FUNCTIONAL SERVICING REPORT

PREMIER GROUP REALTY INC.

2481 Barton Street East, Hamilton, ON
Project No.: 2021-0171-10

December 12, 2022

WALTERFEDY

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Table of Contents

1.0 INTRODUCTION

WalterFedy was retained by Premeir Group to complete a Functional Servicing Report in support of a Rezoning Application for a proposed mixed-use development consisting of a 17-storey residential high-rise with ground floor commercial/retail space and underground parking. The remainder of the site's surface will be comprised of asphalt driveway and parking areas, with some permimeter landscaping. The purpose of this Functional Servicing Report is to identify how the development will be serviced, including water, sanitary, and storm connections to existing municipal infrastructure as well as stormwater management design.

1.1 Background

The property is located at 2481 Barton Street East and has an area of approximately 0.38 ha. The site is bound by an existing commercial parking lot to the north, the Barton Street East right-of-way on the south, existing commercial/industrial development on the east, and an existing ESSO gas station to the west. See Figure 1.0 for a location plan. The property is located just east of Centennial Parkway North. Most recently the site was used for commercial purposes and contained a single detached house with garage and a one-storey accessory brick building.

Figure 1.0 – Proposed Driveway Location

1.2 Reference Reports

The following were referenced in the preparation of this Functional Servicing Report.

1. *Stormwater Management Practices Planning and Design Manual*, Ministry of the Environment, March 2003.
2. *Erosion & Sediment Control Guidelines for Urban Construction*, December 2006.
3. *Sewer and Water Permit Process - Sewer and Water System Design Requirements*, City of Hamilton, November 20, 2019.
4. *Comprehensive Development Guidelines and Financial Policies Manual*, City of Hamilton, 2019
5. *Geotechncial Investigation – 2481 Barton Street East, Hamilton, ON*, EXP Services Inc., February 3, 2021.
6. *Hydrogeological Investigation – 2481 Barton Street East, Hamilton, ON*, EXP Services Inc., February 3, 2021.
7. *Formal Consultation Document File No. FC-21-062*, City of Hamilton, May 18, 2021

2.0 EXISTING INFORMATION

2.1 Topography and Soils

Legal boundary information and topographic information was obtained from a survey by A.T. McLaren Limited, dated September 24, 2020. Geotechnical and hydrogeological reporting was prepared by EXP Servicies Inc. as cited above.

The site topography within the gravel driveway is generally flat, with a gentle slope of 0.3% to 0.5% towards the north. There are low spots within the vegetated area, but the ground generally slopes towards the north.

The geotechnical investigation (see Appendix D) found that the site had surficial topsoil, granular fill and/or fill that extended from approximately 0.8 m to 2.6 m below the ground surface. Underlying this material is a native silty clay till that extends 6.3 m to 11.0 m below the ground surface to the weathered shale bedrock. The hydrogeological investigation (see Appendix D) determined that groundwater elevations across the site varied seasonally from 2.3 m to 5.5 m below the ground surface.

2.2 Servicing and Utilities

The site services will be insufficient to service the proposed development. The original structure on the site was a house. City records indicate that dual 150 mm storm and sanitary services were installed to the dwelling in November 1968.

A 250 mm sanitary sewer (at 0.5% slope) is located within the Barton Street East right-of-way in front of the site. The sanitary sewer starts east of Centennial Parkway and drains east along Barton Street East. Therefore, the proposed development will be outletting into the upstream end of the sanitary sewer system. The full flow capacity of the municipal sanitary sewer is 37 l/s. The sanitary service for the proposed development will connect to the 250 mm sanitary sewer.

There are a number of municipal watermains within the Barton Street East right-of-way fronting the site. 1200 mm and 600 mm trunk watermains are located on the northern and southern sides of the right-of-way, respectively. A 300 mm watermain is located approximately in the middle of the right-of-way under the travelled road.

Municipal fire hydrants are located on the southern side of Barton Street East. A hydrant flow test using the two existing hydrants was conducted by L&D Waterworks on May 6, 2021 (see Appendix B). The hydrant flow test results from the City database as well from the most recent test are shown in Table 2.1. The proposed development will be serviced off of the 300 mm watermain.

Table 2.1 – Existing Hydrant Flow Data

Hydrant ID	City Database Data		2021 Flow Test
	HB77H004	HB77H005	HB77H004 &005
Location	2500 Barton St. E.	Barton St. E.	Barton St. E
Test Date	August 19, 2018	August 19, 2018	May 6, 2021
Static Pressure	65 psi	64 psi	65 psi
Residual Pressure at Test Flow	64 psi	63 psi	60 psi
Test Flow Rate	1140 IGPM (86 l/s)	1220 IGPM (90 l/s)	2014 USGPM (127 l/s)
Theoretical Flow @ 20 psi	8905 IGPM (674 l/s)	9415 IGPM (713 l/s)	6746 USGPM (425 l/s)

An 1050 mm storm sewer (at 0.5% - 0.68% slope) is located on the northern side of the travelled roadway (westbound lanes) of Barton Street East. The storm sewer drains east and conveys upstream flows from Centennial Parkway. The full flow capacity of the municipal storm sewer ranges from 1.94 m^3/s to 2.26 m^3/s. Storm flows from the proposed development will outlet to the 1050 mm storm sewer.

3.0 REVIEW AGENCIES

3.1 City of Hamilton

The City of Hamilton will be responsible for the review and approval of the Zoning and Site Plan Applications, as well as site servicing and grading for the overall development.

3.2 Hamilton Conservation Authority (HCA)

This site is located outside the regulatory boundary for the Hamilton Conservation Authority.

3.3 Other Utilities

The residential development will require review by other utility providers for the supply and installation of services including, but not limited to, hydro, gas, and telecommunications (cable and fiber). As such, drawings will be circulated to relevant agencies for their comment during detailed design.

4.0 SANTIARY SERVICING

The anticipated sanitary sewer discharge from the proposed development was calculated based on Table 8.2.1.3.A - Residential Occupancies and Table 8.2.1.3.B - Other Occupancies of the Ontario Plumbing Code (see Appendix A for relevant tables). Table 4.1 summarizes the anticipated sanitary sewer discharge rates from the proposed development.

Table 4.1 – Proposed Sanitary Sewer Discharge

Occupancy Type:	OBC Flow
Studio and One-Bedroom Units	750 l/unit/day x 132 units **= 99,000 l/day**
Two-Bedroom Units	1,100 l/unit/day x 71 units **= 78,100 l/day**
Three-Bedroom Units	1,600 l/unit/day x 4 units **= 6,400 l/day**
Commercial/Retail (Stores)	5 litres/m^2 x 475 m^2 **= 2375 l/day**
Total Wastewater Generated (l/day):	**185,875**
Total Wastewater Generated (l/s):	**2.15**

The site will be serviced with a 150-mm-diameter sanitary service at 1.0% slope that will be connected to the 250 mm sanitary sewer on Barton Street East. The proposed service stub will have a full flow capacity of 13 l/s.

5.0 WATER SERVICING

5.1 Domestic Water Demand

Domestic water demands for the proposed development were calculated using the OBC fixture unit method per OBC Table 7.6.3.2.A. Appendix B provides a summary table of the fixuture unit count and resulting domestic water demand for the residential and commercial/retail uses. The estimated maximum domestic water demand for the development is 21.0 L/s.

5.2 Fire Flow Demand

Fire flow demands for the development will be governed by the City of Hamilton Fire Flow Policy PW19096. The proposed development is classified as "Residential Multi (greater than 3)" with a prescribed required fire flow of 150 l/s. The proposed development will also contain commercial floor space which also has a prescribed required fire flow of 150 l/s. The recent hydrant flow test conducted in May 2021 (see Table 2.1) indicates that the munipal system can supply 425 l/s at a minimum 20 psi residual pressure; therefore, the system has sufficient capacity to provide the required fire flow plus domestic demand. Please see Appendix B for OBC fire flow calculations.

5.3 Proposed Watermain Servicing Connection

A 200 mm watermain service will be provided for the domestic and fire (internal sprinkler system) demands of the development. The existing fire hydrants on the southern side of Barton Street East are greater than 45 m from the proposed Fire Department Connection. As such, a private hydrant is proposed on the eastern side of the site that will be within 45 m of the proposed Fire Department Connection.

6.0 STORMWATER MANAGEMENT AND STORM SERVICING

6.1 Stormwater Management Requirements

As outlined in the Formal Consultation document, the City has specified the following stormwater management requirements:

- Quantity – Control 100-year, post-development peak flow discharage to less than or equal to the 5-year, pre-development peak flow.

- Quality – Storm runoff from the site will ultimtley drain to Lake Ontario. Therefore, the site design should provide a "Normal" (Level 2, 70% total suspended solids (TSS) removal) level of water quality protection.

6.2 Pre-Development Conditions

In pre-development conditions, the property contains a single detached home with a separate garage and a one-storey concrete block secondary structure. A compacted gravel driveway and parking area surrounds the the buildings. The remainder of the property is covered with open grassed areas that are hard packed due to vehicle and material storage, and existing trees, bushes, and shrubs. Table 6.1 summarizes the pre-development catchment area and characteristics. See Figure 2.0 for a depiction of the pre-development catchment area.

Table 6.1 – Pre-Developoment Catchment Area

Catchment ID	Description	Area (ha)	Percent Impervious
101	Existing Site	0.3760	30%

The pre-development site discharge was modelled with the SWMHYMO hydrologic modelling program developed by J.F Sabourin & Associates for the 2-year to 100-year City of Hamilton (Mount Hope) design storms. A summary of the peak flow rates is provided in Table 6.2. The detailed SWMHYMO input/output for both the pre- and post-development conditions can be found in Appendix C.

Table 6.2 – Pre-Development Site Discharge

Storm Event	Discharge (m^3/s)
2-year	0.018
5-year	**0.038**
10-year	0.054
25-year	0.075
50-year	0.092
100-year	0.109

Therefore, based on the City's quantity control criteria, the maximum allowable post-development flow from the development will be limited to the 5-year pre-development peak flow of 0.038 m^3/s.

6.3 Post-Development Conditions

Under post-development conditions, the site will be developed into a 17-storey residential high-rise with ground floor commercial/retail space and underground parking. The remainder of the site's surface will be comprised of asphalt driveway and parking areas with some permimeter landscaped areas. Table 6.3 summarizes the post-development drainage areas. See Figure 3.0 for a depiction of post-development catchment areas.

Table 6.3 – Post-Development Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious (%)
201	Building Roof Areas	0.1190	100
202	Driveway/Parking Surface/Ramp/Balconies	0.1656	95
203	Landscaping and Amenity Area	0.0622	5
204	Front sidewalk along Barton St. E., low roofs, and balconies	0.0292	100
	Total	**0.3760**	**82**

The increased impervious coverage in post-development conditions and the requirement to control the 100-year, post-development discharge to the 5-year, pre-development flow will necessitate the need for on-site stormwater management controls and related storage. A number of options were considered for providing on-site storage, and the most efficient arrangement was the use of rooftop control drains in conjunction with underground tank storage. This allows the available roof storage to be utilized while minimzing the underground storage tank volume requirements. The underground storage will be provided within the western landscaped area located outside of the underground parking structure. It is proposed to install 95 m^3 GreenStorm (by Stormcon) underground storage tanks in a tank configuration that is one- to two-tanks wide (0.8m to 1.6 m) by three-tanks high (2.40 m).

The post-developmenet conditions were modelled using the SWMHYMO hydrologic modelling program for the 2-year to 100-year City of Hamilton (Mount Hope) design storms. The entire roof area was modelled with a total of 11 rooftop control drains (Zurn Z105 drains with a rating of 0.38 l/s per inch of head). Table 6.4 summarizes the stage-storage-discharge characteristics for the rooftop controls. Discharge from the underground storage tanks will be controlled by a 90-mm-diameter orifice plate located at the downstream side of the storm manhole. Table 6.5 summarizes the stage-storage-discharge characteristics for the underground storage and control. This information was used in the SWMHYMO model. Please see Appendix C for detailed SWMHYMO input/output information as well as a model schematic and detailed stage-storage-discharge worksheet for the underground storage.

Table 6.4 – Roof Control Drains – Stage-Storage-Discharge Characteristics

Depth on Roof (m)	Volume (m^3) [A]	Discharge (m^3/s) [B]
0.00	0	0
0.05	36	0.00836
0.10	72	0.01672
0.15	108	0.02508

[A] Volume based on 60% of roof area (1190 m^2) x Depth
[B] Discharge = (0.38 l/s/inch of head) x 11 roof drains

Table 6.5 – Underground Storage - Stage-Storage-Discharge Characteristics

Elevation (m)	Discharge (m^3/s) [A]	Volume (m^3)	Description
81.95	0	0	Orifice Invert (90 mm)
82.50	0.0118	0	Bottom of storage tanks
83.00	0.0168	24	Tank storage
83.50	0.0206	48	Tank storage
84.00	0.0239	73	Tank storage
84.48	0.0267	95	Top of storage tanks

[A] Discharge based on 90-mm-diameter orifice plate. See Appendix C

The results of the post-developmet analysis are summarized in Table 6.6 and show that the 100-year, post-development controlled discharge is less than the 5-year, pre-development discharge of 0.038 m^3/s indicated in Table 6.2; also, there is sufficient underground tank storage to contain the 100-year storm event.

Table 6.6 – Post-Development Discharge and Stormwater Volumes

Storm Event	Peak Flow (m^3/s)		Req'd Storage Volume (m^3)	
	Uncontrolled	Controlled [A]	Rooftop	Underground Tanks
2-year	0.065	**0.020**	21	16
5-year	0.092	**0.025**	31	31
10-year	0.110	**0.027**	37	44
25-year	0.133	**0.031**	45	61
50-year	0.150	**0.033**	50	73
100-year	0.167	**0.036**	56	88

[A] Controlled discharge = Controlled flow from tank + uncontrolled flow from catchment 204

Water quality control for the site will be provided by a HydroStorm HS-6 Oil/Grit separator (OGS). The unit was sized for an area of 0.3468 ha (Catchments 201+202+203) at an imperviousness of 81%, including City of Hamilton Mount Hope rainfall data, ETV particle size distribution, and the assumption of no upstream controlled flow. The manufacturer's sizing program indicates that an HS-6 unit will provide 81% TSS removal for 100% of the annual flow (see Appendix C). There is limited area within the site to provide a treatment train; however, it should be noted that a larger unit is proposed which exceeds the minimum TSS removal requirement of 70% for Normal protection. Also, over 30% of the area draining to the unit is roof water which is considered clean. Moveover, the the OGS will be located downstream of the orifice control which improves removal efficiency. Therefore, the proposed OGS will provide an acceptable level of water quality control. See Appendix C for sizing output from the manufacturer's software as well as the User Manual for the unit.

6.4 Storm Servicing

The site will be serviced by a 300 mm storm sewer at 2.0% with a capacity of 137 l/s that will be connected to the existing 1050 mm storm sewer on Barton Street East. The capacity is greater than the controlled discharge from the proposed development.

7.0 EROSION AND SEDIMENT CONTROL

Any sediment tracked onto the roadway during the course of construction will be cleaned by the Contractor. To help minimize the amount of mud being tracked onto the roadway, a mud mat will be installed at the primary construction exit. Additionally, silt fence will be installed around the entire site to eliminate any sediment from leaving the site, and will remain in place and be maintained until landscaping has been completed and soil has been vegetated. Silt fence will also be installed around any stockpiles on site, with the stockpiles kept a minimum 2.5 m from the property.

Silt sacs in all storm and sanitary structures will be installed to prevent any silt or sediment-laden water from entering inlets. These will be inspected to ensure that they have been properly installed and function as designed throughout construction.

The controls will be maintained and accumulated sediments removed once their capture capacity has been decreased by one third. It is proposed that, during construction activities, visual monitoring will be conducted following rainfall events meeting or exceeding 12 mm of rainfall. During the construction period, monitoring will consist of visual observation for the effectiveness of the sediment and erosion controls and sediment migration off site. Construction inspections will be conducted until such time as the construction activities are complete and vegetation has established itself to a density equivalent to 70% of the background native vegetation density.

Detailed Erosion and Sediment Control plans and associated details have been provided as part of this submission.

It is assumed that the Contractor will keep in mind weather conditions when scheduling work to minimize dust to the neighbouring residential properties due to construction activities.

8.0 CONCLUSIONS

Based on the analysis presented above, it is concluded that the site can be developed to satisfy the requirements of the City of Hamilton. Therefore it is recommended that:

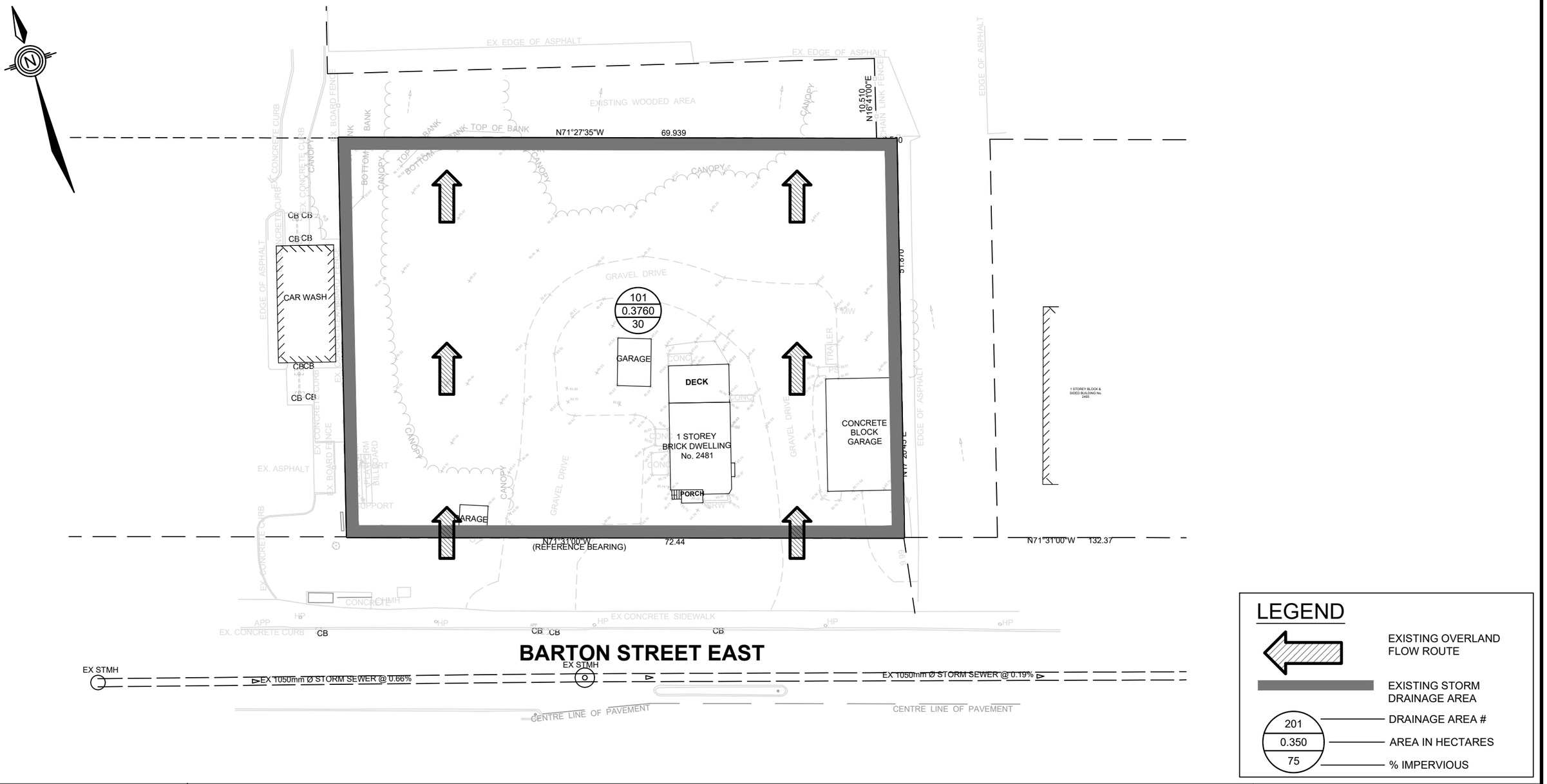
- A 150 mm sanitary service be provided with an outlet to the existing 250 mm municipal sanitary sewer on Barton Street East.
- A 200 mm diameter water service connection be provided from the existing 300 mm watermain on Barton Street East, which will provide sufficient flow and pressures to support the proposed developments fire and domestic water demand. A new hydrant private fire hydrant will be installed to service the proposed Fire Department Connection.
- A 300 mm storm service be provided with an outlet to the existing 1050 mm storm sewer on Barton Street East. On-site quantity control will be provided to control all post-development flows to less than the 5-year pre-development flow rate via a 90 mm orifice plate and 95 m^3 of underground storm tank storage.
- Quality control will be provided by an Hydrostorm HG-6 OGS.
- Erosion control measures will be implemented, monitored, and maintained during the construction period.
- This report be accepted in support of the proposed Rezoning Application.

All of which is respectfully submitted,

WALTERFEDY

John Oreskovic, P.Eng.
Senior Water Resources Engineer, Civil

joreskovic@walterfedy.com
289.799.3547, Ext. 364
JO:ajw



LEGEND

- EXISTING OVERLAND FLOW ROUTE
- EXISTING STORM DRAINAGE AREA
- 201 — DRAINAGE AREA #
- 0.350 — AREA IN HECTARES
- 75 — % IMPERVIOUS

PROJECT:

2481 BARTON STREET EAST, HAMILTON

TITLE:

EXISTING CONDITIONS STORM DRAINAGE CATCHMENT FIGURE

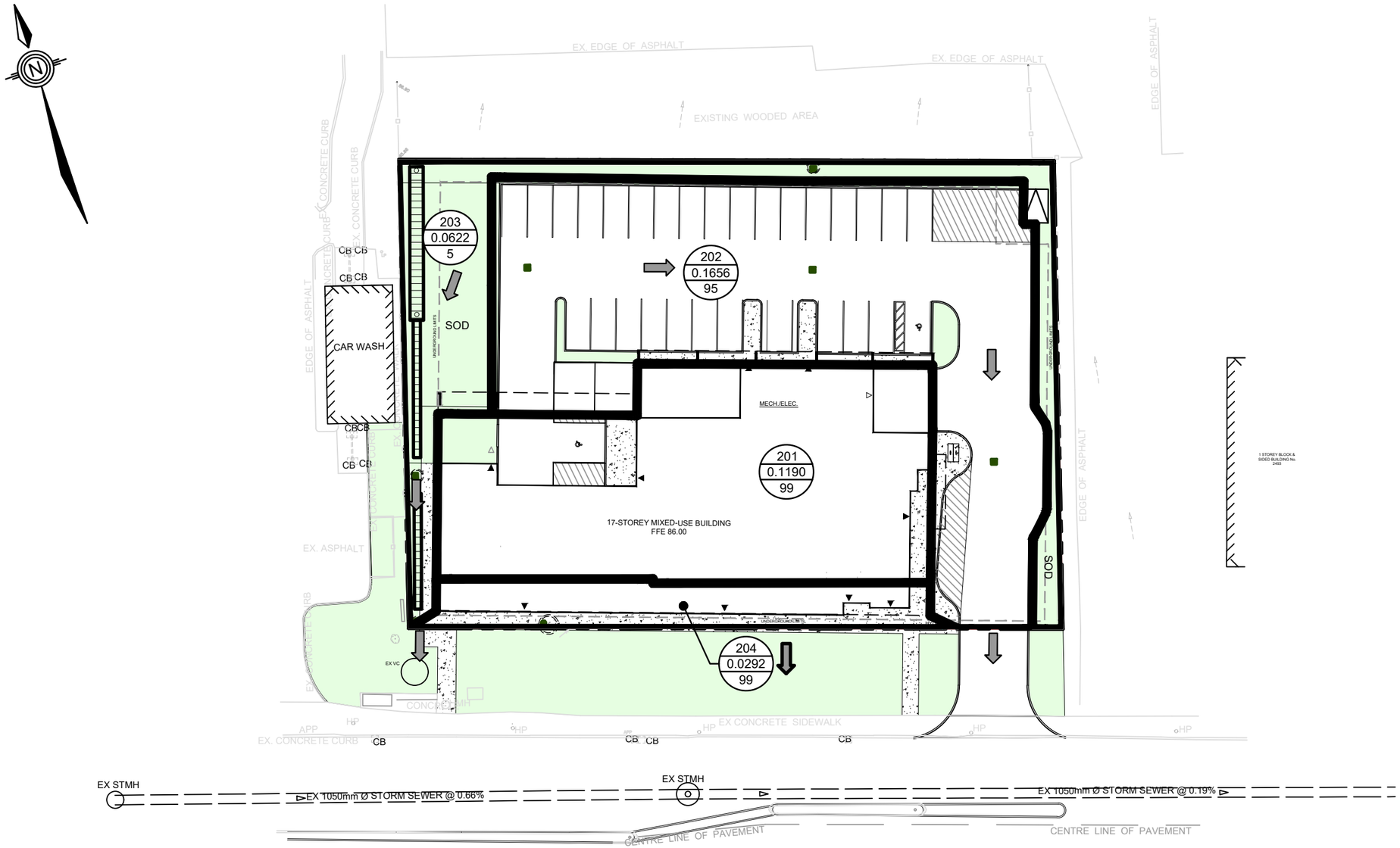
WALTERFEDY

KITCHENER OFFICE
675 Queen Street South, Suite 111, Kitchener, Ontario N2M 1A1
T: 519.576.2150 F: 519.576.5499 walterfedy.com

SCALE:	1:500	DATE:	2022-08-29
DRAWN BY:	MPB	PROJECT NO.:	2021-0171-10
CHECKED BY:	JO	FILE:	2021-0171-10_SWM-PRE

SHEET NO.:

FIG 2.0



LEGEND

- PROPOSED OVERLAND FLOW ROUTE
- PROPOSED STORM DRAINAGE AREA
- 202 — DRAINAGE AREA #
- 0.35 — AREA IN HECTARES
- 75 — % IMPERVIOUS

PROJECT:

2481 BARTON STREET EAST, HAMILTON

TITLE:

PROPOSED CONDITIONS STORM DRAINAGE CATCHMENT FIGURE

WALTERFEDY
KITCHENER OFFICE
675 Queen Street South, Suite 111, Kitchener, Ontario N2M 1A1
T: 519.576.2150 F: 519.576.5499 walterfedy.com

SCALE:	1:500	DATE:	2022-09-06
DRAWN BY:	MPB	PROJECT NO.:	2021-0171-10
CHECKED BY:	JO	FILE:	2021-0171-10_SWM-POST
SHEET NO.:			

FIG 3.0

APPENDIX A

Sanitary Servicing

OBC - Tables 8.2.1.3.A & B

Table 8.2.1.3.A.
Residential Occupancy

Forming Part of Sentence 8.2.1.3.(1)

Item	Column 1 *Residential Occupancy*	Column 2 Volume, litres
1.	Apartments, Condominiums, Other Multi-family Dwellings - per person(1)	275
2.	Boarding Houses	
	a) Per person,	
	i) with meals and laundry facilities, or,	200
	ii) without meal or laundry facilities, and	150
	b) Per non-resident staff per 8 hour shift	40
3.	Boarding School - per person	300
4.	Dwellings	
	a) 1 bedroom dwelling	750
	b) 2 bedroom dwelling	1100
	c) 3 bedroom dwelling	1600
	d) 4 bedroom dwelling	2000
	e) 5 bedroom dwelling	2500
	f) Additional flow for(2)	
	i) each bedroom over 5,	500
	ii) A) each 10 m^2 (or part of it) over 200 m^2 up to 400 m^2 (3),	100
	B) each 10 m^2 (or part of it) over 400 m^2 up to 600 m^2 (3), and	75
	C) each 10 m^2 (or part of it) over 600 m^2 (3), or	50
	iii) each fixture unit over 20 fixture units	50
5.	Hotels and Motels (excluding bars and restaurants)	
	a) Regular, per room	250
	b) Resort hotel, cottage, per person	500
	c) Self service laundry, add per machine	2500
6.	Work Camp/Construction Camp, semi-permanent per worker	250

Notes to Table 8.2.1.3.A.:

(1) The *occupant load* shall be calculated using Subsection 3.1.17.

(2) Where multiple calculations of *sanitary sewage* volume is permitted, the calculation resulting in the highest flow shall be used in determining the design daily *sanitary sewage* flow.

(3) Total finished area, excluding the area of the finished *basement*.

