND	0.2	7084666			
Benzo(a)pyrene	ug/L	5	-	ND	0.2	7084666			
Indeno(1,2,3-cd)pyrene	ug/L	5	-	ND	0.2	7084666			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Hamilton-Wentworth Sanitary Sewer Discharges.
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BV Labs Job #: C0V7932
Report Date: 2020/12/07

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

HAMILTON SANITARY SEWER BYLAW (14-090)

BV Labs ID				OHE576			OHE576		
Sampling Date				2020/11/30 13:30			2020/11/30 13:30		
COC Number				802940-01-01			802940-01-01		
	UNITS	Criteria	Criteria-2	BH 3	RDL	QC Batch	BH 3 Lab-Dup	RDL	QC Batch
Dibenzo(a,h)anthracene	ug/L	5	-	ND	0.2	7084666			
Benzo(g,h,i)perylene	ug/L	5	-	ND	0.2	7084666			
Dibenzo(a,i)pyrene	ug/L	5	-	ND	0.2	7084666			
Benzo(e)pyrene	ug/L	5	-	ND	0.2	7084666			
Perylene	ug/L	5	-	ND	0.2	7084666			
Dibenzo(a,j) acridine	ug/L	5	-	ND	0.4	7084666			
7H-Dibenzo(c,g) Carbazole	ug/L	5	-	ND	0.4	7084666			
Calculated Parameters									
Total PAHs (18 PAHs)	ug/L	5	-	ND	0.96	7083317			
Volatile Organics									
Benzene	ug/L	10	-	ND	0.40	7084964			
Chloroform	ug/L	40	-	ND	0.40	7084964			
1,2-Dichlorobenzene	ug/L	50	-	ND	0.80	7084964			
1,4-Dichlorobenzene	ug/L	80	-	ND	0.80	7084964			
cis-1,2-Dichloroethylene	ug/L	4000	-	ND	1.0	7084964			
trans-1,3-Dichloropropene	ug/L	140	-	ND	0.80	7084964			
Ethylbenzene	ug/L	160	-	ND	0.40	7084964			
Methylene Chloride(Dichloromethane)	ug/L	2000	-	ND	4.0	7084964			
1,1,2,2-Tetrachloroethane	ug/L	1400	-	ND	0.80	7084964			
Tetrachloroethylene	ug/L	1000	-	ND	0.40	7084964			
Toluene	ug/L	16	-	ND	0.40	7084964			
Trichloroethylene	ug/L	400	-	ND	0.40	7084964			
p+m-Xylene	ug/L	-	-	ND	0.40	7084964			
o-Xylene	ug/L	-	-	ND	0.40	7084964			
Total Xylenes	ug/L	1400	-	ND	0.40	7084964			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Hamilton-Wentworth Sanitary Sewer Discharges.
Criteria-2: Hamilton-Wentworth Storm Sewer Discharge.
ND = Not detected

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BV Labs Job #: C0V7932
Report Date: 2020/12/07

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

HAMILTON SANITARY SEWER BYLAW (14-090)

BV Labs ID				OHE576			OHE576		
Sampling Date				2020/11/30 13:30			2020/11/30 13:30		
COC Number				802940-01-01			802940-01-01		
	UNITS	Criteria	Criteria-2	BH 3	RDL	QC Batch	BH 3 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Aldrin + Dieldrin	ug/L	-	-	ND	0.005	7083645			
Chlordane (Total)	ug/L	100	-	ND	0.005	7083645			
DDT+ Metabolites	ug/L	-	-	ND	0.005	7083645			
Heptachlor + Heptachlor epoxide	ug/L	-	-	ND	0.005	7083645			
o,p-DDD + p,p-DDD	ug/L	-	-	ND	0.005	7083645			
o,p-DDE + p,p-DDE	ug/L	-	-	ND	0.005	7083645			
o,p-DDT + p,p-DDT	ug/L	0.1	-	ND	0.005	7083645			
Total Endosulfan	ug/L	-	-	ND	0.005	7083645			
Total PCB	ug/L	1	-	ND	0.05	7083645			
Pesticides & Herbicides									
Aldrin	ug/L	0.2	-	ND	0.005	7088292			
Dieldrin	ug/L	0.2	-	ND	0.005	7088292			
a-Chlordane	ug/L	100	-	ND	0.005	7088292			
g-Chlordane	ug/L	100	-	ND	0.005	7088292			
o,p-DDT	ug/L	0.1	-	ND	0.005	7088292			
p,p-DDT	ug/L	0.1	-	ND	0.005	7088292			
Lindane	ug/L	100	-	ND	0.003	7088292			
Hexachlorobenzene	ug/L	0.1	-	ND	0.005	7088292			
Mirex	ug/L	100	-	ND	0.005	7088292			
Surrogate Recovery (%)									
2,4,6-Tribromophenol	%	-	-	21		7084666			
2-Fluorobiphenyl	%	-	-	52		7084666			
D14-Terphenyl (FS)	%	-	-	104		7084666			
D5-Nitrobenzene	%	-	-	50		7084666			
D8-Acenaphthylene	%	-	-	65		7084666			
2,4,5,6-Tetrachloro-m-xylene	%	-	-	104		7088292			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Hamilton-Wentworth Sanitary Sewer Discharges.
Criteria-2: Hamilton-Wentworth Storm Sewer Discharge.
ND = Not detected