OBC - Tables 8.2.1.3.A & B

Table 8.2.1.3.B.
Other Occupancies

Forming Part of Sentence 8.2.1.3.(2)

Item	Column 1 Establishments[1]	Column 2 Volume, litres
1.	Airports, Bus Terminals, Train Stations, Dock/Port Facilities (Food Services excluded)	
	a) Per passenger, and	20
	b) Per employee per 8 hour shift	40
2.	Assembly Hall - per seat	
	a) No food service, or	8
	b) Food service provided	36
3.	Barber Shop/Beauty Salon - per service chair	650
4.	Bowling Alleys (Food Service not included) - per lane	400
5.	Churches and Similar Places of Worship - per seat	
	a) No kitchen facilities, or	8
	b) Kitchen facilities provided	36
6.	Country Club (excluding Food Service)	
	a) Per resident,	375
	b) Per employee per 8 hour shift, and	50
	c) Per member or patron	40
7.	Day Care Facility per person (staff and children)	75
8.	Dentist Office	
	a) Per wet service chair, and	275
	b) Per dry service chair	190
9.	Doctors Office	
	a) Per practitioner, and	275
	b) Per employee per 8 hour shift	75
10.	Factory (excluding process or cleaning waters) - per employee per 8 hour shift	
	a) No showers, or	75
	b) Including showers	125
11.	Flea Markets[2] (open not more than 3 days per week)	
	a) Per non-food service vendor space,	60
	b) Per food service establishment / 9.25 m^2 of floor space, and	190
	c) Per limited food service outlet	95
12.	Food Service Operations	
	a) Restaurant (not 24 hour), per seat	125
	b) Restaurant (24 hour), per seat	200
	c) Restaurant on controlled-access highway, per seat	400
	d) Paper service restaurant, per seat	60
	e) Donut shop, per seat	400
	f) Bar and cocktail lounge, per seat	125
	g) Drive-in restaurant per parking space	60
	h) Take-out restaurant (no seating area)	
	i) per 9.25 m^2 of floor area, and	190
	ii) per employee per 8 hour shift	75
	i) Cafeteria - per meal	12
	j) Food outlet	
	i) excluding delicatessen, bakery and meat department, per 9.25 m^2 of floor space,	40
	ii) per 9.25 m^2 of delicatessen floor space,	190
	iii) per 9.25 m^2 of bakery floor space,	190
	iv) per 9.25 m^2 of meat department floor space, and	380
	v) per water closet	950
13.	Hospitals - per bed	
	a) Including laundry facilities, or	750
	b) Excluding laundry facilities	550
14.	Long-Term Care Homes, etc. - per bed	450
15.	Office Building[3]	
	a) Per employee per 8 hour shift, or	75
	b) Per each 9.3 m^2 of floor space	75

OBC - Tables 8.2.1.3.A & B

16.	Public Parks	
	a) With toilets only per person, or	20
	b) With bathhouse, showers, and toilets per person	50
17.	Recreational Vehicle or Campground Park	
	a) Per site without water or sewer hook-up, or	275
	b) Per site with water and sewer hook-up	425
18.	Schools - per student	
	a) Day school,	30
	b) With showers,	30
	c) With cafeteria, and	30
	d) Per non-teaching employee per 8 hour shift	50
19.	Service Stations (no vehicle washing)(3)	
	a) Per water closet, and	950
	i) per fuel outlet(4), or	560
	ii) per vehicle served	20
20.	Shopping Centre (excluding food and laundry) - per 1.0 m^2 of floor space	5
21.	Stadiums, Race Tracks, Ball Parks - per seat	20
22.	Stores(3)	
	a) Per 1.0 m^2 of floor area, or	5
	b) Per water closet	1230
23.	Swimming and Bathing Facilities (Public) - per person	40
24.	*Theatres*	
	a) Indoor, auditoriums per seat,	20
	b) Outdoor, drive-ins per space, or	40
	c) Movie theatres per seat	15
25.	Veterinary Clinics	
	a) Per practitioner,	275
	b) Per employee per 8 hour shift, and	75
	c) Per stall, kennel or cage if floor drain connected	75
26.	Warehouse	
	a) Per water closet, and	950
	b) Per loading bay	150

Notes to Table 8.2.1.3.B.:

(1) The *occupant load* shall be calculated using Subsection 3.1.17.

(2) Flea markets open more than 3 days per week shall be assessed using the volumes stated under the heading "Stores".

(3) Where multiple calculations of *sanitary sewage* volume is permitted, the calculation resulting in the highest flow shall be used in determining the design daily *sanitary sewage* flow.

(4) The number of fuel outlets is considered the maximum number of fuel nozzles that could be in use at the same time.

APPENDIX B

Water Servicing

Hydraulic Load (Fixuture Unit Calculation) for Domestic Water Demand per OBC

Building Information

Studio & One-Bedroom	132	units
Two-Bedroom	71	units
Three-Bedroom	4	units
Total	207	units
Commercial Space	475	m^2

Fixture or Device	Fixture Units	Quantity	Total Fixture Load	
Bathroom Group with 6 LPF or less flush tank*	3.6	207	745.2	
Bathtub with or without shower head	1.4	0	0	
Clothes washer	1.4	207	289.8	
Dishwasher (domestic)	1.4	207	289.8	
Hose bibb (1/2")	2.5	5	12.5	(1)
Lavatory	0.7	207	144.9	
Shower head	1.4	0	0	
Shower, spray, multi-head, fixture unit per head	1.4	0	0	
Sink, bar	1.0	0	0	
Sink, kitchen	1.4	207	289.8	
Sink, laundry	1.4	**1**	1.4	(2)
Water closet (6 LPF or less with flush tank)	2.2	0	0	
Additional Fixtures for two and three bedroom units (3)				
Lavatory	0.7	75	52.5	
Water closet (6 LPF or less with flush tank)	2.2	75	165	
Fixtures for Commercial/Retail (4)				
Lavatory	0.7	6	4.2	
Water closet (6 LPF or less with flush tank)	2.2	6	13.2	
Sink, kitchen	1.4	6	8.4	
		Total Fixture Units	**2016.7**	
		Total Flow (IGPM) per OBC Table 7.4.10.5	**276.7**	
		Total Flow (l/s)	**21.0**	

(Fixture Units from Table 7.6.3.2.A, of Dvision B of the OBC

* Bathroom group consists of 1 water closet, 1 basin (lavatory), and 1 bathtub or 1 shower

Notes:

(1) Assume 2 exterior + 2 in underground parking + 1 in garbage room (5 total)

(2) Assume one (1) laundry/mop sink on main floor for building staff

(3) Assume that 2 and 3-bedroom units will have an additional powder room with toilet and sink

(4) Assume six (6) individual commercial/retail units with 1 toilet, 1 sink and 1 kitchen type sink

Use the total Fixture Unit count and the table below to calculate the flow

Table 7.4.10.5.
Maximum Probable Drainage Rate, gal/min
Forming Part of Sentence 7.4.10.5.(2)

Item	Column 1	Column 2	Column 3	Column 4
	Fixture Units in Service	*Fixture Units*	*Fixture Units*	*Fixture Units*
		Col. 1	Col. 1 × 10	Col. 1 × 100
1.	100	53	174	900
2.	90	51	164	835
3.	80	49	153	750
4.	70	47	140	680
5.	60	44	128	600
6.	50	41	115	520
7.	40	38	102	435
8.	30	33	88	350
9.	20	27	72	262
10.	10	21	53	174

1 gal/min (Imp) = 0.075768 l/s

WALTERFEDY

OBC FIRE FLOW WATER SUPPLY

Project:	**Premier Group - 2481 Barton Street East**
Project Number:	2021-0171-10
Date:	August 2022

Type of Development: **Residential (majority)**

Required Fire Water Supply (Q) per OBC: **$Q = K\ V\ S_{tot}$** *(OBC Tables and Figures attached)*

Where:
- Q = Minimim supply of water in litres
- K = Water suppy coefficient from Table 1
- V = total building volume in cubic meters
- S_{tot} = total of spatial coefficient values from property line exposures on all sides
  - $S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + ...]$ from Figure 1. Max. 2.0

Water Supply Coefficient (K)

Building Group/Division Classification: **C (residential)**

From Table 1, **K =** **16**

Building Volume (V)

1-storey + U/G Parking = 215m^2 x (1 storey + 1 u/g park) x 3m/storey =	1290 m^3
5-storey + U/G Parking = 405m^2 x (5 storey + 1 u/g park) x 3m/storey =	7290 m^3
17-storey + U/G Parking = 775m^2 x (17 storey + 1 u/g park) x 3m/storey =	41850 m^3
Remainder of U/G Parking = 1840m^2 x 1 storey x 3m/storey =	5520 m^3

Building Volume (V): ***55950*** **m^3**

Spatial Coefficient (S)

See Figure 1 for Spatial Coefficients

Side	Dist (m)	S_{coeff}
North	50	0
South	40	0
East	16	0
West	13	0
	Total	0.0

Therefore, S_{tot} = **1.0**

Required Water Supply

$Q = K\ V\ S_{tot}$ = **895200** **m^3**

From Table 2, the minimum required water supply flow rate = ***9000*** ***l/min*** ***or*** 150 l/s

City of Hamilton Target flow for Residential Multi (Greater than 3 units) = **150** **l/s = OBC**

OBC Tables and Figures

Table 1

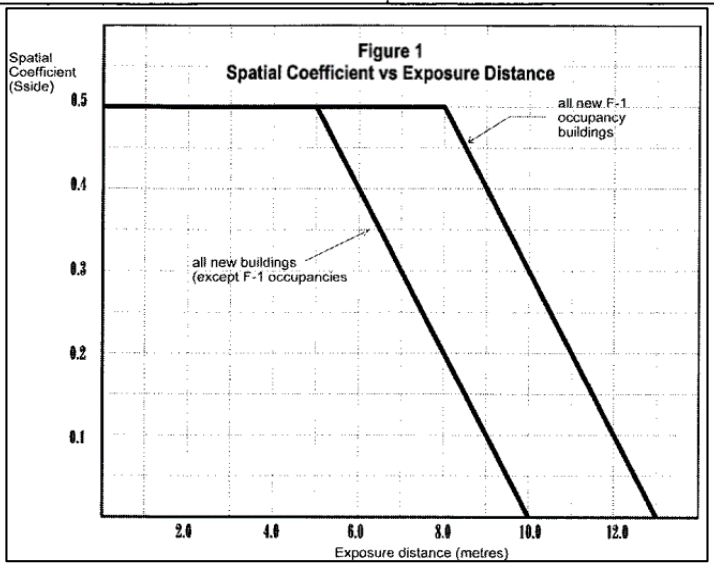
Water Supply Coefficient - K

Type of Construction	Classification by Group or Division in Accordance with Table 3.1.2.1. of the Building Code				
	A-2 B-1 B-2 B-3 C D	A-4 F-3	A-1 A-3	E F-2	F-1
Building is of noncombustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2., including loadbearing walls, columns and arches.	10	12	14	17	23
Building is of noncombustible construction or of heavy timber construction conforming to Article 3.1.4.6. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	16	19	22	27	37
Building is of combustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2., including loadbearing walls, columns and arches. Noncombustible construction may be used in lieu of fire-resistance rating where permitted in Subsection 3.2.2.	18	22	25	31	41
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	23	28	32	39	53
Column 1	2	3	4	5	6

Table 2

Part 3 Buildings under the Building Code	Required Minimum Water Supply Flow Rate, L/min
One-storey building with building area not exceeding 600 m²	1 800
All other buildings	2 700 (if Q ≤ 108 000 L)(1) 3 600 (if Q > 108 000 L and ≤ 135 000 L)(1) 4 500 (if Q > 135 000 L and ≤ 162 000 L)(1) 5 400 (if Q > 162 000 L and ≤ 190 000 L)(1) 6 300 (if Q > 190 000 L and ≤ 270 000 L)(1) 9 000 (if Q > 270 000 L)(1)

Figure 1
Spatial Coefficient vs Exposure Distance



City of Hamilton Target Flows (Policy PW19096)

Table 1: Target Available Fire Flow

Land Use	Target AFF (L/s)
Commercial	150
Small ICI (<1,800 m³)[1]	100
Industrial	250
Institutional	150
Residential Multi (greater than 3 units)	150
Residential Medium (3 or less units)	125
Residential Single	75
Residential Single (Dead End)	50

WALTERFEDY
Kitchener | Hamilton | Toronto | walterfedy.com

September 5, 2022

2019-0171-10

City of Hamilton
71 Main St. W.
Hamilton, ON L8P 4Y5

RE: Fire Flow Estimate
2481 Barton Street East - City of Hamilton

The proposed mixed use development consists of a 17-storey residential building with ground floor commercial/retail space and an underground parking level. The residential component will consist of 207 studio, one, two and three-bedroom units. Approximately 475 m^2 of commercial will be provided on the ground floor. Refer to the Site Plan prepared by SRM Architects Inc. for additional details

The required fire flow in the City of Hamilton is determined as being the greater of the OBC fire flow calculation (OBC section A-3.2.5.7) or the prescribed fire flow per the City of Hamilton Fire Flow Policy PW19096 based on the type of development. The results of the OBC fire flow calculation (see attached) indicate a required fire flow of 9000 l/min (150 l/sec). This is equal to the City of Hamilton prescribed fire flow of 150 l/s for Residential Multi (greater than 3 units) developments. Therefore, the minimum required fire flow for this site is **150 l/sec**. Refer to the attached fire flow calculations.

A hydrant flow test was conducted by L&D Waterworks on May 6, 2021 using the existing municipal hydrants located on Barton Street East, east of Centennial Parkway (see attached for test results). Table 1 summarizes the hydrant flow test results and shows that the water distribution system can supply up to 450 l/s at a residual pressure of 20 psi based on the hydrant flow test.

Table 1 – Hydrant Flow Data	
Hydrant ID	**HB77H004 &005**
Location	Barton St. E (east of Centennial Pkwy.)
Test Date	May 6, 2021
Static Pressure	65 psi
Residual Pressure During Test Flow	60 psi
Test Flow Rate	2014 USGPM (127 l/s)
Theoretical Flow @ 20 psi	6746 USGPM (425 l/s)

20 Hughson Street South
Suite 1000, Hamilton, ON
Canada L8N 2A1

T 289.799.3547
F 519.576.5499

Based on this hydrant flow test data, the theoretical maximum available flow of 425 l/s exceeds the maximum required 150 l/s fire flow for the proposed development. Therefore, the existing water distribution system will have the capacity and pressure required to adequately service the subject site.

We trust this is the information you presently require. Should you have any questions or concerns regarding this correspondence, or if you would like to discuss any of these contents in more detail, please contact the undersigned.

All of which is respectfully submitted,

WALTERFEDY

John Oreskovic, P.Eng.
Water Resources Engineer, Civil
joreskovic@walterfedy.com

APPENDIX C

Stormwater Management

WALTERFEDY

SWMHYMO HYDROLOGIC MODELING PARAMETERS

PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING PARAMETERS

Catchment ID	Catchment Description	Hydrograph Method	Area (ha)	Perv. CN	Perv. Ia (mm)	Impervious (%) TIMP	XIMP	Flow Length (m) Perv.	Imperv.	Manning "n" Perv.	Imperv.	Slope (%) Perv.	Imperv.	Time to Peak Tp (hrs)
101	Existing Conditions	STANDHYD	0.3760	80	4.00	30	1	25	25	0.250	0.015	2.0	2.0	
		TOTAL	**0.3760**											

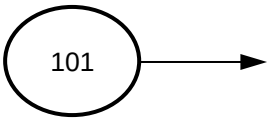
POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING PARAMETERS

Catchment ID	Catchment Description	Hydrograph Method	Area (ha)	Perv. CN	Perv. Ia (mm)	Impervious (%) TIMP	XIMP	Flow Length (m) Perv.	Imperv.	Manning "n" Perv.	Imperv.	Slope (%) Perv.	Imperv.	Time to Peak Tp (hrs)
201	Future building roof (controlled flow)	STANDHYD	0.1190	80	4.00	99	99	0.1	15	0.250	0.015	2.0	1.0	
202	Parking, driveway and uncovered balcony plan area	STANDHYD	0.1656	80	4.00	95	95	5	30	0.250	0.015	2.0	2.0	
203	Amenity area and perimeter landscaping	NASHYD	0.0622	80	4.00									0.11
204	Front walkway and uncovered balcony plans areas draining uncontrolled	STANDHYD	0.0292	80	4.00	99	99	0.1	1.5	0.250	0.015	2.0	2.0	
	Total Area to North Outlet		**0.3760**											

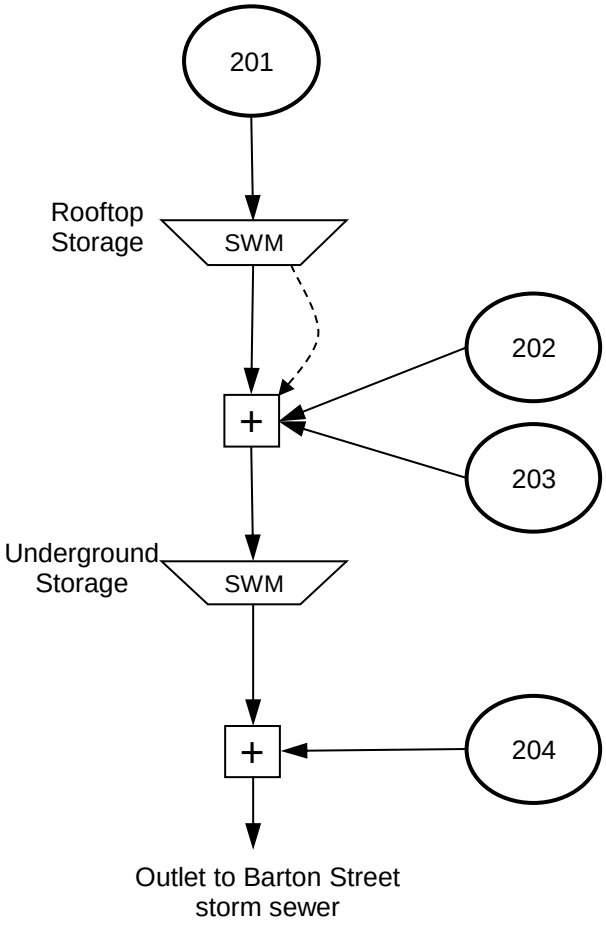
- Pervious Initial Abstraction (Perv. Ia) = 0.1 x S , where S = (25400 / CN) - 254
- Depression Storage over Impervious areas (DPSI) = 1.0 mm

SWMHYMO HYDROLOGIC MODELING SCHEMATIC

PRE-DEVELOPMENT



POST-DEVELOPMENT



WALTERFEDY

Project: 2021-071-102481 Barton Street East, Hamilton,ON

STAGE-STORAGE-DISCHARGE CALCULATIONS FOR UNDERGROUND STORAGE TANKS

Outlet Device No. 1 (Quantity)

Type:	Circular Orifice
Diameter (mm)	**90**
Area (m^2)	0.00636
Invert Elev. (m)	**81.95**
C/L Elev. (m)	82.00
Disch. Coeff. (C_d)	0.6
Discharge (Q) =	C_d A (2 g H)$^{0.5}$
Number of Orifices:	1

Outlet Device No. 2 (Quantity)

Type:	N/A
Diameter (mm)	0
Area (m^2)	0.00000
Invert Elev. (m)	0.00
C/L Elev. (m)	0.00
Disch. Coeff. (C_d)	0
Discharge (Q) =	C_d A (2 g H)$^{0.5}$
Number of Orifices:	0
Spill into structure at elev. (m)	

Outlet Device No. 3

Type:	N/A
Diameter (mm)	0
Area (m^2)	0.00000
Invert Elev. (m)	0.00
C/L Elev. (m)	0.00
Disch. Coeff. (C_d)	0
Discharge (Q) =	0
Number of Orifices:	0

Outlet No. 4 (Quantity)

Type:	N/A
Sill Elevation (m)	0.00
Length (m)	0.0
Discharge (Q) =	1.67 L H $^{1.5}$

		SWM Pond Volumes				Outlet No. 1		Outlet No. 2		Outlet No. 3		Outlet No. 4		
	Elevation m	Area m^2	Incremental Volume m^3	Cumulative Volume m^3	Active Storage Volume m^3	H m	Discharge m^3/s	H m	Discharge m^3/s	H m	Discharge m^3/s	H m	Discharge m^3/s	Total Discharge m^3/s
Orifice Invert	81.95	0	0	0	0	0.000	0.0000							0.0000
Bottom of Tank	82.50	41.20	0	0	0	0.550	0.0118							0.0118
	82.75	41.20	10	10	10	0.800	0.0145							0.0145
	83.00	41.20	10	20	20	1.050	0.0168							0.0168
	83.25	41.20	10	30	30	1.300	0.0188							0.0188
	83.50	41.20	10	40	40	1.550	0.0206							0.0206
	83.75	41.20	10	49	49	1.800	0.0223							0.0223
	84.00	41.20	10	59	59	2.050	0.0239							0.0239
	84.25	41.20	10	69	69	2.300	0.0253							0.0253
	84.50	41.20	10	79	79	2.550	0.0267							0.0267
	84.75	41.20	10	89	89	2.800	0.0280							0.0280
Top of Tank	84.90	41.20	6	95	95	2.950	0.0287							0.0287

Orifice Discharge related to Invert

8.4.4 Orifice Flow for Pond Control

The stage discharge equation for the orifice is calculated for two cases which depend on the relative value of the specific energy H relative to the invert of the orifice and the diameter of the orifice D.

In Case 1, $H > D$ and the orifice is fully submerged.

[8.60] $$Q = C_c \frac{\pi}{4} D^2 \sqrt{2g(H - \frac{2}{3}D)}$$

where H = head relative to the invert of the orifice

D = orifice diameter

g = gravitational acceleration

Cc = coefficient of contraction

In Case 2, $H \leq D$ and the orifice acts as a broad-crested weir of circular shape. The critical discharge can be approximated by equation [8.61]

[8.61] $$Q = f\left(\frac{H}{D}\right) C_c \sqrt{g} D^{5/2}$$

where

$$f\left(\frac{H}{D}\right) = 0.494\left(\frac{H}{D}\right)^{1.57} - 0.04\left(\frac{H}{D}\right)^{0.5}$$

Source: MIDUSS Reference Manual

```
2     Metric units
*#************************************************************************|
*#  Project Name: 2481 BARTON STREET EAST
*#               HAMILTON, ONTARIO
*#  JOB NUMBER  : 2021-0171-10
*#       Date   : AUGUST 2022
*#    Revised   :
*#    Company   : WALTER FEDY
*#       File   : 21-0171A.DAT
*#************************************************************************|
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
                    MHP4_002.STM
*
READ STORM          STORM_FILENAME "STORM.001"
*
*#************************************************************************|
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS
*#
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[10](min), AREA=[0.376](ha),
                    XIMP=[0.01], TIMP=[0.30], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[80],
                    Pervious   surfaces: IAper=[4.0](mm), SLPP=[2.0](%),
                                         LGP=[25](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[25](m), MNI=[0.015], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*#************************************************************************|
*# TOTAL PRE-DEVELOPMENT FLOW
ADD HYD             IDsum=[2], NHYD=["PRE"], IDs to add=[1]
*%-----------------|-------------------------------------------------------|
*#
*%-----------------|-------------------------------------------------------|
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#************************************************************************|
*# CATCHMENT 201 - FUTURE BUIDLING ROOF
*
CALIB STANDHYD      ID=[2], NHYD=["201"], DT=[1](min), AREA=[0.1190](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[80],
                    Pervious   surfaces: IAper=[4.0](mm), SLPP=[2.0](%),
                                         LGP=[0.1](m), MNP=[0.250], SCP=[0](min)
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.0](%),
                                         LGI=[15](m), MNI=[0.015], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*#************************************************************************|
*# ROOF TOP CONTROL DRAINS - ASSUME 11 ROOF DRAINS @ 0.38 L/S/inch of head
*
ROUTE RESERVOIR     IDout=[7],   NHYD=["SWM"],  IDin=[2],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                0       0
                                0.00836 0.0036
```

```
                                    0.01672 0.0072
                                    0.02508 0.0108
                                       -1       -1   (max twenty pts)
                             IDovf=[8], NHYDovf=["RF-OFL"]
*#####################################################################|
*# CATCHMENT 202 - PARKING AND DRIVEWAY SURFACE AND BALCONIES
*
CALIB STANDHYD      ID=[3], NHYD=["202"], DT=[1](min), AREA=[0.1656](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[80],
                    Pervious   surfaces: IAper=[4.0](mm), SLPP=[2.0](%),
                                         LGP=[5](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[30](m), MNI=[0.015], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*#####################################################################|
*# CATCHMENT 203 - AMENITY AREA AND LANDSCAPE STRIP AROUND PERIMITER OF SITE
*
CALIB NASHYD        ID=[4], NHYD=["203"], DT=[1]min, AREA=[0.0622](ha),
                    DWF=[0](cms),  CN/C=[80], IA=[4.0](mm),
                    N=[3], TP=[0.11]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr),  END=-1
*%-----------------|-------------------------------------------------------|
*# CATCHMENT 204 - FRONT WALKWAY DRAINING AND UNCOVERED BALCONIES - UNCONTOLLED
*
CALIB STANDHYD      ID=[5], NHYD=["204"], DT=[1](min), AREA=[0.0292](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[80],
                    Pervious   surfaces: IAper=[4.0](mm), SLPP=[2.0](%),
                                         LGP=[0.1](m), MNP=[0.250], SCP=[0](min)
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[1.5](m), MNI=[0.015], SCI=[0](min)
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*#####################################################################|
*# TOTAL UNCONTROLLED FLOW - 201+202+203+204 (NO CONTROLS)
ADD HYD             IDsum=[6], NHYD=["UNCON"], IDs to add=[2 3 4 5]
*%-----------------|-------------------------------------------------------|
*# TOTAL FLOW TO UNDERGROUND STORAGE - 201(with roof controls)+ 202 + 203
ADD HYD             IDsum=[9], NHYD=["CONT"], IDs to add=[7 8 3 4]
*%-----------------|-------------------------------------------------------|
*# ROUTE FLOWS THROUGH UNDERGROUND STOARGE TANKS
*
ROUTE RESERVOIR     IDout=[1],   NHYD=["SWM"],  IDin=[9],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                   (cms) - (ha-m)
  0       0
  0.0118  0.0000
  0.0145  0.0010
  0.0168  0.0020
  0.0188  0.0030
  0.0206  0.0040
  0.0223  0.0049
  0.0239  0.0059
  0.0253  0.0069
  0.0267  0.0079
  0.0280  0.0089
  0.0287  0.0095
```

```
                                    -1       -1   (max twenty pts)
                          IDovf=[2], NHYDovf=["OFL"]
*%-----------------|-------------------------------------------------------------|
*# TOTAL SITE DISCHARGE - CONTROLLED + UNCONTROLLED
*# SWM TANK DISCHARGE + CATCHMENT 204
ADD HYD             IDsum=[10], NHYD=["TOTAL"], IDs to add=[1 2 5]
*%-----------------|-------------------------------------------------------------|
*
*
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
                    MHP4_005.STM
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[010]
                    MHP4_010.STM
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[025]
                    MHP4_025.STM
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[050]
                    MHP4_050.STM
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                    MHP4_100.STM
*
*
*%-----------------|-------------------------------------------------------------|
FINISH
```

```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M    OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM   O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M   O   O  ##  9   9  9   9   Ver  4.05
       S  W W W  M   M  H   H    Y    M   M   O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M    OOO            9      9   =========
                                                          9   9  9   9   # 2018430
        StormWater Management HYdrologic Model             999    999    =========

 ********************************************************************************
 ***************************** SWMHYMO Ver/4.05  ********************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                OTTHYMO-83 and OTTHYMO-89.                   *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: WalterFedy                                   +++++++++
 +++++++++               Kitchener            SERIAL#:2018430         +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++             *********
 *********           Maximum value for ID numbers  :     10            *********
 *********           Max. number of rainfall points: 105408            *********
 *********           Max. number of flow points    : 105408            *********
 ********************************************************************************


 **********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2022-09-07     TIME: 14:11:36     RUN COUNTER: 000207          *
 ********************************************************************************
 * Input   filename: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1\SWM\21-0171A.d*
 * Output  filename: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1\SWM\21-0171A.o*
 * Summary filename: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1\SWM\21-0171A.s*
 * User comments:                                                             *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 ********************************************************************************

--------------------------------------------------------------------------------
001:0001----------------------------------------------------------------------|
*#*****************************************************************************|
*#  Project Name: 2481 BARTON STREET EAST
*#                HAMILTON, ONTARIO
*#  JOB NUMBER  : 2021-0171-10
*#       Date   : AUGUST 2022
*#    Revised   :
*#    Company   : WALTER FEDY
*#       File   : 21-0171A.DAT
*#*****************************************************************************|
*
  ** END OF RUN :   1

********************************************************************************




--------------------
| START            |  Project  dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
--------------------  Rainfall dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 002
    NSTORM=   1
          #  1=MHP4_002.STM
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------|
*#*****************************************************************************|
*#  Project Name: 2481 BARTON STREET EAST
*#                HAMILTON, ONTARIO
*#  JOB NUMBER  : 2021-0171-10
*#       Date   : AUGUST 2022
*#    Revised   :
*#    Company   : WALTER FEDY
*#       File   : 21-0171A.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------|
*
--------------------
| READ STORM       |    Filename: 2-YR MT. HOPE (A=646 B=6 C=0.781)
| Ptotal=  35.06 mm|    Comments: 2-YR MT. HOPE (A=646 B=6 C=0.781)
--------------------
            TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
             hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
             .17   2.368 |   1.17  18.525 |   2.17   5.648 |   3.17   2.846
             .33   2.712 |   1.33  74.099 |   2.33   4.806 |   3.33   2.644
             .50   3.193 |   1.50  24.316 |   2.50   4.199 |   3.50   2.472
             .67   3.921 |   1.67  12.980 |   2.67   3.739 |   3.67   2.323
             .83   5.164 |   1.83   8.954 |   2.83   3.378 |   3.83   2.193
            1.00   7.836 |   2.00   6.898 |   3.00   3.087 |   4.00   2.078

--------------------------------------------------------------------------------
002:0003----------------------------------------------------------------------|
*
*#*****************************************************************************|
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#*****************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS
*#
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .38
| 01:101    DT=10.00 |   Total Imp(%)=   30.00   Dir. Conn.(%)=    1.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .11          .26
     Dep. Storage     (mm)=       1.00         4.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      25.00        25.00
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=      74.10        35.43
               over (min)        10.00        10.00
     Storage Coeff.  (min)=       1.11 (ii)    9.17 (ii)
     Unit Hyd. Tpeak (min)=      10.00        10.00
     Unit Hyd. peak  (cms)=        .17          .11
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .00          .02          .018 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=      34.06        13.47        13.677
     TOTAL RAINFALL   (mm)=      35.06        35.06        35.063
     RUNOFF COEFFICIENT   =        .97          .38          .390
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0004----------------------------------------------------------------------|
*#*****************************************************************************|
*# TOTAL PRE-DEVELOPMENT FLOW
----------------------
| ADD HYD (PRE       ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
---------------------- |                   (ha)     (cms)   (hrs)   (mm)   (cms)
                       | ID1 01:101          .38      .018    1.33  13.68    .000
                       | ==========================================================
                       | SUM 02:PRE          .00      .000     .00    .00    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
002:0005----------------------------------------------------------------------|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#*****************************************************************************|
*# CATCHMENT 201 - FUTURE BUIDLING ROOF
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .12
| 02:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .12          .00
     Dep. Storage     (mm)=       1.00         4.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      15.00          .10
     Mannings n            =       .015         .250

     Max.eff.Inten.(mm/hr)=      74.10        25.63
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       1.01 (ii)    1.34 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.07          .89
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .02          .00          .024 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=      34.06        10.20        33.824
     TOTAL RAINFALL   (mm)=      35.06        35.06        35.063
     RUNOFF COEFFICIENT   =        .97          .29          .965

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0006----------------------------------------------------------------------|
*#*****************************************************************************|
*# ROOF TOP CONTROL DRAINS - ASSUME 11 ROOF DRAINS @ 0.38 L/S/inch of head
*
----------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>02:(201   )    |
| OUT<07:(SWM   )    |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)  |    (cms)    (ha.m.)
                            .000  .0000E+00  |     .017  .7200E-02
                            .008  .3600E-02  |     .025  .1080E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (201   )        .12      .024     1.333     33.824
    OUTFLOW<07: (SWM   )        .12      .005     1.533     33.824
   OVERFLOW<08: (RF-OFL)        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   19.905
                  TIME SHIFT OF PEAK FLOW          (min)=    12.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.2085E-02

--------------------------------------------------------------------------------
002:0007----------------------------------------------------------------------|
*#*****************************************************************************|
*# CATCHMENT 202 - PARKING AND DRIVEWAY SURFACE AND BALCONIES
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
```

```
| 03:202    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .16          .01
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=     30.00         5.00
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=     74.10        22.35
               over (min)        1.00         5.00
     Storage Coeff.  (min)=     1.24 (ii)    4.93 (ii)
     Unit Hyd. Tpeak (min)=     1.00         5.00
     Unit Hyd. peak  (cms)=      .94          .23
                                                    *TOTALS*
     PEAK FLOW       (cms)=      .03          .00        .033 (iii)
     TIME TO PEAK    (hrs)=     1.33         1.38       1.333
     RUNOFF VOLUME    (mm)=    34.06        10.20      32.870
     TOTAL RAINFALL   (mm)=    35.06        35.06      35.063
     RUNOFF COEFFICIENT   =      .97          .29        .937

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
002:0008------------------------------------------------------------------------
*#*********************************************************************|
*# CATCHMENT 203 - AMENITY AREA AND LANDSCAPE STRIP AROUND PERIMITER OF SITE
*
----------------------
| CALIB NASHYD       |   Area    (ha)=    .06   Curve Number   (CN)=80.00
| 04:203    DT= 1.00 |   Ia      (mm)=   4.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .110

     Unit Hyd Qpeak  (cms)=     .022

     PEAK FLOW       (cms)=     .002 (i)
     TIME TO PEAK    (hrs)=    1.417
     RUNOFF VOLUME    (mm)=   10.200
     TOTAL RAINFALL   (mm)=   35.063
     RUNOFF COEFFICIENT   =     .291

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
002:0009------------------------------------------------------------------------
*# CATCHMENT 204 - FRONT WALKWAY DRAINING AND UNCOVERED BALCONIES - UNCONTOLLED
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 05:204    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .03          .00
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=      1.50          .10
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=     74.10        25.63
               over (min)        1.00         1.00
     Storage Coeff.  (min)=      .21 (ii)     .54 (ii)
     Unit Hyd. Tpeak (min)=     1.00         1.00
     Unit Hyd. peak  (cms)=     1.69         1.43
                                                    *TOTALS*
     PEAK FLOW       (cms)=      .01          .00        .006 (iii)
     TIME TO PEAK    (hrs)=     1.22         1.33       1.333
     RUNOFF VOLUME    (mm)=    34.06        10.20      33.824
     TOTAL RAINFALL   (mm)=    35.06        35.06      35.063
     RUNOFF COEFFICIENT   =      .97          .29        .965

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
002:0010------------------------------------------------------------------------
*#*********************************************************************|
*# TOTAL UNCONTROLLED FLOW - 201+202+203+204 (NO CONTROLS)
----------------------
| ADD HYD (UNCON     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 02:201           .12      .024    1.33  33.82    .000
                       +ID2 03:202           .17      .033    1.33  32.87    .000
                       +ID3 04:203           .06      .002    1.42  10.20    .000
                       +ID4 05:204           .03      .006    1.33  33.82    .000
                        ========================================================
                        SUM 06:UNCON         .38      .065    1.33  29.50    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
002:0011------------------------------------------------------------------------
*# TOTAL FLOW TO UNDERGROUND STORAGE - 201(with roof controls)+ 202 + 203
----------------------
| ADD HYD (CONT      ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 07:SWM           .12      .005    1.53  33.82    .000
                       +ID2 08:RF-OFL        .00      .000     .00    .00    .000
                       +ID3 03:202           .17      .033    1.33  32.87    .000
                       +ID4 04:203           .06      .002    1.42  10.20    .000
                        ========================================================
                        SUM 09:CONT          .35      .039    1.33  29.13    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
002:0012------------------------------------------------------------------------
*# ROUTE FLOWS THROUGH UNDERGROUND STOARGE TANKS
*
----------------------
| ROUTE RESERVOIR    |   Requested routing time step =  1.0 min.
|  IN>09:(CONT  )    |
| OUT<01:(SWM   )    |   =========  OUTLFOW STORAGE TABLE  =========
----------------------   OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)  |   (cms)    (ha.m.)
                           .000  .0000E+00    |    .022  .4900E-02
                           .012  .0000E+00    |    .024  .5900E-02
                           .014  .1000E-02    |    .025  .6900E-02
                           .017  .2000E-02    |    .027  .7900E-02
                           .019  .3000E-02    |    .028  .8900E-02
                           .021  .4000E-02    |    .029  .9500E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (CONT  )        .35      .039     1.333     29.131
     OUTFLOW<01: (SWM   )        .35      .016     1.517     29.177
    OVERFLOW<02: (OFL   )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   40.544
                    TIME SHIFT OF PEAK FLOW          (min)=    11.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1495E-02

------------------------------------------------------------------------------
002:0013------------------------------------------------------------------------
*# TOTAL SITE DISCHARGE - CONTROLLED + UNCONTROLLED
*# SWM TANK DISCHARGE + CATCHMENT 204
----------------------
| ADD HYD (TOTAL     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 01:SWM           .35      .016    1.52  29.18    .000
                       +ID2 02:OFL           .00      .000     .00    .00    .000
                       +ID3 05:204           .03      .006    1.33  33.82    .000
                        ========================================================
                        SUM 10:TOTAL         .38      .021    1.33  29.54    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
002:0014------------------------------------------------------------------------
*
*
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*
  ** END OF RUN :   4

*********************************************************************************




----------------------
| START              |  Project  dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
----------------------  Rainfall dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
    TZERO =    .00 hrs on        0
    METOUT=    2 (output = METRIC)
    NRUN  = 005
    NSTORM=    1
           #  1=MHP4_005.STM
------------------------------------------------------------------------------
005:0002------------------------------------------------------------------------
*#*********************************************************************|
*#  Project Name: 2481 BARTON STREET EAST
*#               HAMILTON, ONTARIO
*#  JOB NUMBER  : 2021-0171-10
*#       Date   : AUGUST 2022
*#    Revised   :
*#    Company   : WALTER FEDY
*#       File   : 21-0171A.DAT
*#*********************************************************************|
*
------------------------------------------------------------------------------
005:0002------------------------------------------------------------------------
*
----------------------
| READ STORM         |    Filename: 5-YR MT. HOPE (A=1049.5 B=8 C=0.803)
| Ptotal=  50.14 mm  |    Comments: 5-YR MT. HOPE (A=1049.5 B=8 C=0.803)
----------------------
            TIME    RAIN  |  TIME    RAIN  |  TIME    RAIN  |  TIME    RAIN
             hrs   mm/hr  |   hrs   mm/hr  |   hrs   mm/hr  |   hrs   mm/hr
             .17   3.196  |  1.17  28.027  |  2.17   8.084  |  3.17   3.885
             .33   3.691  |  1.33 103.038  |  2.33   6.801  |  3.33   3.593
             .50   4.393  |  1.50  36.919  |  2.50   5.885  |  3.50   3.344
             .67   5.470  |  1.67  19.516  |  2.67   5.198  |  3.67   3.130
             .83   7.347  |  1.83  13.211  |  2.83   4.664  |  3.83   2.945
            1.00  11.470  |  2.00  10.009  |  3.00   4.236  |  4.00   2.782

------------------------------------------------------------------------------
005:0003------------------------------------------------------------------------
*
*#*********************************************************************|
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#*********************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS
*#
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .38
| 01:101    DT=10.00 |   Total Imp(%)=   30.00   Dir. Conn.(%)=    1.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .11          .26
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=     25.00        25.00
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=    103.04        65.87
               over (min)       10.00        10.00
```

```
     Storage Coeff.  (min)=       .97 (ii)    7.26 (ii)
     Unit Hyd. Tpeak (min)=     10.00        10.00
     Unit Hyd. peak  (cms)=       .17          .13
                                                *TOTALS*
     PEAK FLOW       (cms)=       .00          .04          .038 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     49.14        24.27        24.523
     TOTAL RAINFALL   (mm)=     50.14        50.14        50.139
     RUNOFF COEFFICIENT   =       .98          .48          .489
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
005:0004---------------------------------------------------------------------
*#*************************************************************************|
*# TOTAL PRE-DEVELOPMENT FLOW
----------------------
| ADD HYD (PRE      ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 01:101           .38      .038    1.33  24.52    .000
                       ==========================================================
                       SUM 02:PRE           .00      .000     .00    .00    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
005:0005---------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#*************************************************************************|
*# CATCHMENT 201 - FUTURE BUIDLING ROOF
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .12
| 02:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .12          .00
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      1.00         2.00
     Length            (m)=     15.00          .10
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=    103.04        47.39
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .88 (ii)    1.14 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.15          .99
                                                *TOTALS*
     PEAK FLOW       (cms)=       .03          .00          .034 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     49.14        19.42        48.842
     TOTAL RAINFALL   (mm)=     50.14        50.14        50.139
     RUNOFF COEFFICIENT   =       .98          .39          .974

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
005:0006---------------------------------------------------------------------
*#*************************************************************************|
*# ROOF TOP CONTROL DRAINS - ASSUME 11 ROOF DRAINS @ 0.38 L/S/inch of head
*
----------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>02:(201   )    |
| OUT<07:(SWM   )    |     =========  OUTLFOW STORAGE TABLE  =========
----------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .017  .7200E-02
                             .008  .3600E-02    |     .025  .1080E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (201   )        .12      .034     1.333     48.842
     OUTFLOW<07: (SWM   )        .12      .007     1.533     48.841
    OVERFLOW<08: (RF-OFL)        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   20.690
                  TIME SHIFT OF PEAK FLOW          (min)=    12.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.3018E-02

-------------------------------------------------------------------------------
005:0007---------------------------------------------------------------------
*#*************************************************************************|
*# CATCHMENT 202 - PARKING AND DRIVEWAY SURFACE AND BALCONIES
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 03:202    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .16          .01
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=     30.00         5.00
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=    103.04        43.83
               over (min)        1.00         4.00
     Storage Coeff.  (min)=      1.08 (ii)    3.90 (ii)
     Unit Hyd. Tpeak (min)=      1.00         4.00
     Unit Hyd. peak  (cms)=      1.02          .29
                                                *TOTALS*
     PEAK FLOW       (cms)=       .05          .00          .046 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.35         1.333
     RUNOFF VOLUME    (mm)=     49.14        19.42        47.653
     TOTAL RAINFALL   (mm)=     50.14        50.14        50.139
     RUNOFF COEFFICIENT   =       .98          .39          .950

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
005:0008---------------------------------------------------------------------
*#*************************************************************************|
*# CATCHMENT 203 - AMENITY AREA AND LANDSCAPE STRIP AROUND PERIMITER OF SITE
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .06   Curve Number   (CN)=80.00
| 04:203    DT= 1.00 |   Ia      (mm)=   4.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .110

     Unit Hyd Qpeak  (cms)=     .022

     PEAK FLOW       (cms)=     .005 (i)
     TIME TO PEAK    (hrs)=    1.400
     RUNOFF VOLUME    (mm)=   19.413
     TOTAL RAINFALL   (mm)=   50.139
     RUNOFF COEFFICIENT   =     .387

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
005:0009---------------------------------------------------------------------
*# CATCHMENT 204 - FRONT WALKWAY DRAINING AND UNCOVERED BALCONIES - UNCONTOLLED
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 05:204    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .03          .00
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=      1.50          .10
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=    103.04        47.39
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .18 (ii)     .44 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.69         1.52
                                                *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .008 (iii)
     TIME TO PEAK    (hrs)=      1.22         1.33         1.333
     RUNOFF VOLUME    (mm)=     49.14        19.41        48.842
     TOTAL RAINFALL   (mm)=     50.14        50.14        50.139
     RUNOFF COEFFICIENT   =       .98          .39          .974

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
005:0010---------------------------------------------------------------------
*#*************************************************************************|
*# TOTAL UNCONTROLLED FLOW - 201+202+203+204 (NO CONTROLS)
----------------------
| ADD HYD (UNCON     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 02:201           .12      .034    1.33  48.84    .000
                      +ID2 03:202           .17      .046    1.33  47.65    .000
                      +ID3 04:203           .06      .005    1.40  19.41    .000
                      +ID4 05:204           .03      .008    1.33  48.84    .000
                       ==========================================================
                       SUM 06:UNCON         .38      .092    1.33  43.45    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
005:0011---------------------------------------------------------------------
*# TOTAL FLOW TO UNDERGROUND STORAGE - 201(with roof controls)+ 202 + 203
----------------------
| ADD HYD (CONT      ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 07:SWM           .12      .007    1.53  48.84    .000
                      +ID2 08:RF-OFL        .00      .000     .00    .00    .000
                      +ID3 03:202           .17      .046    1.33  47.65    .000
                      +ID4 04:203           .06      .005    1.40  19.41    .000
                       ==========================================================
                       SUM 09:CONT          .35      .055    1.33  43.00    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
005:0012---------------------------------------------------------------------
*# ROUTE FLOWS THROUGH UNDERGROUND STOARGE TANKS
*
----------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>09:(CONT  )    |
| OUT<01:(SWM   )    |     =========  OUTLFOW STORAGE TABLE  =========
----------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                             .000  .0000E+00    |     .022  .4900E-02
                             .012  .0000E+00    |     .024  .5900E-02
                             .014  .1000E-02    |     .025  .6900E-02
                             .017  .2000E-02    |     .027  .7900E-02
                             .019  .3000E-02    |     .028  .8900E-02
```

```
                          .021  .4000E-02   |     .029  .9500E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (CONT  )        .35      .055     1.333     42.996
     OUTFLOW<01: (SWM   )        .35      .019     1.633     43.010
    OVERFLOW<02: (OFL   )        .00      .000      .000      .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   33.775
                   TIME SHIFT OF PEAK FLOW          (min)=    18.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2954E-02

--------------------------------------------------------------------------------
005:0013----------------------------------------------------------------------
*# TOTAL SITE DISCHARGE - CONTROLLED + UNCONTROLLED
*# SWM TANK DISCHARGE + CATCHMENT 204
---------------------
| ADD HYD (TOTAL     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                      (ha)     (cms)   (hrs)   (mm)    (cms)
                       ID1 01:SWM            .35      .019   1.63  43.01    .000
                      +ID2 02:OFL            .00      .000    .00    .00    .000
                      +ID3 05:204            .03      .008   1.33  48.84    .000
                       ==========================================================
                       SUM 10:TOTAL          .38      .025   1.33  43.46    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
005:0014----------------------------------------------------------------------
*
*
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*
--------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*
  ** END OF RUN :   9

********************************************************************************




---------------------
| START             |  Project  dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
---------------------  Rainfall dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 010
    NSTORM=   1
          #  1=MHP4_010.STM
--------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 2481 BARTON STREET EAST
*#                HAMILTON, ONTARIO
*#  JOB NUMBER  : 2021-0171-10
*#       Date   : AUGUST 2022
*#    Revised   :
*#    Company   : WALTER FEDY
*#       File   : 21-0171A.DAT
*#*****************************************************************************|
*
--------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*
---------------------
| READ STORM        |    Filename: 10-YR MT. HOPE (A=1343.7 B=9 C=0.814)
| Ptotal=  60.22 mm |    Comments: 10-YR MT. HOPE (A=1343.7 B=9 C=0.814)
---------------------
            TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
             hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
             .17   3.725 |  1.17  34.487 |  2.17   9.714 |  3.17   4.557
             .33   4.322 |  1.33 122.292 |  2.33   8.126 |  3.33   4.203
             .50   5.173 |  1.50  45.465 |  2.50   6.998 |  3.50   3.903
             .67   6.489 |  1.67  23.981 |  2.67   6.156 |  3.67   3.646
             .83   8.802 |  1.83  16.104 |  2.83   5.503 |  3.83   3.423
            1.00  13.931 |  2.00  12.108 |  3.00   4.982 |  4.00   3.228

--------------------------------------------------------------------------------
010:0003----------------------------------------------------------------------
*
*#*****************************************************************************|
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#*****************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS
*#
---------------------
| CALIB STANDHYD    |   Area    (ha)=     .38
| 01:101    DT=10.00|   Total Imp(%)=   30.00   Dir. Conn.(%)=    1.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .11          .26
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=     25.00        25.00
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=    122.29        88.57
               over (min)        10.00        10.00
     Storage Coeff.  (min)=      .91 (ii)    6.50 (ii)
     Unit Hyd. Tpeak (min)=     10.00        10.00
     Unit Hyd. peak  (cms)=       .17          .13
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .00          .05          .054 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     59.22        32.20        32.470
     TOTAL RAINFALL   (mm)=     60.22        60.22        60.219

     RUNOFF COEFFICIENT   =       .98          .53          .539
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
010:0004----------------------------------------------------------------------
*#*****************************************************************************|
*# TOTAL PRE-DEVELOPMENT FLOW
-----------------------
| ADD HYD (PRE        ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                     (ha)     (cms)   (hrs)   (mm)    (cms)
                        ID1 01:101            .38      .054    1.33  32.47    .000
                        ========================================================
                        SUM 02:PRE            .00      .000     .00    .00    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
010:0005----------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#*****************************************************************************|
*# CATCHMENT 201 - FUTURE BUIDLING ROOF
*
---------------------
| CALIB STANDHYD    |   Area    (ha)=     .12
| 02:201    DT= 1.00|   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .12          .00
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      1.00         2.00
     Length            (m)=     15.00          .10
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=    122.29        63.62
               over (min)        1.00         1.00
     Storage Coeff.  (min)=      .82 (ii)    1.06 (ii)
     Unit Hyd. Tpeak (min)=     1.00         1.00
     Unit Hyd. peak  (cms)=     1.20         1.04
                                                    *TOTALS*
     PEAK FLOW       (cms)=      .04          .00          .040 (iii)
     TIME TO PEAK    (hrs)=     1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=    59.22        26.40        58.891
     TOTAL RAINFALL   (mm)=    60.22        60.22        60.219
     RUNOFF COEFFICIENT   =      .98          .44          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
010:0006----------------------------------------------------------------------
*#*****************************************************************************|
*# ROOF TOP CONTROL DRAINS - ASSUME 11 ROOF DRAINS @ 0.38 L/S/inch of head
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>02:(201   )   |
| OUT<07:(SWM   )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------   OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                          .000  .0000E+00    |     .017  .7200E-02
                          .008  .3600E-02    |     .025  .1080E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (201   )        .12      .040     1.333     58.891
     OUTFLOW<07: (SWM   )        .12      .008     1.533     58.891
    OVERFLOW<08: (RF-OFL)        .00      .000      .000      .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.034
                   TIME SHIFT OF PEAK FLOW          (min)=    12.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3644E-02

--------------------------------------------------------------------------------
010:0007----------------------------------------------------------------------
*#*****************************************************************************|
*# CATCHMENT 202 - PARKING AND DRIVEWAY SURFACE AND BALCONIES
*
---------------------
| CALIB STANDHYD    |   Area    (ha)=     .17
| 03:202    DT= 1.00|   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
---------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .16          .01
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=     30.00         5.00
     Mannings n            =      .015         .250

     Max.eff.Inten.(mm/hr)=    122.29        60.86
               over (min)        1.00         3.00
     Storage Coeff.  (min)=     1.01 (ii)    3.49 (ii)
     Unit Hyd. Tpeak (min)=     1.00         3.00
     Unit Hyd. peak  (cms)=     1.07          .34
                                                    *TOTALS*
     PEAK FLOW       (cms)=      .05          .00          .055 (iii)
     TIME TO PEAK    (hrs)=     1.33         1.35         1.333
     RUNOFF VOLUME    (mm)=    59.22        26.40        57.578
     TOTAL RAINFALL   (mm)=    60.22        60.22        60.219
```

```
     RUNOFF COEFFICIENT   =        .98          .44          .956

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
010:0008------------------------------------------------------------------------
*#*********************************************************************|
*# CATCHMENT 203 - AMENITY AREA AND LANDSCAPE STRIP AROUND PERIMITER OF SITE
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .06   Curve Number   (CN)=80.00
| 04:203    DT= 1.00 |   Ia      (mm)=   4.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .110

     Unit Hyd Qpeak  (cms)=     .022

     PEAK FLOW       (cms)=     .007 (i)
     TIME TO PEAK    (hrs)=    1.400
     RUNOFF VOLUME    (mm)=   26.397
     TOTAL RAINFALL   (mm)=   60.219
     RUNOFF COEFFICIENT   =     .438

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
010:0009------------------------------------------------------------------------
*# CATCHMENT 204 - FRONT WALKWAY DRAINING AND UNCOVERED BALCONIES - UNCONTOLLED
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 05:204    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------

                         IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .03          .00
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=      1.50          .10
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    122.29        63.62
               over (min)        1.00         1.00
     Storage Coeff.  (min)=      .17 (ii)     .40 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.69         1.56
                                                        *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .010 (iii)
     TIME TO PEAK    (hrs)=      1.28         1.33         1.333
     RUNOFF VOLUME    (mm)=     59.22        26.40        58.891
     TOTAL RAINFALL   (mm)=     60.22        60.22        60.219
     RUNOFF COEFFICIENT   =       .98          .44          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
010:0010------------------------------------------------------------------------
*#*********************************************************************|
*# TOTAL UNCONTROLLED FLOW - 201+202+203+204 (NO CONTROLS)
-------------------------
| ADD HYD (UNCON     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-------------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 02:201          .12      .040   1.33  58.89    .000
                       +ID2 03:202          .17      .055   1.33  57.58    .000
                       +ID3 04:203          .06      .007   1.40  26.40    .000
                       +ID4 05:204          .03      .010   1.33  58.89    .000
                        ========================================================
                        SUM 06:UNCON        .38      .110   1.33  52.94    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
010:0011------------------------------------------------------------------------
*# TOTAL FLOW TO UNDERGROUND STORAGE - 201(with roof controls)+ 202 + 203
-------------------------
| ADD HYD (CONT      ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-------------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 07:SWM          .12      .008   1.53  58.89    .000
                       +ID2 08:RF-OFL       .00      .000    .00    .00    .000
                       +ID3 03:202          .17      .055   1.33  57.58    .000
                       +ID4 04:203          .06      .007   1.40  26.40    .000
                        ========================================================
                        SUM 09:CONT         .35      .067   1.33  52.44    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
010:0012------------------------------------------------------------------------
*# ROUTE FLOWS THROUGH UNDERGROUND STOARGE TANKS
*
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>09:(CONT  )   |
| OUT<01:(SWM   )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)  |    (cms)    (ha.m.)
                           .000  .0000E+00    |     .022  .4900E-02
                           .012  .0000E+00    |     .024  .5900E-02
                           .014  .1000E-02    |     .025  .6900E-02
                           .017  .2000E-02    |     .027  .7900E-02
                           .019  .3000E-02    |     .028  .8900E-02
                           .021  .4000E-02    |     .029  .9500E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (CONT  )        .35      .067     1.333     52.436
     OUTFLOW<01: (SWM   )        .35      .021     1.683     52.472
    OVERFLOW<02: (OFL   )        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   31.257
                  TIME SHIFT OF PEAK FLOW          (min)=    21.00
                  MAXIMUM  STORAGE   USED        (ha.m.)=.4170E-02

------------------------------------------------------------------------------
010:0013------------------------------------------------------------------------
*# TOTAL SITE DISCHARGE - CONTROLLED + UNCONTROLLED
*# SWM TANK DISCHARGE + CATCHMENT 204
-------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-------------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 01:SWM          .35      .021   1.68  52.47    .000
                       +ID2 02:OFL          .00      .000    .00    .00    .000
                       +ID3 05:204          .03      .010   1.33  58.89    .000
                        ========================================================
                        SUM 10:TOTAL        .38      .028    1.33  52.97    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
010:0014------------------------------------------------------------------------
*
*
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*
------------------------------------------------------------------------------
010:0002------------------------------------------------------------------------
*
------------------------------------------------------------------------------
010:0002------------------------------------------------------------------------
*
  ** END OF RUN :  24

********************************************************************************




---------------------
| START             |  Project  dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
--------------------  Rainfall dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 025
    NSTORM=   1
          #  1=MHP4_025.STM
------------------------------------------------------------------------------
025:0002------------------------------------------------------------------------
*#*********************************************************************|
*#  Project Name: 2481 BARTON STREET EAST
*#               HAMILTON, ONTARIO
*#  JOB NUMBER  : 2021-0171-10
*#       Date   : AUGUST 2022
*#    Revised   :
*#    Company   : WALTER FEDY
*#       File   : 21-0171A.DAT
*#*********************************************************************|
*
------------------------------------------------------------------------------
025:0002------------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 25-YR MT. HOPE (A=1719.5 B=10 C=0.823)
| Ptotal=  73.09 mm|    Comments: 25-YR MT. HOPE (A=1719.5 B=10 C=0.823)
--------------------
            TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
             hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
             .17   4.422 |  1.17  42.745 |  2.17  11.847 |  3.17   5.440
             .33   5.152 |  1.33 146.101 |  2.33   9.863 |  3.33   5.006
             .50   6.198 |  1.50  56.322 |  2.50   8.458 |  3.50   4.639
             .67   7.827 |  1.67  29.752 |  2.67   7.413 |  3.67   4.326
             .83  10.708 |  1.83  19.870 |  2.83   6.605 |  3.83   4.055
            1.00  17.140 |  2.00  14.849 |  3.00   5.963 |  4.00   3.818

------------------------------------------------------------------------------
025:0003------------------------------------------------------------------------
*
*#*********************************************************************|
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#*********************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS
*#
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .38
| 01:101    DT=10.00 |   Total Imp(%)=   30.00   Dir. Conn.(%)=    1.00
----------------------

                         IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .11          .26
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=     25.00        25.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    146.10       118.82
               over (min)       10.00        10.00
     Storage Coeff.  (min)=       .85 (ii)    5.81 (ii)
     Unit Hyd. Tpeak (min)=     10.00        10.00
     Unit Hyd. peak  (cms)=       .17          .14
                                                        *TOTALS*
     PEAK FLOW       (cms)=       .00          .07          .075 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     72.09        42.86        43.157
     TOTAL RAINFALL   (mm)=     73.09        73.09        73.086
     RUNOFF COEFFICIENT   =       .99          .59          .590
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
```

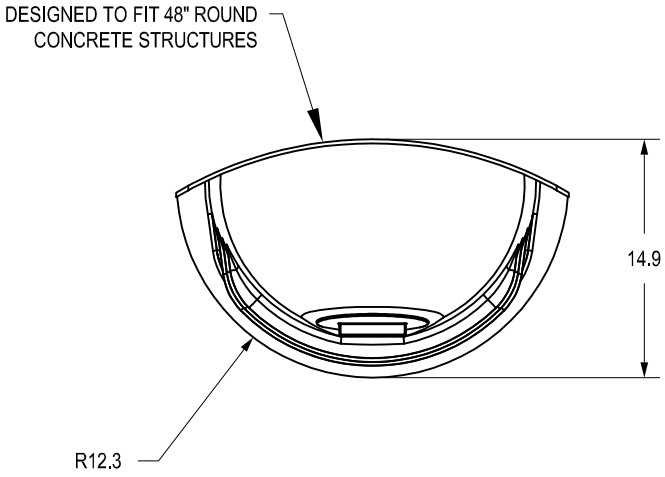
```
          CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
025:0004------------------------------------------------------------------------
*#*************************************************************************|
*# TOTAL PRE-DEVELOPMENT FLOW
----------------------
| ADD HYD (PRE      ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                    (ha)     (cms)   (hrs)   (mm)    (cms)
                       ID1 01:101           .38      .075    1.33  43.16    .000
                       ==========================================================
                       SUM 02:PRE           .00      .000     .00    .00    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
025:0005------------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#*************************************************************************|
*# CATCHMENT 201 - FUTURE BUIDLING ROOF
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .12
| 02:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .12          .00
     Dep. Storage     (mm)=       1.00         4.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=      15.00          .10
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=     146.10        85.16
               over (min)          1.00         1.00
     Storage Coeff.  (min)=        .77 (ii)     .97 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.24         1.09
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .05          .00          .048 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=      72.09        36.00        71.725
     TOTAL RAINFALL   (mm)=      73.09        73.09        73.086
     RUNOFF COEFFICIENT   =        .99          .49          .981

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
025:0006------------------------------------------------------------------------
*#*************************************************************************|
*# ROOF TOP CONTROL DRAINS - ASSUME 11 ROOF DRAINS @ 0.38 L/S/inch of head
*
----------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>02:(201   )    |
| OUT<07:(SWM   )    |     =========  OUTLFOW STORAGE TABLE  =========
----------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                              .000  .0000E+00   |     .017  .7200E-02
                              .008  .3600E-02   |     .025  .1080E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     ---------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (201   )         .12      .048     1.333     71.725
     OUTFLOW<07: (SWM   )         .12      .010     1.533     71.725
    OVERFLOW<08: (RF-OFL)         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.403
                    TIME SHIFT OF PEAK FLOW         (min)=    12.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4433E-02

------------------------------------------------------------------------------
025:0007------------------------------------------------------------------------
*#*************************************************************************|
*# CATCHMENT 202 - PARKING AND DRIVEWAY SURFACE AND BALCONIES
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 03:202    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .16          .01
     Dep. Storage     (mm)=       1.00         4.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      30.00         5.00
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=     146.10        81.95
               over (min)          1.00         3.00
     Storage Coeff.  (min)=        .94 (ii)    3.14 (ii)
     Unit Hyd. Tpeak (min)=       1.00         3.00
     Unit Hyd. peak  (cms)=       1.11          .36
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .06          .00          .065 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.35         1.333
     RUNOFF VOLUME    (mm)=      72.09        36.00        70.282
     TOTAL RAINFALL   (mm)=      73.09        73.09        73.086
     RUNOFF COEFFICIENT   =        .99          .49          .962

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
025:0008------------------------------------------------------------------------
*#*************************************************************************|
*# CATCHMENT 203 - AMENITY AREA AND LANDSCAPE STRIP AROUND PERIMITER OF SITE
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .06   Curve Number   (CN)=80.00
| 04:203    DT= 1.00 |   Ia      (mm)=   4.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .110

     Unit Hyd Qpeak  (cms)=     .022

     PEAK FLOW       (cms)=     .009 (i)
     TIME TO PEAK    (hrs)=    1.400
     RUNOFF VOLUME    (mm)=   35.996
     TOTAL RAINFALL   (mm)=   73.086
     RUNOFF COEFFICIENT   =     .493

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
025:0009------------------------------------------------------------------------
*# CATCHMENT 204 - FRONT WALKWAY DRAINING AND UNCOVERED BALCONIES - UNCONTOLLED
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 05:204    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .03          .00
     Dep. Storage     (mm)=       1.00         4.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=       1.50          .10
     Mannings n           =       .015         .250

     Max.eff.Inten.(mm/hr)=     146.10        85.16
               over (min)          1.00         1.00
     Storage Coeff.  (min)=        .16 (ii)     .36 (ii)
     Unit Hyd. Tpeak (min)=       1.00         1.00
     Unit Hyd. peak  (cms)=       1.70         1.59
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .012 (iii)
     TIME TO PEAK    (hrs)=       1.22         1.33         1.333
     RUNOFF VOLUME    (mm)=      72.09        36.00        71.726
     TOTAL RAINFALL   (mm)=      73.09        73.09        73.086
     RUNOFF COEFFICIENT   =        .99          .49          .981

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
025:0010------------------------------------------------------------------------
*#*************************************************************************|
*# TOTAL UNCONTROLLED FLOW - 201+202+203+204 (NO CONTROLS)
----------------------
| ADD HYD (UNCON     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                    (ha)     (cms)   (hrs)   (mm)    (cms)
                       ID1 02:201           .12      .048    1.33  71.73    .000
                      +ID2 03:202           .17      .065    1.33  70.28    .000
                      +ID3 04:203           .06      .009    1.40  36.00    .000
                      +ID4 05:204           .03      .012    1.33  71.73    .000
                       ==========================================================
                       SUM 06:UNCON         .38      .133    1.33  65.18    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
025:0011------------------------------------------------------------------------
*# TOTAL FLOW TO UNDERGROUND STORAGE - 201(with roof controls)+ 202 + 203
----------------------
| ADD HYD (CONT      ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                    (ha)     (cms)   (hrs)   (mm)    (cms)
                       ID1 07:SWM           .12      .010    1.53  71.73    .000
                      +ID2 08:RF-OFL        .00      .000     .00    .00    .000
                      +ID3 03:202           .17      .065    1.33  70.28    .000
                      +ID4 04:203           .06      .009    1.40  36.00    .000
                       ==========================================================
                       SUM 09:CONT          .35      .081    1.33  64.63    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
025:0012------------------------------------------------------------------------
*# ROUTE FLOWS THROUGH UNDERGROUND STOARGE TANKS
*
----------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>09:(CONT  )    |
| OUT<01:(SWM   )    |     =========  OUTLFOW STORAGE TABLE  =========
----------------------     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                             (cms)    (ha.m.)   |    (cms)    (ha.m.)
                              .000  .0000E+00   |     .022  .4900E-02
                              .012  .0000E+00   |     .024  .5900E-02
                              .014  .1000E-02   |     .025  .6900E-02
                              .017  .2000E-02   |     .027  .7900E-02
                              .019  .3000E-02   |     .028  .8900E-02
                              .021  .4000E-02   |     .029  .9500E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     ---------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (CONT  )         .35      .081     1.333     64.628
     OUTFLOW<01: (SWM   )         .35      .024     1.717     64.653
    OVERFLOW<02: (OFL   )         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00
```