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BV Labs Job #: C0V7932
Report Date: 2020/12/07

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

HAMILTON SANITARY SEWER BYLAW (14-090)

BV Labs ID				OHE576			OHE576		
Sampling Date				2020/11/30 13:30			2020/11/30 13:30		
COC Number				802940-01-01			802940-01-01		
	UNITS	Criteria	Criteria-2	BH 3	RDL	QC Batch	BH 3 Lab-Dup	RDL	QC Batch
Decachlorobiphenyl	%	-	-	111		7088292			
4-Bromofluorobenzene	%	-	-	85		7084964			
D4-1,2-Dichloroethane	%	-	-	117		7084964			
D8-Toluene	%	-	-	89		7084964			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Hamilton-Wentworth Sanitary Sewer Discharges.
Criteria-2: Hamilton-Wentworth Storm Sewer Discharge.

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BV Labs Job #: C0V7932
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exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

TEST SUMMARY

BV Labs ID: OHE576
Sample ID: BH 3
Matrix: Water

Collected: 2020/11/30
Shipped:
Received: 2020/11/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sewer Use By-Law Semivolatile Organics	GC/MS	7084666	2020/12/01	2020/12/01	Kathy Horvat
Carbonaceous BOD	DO	7084962	2020/12/01	2020/12/06	Nusrat Naz
Chloride by Automated Colourimetry	KONE	7085465	N/A	2020/12/02	Deonarine Ramnarine
Total Cyanide	SKAL/CN	7087265	2020/12/02	2020/12/03	Louise Harding
Fluoride	ISE	7087239	2020/12/02	2020/12/02	Surinder Rai
Mercury in Water by CVAA	CV/AA	7089481	2020/12/03	2020/12/03	Prempal Bhatti
Total Metals Analysis by Axial ICP	ICPX	7090042	2020/12/03	2020/12/04	Jolly John
Animal and Vegetable Oil and Grease	BAL	7083167	N/A	2020/12/03	Automated Statchk
Total Oil and Grease	BAL	7090522	2020/12/03	2020/12/03	Saumya Modh
OC Pesticides (Selected) & PCB	GC/ECD	7088292	2020/12/02	2020/12/04	Mahmudul Khan
OC Pesticides Summed Parameters	CALC	7083645	N/A	2020/12/02	Automated Statchk
pH	AT	7087241	2020/12/02	2020/12/02	Surinder Rai
Phenols (4AAP)	TECH/PHEN	7087149	N/A	2020/12/02	Bramdeo Motiram
Sulphate by Automated Colourimetry	KONE	7085467	N/A	2020/12/02	Deonarine Ramnarine
Total Kjeldahl Nitrogen in Water	SKAL	7088653	2020/12/02	2020/12/03	Rajni Tyagi
Total PAHs (Hamilton, Ottawa S.U.B.)	CALC	7083317	N/A	2020/12/02	Automated Statchk
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	7090534	2020/12/03	2020/12/03	Saumya Modh
Total Suspended Solids	BAL	7085212	2020/12/01	2020/12/02	Shaneil Hall
Volatile Organic Compounds in Water	GC/MS	7084964	N/A	2020/12/02	Blair Gannon