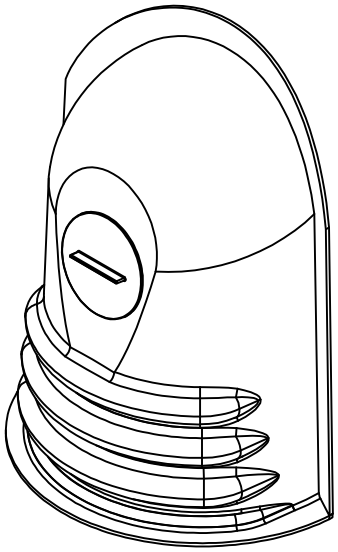
```
                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   29.082
                  TIME SHIFT OF PEAK FLOW          (min)=    23.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.5769E-02

------------------------------------------------------------------------------
025:0013----------------------------------------------------------------------
*# TOTAL SITE DISCHARGE - CONTROLLED + UNCONTROLLED
*# SWM TANK DISCHARGE + CATCHMENT 204
-----------------------
| ADD HYD (TOTAL     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 01:SWM            .35     .024    1.72  64.65    .000
                       +ID2 02:OFL            .00     .000     .00    .00    .000
                       +ID3 05:204            .03     .012    1.33  71.73    .000
                        ==========================================================
                        SUM 10:TOTAL          .38     .032    1.33  65.20    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
025:0014----------------------------------------------------------------------
*
*
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*
------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
------------------------------------------------------------------------------
025:0002----------------------------------------------------------------------
*
  ** END OF RUN :  49

********************************************************************************




--------------------
| START            |  Project  dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
--------------------  Rainfall dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 050
    NSTORM=   1
          #  1=MHP4_050.STM
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*#****************************************************************************|
*#  Project Name: 2481 BARTON STREET EAST
*#               HAMILTON, ONTARIO
*#  JOB NUMBER  : 2021-0171-10
*#       Date   : AUGUST 2022
*#    Revised   :
*#    Company   : WALTER FEDY
*#       File   : 21-0171A.DAT
*#****************************************************************************|
*
------------------------------------------------------------------------------
050:0002----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: 50-YR MT. HOPE (A=1954.8 B=10 C=0.826)
| Ptotal=  81.72 mm|    Comments: 50-YR MT. HOPE (A=1954.8 B=10 C=0.826)
--------------------
              TIME    RAIN  |   TIME    RAIN  |   TIME    RAIN  |   TIME    RAIN
               hrs   mm/hr  |    hrs   mm/hr  |    hrs   mm/hr  |    hrs   mm/hr
               .17   4.881  |   1.17  47.876  |   2.17  13.160  |   3.17   6.012
               .33   5.692  |   1.33 164.608  |   2.33  10.942  |   3.33   5.529
               .50   6.856  |   1.50  63.166  |   2.50   9.374  |   3.50   5.122
               .67   8.670  |   1.67  33.244  |   2.67   8.209  |   3.67   4.774
               .83  11.887  |   1.83  22.146  |   2.83   7.309  |   3.83   4.473
              1.00  19.086  |   2.00  16.518  |   3.00   6.594  |   4.00   4.210

------------------------------------------------------------------------------
050:0003----------------------------------------------------------------------
*
*#****************************************************************************|
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#****************************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS
*#
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .38
| 01:101    DT=10.00 |   Total Imp(%)=   30.00   Dir. Conn.(%)=    1.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .11           .26
     Dep. Storage     (mm)=       1.00          4.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=      25.00         25.00
     Mannings n            =       .015          .250

     Max.eff.Inten.(mm/hr)=     164.61        142.23
               over (min)        10.00         10.00
     Storage Coeff.  (min)=        .81 (ii)    5.43 (ii)
     Unit Hyd. Tpeak (min)=      10.00         10.00
     Unit Hyd. peak  (cms)=        .17           .14
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .00           .09          .092 (iii)
     TIME TO PEAK    (hrs)=       1.33          1.33         1.333
     RUNOFF VOLUME    (mm)=      80.72         50.28        50.585
     TOTAL RAINFALL   (mm)=      81.72         81.72        81.723
     RUNOFF COEFFICIENT   =        .99           .62          .619
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
050:0004----------------------------------------------------------------------
*#****************************************************************************|
*# TOTAL PRE-DEVELOPMENT FLOW
-----------------------
| ADD HYD (PRE       ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                        ID1 01:101            .38     .092    1.33  50.58    .000
                        ==========================================================
                        SUM 02:PRE            .00     .000     .00    .00    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
050:0005----------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#****************************************************************************|
*# CATCHMENT 201 - FUTURE BUIDLING ROOF
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .12
| 02:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .12           .00
     Dep. Storage     (mm)=       1.00          4.00
     Average Slope     (%)=       1.00          2.00
     Length            (m)=      15.00          .10
     Mannings n            =       .015          .250

     Max.eff.Inten.(mm/hr)=     164.61        102.10
               over (min)        1.00          1.00
     Storage Coeff.  (min)=        .73 (ii)     .92 (ii)
     Unit Hyd. Tpeak (min)=       1.00          1.00
     Unit Hyd. peak  (cms)=       1.27          1.12
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .05           .00          .054 (iii)
     TIME TO PEAK    (hrs)=       1.33          1.33         1.333
     RUNOFF VOLUME    (mm)=      80.72         42.78        80.343
     TOTAL RAINFALL   (mm)=      81.72         81.72        81.723
     RUNOFF COEFFICIENT   =        .99           .52          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
050:0006----------------------------------------------------------------------
*#****************************************************************************|
*# ROOF TOP CONTROL DRAINS - ASSUME 11 ROOF DRAINS @ 0.38 L/S/inch of head
*
----------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>02:(201   )    |
| OUT<07:(SWM   )    |    =========  OUTLFOW STORAGE TABLE  =========
----------------------    OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                            (cms)    (ha.m.)  |    (cms)    (ha.m.)
                             .000  .0000E+00  |     .017  .7200E-02
                             .008  .3600E-02  |     .025  .1080E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------           (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (201   )        .12      .054     1.333     80.343
     OUTFLOW<07: (SWM   )        .12      .012     1.533     80.343
    OVERFLOW<08: (RF-OFL)        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.348
                    TIME SHIFT OF PEAK FLOW          (min)=    12.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.4983E-02

------------------------------------------------------------------------------
050:0007----------------------------------------------------------------------
*#****************************************************************************|
*# CATCHMENT 202 - PARKING AND DRIVEWAY SURFACE AND BALCONIES
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 03:202    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .16           .01
     Dep. Storage     (mm)=       1.00          4.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=      30.00          5.00
     Mannings n            =       .015          .250

     Max.eff.Inten.(mm/hr)=     164.61         98.53
               over (min)        1.00          3.00
     Storage Coeff.  (min)=        .90 (ii)     2.94 (ii)
     Unit Hyd. Tpeak (min)=       1.00          3.00
     Unit Hyd. peak  (cms)=       1.14           .38
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .07           .00          .074 (iii)
     TIME TO PEAK    (hrs)=       1.33          1.33         1.333
     RUNOFF VOLUME    (mm)=      80.72         42.78        78.825
     TOTAL RAINFALL   (mm)=      81.72         81.72        81.723
     RUNOFF COEFFICIENT   =        .99           .52          .965

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

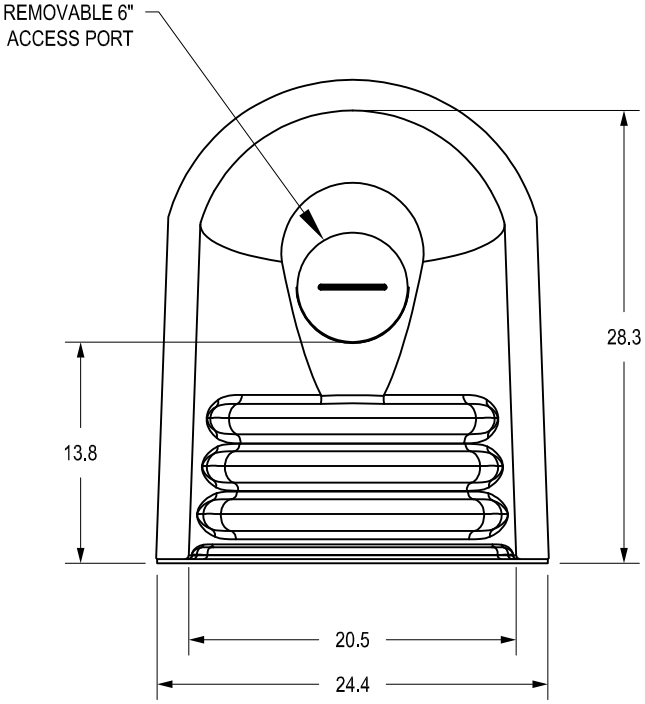
```
050:0008----------------------------------------------------------------------
*#*********************************************************************|
*# CATCHMENT 203 - AMENITY AREA AND LANDSCAPE STRIP AROUND PERIMITER OF SITE
*
---------------------
| CALIB NASHYD      |   Area    (ha)=     .06   Curve Number   (CN)=80.00
| 04:203    DT= 1.00|   Ia      (mm)=   4.000   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .110

     Unit Hyd Qpeak  (cms)=     .022

     PEAK FLOW       (cms)=     .011 (i)
     TIME TO PEAK    (hrs)=    1.400
     RUNOFF VOLUME    (mm)=   42.772
     TOTAL RAINFALL   (mm)=   81.723
     RUNOFF COEFFICIENT   =     .523

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

050:0009----------------------------------------------------------------------
*# CATCHMENT 204 - FRONT WALKWAY DRAINING AND UNCOVERED BALCONIES - UNCONTOLLED
*
---------------------
| CALIB STANDHYD    |   Area    (ha)=     .03
| 05:204    DT= 1.00|   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
---------------------

                        IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .03          .00
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=      1.50          .10
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    164.61       102.10
               over (min)        1.00         1.00
     Storage Coeff.  (min)=      .15 (ii)     .34 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.70         1.61
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .013 (iii)
     TIME TO PEAK    (hrs)=      1.22         1.33         1.333
     RUNOFF VOLUME    (mm)=     80.72        42.77        80.344
     TOTAL RAINFALL   (mm)=     81.72        81.72        81.723
     RUNOFF COEFFICIENT   =       .99          .52          .983

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

050:0010----------------------------------------------------------------------
*#*********************************************************************|
*# TOTAL UNCONTROLLED FLOW - 201+202+203+204 (NO CONTROLS)
-----------------------
| ADD HYD (UNCON    ) | ID: NHYD        AREA    QPEAK   TPEAK   R.V.    DWF
-----------------------                 (ha)    (cms)   (hrs)   (mm)   (cms)
                       ID1 02:201         .12     .054    1.33  80.34    .000
                      +ID2 03:202         .17     .074    1.33  78.83    .000
                      +ID3 04:203         .06     .011    1.40  42.77    .000
                      +ID4 05:204         .03     .013    1.33  80.34    .000
                       ==========================================================
                       SUM 06:UNCON       .38     .150    1.33  73.46    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

050:0011----------------------------------------------------------------------
*# TOTAL FLOW TO UNDERGROUND STORAGE - 201(with roof controls)+ 202 + 203
-----------------------
| ADD HYD (CONT     ) | ID: NHYD        AREA    QPEAK   TPEAK   R.V.    DWF
-----------------------                 (ha)    (cms)   (hrs)   (mm)   (cms)
                       ID1 07:SWM         .12     .012    1.53  80.34    .000
                      +ID2 08:RF-OFL      .00     .000     .00    .00    .000
                      +ID3 03:202         .17     .074    1.33  78.83    .000
                      +ID4 04:203         .06     .011    1.40  42.77    .000
                       ==========================================================
                       SUM 09:CONT        .35     .093    1.33  72.88    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

050:0012----------------------------------------------------------------------
*# ROUTE FLOWS THROUGH UNDERGROUND STOARGE TANKS
*
---------------------
| ROUTE RESERVOIR   |     Requested routing time step =  1.0 min.
|  IN>09:(CONT  )   |
| OUT<01:(SWM   )   |     =========  OUTLFOW STORAGE TABLE  =========
---------------------     OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                            (cms)     (ha.m.)  |    (cms)     (ha.m.)
                            .000  .0000E+00    |     .022  .4900E-02
                            .012  .0000E+00    |     .024  .5900E-02
                            .014  .1000E-02    |     .025  .6900E-02
                            .017  .2000E-02    |     .027  .7900E-02
                            .019  .3000E-02    |     .028  .8900E-02
                            .021  .4000E-02    |     .029  .9500E-02

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     ---------------            (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (CONT  )        .35      .093     1.333     72.880
     OUTFLOW<01: (SWM   )        .35      .025     1.767     72.906
    OVERFLOW<02: (OFL   )        .00      .000      .000      .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =       0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=     .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=     .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   27.370
                    TIME SHIFT OF PEAK FLOW         (min)=   26.00

                    MAXIMUM  STORAGE   USED       (ha.m.)=.6947E-02

050:0013----------------------------------------------------------------------
*# TOTAL SITE DISCHARGE - CONTROLLED + UNCONTROLLED
*# SWM TANK DISCHARGE + CATCHMENT 204
-----------------------
| ADD HYD (TOTAL    ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 01:SWM           .35      .025    1.77  72.91    .000
                      +ID2 02:OFL           .00      .000     .00    .00    .000
                      +ID3 05:204           .03      .013    1.33  80.34    .000
                       ==========================================================
                       SUM 10:TOTAL         .38      .035    1.33  73.48    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

050:0014----------------------------------------------------------------------
*
*
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*
050:0002----------------------------------------------------------------------
*
050:0002----------------------------------------------------------------------
*
050:0002----------------------------------------------------------------------
*
050:0002----------------------------------------------------------------------
*
  ** END OF RUN :  99

**********************************************************************************

---------------------
| START             |  Project  dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
---------------------  Rainfall dir.: C:\USERS\JORESK~1\DESKTOP\JOHNOW~1\2021-0~1
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
           #  1=MHP4_100.STM

100:0002----------------------------------------------------------------------
*#*********************************************************************|
*#  Project Name: 2481 BARTON STREET EAST
*#               HAMILTON, ONTARIO
*#  JOB NUMBER  : 2021-0171-10
*#       Date   : AUGUST 2022
*#    Revised   :
*#    Company   : WALTER FEDY
*#       File   : 21-0171A.DAT
*#*********************************************************************|
*
100:0002----------------------------------------------------------------------
*
---------------------
| READ STORM        |    Filename: 100-YR MT. HOPE (A=2317.4 B=11 C=0.836)
| Ptotal=  91.37 mm |    Comments: 100-YR MT. HOPE (A=2317.4 B=11 C=0.836)
---------------------
              TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
               .17   5.311 |  1.17  54.599 |  2.17  14.754 |  3.17   6.584
               .33   6.222 |  1.33 181.813 |  2.33  12.204 |  3.33   6.040
               .50   7.538 |  1.50  72.007 |  2.50  10.407 |  3.50   5.582
               .67   9.603 |  1.67  37.943 |  2.67   9.076 |  3.67   5.191
               .83  13.290 |  1.83  25.134 |  2.83   8.053 |  3.83   4.855
              1.00  21.597 |  2.00  18.629 |  3.00   7.242 |  4.00   4.561

100:0003----------------------------------------------------------------------
*
*#*********************************************************************|
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#*********************************************************************|
*# CATCHMENT 101 - EXISTING CONDITIONS
*#
---------------------
| CALIB STANDHYD    |   Area    (ha)=     .38
| 01:101    DT=10.00|   Total Imp(%)=   30.00   Dir. Conn.(%)=    1.00
---------------------

                        IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .11          .26
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=     25.00        25.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    181.81       165.98
               over (min)       10.00        10.00
     Storage Coeff.  (min)=       .77 (ii)    5.12 (ii)
     Unit Hyd. Tpeak (min)=      10.00        10.00
     Unit Hyd. peak  (cms)=       .17          .15
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .00          .11          .109 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     90.37        58.75        59.068
     TOTAL RAINFALL   (mm)=     91.37        91.37        91.372
     RUNOFF COEFFICIENT   =       .99          .64          .646
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
```

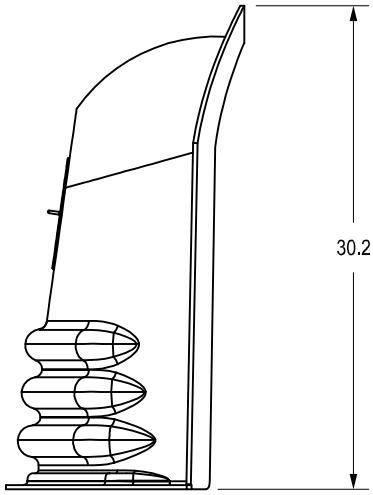
```
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
100:0004----------------------------------------------------------------------
*#*********************************************************************|
*# TOTAL PRE-DEVELOPMENT FLOW
----------------------
| ADD HYD (PRE      ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 01:101           .38      .109    1.33  59.07    .000
                       ==========================================================
                       SUM 02:PRE           .00      .000     .00    .00    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
100:0005----------------------------------------------------------------------
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#*********************************************************************|
*# CATCHMENT 201 - FUTURE BUIDLING ROOF
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .12
| 02:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .12          .00
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      1.00         2.00
     Length            (m)=     15.00          .10
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    181.81       118.93
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .70 (ii)     .88 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.29         1.15
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .06          .00          .060 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     90.37        50.59        89.974
     TOTAL RAINFALL   (mm)=     91.37        91.37        91.372
     RUNOFF COEFFICIENT   =       .99          .55          .985

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
100:0006----------------------------------------------------------------------
*#*********************************************************************|
*# ROOF TOP CONTROL DRAINS - ASSUME 11 ROOF DRAINS @ 0.38 L/S/inch of head
*
----------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>02:(201   )    |
| OUT<07:(SWM   )    |     =========  OUTLFOW STORAGE TABLE  =========
--------------------     OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)  |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .017  .7200E-02
                            .008  .3600E-02   |     .025  .1080E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     ---------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >02: (201   )         .12      .060     1.333     89.974
     OUTFLOW<07: (SWM   )         .12      .013     1.533     89.974
    OVERFLOW<08: (RF-OFL)         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   21.651
                    TIME SHIFT OF PEAK FLOW       (min)=    12.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.5584E-02

------------------------------------------------------------------------------
100:0007----------------------------------------------------------------------
*#*********************************************************************|
*# CATCHMENT 202 - PARKING AND DRIVEWAY SURFACE AND BALCONIES
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 03:202    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .16          .01
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=     30.00         5.00
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    181.81       115.13
               over (min)        1.00         3.00
     Storage Coeff.  (min)=       .86 (ii)    2.78 (ii)
     Unit Hyd. Tpeak (min)=      1.00         3.00
     Unit Hyd. peak  (cms)=      1.16          .39
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .08          .00          .082 (iii)
     TIME TO PEAK    (hrs)=      1.33         1.33         1.333
     RUNOFF VOLUME    (mm)=     90.37        50.60        88.384
     TOTAL RAINFALL   (mm)=     91.37        91.37        91.372
     RUNOFF COEFFICIENT   =       .99          .55          .967

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
100:0008----------------------------------------------------------------------
*#*********************************************************************|
*# CATCHMENT 203 - AMENITY AREA AND LANDSCAPE STRIP AROUND PERIMITER OF SITE
*
----------------------
| CALIB NASHYD       |   Area    (ha)=     .06   Curve Number    (CN)=80.00
| 04:203    DT= 1.00 |   Ia      (mm)=   4.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .110

     Unit Hyd Qpeak  (cms)=     .022

     PEAK FLOW       (cms)=     .013 (i)
     TIME TO PEAK    (hrs)=    1.400
     RUNOFF VOLUME    (mm)=   50.596
     TOTAL RAINFALL   (mm)=   91.372
     RUNOFF COEFFICIENT   =     .554

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
100:0009----------------------------------------------------------------------
*# CATCHMENT 204 - FRONT WALKWAY DRAINING AND UNCOVERED BALCONIES - UNCONTOLLED
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .03
| 05:204    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                          IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .03          .00
     Dep. Storage     (mm)=      1.00         4.00
     Average Slope     (%)=      2.00         2.00
     Length            (m)=      1.50          .10
     Mannings n           =      .015         .250

     Max.eff.Inten.(mm/hr)=    181.81       118.93
               over (min)        1.00         1.00
     Storage Coeff.  (min)=       .14 (ii)     .32 (ii)
     Unit Hyd. Tpeak (min)=      1.00         1.00
     Unit Hyd. peak  (cms)=      1.70         1.62
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .01          .00          .015 (iii)
     TIME TO PEAK    (hrs)=      1.23         1.33         1.333
     RUNOFF VOLUME    (mm)=     90.37        50.59        89.975
     TOTAL RAINFALL   (mm)=     91.37        91.37        91.372
     RUNOFF COEFFICIENT   =       .99          .55          .985

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  80.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
100:0010----------------------------------------------------------------------
*#*********************************************************************|
*# TOTAL UNCONTROLLED FLOW - 201+202+203+204 (NO CONTROLS)
----------------------
| ADD HYD (UNCON     ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 02:201           .12      .060    1.33  89.97    .000
                      +ID2 03:202           .17      .082    1.33  88.38    .000
                      +ID3 04:203           .06      .013    1.40  50.60    .000
                      +ID4 05:204           .03      .015    1.33  89.97    .000
                       ==========================================================
                       SUM 06:UNCON         .38      .167    1.33  82.76    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
100:0011----------------------------------------------------------------------
*# TOTAL FLOW TO UNDERGROUND STORAGE - 201(with roof controls)+ 202 + 203
----------------------
| ADD HYD (CONT      ) | ID: NHYD          AREA     QPEAK   TPEAK   R.V.    DWF
----------------------                     (ha)     (cms)   (hrs)   (mm)   (cms)
                       ID1 07:SWM           .12      .013    1.53  89.97    .000
                      +ID2 08:RF-OFL        .00      .000     .00    .00    .000
                      +ID3 03:202           .17      .082    1.33  88.38    .000
                      +ID4 04:203           .06      .013    1.40  50.60    .000
                       ==========================================================
                       SUM 09:CONT          .35      .104    1.33  82.15    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
100:0012----------------------------------------------------------------------
*# ROUTE FLOWS THROUGH UNDERGROUND STOARGE TANKS
*
----------------------
| ROUTE RESERVOIR    |     Requested routing time step =  1.0 min.
|  IN>09:(CONT  )    |
| OUT<01:(SWM   )    |     =========  OUTLFOW STORAGE TABLE  =========
--------------------     OUTFLOW    STORAGE  |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)  |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .022  .4900E-02
                            .012  .0000E+00   |     .024  .5900E-02
                            .014  .1000E-02   |     .025  .6900E-02
                            .017  .2000E-02   |     .027  .7900E-02
                            .019  .3000E-02   |     .028  .8900E-02
                            .021  .4000E-02   |     .029  .9500E-02

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     ---------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >09: (CONT  )         .35      .104     1.333     82.152
     OUTFLOW<01: (SWM   )         .35      .027     1.833     82.204
    OVERFLOW<02: (OFL   )         .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   26.332
```

```
                TIME SHIFT OF PEAK FLOW         (min)=    30.00
                MAXIMUM  STORAGE   USED       (ha.m.)=.8328E-02

--------------------------------------------------------------------------------
100:0013----------------------------------------------------------------------
*# TOTAL SITE DISCHARGE - CONTROLLED + UNCONTROLLED
*# SWM TANK DISCHARGE + CATCHMENT 204
-------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                    (ha)     (cms)   (hrs)   (mm)    (cms)
                        ID1 01:SWM           .35     .027    1.83  82.20    .000
                       +ID2 02:OFL           .00     .000     .00    .00    .000
                       +ID3 05:204           .03     .015    1.33  89.97    .000
                        ==========================================================
                        SUM 10:TOTAL         .38     .037    1.33  82.81    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
100:0014----------------------------------------------------------------------
*
*
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
100:0002----------------------------------------------------------------------
*
*
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 002:0003 CALIB STANDHYD
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.
   Simulation ended on 2022-09-07     at 14:11:38
================================================================================
```



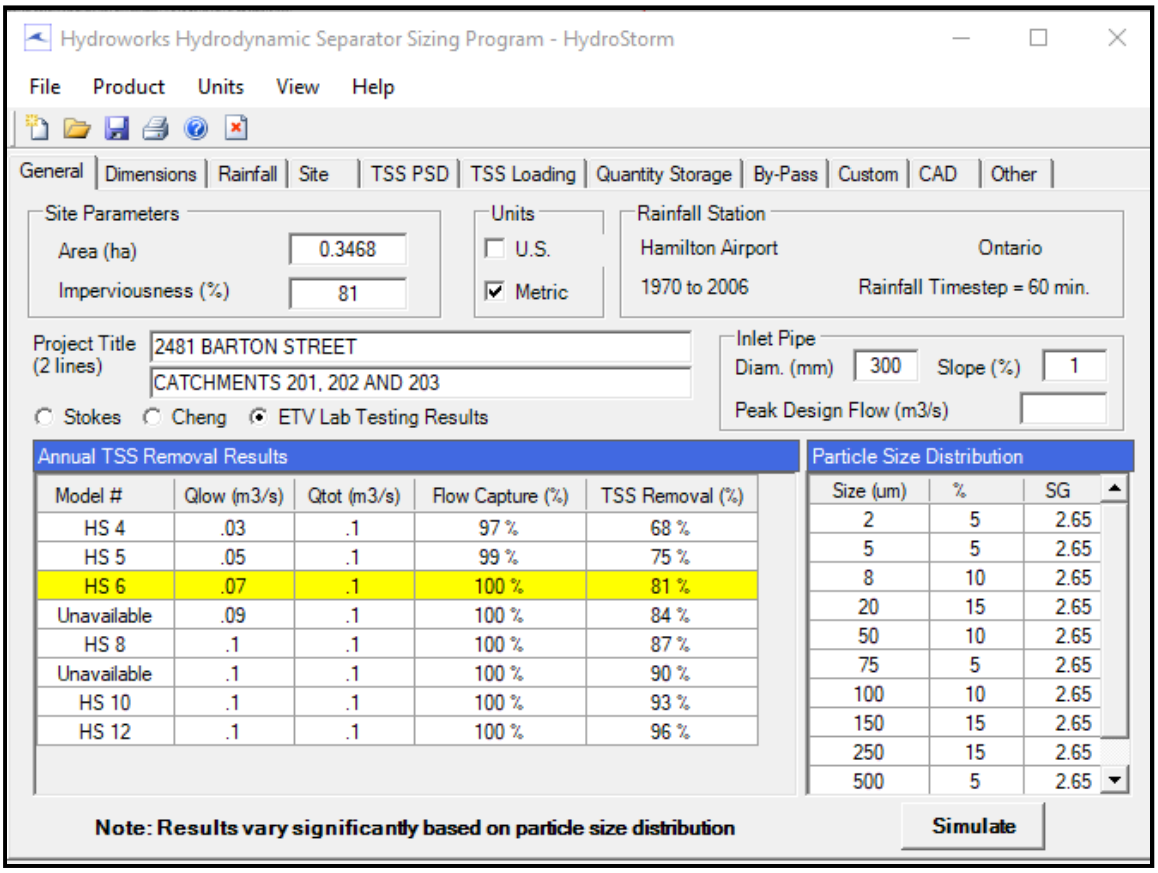






DRAWN BY JJC	MATERIAL HIGH DENSITY POLYETHYLENE	ADS Nyloplast	3130 VERONA AVE BUFORD, GA 30518 PHN (770) 932-2443 FAX (770) 932-2490 www.nyloplast-us.com
DATE 7-2-12			
APPD BY JJC	PROJECT NO./NAME	TITLE 18R ENVIROHOOD FOR 48" ROUND CONCRETE STRUCTURES	
DATE 7-2-12			
DWG SIZE A	SCALE NTS SHEET 1 OF 1	DWG NO. 7004-110-102	REV A

OIL-GRIT UNIT SIZING



Hydroworks® HydroStorm

Operations & Maintenance Manual

Version 1.0

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please fax a copy of the completed checklist to Hydroworks at 888-783-7271 for our records.

Introduction

The HydroStorm is a state of the art hydrodynamic separator. Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroStorm is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroStorm.

Hydroworks® HydroStorm Operation

The Hydroworks HydroStorm (HS) separator is a unique hydrodynamic by-pass separator. It incorporates a protected submerged pretreatment zone to collect larger solids, a treatment tank to remove finer solids, and a dual set of weirs to create a high flow bypass. High flows are conveyed directly to the outlet and do not enter the treatment area, however, the submerged pretreatment area still allows removal of coarse solids during high flows.

Under normal or low flows, water enters an inlet area with a horizontal grate. The area underneath the grate is submerged with openings to the main treatment area of the separator. Coarse solids fall through the grate and are either trapped in the pretreatment area or conveyed into the main treatment area depending on the flow rate. Fines are transported into the main treatment area. Openings and weirs in the pretreatment area allow entry of water and solids into the main treatment area and cause water to rotate in the main treatment area creating a vortex motion. Water in the main treatment area is forced to rise along the walls of the separator to discharge from the treatment area to the downstream pipe.

The vortex motion forces solids and floatables to the middle of the inner chamber. Floatables are trapped since the inlet to the treatment area is submerged. The design maximizes the retention of settled solids since solids are forced to the center of the inner chamber by the vortex motion of water while water must flow up the walls of the separator to discharge into the downstream pipe.

A set of high flow weirs near the outlet pipe create a high flow bypass over both the pretreatment area and main treatment chamber. The rate of flow into the treatment area is regulated by the number and size of openings into the treatment chamber and the height of by-pass weirs. High flows flow over the weirs directly to the outlet pipe preventing the scour and resuspension of any fines collected in the treatment chamber.

A central access tube is located in the structure to provide access for cleaning. The arrangement of the inlet area and bypass weirs near the outlet pipe facilitate the use of multiple inlet pipes.

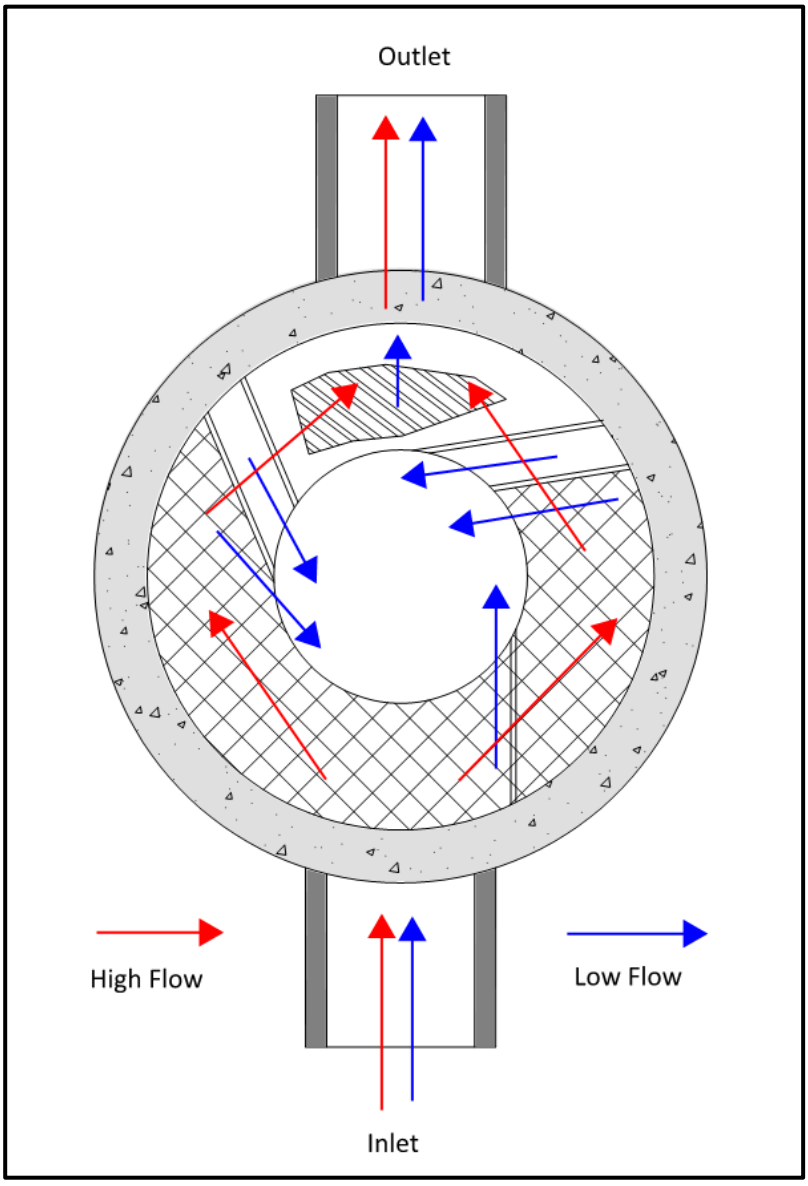


Figure 1. Hydroworks HydroStorm Operation – Plan View

Figure 2 is a profile view of the HydroStorm separator showing the flow patterns for low and high flows.

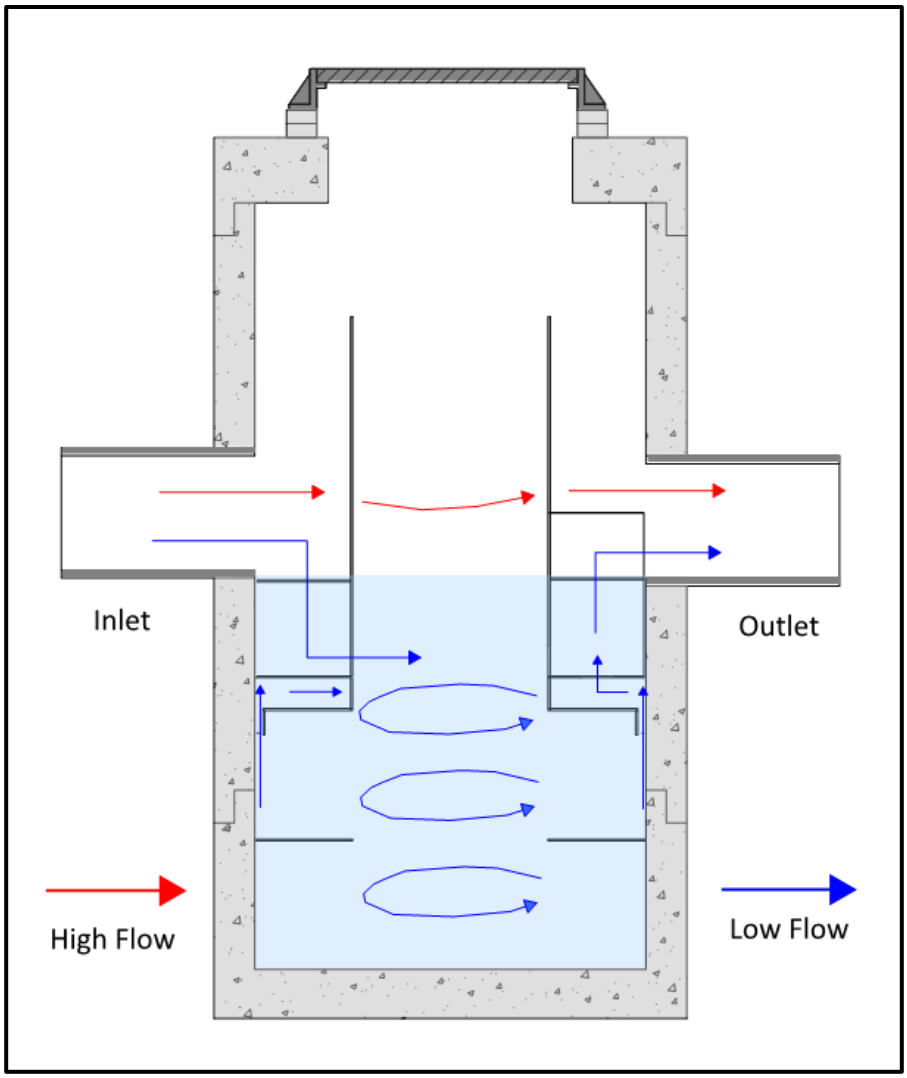


Figure 2. Hydroworks HydroStorm Operation – Profile View

The HS 4i is an inlet version of the HS 4 separator. There is a catch-basin grate on top of the HS 4i. A funnel sits sits underneath the grate on the frame and directs the water to the inlet side of the separator to ensure all lows flows are properly treated. The whole funnel is removed for inspection and cleaning.

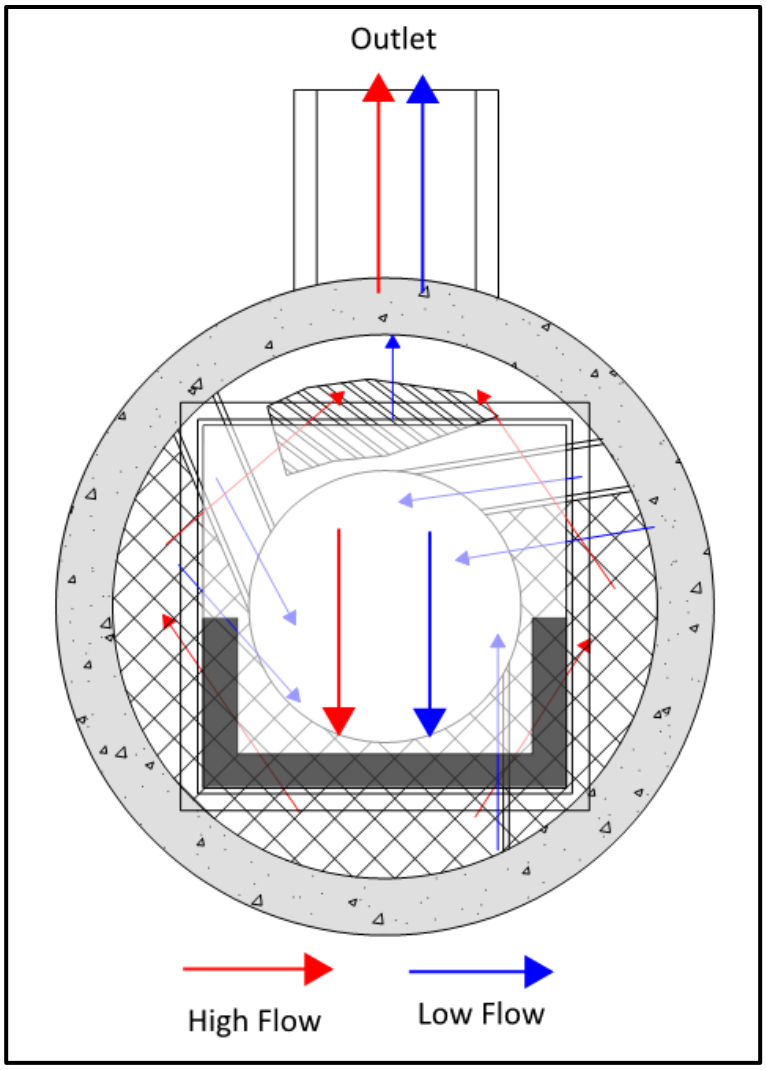


Figure 3. Hydroworks HS 4i Funnel

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the covers and looking down into the center access tube of the separator. Separators with an inlet grate (HS 4i or custom separator) will have a plastic funnel located under the grate that must be removed from the frame prior to inspection or maintenance. If you are missing a funnel please contact Hydroworks at the numbers provided at the end of this document.

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TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. The unit should be inspected for TSS through each of the access covers. Several readings (2 or 3) should be made at each access cover to ensure that an accurate TSS depth measurement is recorded.

Frequency

Construction Period

The HydroStorm separator should be inspected every four weeks and after every large storm (over 0.5" (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroStorm separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized (storage piles, exposed soils) areas the HydroStorm separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required future frequency of inspection and maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, blockages)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HydroStorm unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroStorm separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

A central access opening (24” or greater) is provided to the gain access to the lower treatment tank of the unit. This is the primary location to maintain by vacuum truck. The pretreatment area can also be vacuumed and/or flushed into the lower treatment tank of the separator for cleaning via the central access once the water level is lowered below the pretreatment floor.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature. Disposal of the water will depend on local requirements. Disposal options for the decanted water may include:

1. Discharge into a nearby sanitary sewer manhole
2. Discharge into a nearby LID practice (grassed swale, bioretention)
3. Discharge through a filter bag into a downstream storm drain connection

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Disposal of the contents of the separator depend on local requirements. Maintenance of a Hydroworks HydroStorm unit will typically take 1 to 2 hours based on a vacuum truck and longer for other cleaning methods (i.e. clamshell bucket).

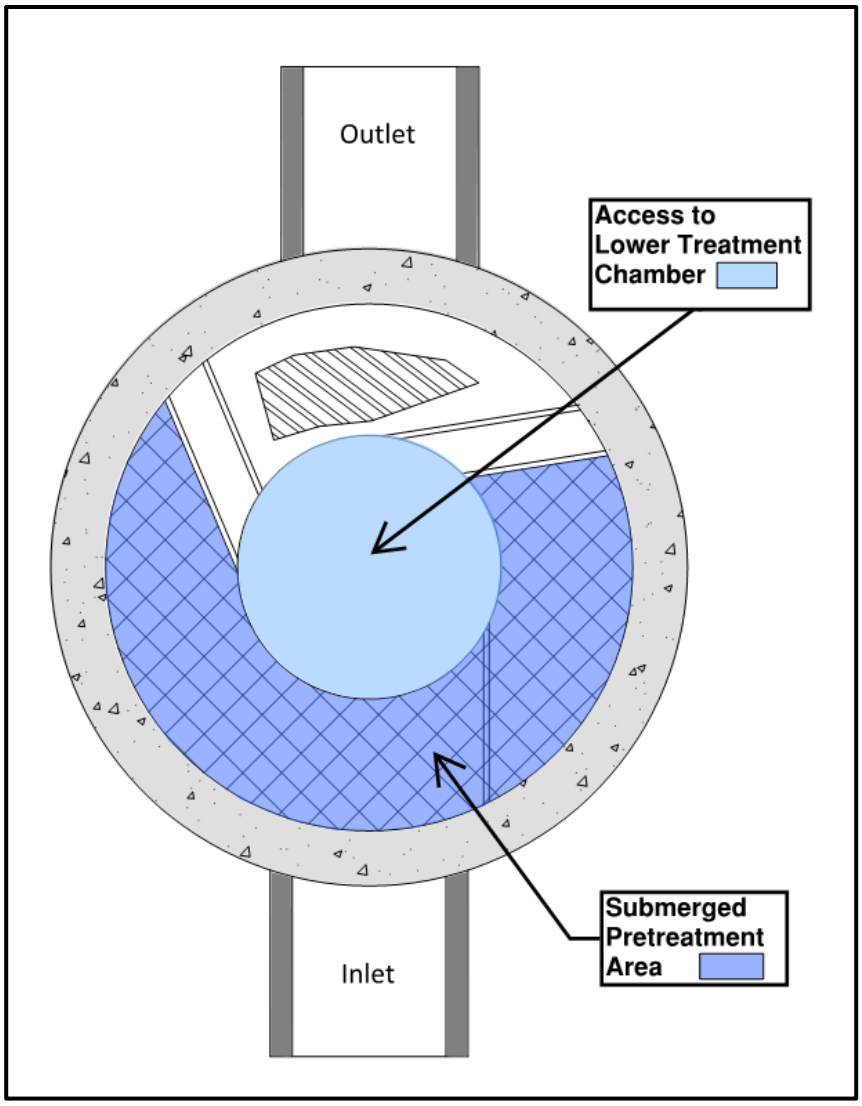


Figure 3. Maintenance Access

Frequency

Construction Period

A HydroStorm separator can fill with construction sediment quickly during the construction period. The HydroStorm must be maintained during the construction period when the depth of TSS/sediment reaches 24” (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroStorm separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The HydroStorm was independently tested by Alden Research Laboratory in 2017. A HydroStorm HS 4 was tested for scour with a 50% sediment depth of 0.5 ft. Therefore, maintenance for sediment accumulation is required if the depth of sediment is 1 ft or greater in separators with standard water (sump) depths (Table 1).

There will be designs with increased sediment storage based on specifications or site-specific criteria. A measurement of the total water depth in the separator through the central access tube should be taken and compared to water depth given in Table 1. The standard water depth from Table 1 should be subtracted from the measured water depth and the resulting extra depth should be added to the 1 ft to determine the site-specific sediment maintenance depth for that separator.

For example, if the measured water depth in the HS-7 is 7 feet, then the sediment maintenance depth for that HS-7 is 2 ft (= 1 + 7 – 6) and the separator does not need to be cleaned for sediment accumulation until the measure sediment depth is 2 ft.

The HydroStorm separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroStorm Models

Model	Diameter (ft)	Total Water Depth (ft)	Sediment Maintenance Depth for Table 1 Total Water Depth(ft)
HS-3	3	3	1
HS-4	4	4	1
HS-5	5	4	1
HS-6	6	4	1
HS-7	7	6	1
HS-8	8	7	1
HS-9	9	7.5	1
HS-10	10	8	1
HS-11	11	9	1
HS-12	12	9.5	1

HYDROSTORM INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroStorm	**Yes**	**No**
Obstructions in the inlet or outlet	☐ *	☐
Missing internal components	☐ **	☐
Improperly installed inlet or outlet pipes	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____“

Routine Measurements

Floating debris depth	**< 0.5” (13mm)**	☐	**>0.5” 13mm)**	☐ *
Floating debris coverage	**< 50% of surface area**	☐	**> 50% surface area**	☐ *
Sludge depth	**< 12” (300mm)**	☐	**> 12” (300mm)**	☐ ****

* Maintenance required
** Repairs required
*** Further investigation is required

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroStorm

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroStorm to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroStorm are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroStorm, or the cost of other goods or services related to the purchase and installation of the HydroStorm. For this Limited Warranty to apply, the HydroStorm must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroStorm arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroStorm, whether the claim is based upon contract, tort, or other legal basis.

APPENDIX D

Geotechnical Report

2481 Barton Street East, Hamilton, ON

Barton Street Developments Inc.

Type of Document:
Geotechnical Investigation Report

Project Name:
Proposed Mid-Rise Apartment Building
2481 Barton Street East
Hamilton, Ontario

Project Number:
HAM-00802036-A0

Prepared By:
EXP Services Inc.
1266 South Service Road, Suite C1-1
Stoney Creek, Ontario L8E 5R9
t: +1.905.573.4000
f: +1.905.573.9693

Date Submitted:
February 3, 2021

Table of Contents

List of Appendices

1. Introduction and Background

This report presents the results of the geotechnical investigation carried out at the site of the proposed development at 2481 Barton Street East in Hamilton, Ontario. The investigation was authorized by Mr. Rajan Banwait on behalf of Barton Street Developments Inc. (Client).

At the time of the investigation, the site was occupied by a single-family dwelling and garage structure with associated gravel driveway and parking areas. Brush and mature trees were also present throughout the property and were dense on the west and north sides. Details of the proposed development were not finalized at the time of the investigation, but it is expected that the existing structures will be demolished to make way for the construction of an apartment building with 12 to 17 storeys and 1 or 2 levels of underground parking.