BV Labs ID: OHE576 Dup
Sample ID: BH 3
Matrix: Water

Collected: 2020/11/30
Shipped:
Received: 2020/11/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Kjeldahl Nitrogen in Water	SKAL	7088653	2020/12/02	2020/12/03	Rajni Tyagi

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BV Labs Job #: C0V7932
Report Date: 2020/12/07

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.7°C

Sample OHE576 [BH 3] : VOC Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

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BV Labs Job #: C0V7932
Report Date: 2020/12/07

QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7084666	2,4,6-Tribromophenol	2020/12/01	97	10 - 130	96	10 - 130	71	%				
7084666	2-Fluorobiphenyl	2020/12/01	75	30 - 130	79	30 - 130	79	%				
7084666	D14-Terphenyl (FS)	2020/12/01	105	30 - 130	104	30 - 130	106	%				
7084666	D5-Nitrobenzene	2020/12/01	82	30 - 130	87	30 - 130	76	%				
7084666	D8-Acenaphthylene	2020/12/01	81	30 - 130	84	30 - 130	74	%				
7084964	4-Bromofluorobenzene	2020/12/02	99	70 - 130	99	70 - 130	90	%				
7084964	D4-1,2-Dichloroethane	2020/12/02	106	70 - 130	103	70 - 130	110	%				
7084964	D8-Toluene	2020/12/02	107	70 - 130	107	70 - 130	90	%				
7088292	2,4,5,6-Tetrachloro-m-xylene	2020/12/04	80	50 - 130	76	50 - 130	80	%				
7088292	Decachlorobiphenyl	2020/12/04	117	50 - 130	117	50 - 130	119	%				
7084666	3,3'-Dichlorobenzidine	2020/12/01	90	30 - 130	118	30 - 130	ND, RDL=0.8	ug/L	NC	40		
7084666	7H-Dibenzo(c,g) Carbazole	2020/12/01	107	30 - 130	108	30 - 130	ND, RDL=0.4	ug/L	NC	40		
7084666	Anthracene	2020/12/01	92	30 - 130	93	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Benzo(a)anthracene	2020/12/01	106	30 - 130	106	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Benzo(a)pyrene	2020/12/01	97	30 - 130	97	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Benzo(b/j)fluoranthene	2020/12/01	113	30 - 130	112	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Benzo(e)pyrene	2020/12/01	110	30 - 130	110	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Benzo(g,h,i)perylene	2020/12/01	110	30 - 130	109	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Benzo(k)fluoranthene	2020/12/01	104	30 - 130	106	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Bis(2-ethylhexyl)phthalate	2020/12/01	94	30 - 130	91	30 - 130	ND,RDL=2	ug/L	NC	40		
7084666	Chrysene	2020/12/01	103	30 - 130	104	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Dibenzo(a,h)anthracene	2020/12/01	110	30 - 130	110	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Dibenzo(a,i)pyrene	2020/12/01	124	30 - 130	125	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Dibenzo(a,j) acridine	2020/12/01	109	30 - 130	108	30 - 130	ND, RDL=0.4	ug/L	NC	40		
7084666	Di-N-butyl phthalate	2020/12/01	97	30 - 130	95	30 - 130	ND,RDL=2	ug/L	NC	40		