The purpose of this investigation was to determine the subsoil and groundwater conditions at the site by advancing ten (10) boreholes and based on an assessment of the factual subsurface data, provide an engineering report containing general geotechnical recommendations pertinent to the proposed construction. This report does not address the environmental aspects of the development. Additional fieldwork and testing was carried out at the site by EXP as part of the hydrogeological investigation, the results of which are presented under separate cover.

The comments and recommendations given in this report assume that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or the requirement of additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Field Investigation

As requested, EXP advanced a total of ten (10) boreholes at the site, numbered BH-01 to BH-10. The approximate borehole locations are shown on Drawing No. 1 in Appendix A. The boreholes were advanced to depths ranging from approximately 5.8 to 11.1 m below existing grade.

The fieldwork for this investigation was carried out on November 9, 10, and 11, 2020. Drilling and sampling operations were completed by a combination of auger and split-spoon techniques using track mounted drilling equipment owned and operated by specialist drilling subcontractor. Prior to the commencement of the drilling, the public and private-owned underground services were located to minimize the risk of contacting any such services during the investigation.

Soil samples were obtained using a 51 mm (2 inch) outside diameter split-spoon sampler driven in conjunction with Standard Penetration Test procedure (ASTM D1586) at the depths noted graphically on the borehole logs. The retained soil samples were logged in the field and then carefully packaged and transported to our Hamilton laboratory for detailed visual, textural and olfactory classification. The Standard Penetration Test (SPT) N values and pocket penetrometer measurements were recorded and used to provide an assessment of the consistency of the in-situ soils.

Groundwater levels within the boreholes were measured prior to backfilling. Three (3) 50 mm diameter monitoring wells were installed to allow for stabilized groundwater level measurements and hydrogeological testing. The remaining boreholes were backfilled upon completion of drilling in accordance with O.Reg. 903.

Ground surface elevations at the borehole locations were surveyed by EXP and referenced to a temporary benchmark (TBM), described as follows:

TBM:	Top of catch basin, in the north curb of Barton Street East and approximately 25 m east of the west property line of 2481 Barton Street East
Elevation:	85.23 m (as per the topographical survey provided by the client dated September 24, 2020 by A.T. McLaren Ltd.)

3. Subsurface Conditions

Details of the subsurface conditions encountered during the drilling program are summarized on the borehole logs in Appendix A.

The logs include textural descriptions of the subsoil and groundwater conditions and indicate the soil boundaries inferred from non-continuous sampling and observations during drilling. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Notes on Sample Description" preceding the borehole logs form an integral part of and should be read in conjunction with this report.

3.1 Soil Stratigraphy

The boreholes each encountered surficial topsoil, granular fill, and/or fill, extending to depths ranging from approximately 0.8 to 2.6 m below grade. The underlying native silty clay till extended to the bedrock surface or borehole termination depth. Where encountered, the bedrock was contacted at depths ranging from approximately 6.3 to 11.0 m below grade. Details of the encountered materials are provided in the following subsections.

3.1.1 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.

3.1.2 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.

3.1.3 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.

3.1.4 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%. SPT N values ranged from 16 to over 50 blows per 305 mm penetration. Based on estimated undrained shear strengths from 125 to greater than 225 kPa as determined by pocket penetrometer measurements, the silty clay till is classified as very stiff to hard in consistency. 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.

Three (3) grain size analysis were conducted with the results included in Appendix B and summarized in the table below.

Table 3-1: Summary of Grain Size Analyses

Sample	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BH-01 SS9	18	60	22	0
BH-05 SS6	35	50	15	0
BH-09 SS7	15	60	25	0

Atterberg limits testing was also conducted on the above samples, indicating the stratum is of intermediate plasticity. The results of this testing are also included in Appendix B.

3.1.5 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 bedrock surface depths and elevations are summarized in the table below.

Table 3-2: Depths and Elevations of Bedrock Surface

Borehole No.	Depth of Bedrock Surface (m)	Elevation of Bedrock Surface (m)
BH-01	9.3	76.2
BH-03	8.2	77.1
BH-04	9.3	76.1
BH-06	7.7	77.7
BH-07	10.9	74.6

Borehole No.	Depth of Bedrock Surface (m)	Elevation of Bedrock Surface (m)
BH-08	7.8	77.9
BH-09	7.9	77.7
BH-10	6.3	79.4

3.2 Groundwater Conditions

Groundwater conditions were monitored in the open boreholes during and upon completion of the investigation. Upon borehole completion, groundwater was encountered at 10.2 m at Borehole BH-09 and at 9.2 m at Borehole BH-10 with no free water encountered at the remaining locations, but groundwater levels are not anticipated to have stabilized during the short term of the investigation. 50 mm diameter groundwater monitoring wells were installed at three (3) borehole locations with the groundwater depths and elevations summarized in the table below.

Table 3-3: Groundwater Level Measurements at Monitoring Well Locations

Borehole No.	Groundwater Depth/Elevation (m)		
	Upon Completion	November 23, 2020	November 30, 2020
BH-01	no free water	4.5/81.0	5.5/80.0
BH-03	no free water	2.3/83.0	2.4/82.9
BH-09	10.2/75.4	2.9/82.7	2.6/83.0

Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (spring thaw and late fall) and lower levels occurring during dry weather conditions. Reference should be made to the hydrogeological report for additional groundwater comments.

4. Discussion and Recommendations

Details of the proposed development were not finalized at the time of the investigation, but it is expected to consist of an apartment building with 12 to 17 storeys and 1 or 2 levels of underground parking. We offer the following comments and recommendations for the proposed construction.

4.1 Site Grading

The proposed site grading was not available at the time of this report. However, based on the presence of fill and existing structures, it is expected that regrading (cut and fill operations) will be carried out at the site. The following procedures are recommended for the construction of building and pavement areas at the site, where required:

- All existing topsoil, fill, disturbed soils, foundations, services, and organic/deleterious materials should be removed from the proposed building and pavement areas. Fill materials in pavement areas may remain in place,

subject to being proof-rolled and replaced as directed by a geotechnical representative, but pavements constructed over fill may require more frequent maintenance and experience a reduced service life.

- The exposed subgrade surface should be proof-rolled with a heavy roller or partially loaded truck and reviewed by a geotechnical representative. Any soft areas detected during the proof-rolling process should be sub-excavated and replaced with approved material compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD).

- Low areas can then be brought up to final subgrade level with approved on-site or imported material placed in lifts not exceeding 200 mm. Fill placed in building floor slab areas must be compacted to 100 percent of SPMDD. Fill placed in pavement areas should be compacted to at least 95 percent SPMDD, with the upper 600 mm compacted to at least 98 percent SPMDD. The moisture content of the fill should be at or near its optimum moisture content to ensure the specified densities can be achieved with reasonable compactive effort.

- Re-use of the on-site fill should be at the discretion of the geotechnical consultant during construction. Some adjustment of moisture content may be required to facilitate compaction of re-used materials. Re-used materials must also be free from organics and deleterious materials.

- All imported borrow fill material from local sources should be free from organic material and foreign objects (trees, roots, debris, etc.) and should be approved by EXP prior to transport to the site. In addition, the chemical quality of the borrowed fill material should be assessed by EXP in accordance with the current applicable MECP regulations and guidelines.

- All excavation, backfilling and compaction operations should be monitored on a full-time basis by EXP's geotechnical staff to approve materials and to ensure the specified degrees of compaction have been obtained.

4.2 Building Foundation Recommendations

It is understood that the building will consist of a 12 to 17 storey structure with 1 or 2 levels of underground parking (corresponding to a founding level in the order of 4 to 7 m below grade).

Based on the subsurface conditions encountered at the site, the proposed building may be supported on conventional spread and strip footings founded on silty clay till. Alternatively, caissons bearing on the shale bedrock may be a preferred option.

4.2.1 Conventional Footings

Conventional spread and strip footing foundations constructed on the undisturbed silty clay till can be designed with a geotechnical resistance of 300 kPa at Serviceability Limit State (SLS) or 450 kPa at ULS at or below the depths provided in the table below, subject to review by EXP during construction. A capacity of 1,000 kPa at SLS/ULS may be used for foundations constructed in the weathered shale.

Table 4-1: Available Geotechnical Resistance

Borehole No.	Available Geotechnical Resistance (kPa)	Founding Soils	Recommended Minimum Founding Depth / Elevation (m)
BH-01	300 SLS / 450 ULS 1,000 SLS/ULS	Native Silty Clay Till Shale Bedrock	1.8 / 83.7 9.6 / 75.9
BH-02	300 SLS / 450 ULS	Native Silty Clay Till	2.6 / 82.7
BH-03	300 SLS / 450 ULS 1,000 SLS/ULS	Native Silty Clay Till Shale Bedrock	1.2 / 84.1 8.5 / 76.8
BH-04	300 SLS / 450 ULS 1,000 SLS/ULS	Native Silty Clay Till Shale Bedrock	1.5 / 83.9 9.6 / 75.8
BH-05	300 SLS / 450 ULS	Native Silty Clay Till	1.4 / 84.0
BH-06	300 SLS / 450 ULS 1,000 SLS/ULS	Native Silty Clay Till Shale Bedrock	2.9 / 82.5 8.1 / 77.3
BH-07	300 SLS / 450 ULS 1,000 SLS/ULS	Native Silty Clay Till Shale Bedrock	1.4 / 84.1 11.3 / 74.2
BH-08	300 SLS / 450 ULS 1,000 SLS/ULS	Native Silty Clay Till Shale Bedrock	2.1 / 83.6 8.1 / 77.6
BH-09	300 SLS / 450 ULS 1,000 SLS/ULS	Native Silty Clay Till Shale Bedrock	2.6 / 83.0 8.2 / 77.4
BH-10	300 SLS / 450 ULS 1,000 SLS/ULS	Native Silty Clay Till Shale Bedrock	1.1 / 84.6 6.6 / 79.1

Prior to placement of foundation concrete, all existing fill, organics, and other deleterious material must be removed down to the competent native soils or, if founding on bedrock, all loose rock must be removed. The exposed founding surface is to be reviewed by EXP.

4.2.2 Caissons

Alternatively, a deep foundation scheme consisting of caissons may be considered. Caissons founded in the shale bedrock below any highly weathered/fractured rock can be designed for an end-bearing resistance of 1,000 kPa at the approximate depths provided in Table 4-1 above. The actual founding depth of the caissons are subject to verification by EXP during construction.

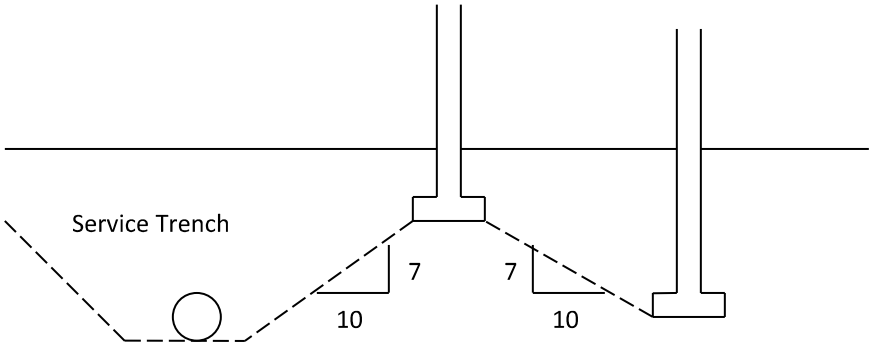
The use of temporary liners may be required for caisson installation to prevent the soil from caving and thus minimize the possible formation of voids below the floor slab, and to help control any water seepage into the caissons. The liners should be tightly sealed into the bedrock to prevent the infiltration of groundwater into the hole. Once the caissons have been drilled to the final founding elevation and the rock conditions confirmed by EXP, it is recommended that the base be cleaned by placing about 0.3 to 0.5 m of concrete into the final base and mixing it with any loose material present at the base. All concrete and loose soil should then be removed prior to placing the reinforcing cage and the structural concrete.

Prior to withdrawal of the liner, the contractor should be prepared to place concrete by tremie method if the liner cannot form a seal to prevent groundwater infiltration. An experienced contractor should be employed to ensure the above procedures are followed and no necking or voids in the concrete occurs in the caisson shaft during the concrete pour.

Concrete being placed into the caissons should have a slump of about 150 mm in order to minimize the risk of necking in the shaft. Once the method of construction is established the concrete mix must be reviewed by this office.

4.3 General Foundation Recommendations

Conventional foundations in soil at different elevations should be located such that higher footings are set below a line drawn up at 10:7, horizontal to vertical from the near edge of the lower footing. This requirement is not applicable for foundations in sound bedrock. This concept should also be applied to excavations for new foundations in relation to existing foundations or underground services.



FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

All foundations and grade beams for caissons exposed to freezing conditions must be provided with a minimum of 1.2 m of earth cover or equivalent insulation for frost protection, depending on the final grade requirements.

The recommended geotechnical resistances have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, it should be appreciated that modifications to bearing levels may be required if unforeseen subsoil conditions are revealed after the excavation is exposed to full view or if final design decisions differ from those assumed in this report. For this reason, this office should be retained to review final foundation drawings and to provide field inspections during the construction stage.

4.4 Excavations

Excavations for 1 to 2 underground levels are expected to extend to depths of approximately 4 to 7 m below existing grade. Excavations within the encountered overburden may be undertaken with a sufficiently sized hydraulic excavator. Bedrock was encountered as high as 6.3 m below grade at the borehole locations and varied between borings. Excavations proceeding into the weathered bedrock (Queenston Shale) will likely require the excavator be equipped with rock teeth. Limestone lenses are commonly encountered in the shale and so may be encountered during construction. The use of rock breaking equipment, e.g. rippers or pneumatic rock hammers, should be anticipated in the sound shale or where thicker limestone interbedding is encountered.

The silty clay till is a non-sorted sediment and cobbles and boulders should be anticipated in the stratum, as was encountered in Borehole BH-02. Consequently, provisions should be made in the contract documents to cover any delays caused by limestone interbedding, boulders, obstructions, etc.

All excavations must be completed in accordance with the most recent regulations of the Ontario Occupation Health and Safety Act (OHSA). The encountered fill may generally be classified as Type 3 Soil above the groundwater level. The very stiff to hard silty clay may generally be classified as Type 2 Soil. In accordance with the OHSA regulations if the excavation contains more than one type of soil, the soil shall be classified as the type with the highest number.

The OHSA requires that unsupported excavation slopes be cut at predetermined inclinations, based on the soil types encountered. The bedrock excavations can be sloped at near vertical (1 horizontal to 6 vertical) provided any loose rock is scaled from the face. The need to excavate flatter side slopes if excessively wet or soft/loose materials, or concentrated seepage zones are encountered, should not be overlooked. Water (i.e. surface water runoff) should not be permitted to enter and/or pond within the construction area.

It is important to note that soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in the boreholes advanced at the site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, we recommend that EXP be contacted immediately to evaluate the conditions encountered.

4.5 Temporary Shoring

If required, the shoring method chosen by the structural engineer and/or contractor will depend on the settlement tolerance of the surrounding structures and infrastructure. Where settlement sensitive structures or services are located within a distance from the excavation equal or less than the overburden excavation depth, the use of a rigid retaining structure will be required.

Properly designed shoring may be used to reduce the lateral extent of the excavations. The lateral earth pressure acting on the shoring may be computed using the following equation, assuming a rectangular pressure distribution and dewatering will be carried out:

$$p = K(\gamma h + q)$$

where p = lateral earth pressure intensity at depth h (kPa)
K = earth pressure coefficient
γ = unit weight of retained soil
h = depth to point of interest (m)
q = surcharge load acting adjacent to the shoring at the ground surface (kPa)

In general, an earth pressure coefficient, K, of 0.45 may be used where movements must be minimized and 0.25 where minor movements can be tolerated. A unit weight of 21 kN/m^3 may be used for the encountered soils.

4.6 Lateral Earth Pressure

The lateral earth pressure acting on the foundation walls may be calculated using the following equation:

$$p = K(\gamma h + q)$$

where p = lateral earth pressure intensity at depth h (kPa)

K = earth pressure coefficient (assume 0.40)

γ = unit weight of retained soil, assume 21.0 kN/m^3 for granular backfill

h = depth to point of interest (m)

q = surcharge load acting adjacent to the wall at the ground surface (kPa)

If the building is constructed as a tank without drainage, lateral hydrostatic and uplift pressures below the slab will need to be accounted for using the expression below.

$$p = K[(\gamma h_w) + (\gamma' (h - h_w))] + (\gamma_w (h - h_w)) + K q$$

where p = lateral earth pressure and hydrostatic pressure in kPa acting at depth h (kN/m^2)

K = active earth pressure coefficient, assume 0.30

γ_w = unit weight of water, 9.8 kN/m^3

γ = unit weight of soil surrounding the structure, assume 21.0 kN/m^3

γ' = effective unit weight of retained soil, assume 11.2 kN/m^3

h = depth to point of interest (m)

q = equivalent value of surcharge on the ground surface (kPa)

4.7 Groundwater Control

Groundwater levels in the monitoring wells on site ranged from 2.3 to 5.5 m below grade. For excavations above these levels, perched water from the fill as well as minor seepage from the native soils should be anticipated. Groundwater should be anticipated during construction, but is expected to be controllable using conventional construction sump pumping techniques. However, if two levels of basement are included and excavations extend below approximately 3 to 4 m then more significant dewatering should be anticipated, and a reference should be made to the EXP hydrogeological investigation report for the subject site for additional groundwater control comments. Seasonal variations in the water table should be anticipated, with higher levels occurring during wet weather conditions (spring thaw and late fall) and lower levels occurring during dry weather.

Dewatering requirements will be governed by the time of year the construction is performed. It is the responsibility of the contractor to propose a suitable dewatering system based on the time of construction and the groundwater levels. The method used should not undermine adjacent structures.

4.8 Building Floor Slab-on-Grade and Permanent Drainage

The basement floor slab-on-grade can be supported on the native soil. It is recommended that the exposed subgrade be examined by a geotechnical engineer prior to constructing the floor slab-on-grade. Any loose or disturbed material encountered during the review should be sub-excavated and replaced with approved fill placed in lifts not exceeding 200 mm and compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD) within 2 percent of the optimum moisture content. The floor slab should be cast on a moisture barrier consisting of 19 mm clear stone with

a thickness of at least 200 mm. The clear stone layer will minimize the capillary rise of moisture from the subgrade to the floor slab (moisture barrier). Adequate saw cuts should be provided in the floor slab as directed by the structural engineer to help control cracking. The installation of a perimeter drainage is required for buildings with basements and underfloor drainage system at 3 m intervals is recommended for the groundwater levels encountered on site. The exterior grade should be sloped to ensure positive drainage of surface water away from the structure and reduce groundwater infiltration adjacent to the foundations.

4.9 Backfill

Backfill used to satisfy under slab requirements and service trenches, etc., should be compactible fill, i.e. inorganic soil with its moisture content close to its optimum moisture content as determined in the standard Proctor test. Fill placed below concrete slab areas should be compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD) in lifts not exceeding 200 mm.

To minimize potential problem, any trench backfilling operations should follow closely after excavation so that only minimal length of trench slope is exposed. This will minimize wetting of the subgrade material. Should construction extend to the winter season, particular attention should be given to ensure that frozen material is not used as backfill.

The majority of excavated material will likely consist of silty clay fill or native silty clay till. In general, the excavated material may be reused for backfill subject to the removal of any organics or other obviously unsuitable material. However, moisture content adjustment of re-used soils might be required.

In general, the overburden soils are not free draining and therefore should not be used where this characteristic is required, or in confined areas. Imported granular material conforming to OPSS Granular B Type I or II would be suitable for these purposes.

All backfilling and compaction operations must be closely examined by a qualified geotechnical consultant to ensure uniform compaction to specification requirements, especially in the vicinity of manholes and catch basins, and in all areas that are not readily accessible to compaction equipment.

4.10 Earthquake Considerations

The recommendations for the geotechnical aspects to determine the earthquake loading are presented in the subsections below.

4.10.1 Subsoil Conditions

The subsoil and groundwater information at this site have been examined in relation to Section 4.1.8.4 of the OBC 2012. Conventional foundations are anticipated to be founded on the encountered silty clay till whereas caisson foundations are anticipated to be founded on the encountered shale bedrock.

There have been no shear wave velocity measurements carried out at this site and therefore, N values and EXP's knowledge of the soil conditions in the area have been used to determine the site classification.

4.10.2 Site Classification

Based on the above assumptions and interpretations and the known soil conditions, the Site Class for this site is "C" as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012. It should be noted that, depending on the founding level, an improved site classification may be achievable if shear wave velocity testing is carried out. EXP can be contacted to provide this service if required.

4.11 Roadway and Parking Lot Construction