7084666	Fluoranthene	2020/12/01	96	30 - 130	96	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Indeno(1,2,3-cd)pyrene	2020/12/01	118	30 - 130	118	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Pentachlorophenol	2020/12/01	69	30 - 130	55	30 - 130	ND,RDL=1	ug/L	NC	40		
7084666	Perylene	2020/12/01	105	30 - 130	105	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084666	Phenanthrene	2020/12/01	92	30 - 130	91	30 - 130	ND, RDL=0.2	ug/L	NC	40		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7084666	Pyrene	2020/12/01	97	30 - 130	98	30 - 130	ND, RDL=0.2	ug/L	NC	40		
7084962	Total Carbonaceous BOD	2020/12/06					ND,RDL=2	mg/L	NC	30	92	85 - 115
7084964	1,1,2,2-Tetrachloroethane	2020/12/02	104	70 - 130	97	70 - 130	ND, RDL=0.40	ug/L				
7084964	1,2-Dichlorobenzene	2020/12/02	102	70 - 130	99	70 - 130	ND, RDL=0.40	ug/L				
7084964	1,4-Dichlorobenzene	2020/12/02	115	70 - 130	113	70 - 130	ND, RDL=0.40	ug/L				
7084964	Benzene	2020/12/02	101	70 - 130	97	70 - 130	ND, RDL=0.20	ug/L				
7084964	Chloroform	2020/12/02	108	70 - 130	103	70 - 130	ND, RDL=0.20	ug/L				
7084964	cis-1,2-Dichloroethylene	2020/12/02	109	70 - 130	104	70 - 130	ND, RDL=0.50	ug/L				
7084964	Ethylbenzene	2020/12/02	94	70 - 130	92	70 - 130	ND, RDL=0.20	ug/L				
7084964	Methylene Chloride(Dichloromethane)	2020/12/02	108	70 - 130	101	70 - 130	ND, RDL=2.0	ug/L				
7084964	o-Xylene	2020/12/02	92	70 - 130	94	70 - 130	ND, RDL=0.20	ug/L				
7084964	p+m-Xylene	2020/12/02	100	70 - 130	98	70 - 130	ND, RDL=0.20	ug/L				
7084964	Tetrachloroethylene	2020/12/02	98	70 - 130	95	70 - 130	ND, RDL=0.20	ug/L				
7084964	Toluene	2020/12/02	104	70 - 130	100	70 - 130	ND, RDL=0.20	ug/L	NC	30		
7084964	Total Xylenes	2020/12/02					ND, RDL=0.20	ug/L				
7084964	trans-1,3-Dichloropropene	2020/12/02	121	70 - 130	110	70 - 130	ND, RDL=0.40	ug/L				
7084964	Trichloroethylene	2020/12/02	110	70 - 130	107	70 - 130	ND, RDL=0.20	ug/L				
7085212	Total Suspended Solids	2020/12/02					ND, RDL=10	mg/L	0	25	95	85 - 115
7085465	Dissolved Chloride (Cl-)	2020/12/02	NC	80 - 120	102	80 - 120	ND, RDL=1.0	mg/L	1.3	20		
7085467	Dissolved Sulphate (SO4)	2020/12/02	NC	75 - 125	102	80 - 120	ND, RDL=1.0	mg/L	1.9	20		
7087149	Phenols-4AAP	2020/12/02	98	80 - 120	98	80 - 120	ND, RDL=0.0010	mg/L	NC	20		
7087239	Fluoride (F-)	2020/12/02	97	80 - 120	101	80 - 120	ND, RDL=0.10	mg/L	13	20		
7087241	pH	2020/12/02			102	98 - 103			1.2	N/A		
7087265	Total Cyanide (CN)	2020/12/02	95	80 - 120	94	80 - 120	ND, RDL=0.0050	mg/L	NC	20		
7088292	a-Chlordane	2020/12/04	94	50 - 130	95	50 - 130	ND, RDL=0.005	ug/L	NC	30		
7088292	Aldrin	2020/12/04	78	50 - 130	77	50 - 130	ND, RDL=0.005	ug/L	NC	30		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7088292	Dieldrin	2020/12/04	114	50 - 130	110	50 - 130	ND, RDL=0.005	ug/L	NC	30		
7088292	g-Chlordane	2020/12/04	98	50 - 130	91	50 - 130	ND, RDL=0.005	ug/L	NC	30		
7088292	Hexachlorobenzene	2020/12/04	88	50 - 130	109	50 - 130	ND, RDL=0.005	ug/L	NC	30		
7088292	Lindane	2020/12/04	94	50 - 130	92	50 - 130	ND, RDL=0.003	ug/L	NC	30		
7088292	Mirex	2020/12/04	96	30 - 130	93	30 - 130	ND, RDL=0.005	ug/L	5.7	40		
7088292	o,p-DDT	2020/12/04	87	50 - 130	82	50 - 130	ND, RDL=0.005	ug/L	NC	30		
7088292	p,p-DDT	2020/12/04	81	50 - 130	76	50 - 130	ND, RDL=0.005	ug/L	NC	30		
7088653	Total Kjeldahl Nitrogen (TKN)	2020/12/03	NC	80 - 120	100	80 - 120	ND, RDL=0.10	mg/L	4.5	20	104	80 - 120
7089481	Mercury (Hg)	2020/12/03	95	75 - 125	91	80 - 120	ND, RDL=0.00010	mg/L	NC	20		
7090042	Total Aluminum (Al)	2020/12/04	99	80 - 120	101	80 - 120	ND, RDL=0.1	mg/L				
7090042	Total Antimony (Sb)	2020/12/04	104	80 - 120	103	80 - 120	ND, RDL=0.02	mg/L				
7090042	Total Arsenic (As)	2020/12/04	101	80 - 120	99	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7090042	Total Bismuth (Bi)	2020/12/04	99	80 - 120	100	80 - 120	ND, RDL=0.05	mg/L				
7090042	Total Cadmium (Cd)	2020/12/04	101	80 - 120	100	80 - 120	ND, RDL=0.002	mg/L	NC	20		
7090042	Total Chromium (Cr)	2020/12/04	98	80 - 120	97	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7090042	Total Cobalt (Co)	2020/12/04	96	80 - 120	99	80 - 120	ND, RDL=0.002	mg/L				
7090042	Total Copper (Cu)	2020/12/04	97	80 - 120	99	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7090042	Total Iron (Fe)	2020/12/04	98	80 - 120	102	80 - 120	ND, RDL=0.02	mg/L				
7090042	Total Lead (Pb)	2020/12/04	97	80 - 120	99	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7090042	Total Manganese (Mn)	2020/12/04	95	80 - 120	98	80 - 120	ND, RDL=0.001	mg/L	0.23	20		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7090042	Total Molybdenum (Mo)	2020/12/04	102	80 - 120	102	80 - 120	ND, RDL=0.005	mg/L				
7090042	Total Nickel (Ni)	2020/12/04	95	80 - 120	98	80 - 120	ND, RDL=0.005	mg/L	NC	20		
7090042	Total Phosphorus (P)	2020/12/04	105	80 - 120	105	80 - 120	ND, RDL=0.05	mg/L	NC	20		
7090042	Total Selenium (Se)	2020/12/04	102	80 - 120	102	80 - 120	ND, RDL=0.02	mg/L	NC	20		
7090042	Total Silver (Ag)	2020/12/04	96	80 - 120	99	80 - 120	ND, RDL=0.01	mg/L	NC	20		
7090042	Total Tin (Sn)	2020/12/04	102	80 - 120	103	80 - 120	ND, RDL=0.02	mg/L				
7090042	Total Titanium (Ti)	2020/12/04	101	80 - 120	101	80 - 120	ND, RDL=0.005	mg/L				
7090042	Total Vanadium (V)	2020/12/04	97	80 - 120	97	80 - 120	ND, RDL=0.005	mg/L				
7090042	Total Zinc (Zn)	2020/12/04	NC	80 - 120	100	80 - 120	ND, RDL=0.005	mg/L	0.49	20		
7090522	Total Oil & Grease	2020/12/03			96	85 - 115	ND, RDL=0.50	mg/L	1.6	25		
7090534	Total Oil & Grease Mineral/Synthetic	2020/12/03			91	85 - 115	ND, RDL=0.50	mg/L	0.55	25		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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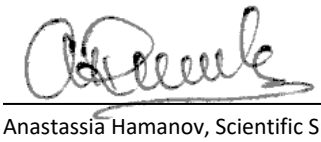
BV Labs Job #: C0V7932
Report Date: 2020/12/07

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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Page 1 of 1

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#30554 exp Services Inc	Company Name:	SAA.	Quotation #:	B91717 STREAM 2	BV Labs Job #:	Bottle Order #:
Attention:	Central Services	Attention:	Jay Samarakkody	P.O. #:	Env-brm		802940
Address:	1595 Clark Blvd	Address:	CHANTEL.SIMON@EXP.COM	Project:	HAM-00802036 -A0	COC #:	Project Manager:
	Brampton ON L6T 4V1		TOMSON.HECKY@EXP.COM	Project Name:		C#802940-01-01	Christine Gripton
Tel:	(905) 793-9800 Fax: (905) 793-0641	Tel:	Fax:	Site #:	2481 Baron St, Hamilton		
Email:	Karen.Burke@exp.com; Luizza.Jose@exp.com; AP@e	Email:	jay.samarakkody@exp.com	Sampled By:	C.S.		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
- ☐ Table 1 ☐ Res/Park ☐ Medium/Fine
- ☐ Table 2 ☐ Ind/Comm ☐ Coarse
- ☐ Table 3 ☐ Agri/Other ☐ For RSC
- ☐ Table ___

Other Regulations
- ☐ CCME ☒ Sanitary Sewer Bylaw
- ☐ Reg 558. ☒ Storm Sewer Bylaw
- ☐ MISA Municipality HAMILTON
- ☐ PWQO ☐ Reg 406 Table ___
- ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? YES

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests..
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	ANALYSIS REQUESTED (PLEASE BE SPECIFIC): Hamilton Sanitary Sewer Bylaw (14-090)	# of Bottles	Comments
1		BH 3	30/11/2020	13:30	GW	N	X	16	5 DAY FIRM TAT PLEASE
2									
3									
4									
5									
6									
7									
8									
9									
10									

30-Nov-20 14:50
Christine Gripton
C0V7932
ASR ENV-1185

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Chantel Simon	20/11/30	14:45	[illegible] TOMSON [illegible]	2020/11/30	14:50	

Laboratory Use Only: ON ICE

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	9.9	Present	✓	
		Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

BV Labs Job #: C0V7932
Report Date: 2020/12/07

exp Services Inc
Client Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
Your P.O. #: Env-brm
Sampler Initials: C.S

Exceedance Summary Table – Hamilton-Wentworth Sani.

Result Exceedances

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	UNITS
BH 3	OHE576-04	Dissolved Sulphate (SO4)	1500	2600	10	mg/L

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.

Exceedance Summary Table – Hamilton-Wentworth Storm

Result Exceedances

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	UNITS
BH 3	OHE576-11	Total Suspended Solids	15	34	10	mg/L

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.

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Appendix E – Construction Flow Rate Calculations

APPENDIX E: Short-Term Flow Rate

2481 Barton St, Hamilton, ON
HAM-00802036-A0

Table E-1: Flow from Under-Slab Drain System

Parameters	Symbols	Unit	Value P1	Value P2
Geological Formation	-	-	Glacial Deposit	Glacial Deposit
Lowest Ground Elevation	-	mASL	85.30	85.3
Lowest Top Slab Elevation	-	mASL	81.80	78.30
Highest Groundwater Elevation	-	mASL	84.77	84.77
Lowest Footing Elevation	-	mASL	**80.80**	**77.30**
Base of the Water-Bearing Zone	-	mASL	74.50	74.5
Height of Static Water Table Above the Base of the Water-Bearing Zone	**H**	m	10.27	10.27
Dewatering Target Elevation	-	mASL	79.80	76.30
Height of Target Water Level Above the Base of Water-Bearing Zone	$\mathbf{h_w}$	m	5.30	1.80
Hydraulic Conductivity	**K**	m/s	4.6E-08	4.6E-08
Length of Excavation	-	m	66.00	66
Width of Excavation	-	m	46.00	46
Equivalent Radius (equivalent perimeter)	$\mathbf{r_e}$	m	35.65	35.65
Method to Calculate Radius of Influence	-	-	**Cooper-Jacob**	**Cooper-Jacob**
Time (30 days)	**t**	s	2592000	2592000
Specific Yield	**Sy**		0.20	0.2
Cooper-Jacob's Radius of Influence from Sides of Excavation	**Rcj**	m	3.71	3.71
Radius of Influence	**Ro**	m	39.36	39.36
Dewatering Flow Rate (unconfined radial flow component)	**Q**	m^3/day	9.76	12.89
Factor of Safety	**fs**	-	2.00	2.00
Dewatering Flow Rate (multiplied by factor of safety)	**Q.fs**	m^3/day	20	26
Precipitation Event	-	mm/day	15	15
Volume from Precipitation	-	m^3/day	46	46
Dewatering Flow Rate **Without Safety Factor** (including stormwater collection)	-	m^3/day	55	58
Dewatering Flow Rate **With Safety Factor** (including stormwater collection)	-	m^3/day	65	70

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)

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

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)