It is understood that paved areas will be constructed at the site. The proposed development is anticipated to include medium duty parking/driveway areas as well as heavy duty truck routes.

The recommended pavement structures are provided in table below and are based on an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples and traffic requirements. Consequently, the recommended pavement structures should be considered for preliminary design purposes only.

Table 4-2: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Medium-Duty Parking	Truck Routes & Heavy-Duty Parking
Asphaltic Concrete (OPSS 1150)	Min 92.0% Maximum Relative Density (MRD)	40 mm HL3 50 mm HL8	40 mm HL3 80 mm HL8
Granular A Crusher Run Limestone (OPSS 1010)	100% SPMDD	150 mm	150 mm
Granular B Type II (OPSS 1010)	100% SPMDD	250 mm	350 mm

The granular base and sub-base must be placed in maximum 200 mm lifts and compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) at a moisture content within 2 percent of the optimum moisture content. The subgrade should be compacted to 98 percent SPMDD for at least the upper 600 mm. The recommended pavement structures outlined assume adequate provision for drainage.

The foregoing design assumes construction is carried out during dry periods and the subgrade is prepared according to Section 4.1 of this report. If construction is carried out during wet weather, and heaving or rolling of the subgrade is experienced, additional thickness of sub-base course material may be required.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped to provide effective surface drainage toward catch basins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. Subdrains should be installed to intercept excess subsurface moisture and prevent subgrade softening.

Additional comments on the construction of the paved areas are as follows:

- The location and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed site grading. In view of the fine-grained nature of the subgrade soils, subdrains should be installed on both sides of roadways and radially to catch basins in parking areas.

- To minimize problems of differential movement between the pavement and catch basins/manholes due to frost action, the backfill around the structures should consist of free draining granular fill.

- The most severe loading conditions on pavement areas and the subgrade may occur during construction. Consequently, special provisions such as half loads during paving, etc. may be required, especially if construction is carried out during unfavourable weather.

- The subgrade should be properly shaped, crowned, and then proof-rolled in the full-time presence of a representative of this office. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved backfill compacted to at least 98 percent SPMDD.

5. General Comments

The information presented in this report is based on a limited investigation designed to provide information to support an overall assessment of the current geotechnical conditions of the subject property. The conclusions presented in this report reflect site conditions existing at the time of the investigation.

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

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

More specific information, with respect to the conditions between samples, or the lateral and vertical extent of materials, may become apparent during excavation operations. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, EXP Services Inc. should be contacted to assess the situation and additional testing and reporting may be required. EXP Services Inc. has qualified personnel to provide assistance in regard to future geotechnical and environmental issues related to this property.

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

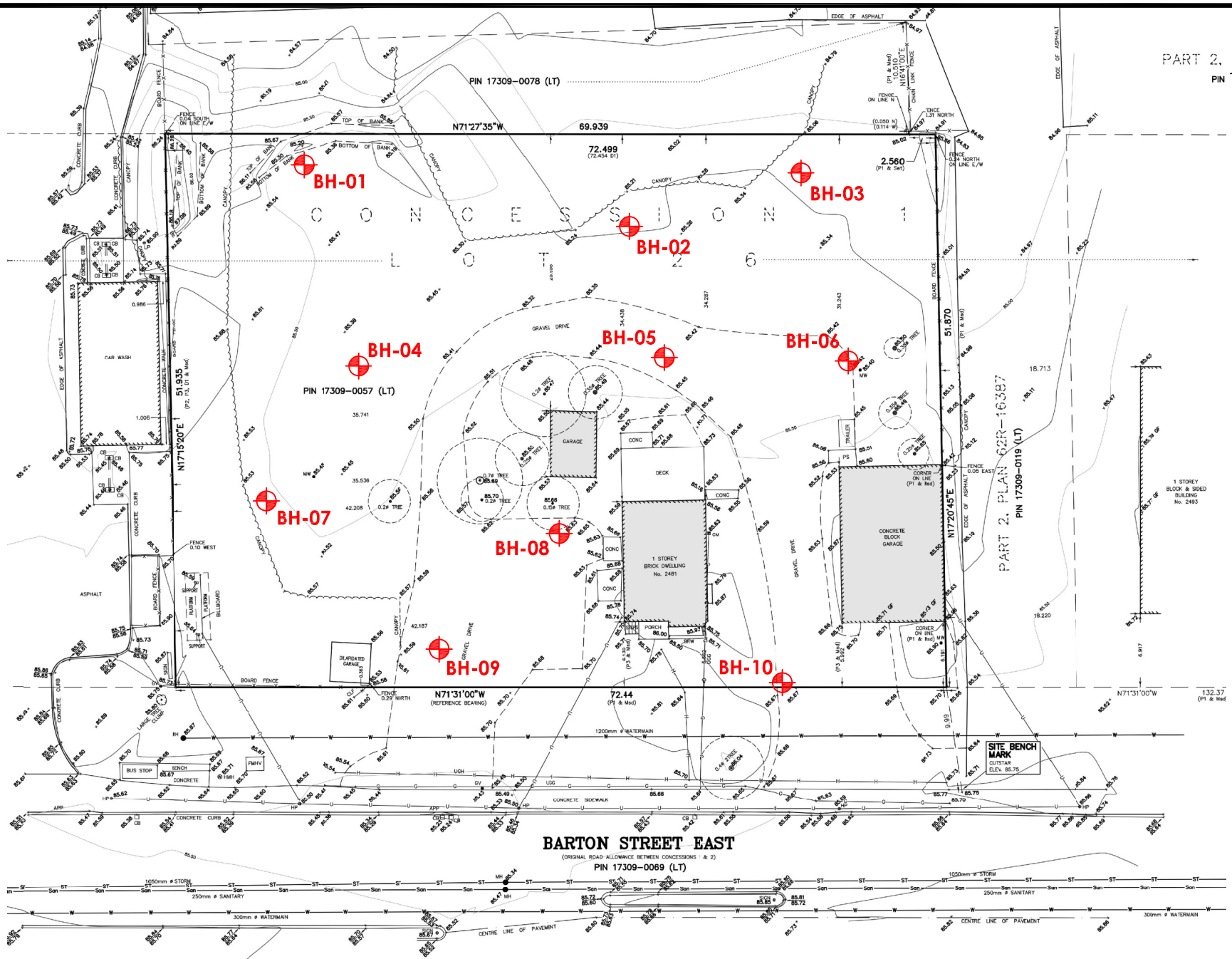
Dilsher Bhangal, P.Eng., M.Eng.
Geotechnical Project Manager

LICENSED PROFESSIONAL ENGINEER
D. S. BHANGAL
100532454
PROVINCE OF ONTARIO

Jeffrey Golder, P.Eng.
Manager, Hamilton Geotechnical Services

Appendix A

Drawings & Borehole Logs



EXP Services Inc.
t: +1.905.573.4000 | f: +1.905.573.9693
1266 South Service Road
Stoney Creek, ON L8E 5R9
Canada
www.exp.com
• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

LEGEND:

APPROXIMATE BOREHOLE LOCATION

TITLE AND LOCATION:

BOREHOLE LOCATION PLAN

PROPOSED MID-RISE APARTMENT BUILDING
2481 BARTON STREET EAST, HAMILTON, ON

JOB NO.:	DRAWN BY:
HAM-00802036-A0	DB
SCALE: NTS	CHECKED BY: JG
DATE: DECEMBER 2020	DWG NO.: 1

Notes on Sample Descriptions

1. All sample descriptions included in this report follow the International Society for Soil Mechanics and Foundation Engineering (ISSMFE), as outlined in the Canadian Foundation Engineering Manual. Note, however, that behavioral properties (i.e. plasticity, permeability) take precedence over particle gradation when classifying soil. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

UNIFIED SOIL CLASSIFICATION

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Notes On Soil Descriptions

4. The following table gives a description of the soil based on particle sizes. With the exception of those samples where grain size analyses have been performed, all samples are classified visually. The accuracy of visual examination is not sufficient to differentiate between this classification system or exact grain size.

Soil Classification		Terminology	Proportion
Clay and Silt	<0.060 mm	“trace” (e.g. Trace sand)	1% to 10%
Sand	0.060 to 2.0 mm	“some” (e.g. Some sand)	10% to 20%
Gravel	2.0 to 75 mm	adjective (e.g. sandy, silty)	20% to 35%
Cobbles	75 to 200 mm	“and” (e.g. and sand)	35% to 50%
Boulders	>200 mm		

The compactness of Cohesionless soils and the consistency of the cohesive soils are defined by the following:

Cohesionless Soil		Cohesive Soil		
Compactness	**Standard Penetration Resistance “N” Blows / 0.3 m**	**Consistency**	**Undrained Shear Strength (kPa)**	**Standard Penetration Resistance “N” Blows / 0.3 m**
Very Loose	0 to 4	Very soft	<12	<2
Loose	4 to 10	Soft	12 to 25	2 to 4
Compact	10 to 30	Firm	25 to 50	4 to 8
Dense	30 to 50	Stiff	50 to 100	8 to 15
Very Dense	Over 50	Very Stiff	100 to 200	15 to 30
		Hard	>200	>30

5. **ROCK CORING**

Where rock drilling was carried out, the term RQD (Rock Quality Designation) is used. The RQD is an indirect measure of the number of fractures and soundless of the rock mass. It is obtained from the rock cores by summing the length of the core covered, counting only those pieces of sound core that are 100 mm or more length. The RQD value is expressed as a percentage and is the ratio of the summed core lengths to the total length of core run. The classification based on the RQD value is given below.

RQD Classification	RQD (%)
Very Poor Quality	<25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

$$\text{Recovery Designation \% Recovery} = \frac{\text{Length of Core Per Run}}{\text{Total Length of Run}} \times 100$$

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

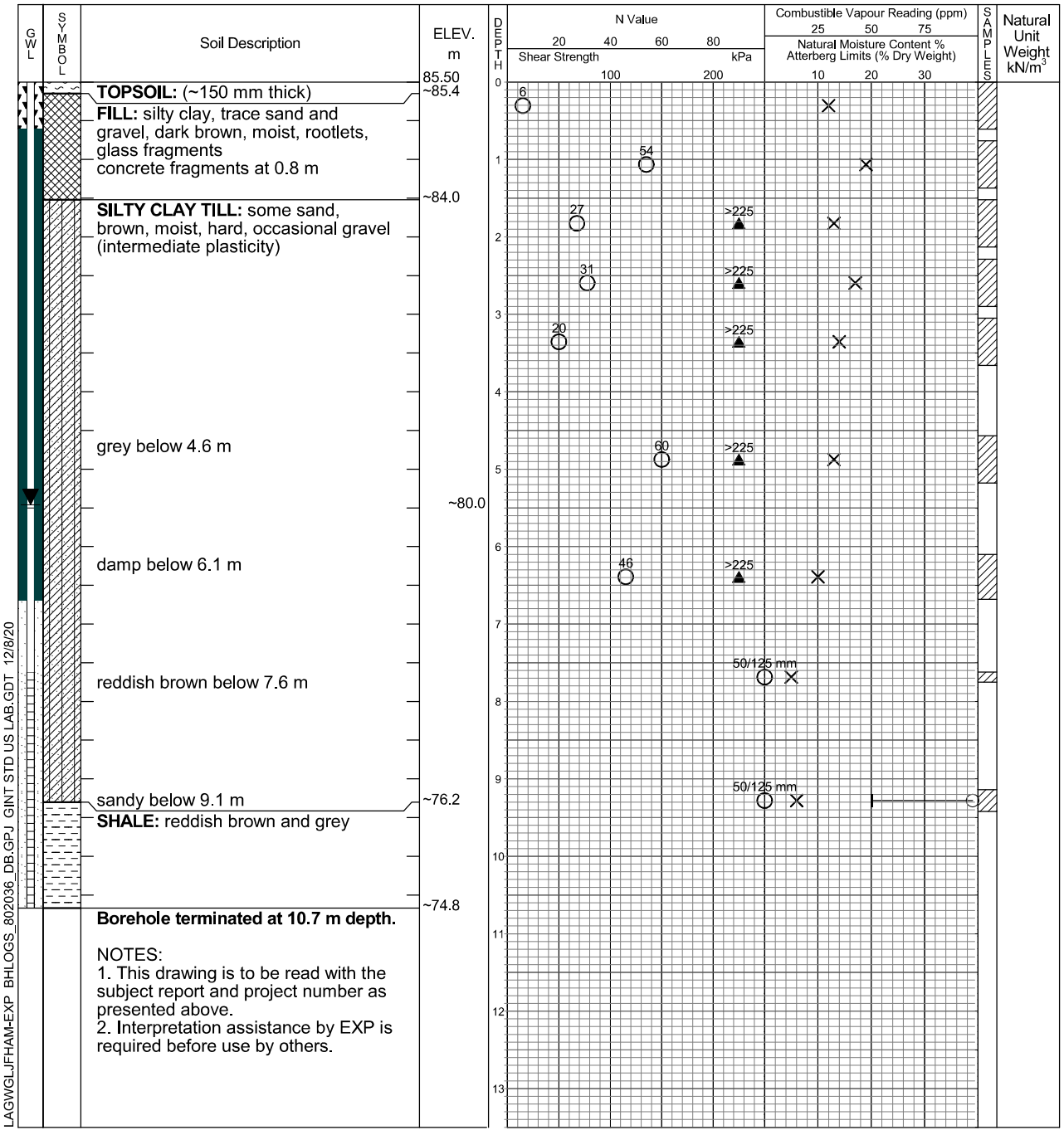
Date Drilled: November 10, 2020

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



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

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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

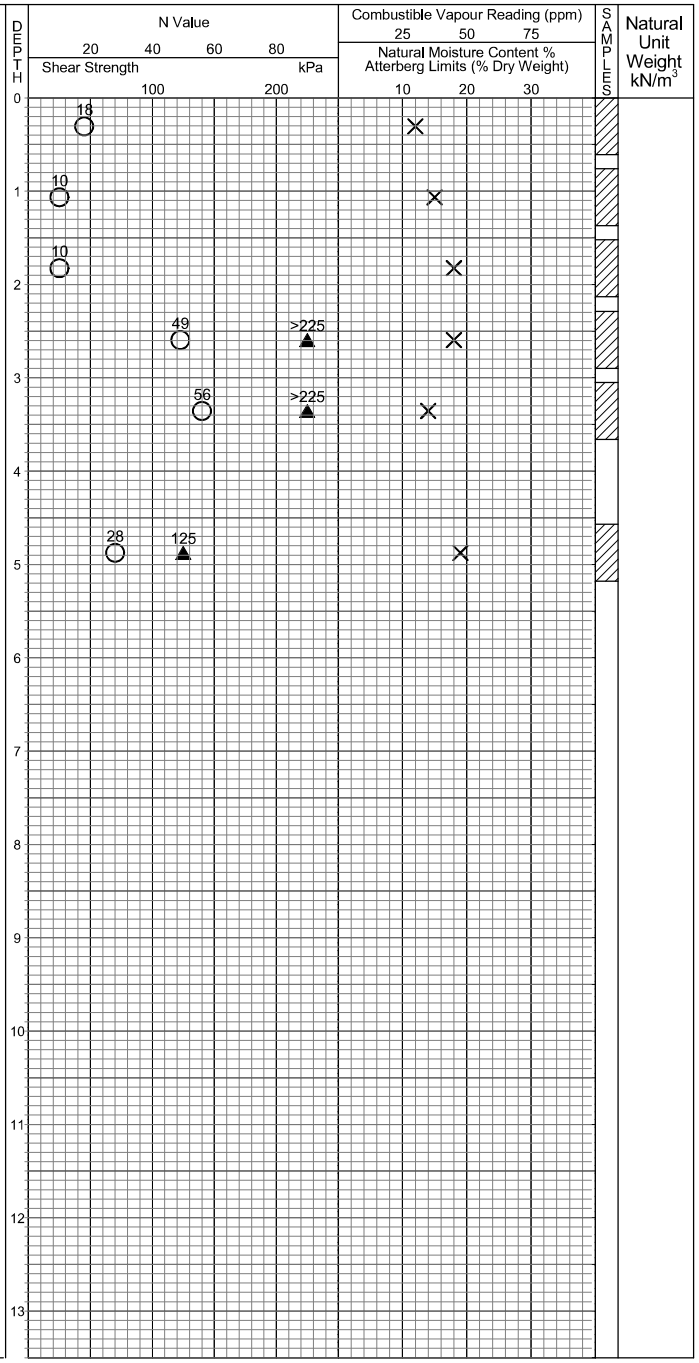
Datum: Geodetic

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

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

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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

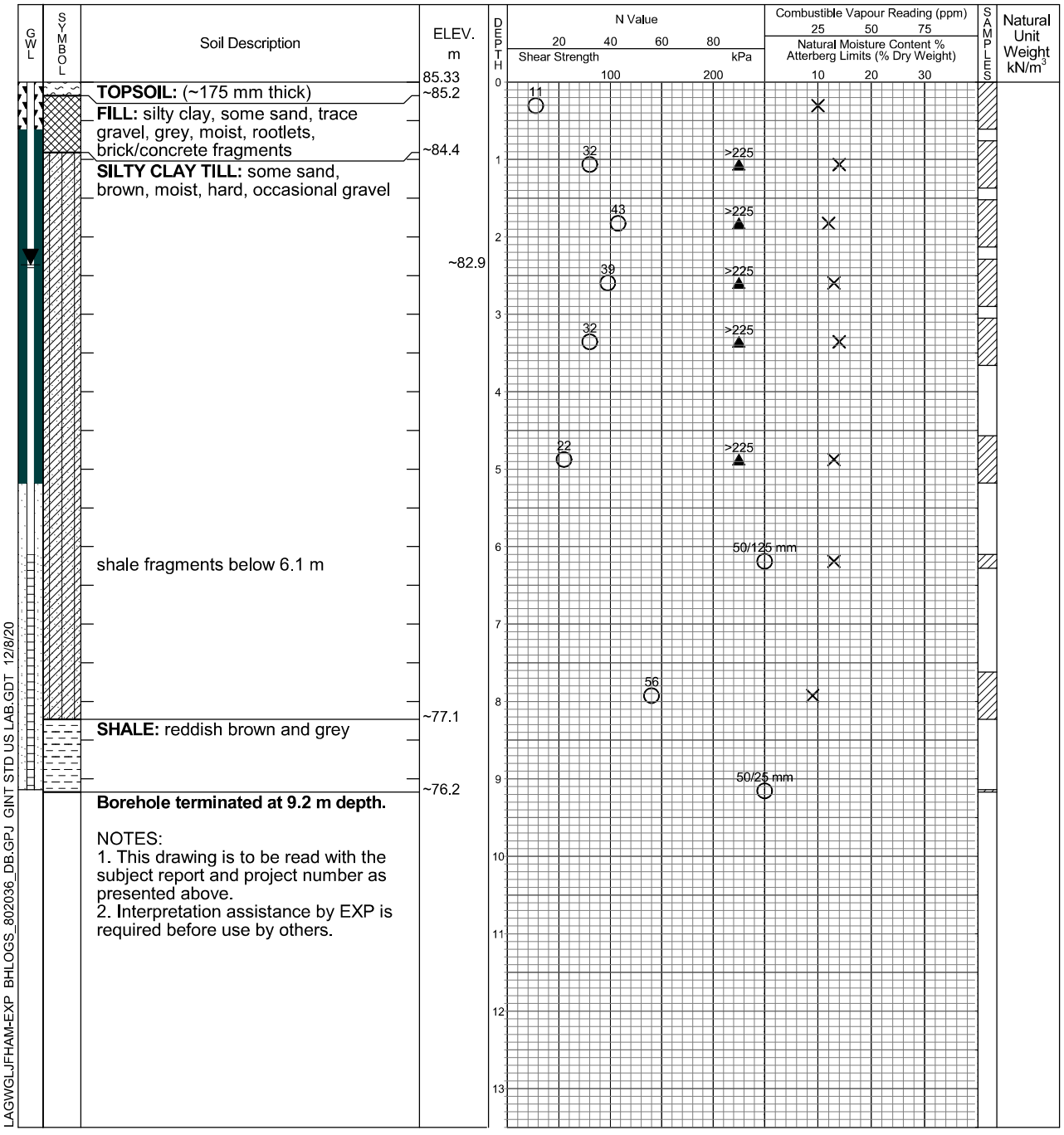
Date Drilled: November 9, 2020

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.

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	9.2
November 23, 2020	2.3	N/A
November 30, 2020	2.4	N/A

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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

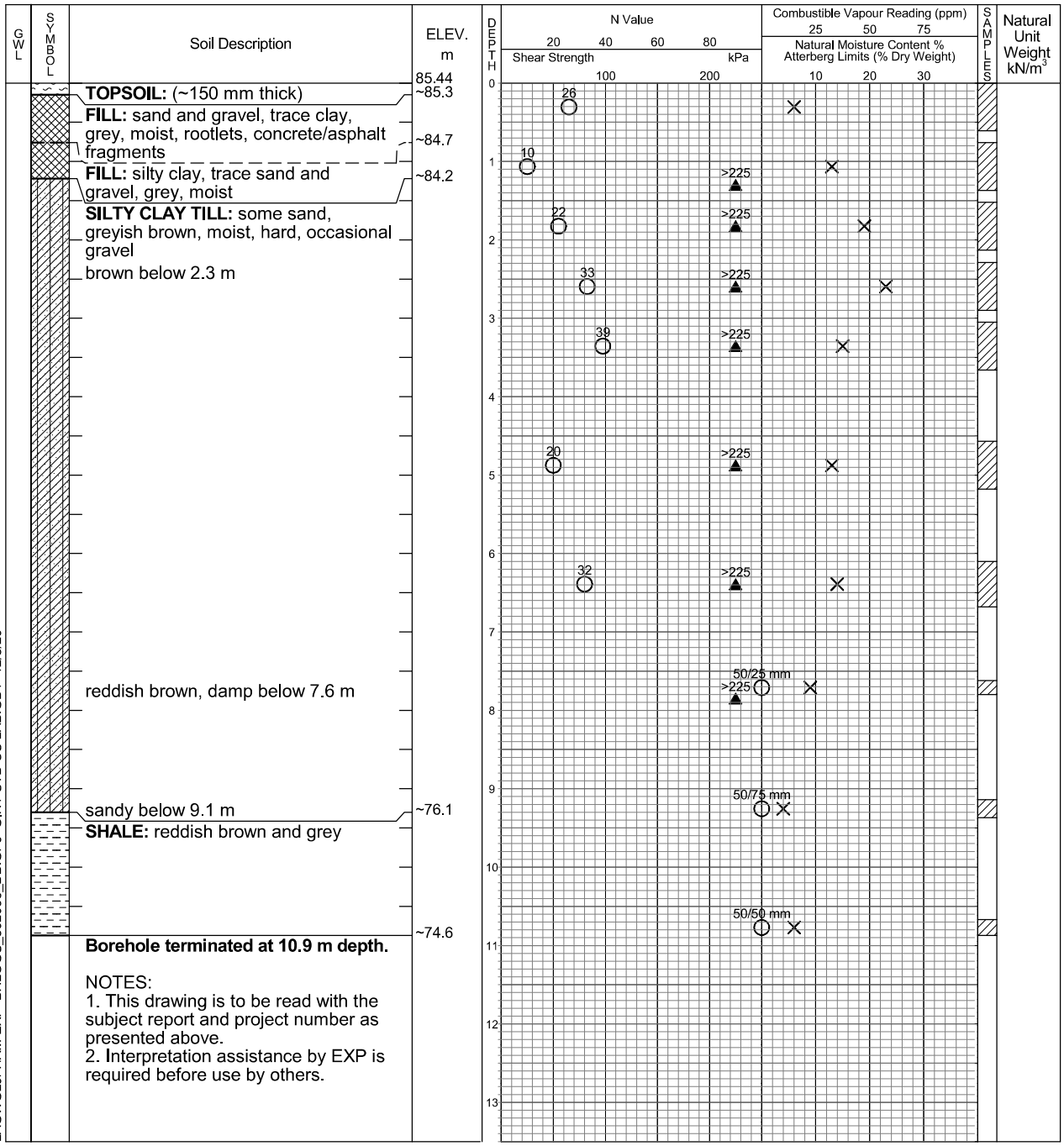
Date Drilled: November 10, 2020

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

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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

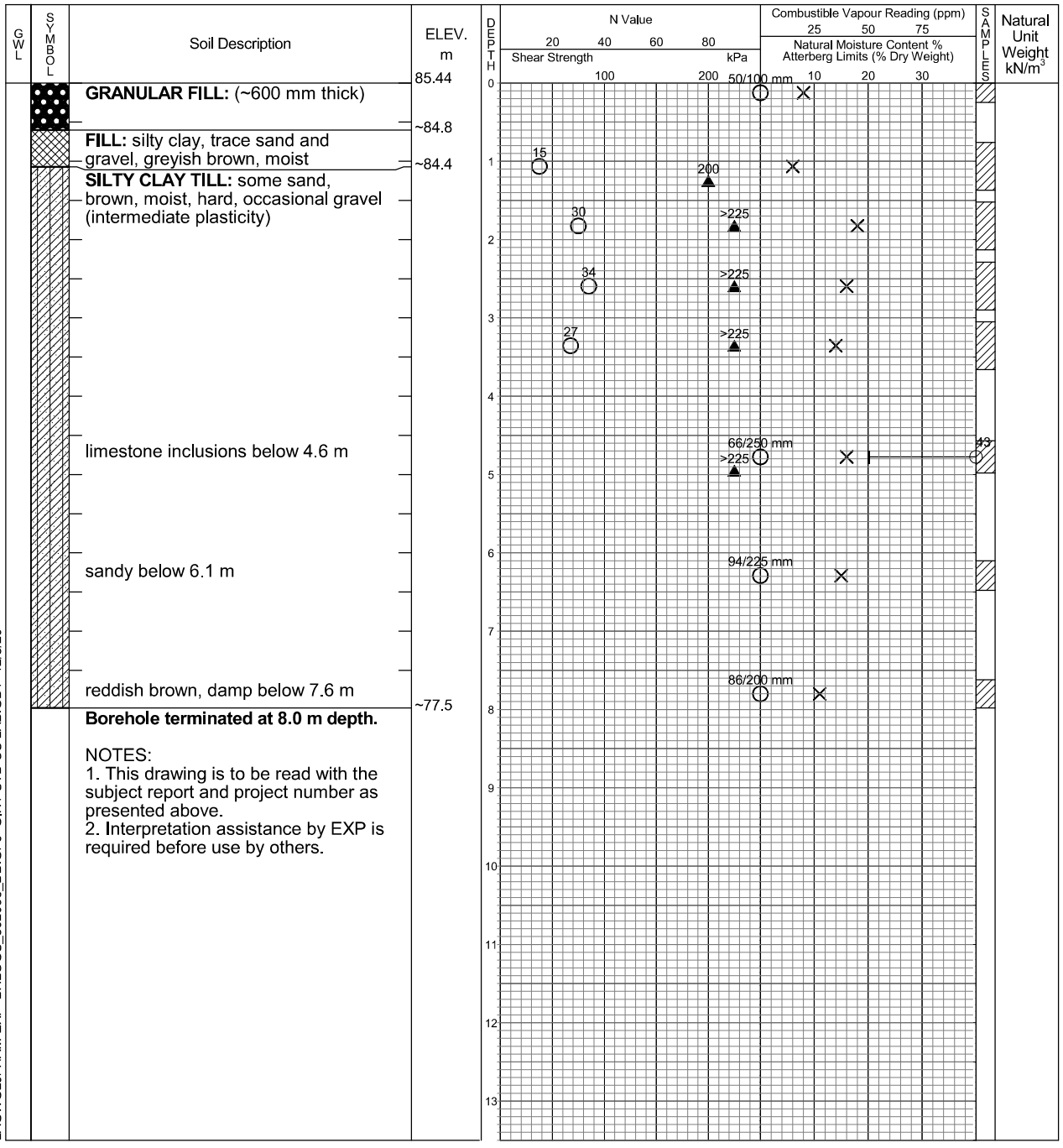
Date Drilled: November 11, 2020

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

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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

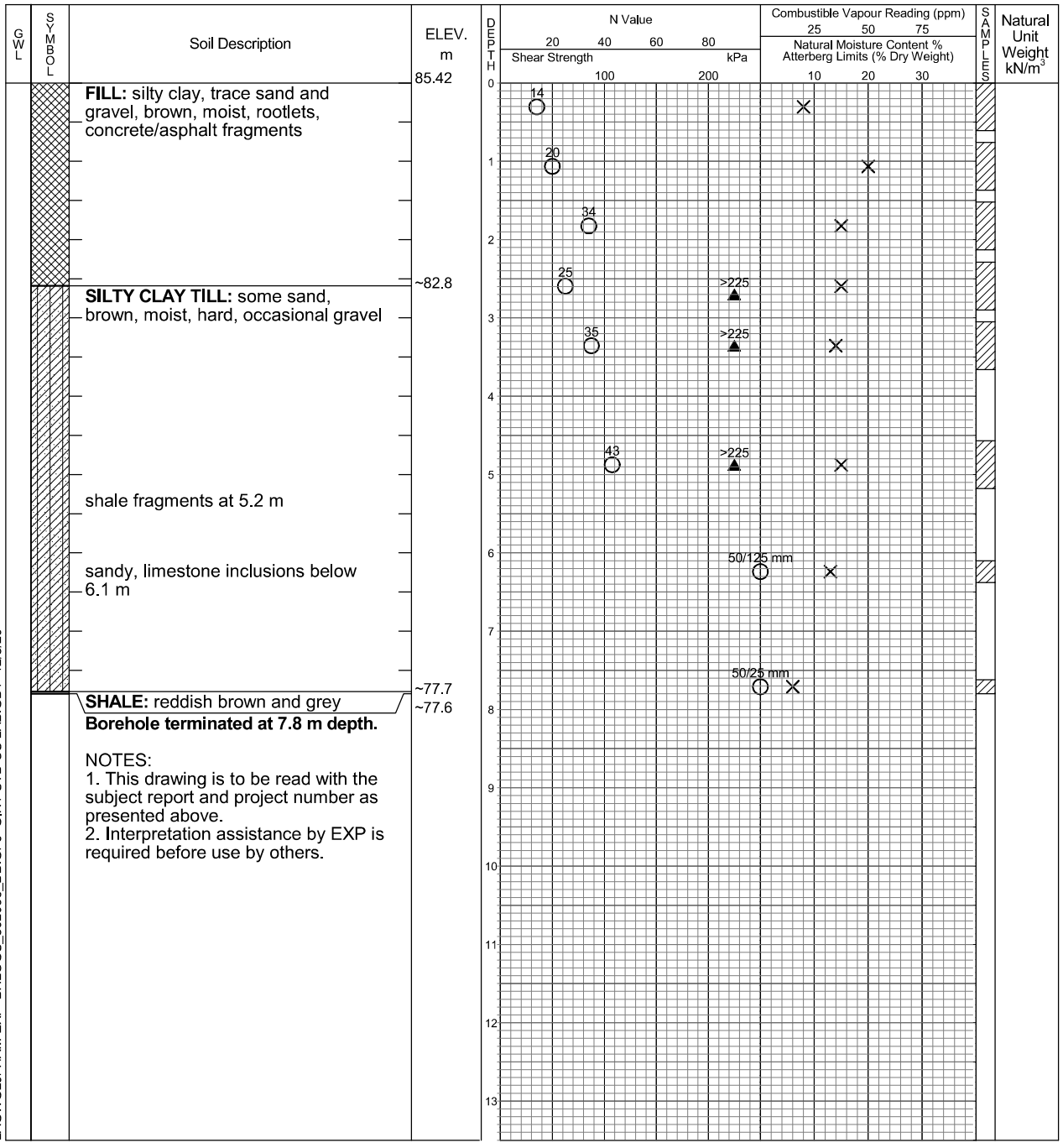
Date Drilled: November 9, 2020

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

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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

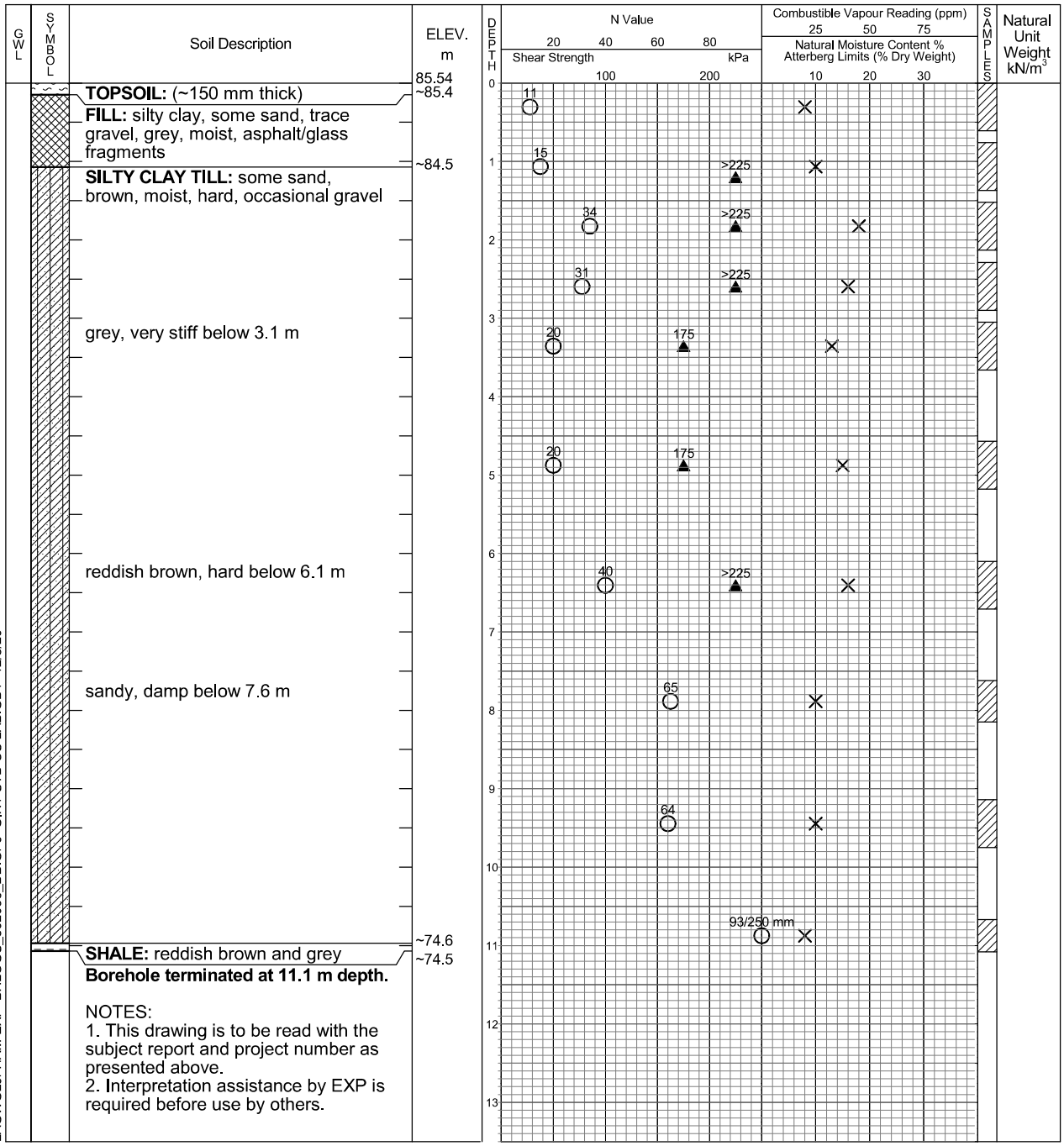
Date Drilled: November 11, 2020

Drill Type: CME-55 Track Mount. Solid Stem

Datum: Geodetic

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

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

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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

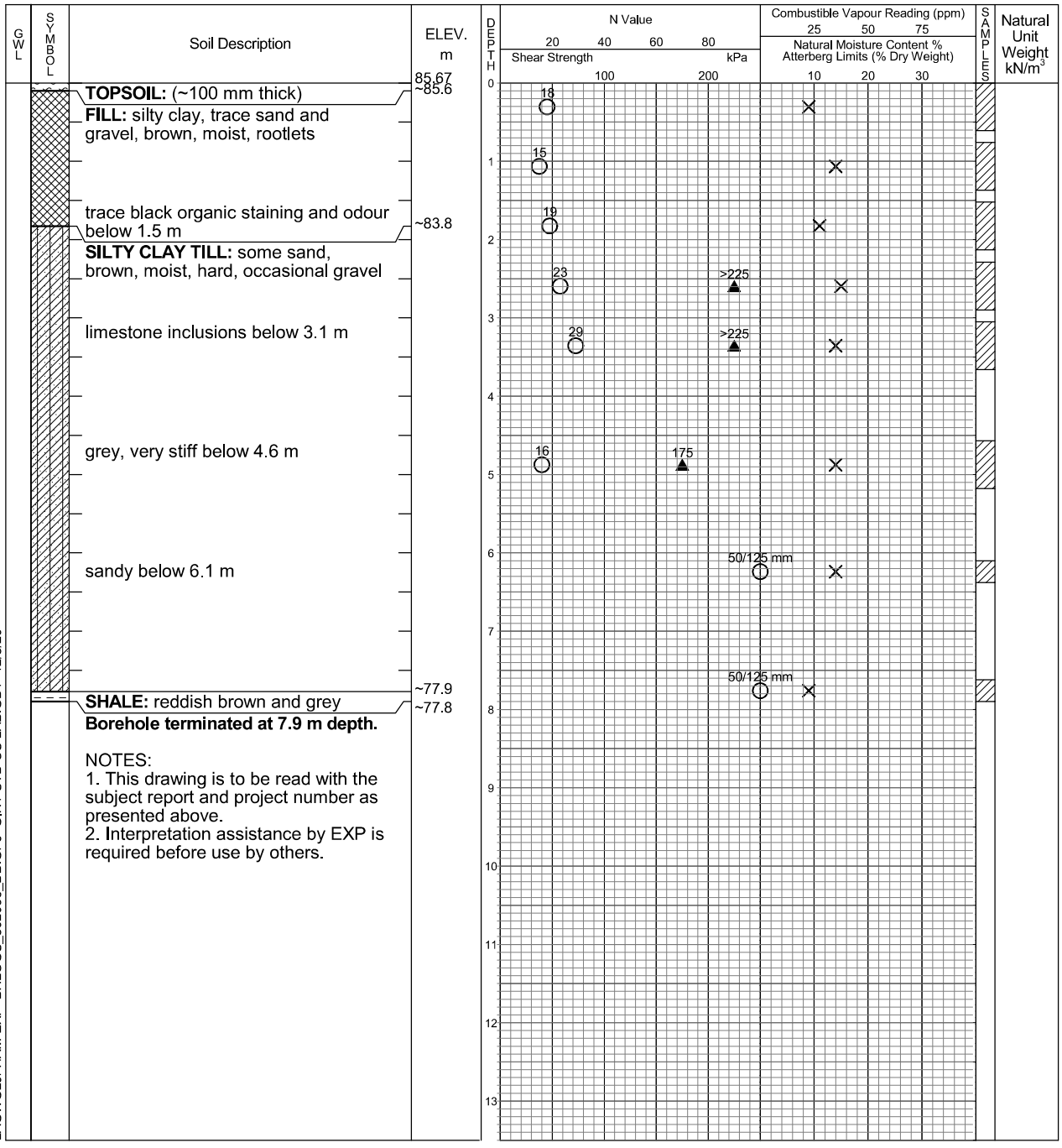
Date Drilled: November 11, 2020

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

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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

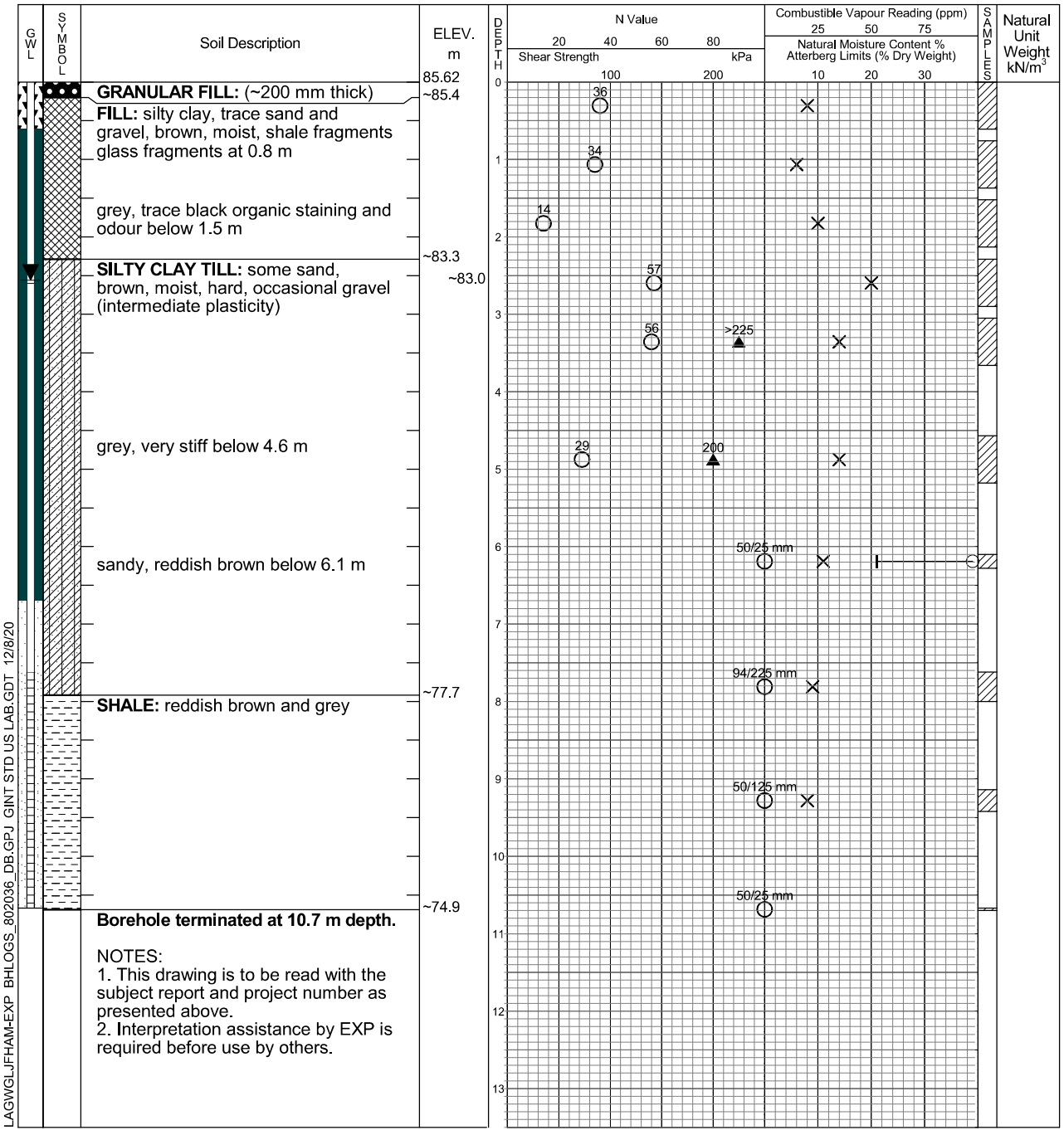
Date Drilled: November 11, 2020

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

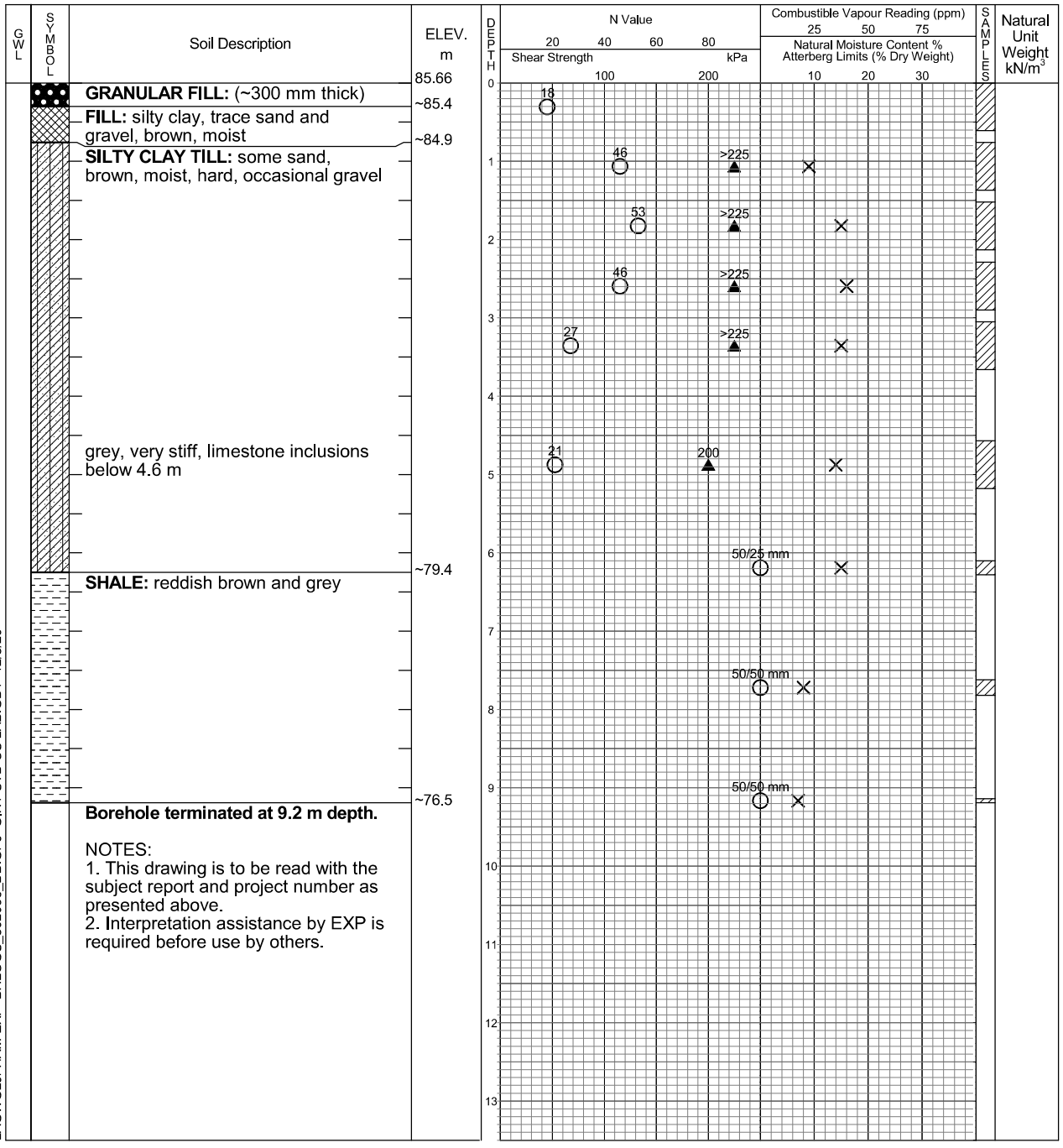
Date Drilled: November 9, 2020

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

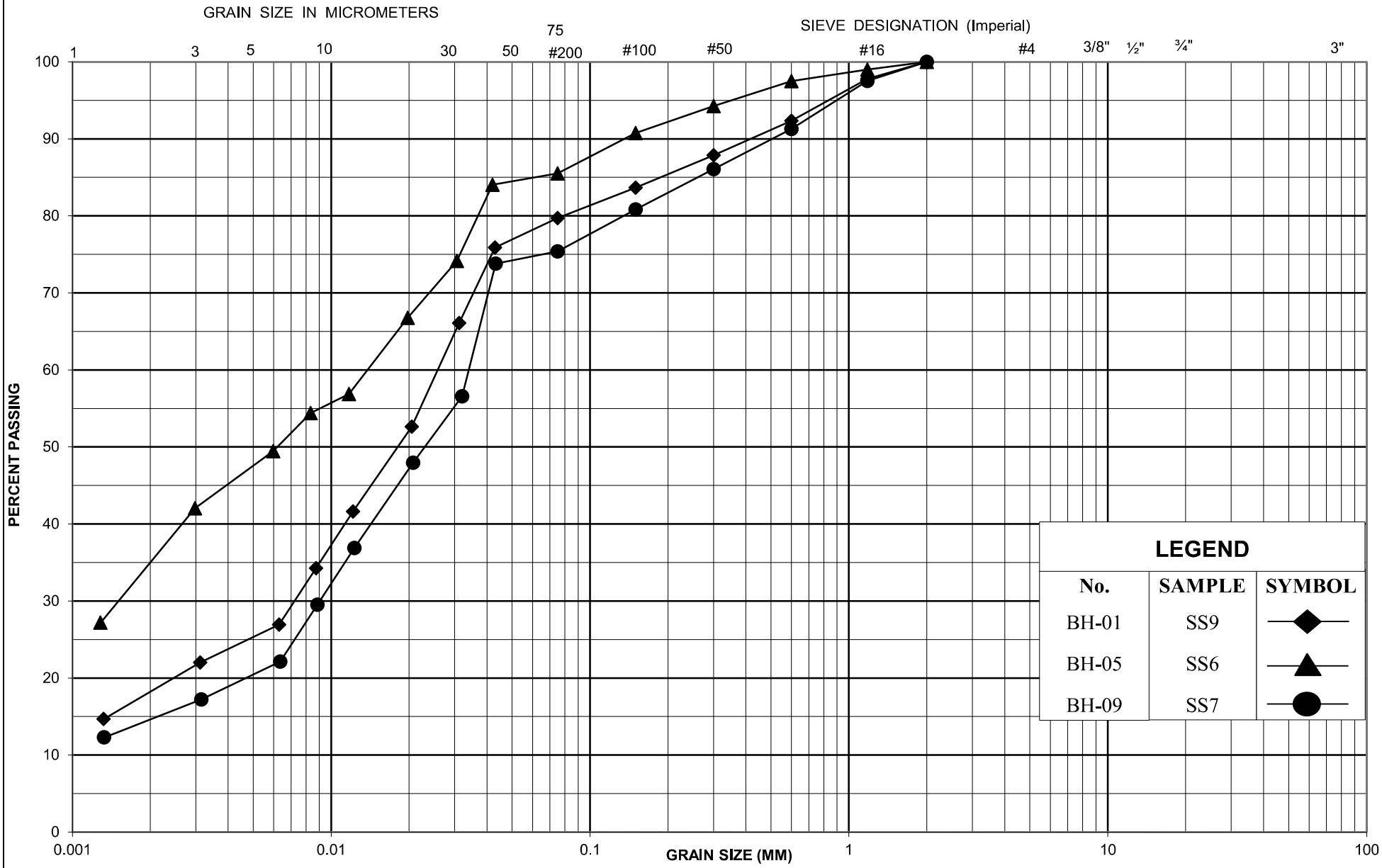
EXP Services Inc.
Hamilton, ON
Telephone: 905.573.4000
Facsimile: 905.573.9693

Appendix B

Laboratory Test Results

ISSMFE SOIL CLASSIFICATION SYSTEM

CLAY	SILT			SAND			GRAVEL			Cobbles
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

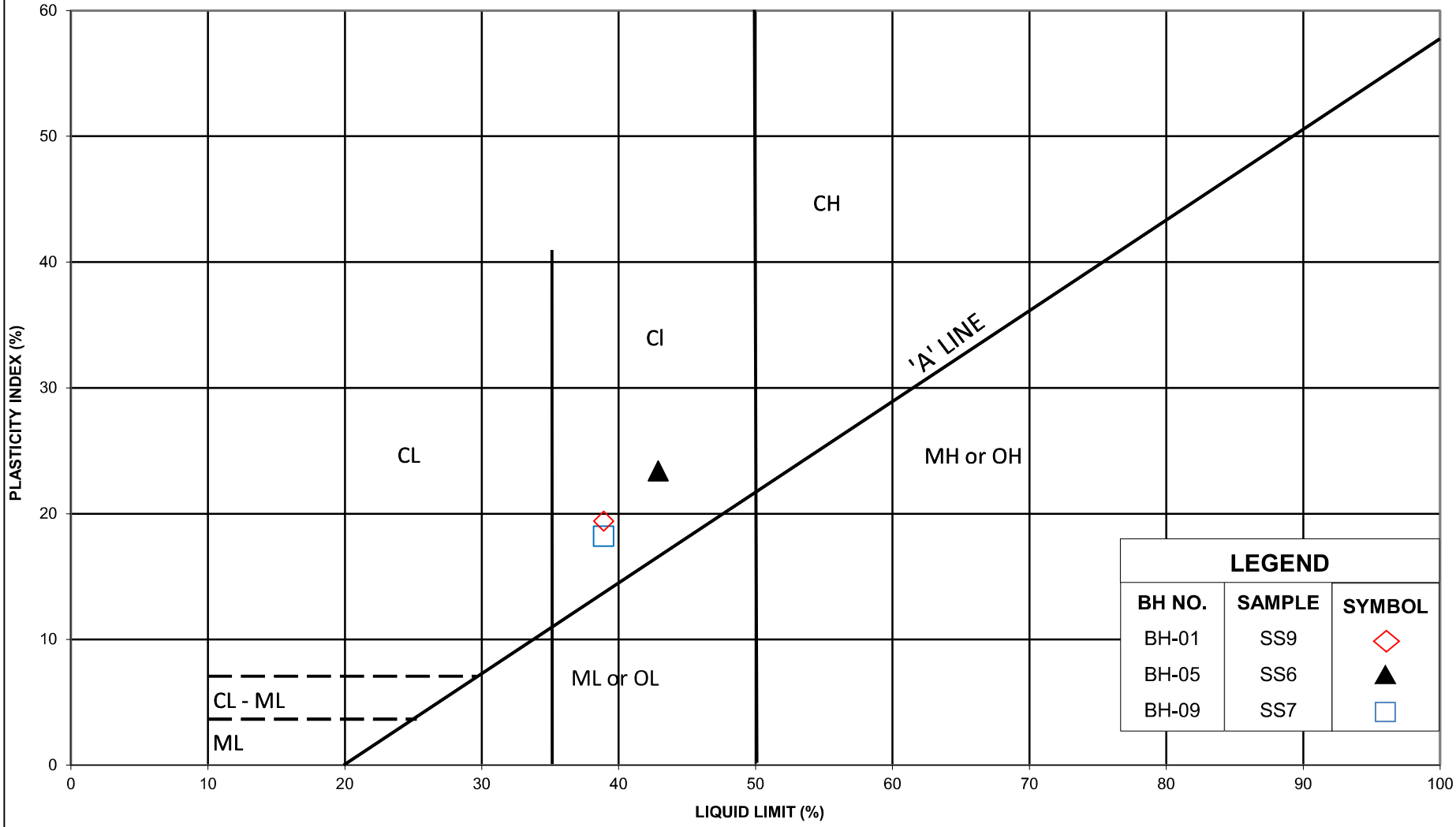


exp.

GRAIN SIZE DISTRIBUTION

DRAWING NO.:	B1
PROJECT NO.:	HAM-00802036-A0
DATE:	DECEMBER 2020

Proposed Mid-Rise Apartment Building
2481 Barton Street East, Hamilton, ON



exp.

PLASTICITY CHART

SILTY CLAY (CI)

DRAWING NO.:	B2
PROJECT NO.:	HAM-00802036-A0
DATE:	DECEMBER 2020

2481 Barton Street, Hamilton, Ontario

L8E 2X1

Hydrogeological Investigation

Client:
Barton Street Developments Inc.
12 Chiavatti Drive, Markham, ON L3R 1E2

Attention: Mr. Rajan Banwait

Type of Document:
Final

Project Name:
2481 Barton Street, Hamilton, Ontario

Project Number:
HAM-00802036-A0

EXP Services Inc.
1595 Clark Boulevard
Brampton, ON, L6T 4V1
t: 905.793.9800
f: 905.793.0641

Date Submitted:
2021-02-03

Table of Contents

List of Figures

List of Appendices

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

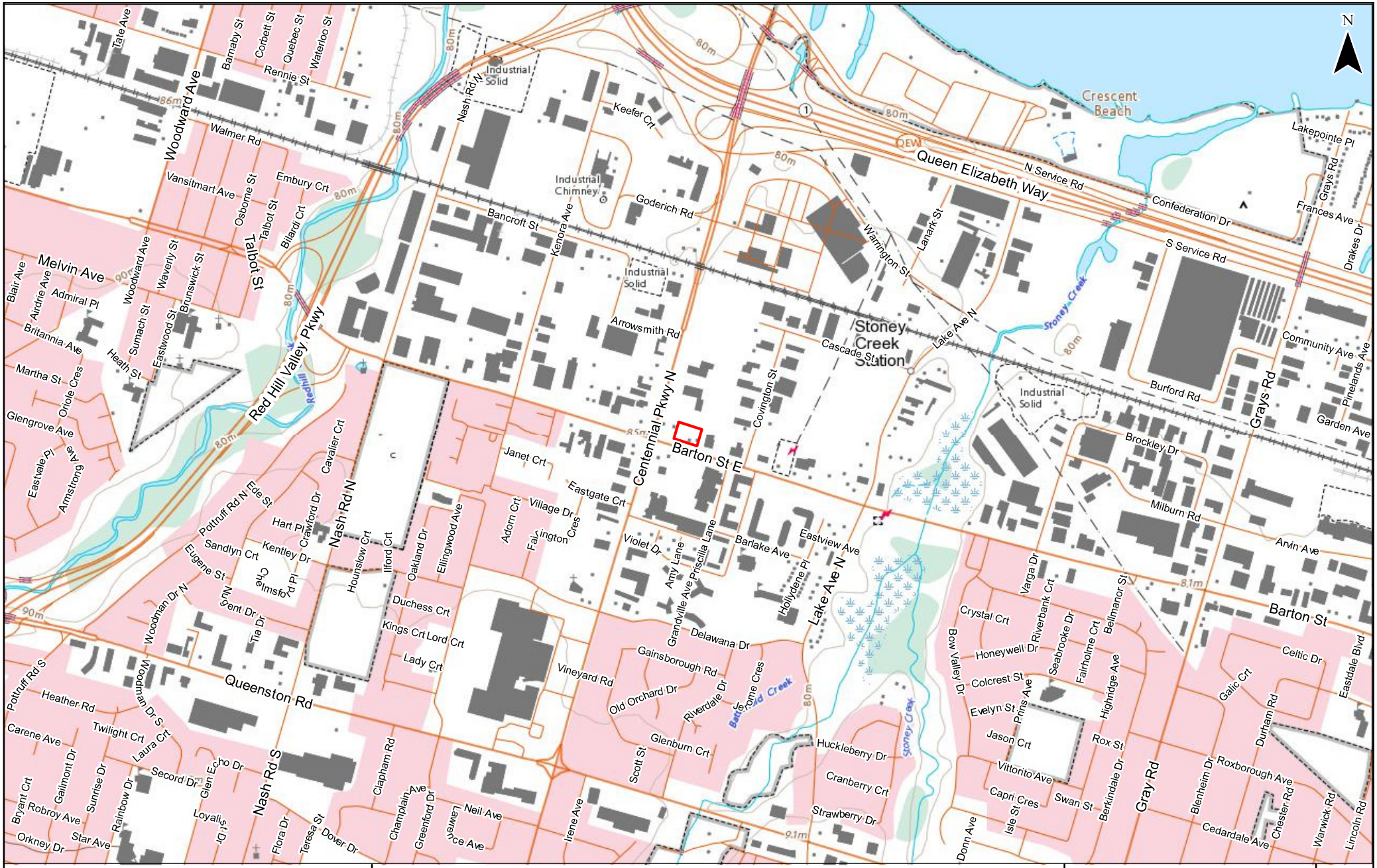
Cashman and Preene (2013) Groundwater Lowering in Construction, 2nd Edition.

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

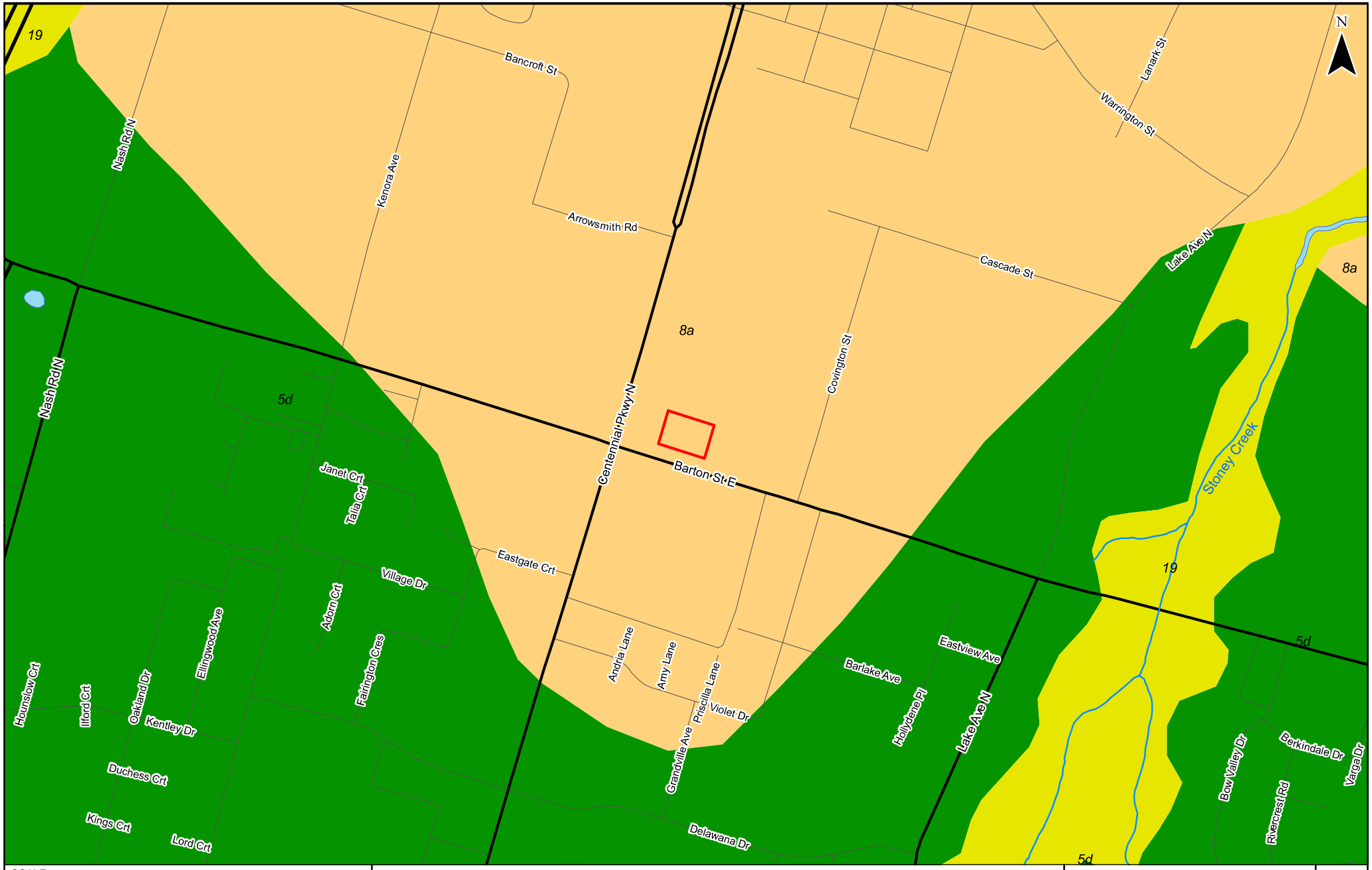
HYDROGEOLOGICAL INVESTIGATION
2481 BARTON STREET
HAMILTON, ONTARIO

exp.

DRAWN BY:	CHECKED BY:
AC	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

DRAWN BY: AC

CHECKED BY: 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

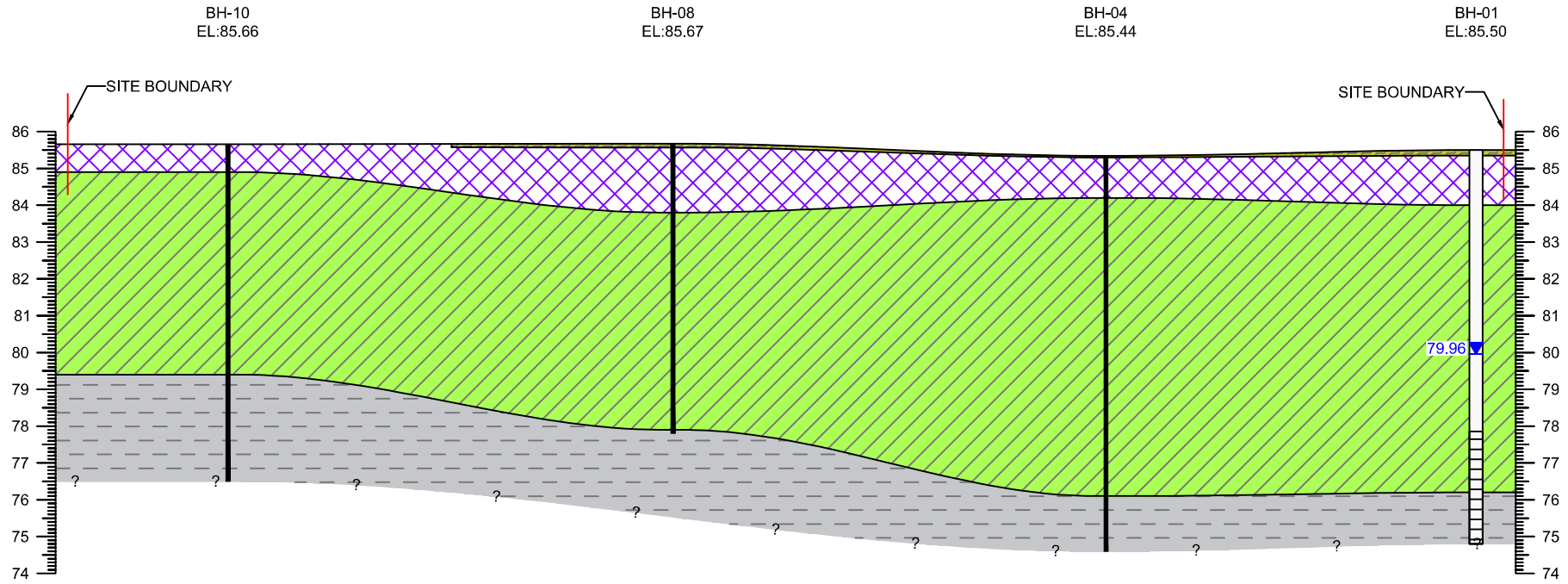
HYDROGEOLOGICAL INVESTIGATION
2481 BARTON STREET EAST
HAMILTON, ONTARIO

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.
t: +1.905.793.9800 | f: +1.905.793.0641
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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

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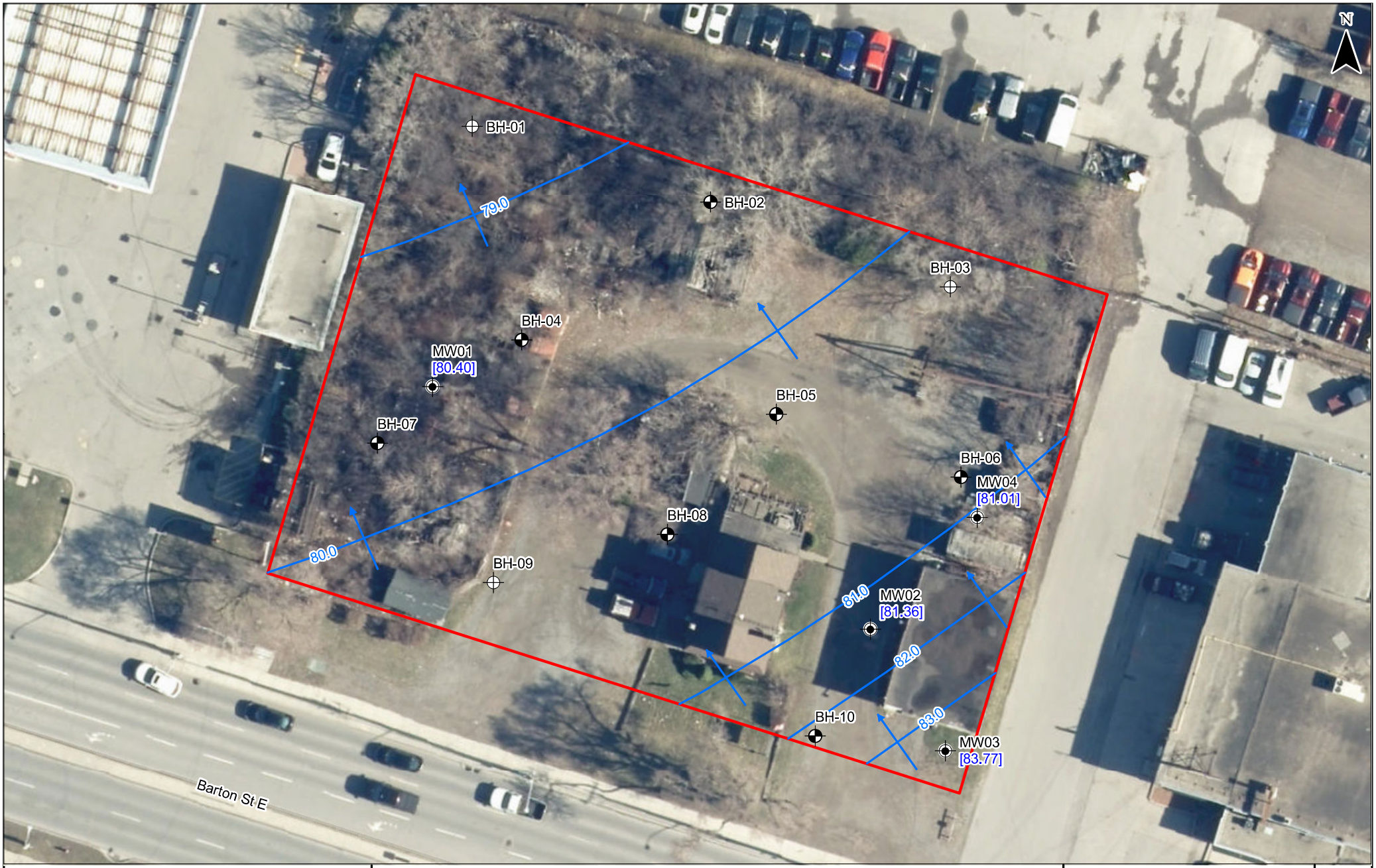


SCALE:

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

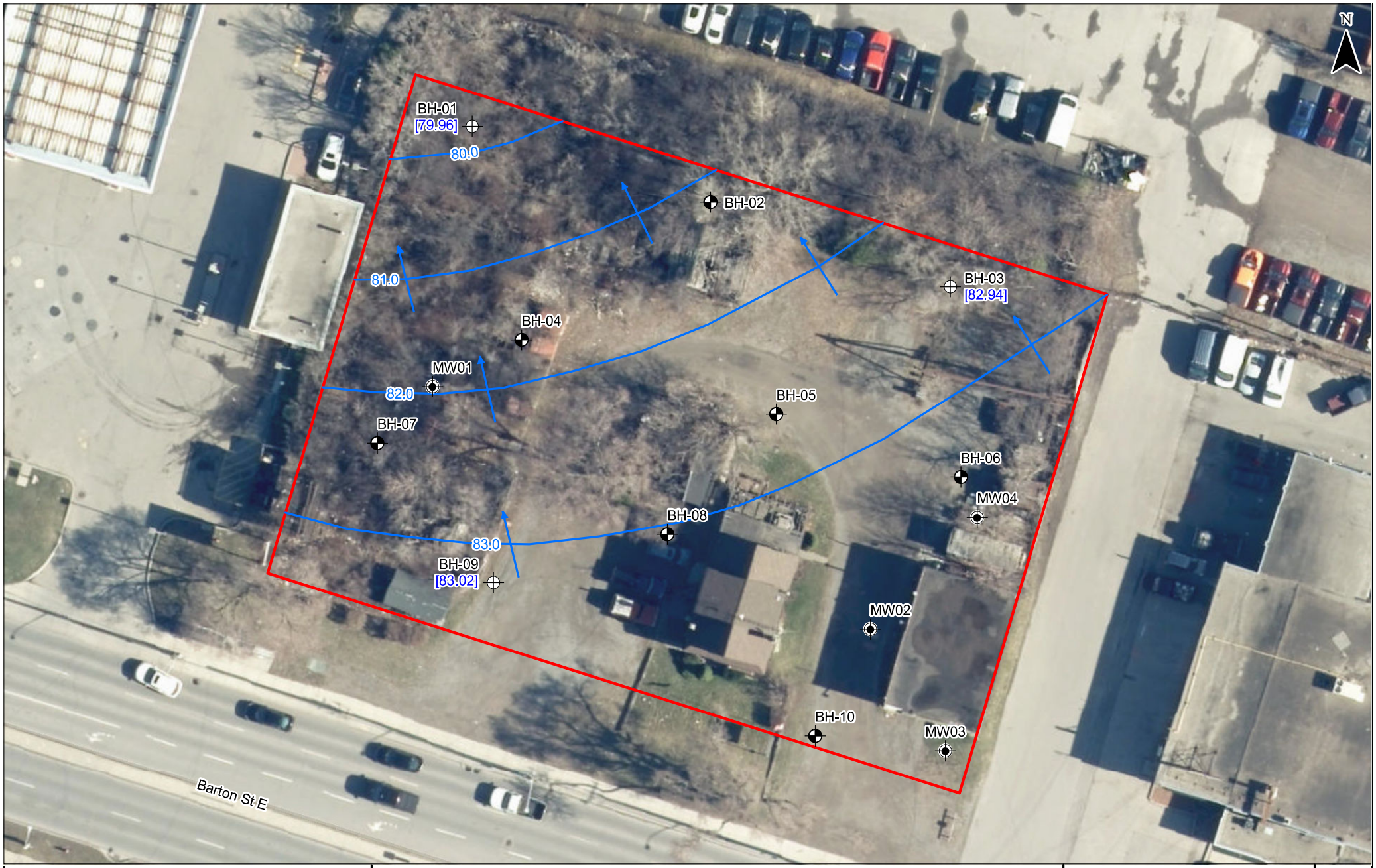
SHALLOW CONTOUR PLAN

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

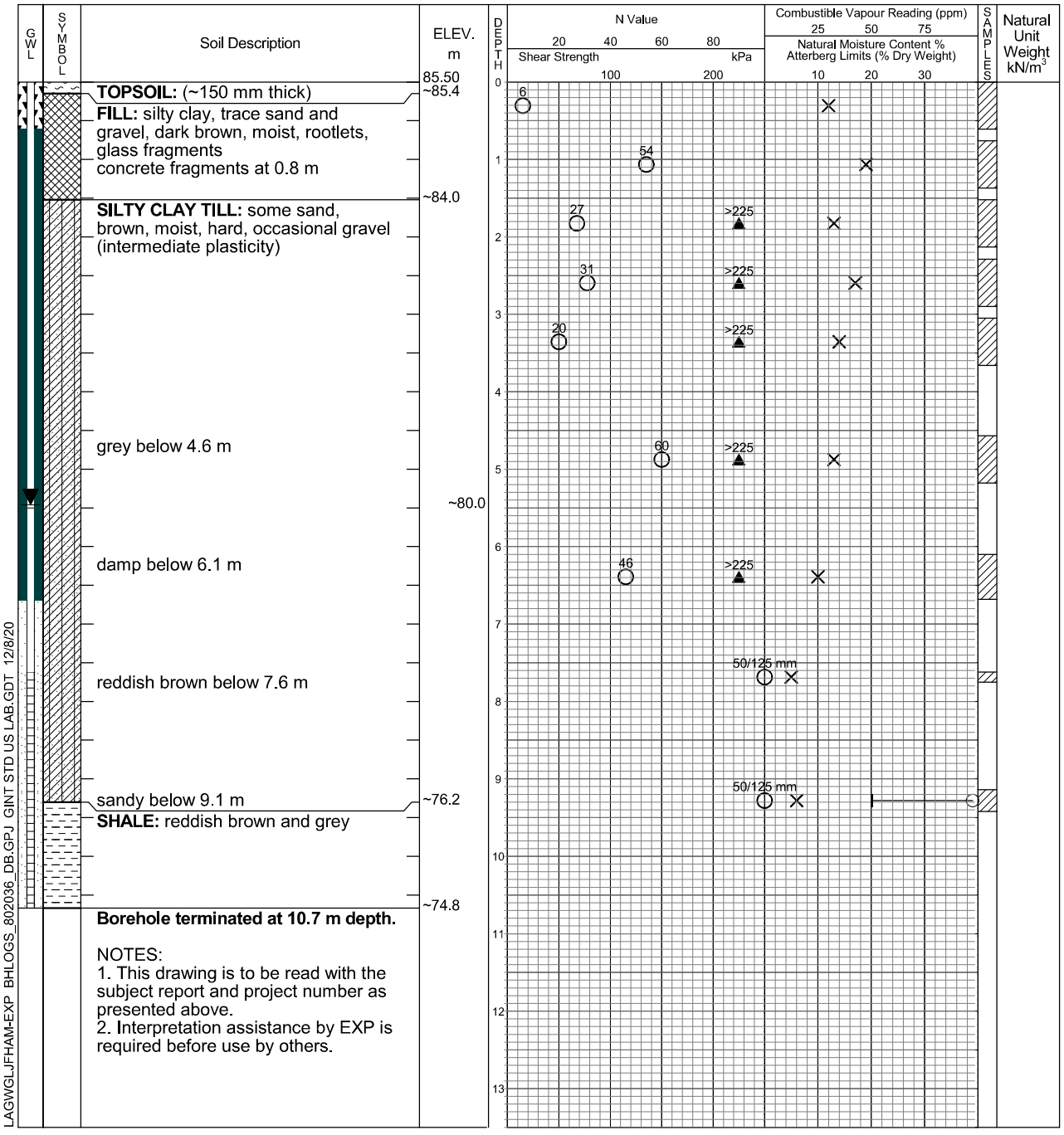
Date Drilled: November 10, 2020

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



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

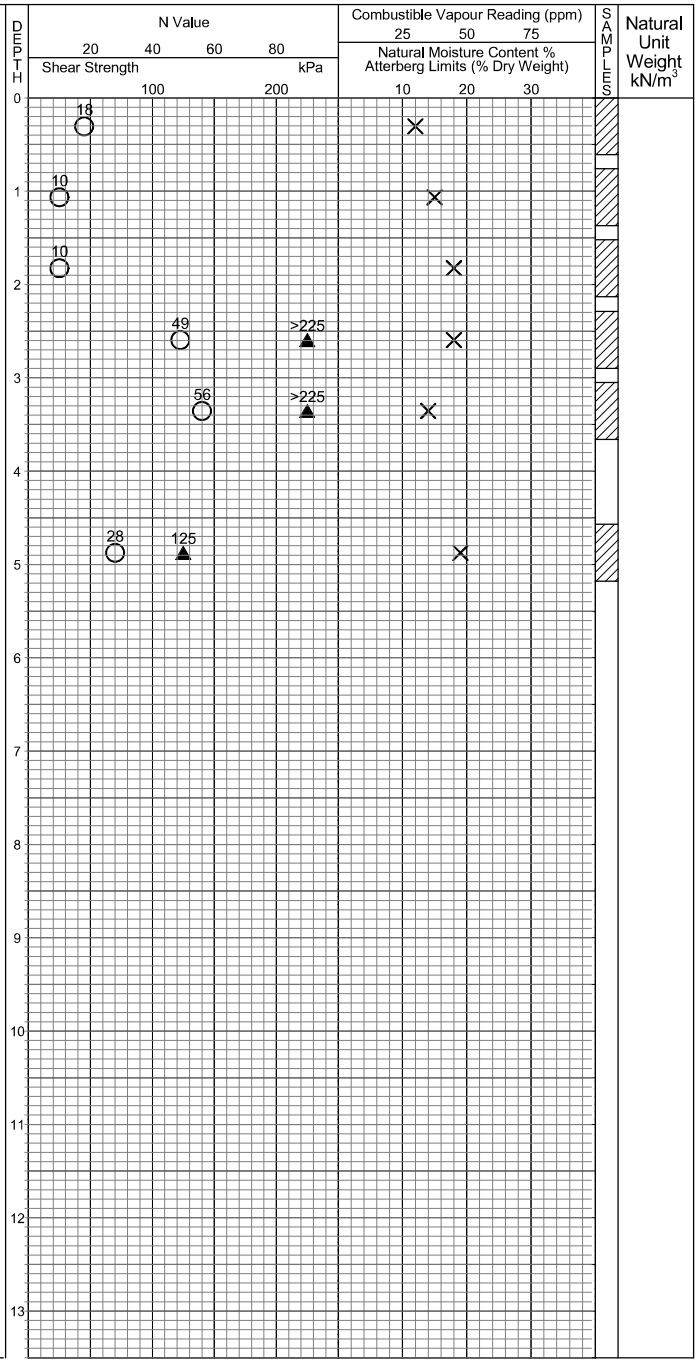
Datum: Geodetic

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

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

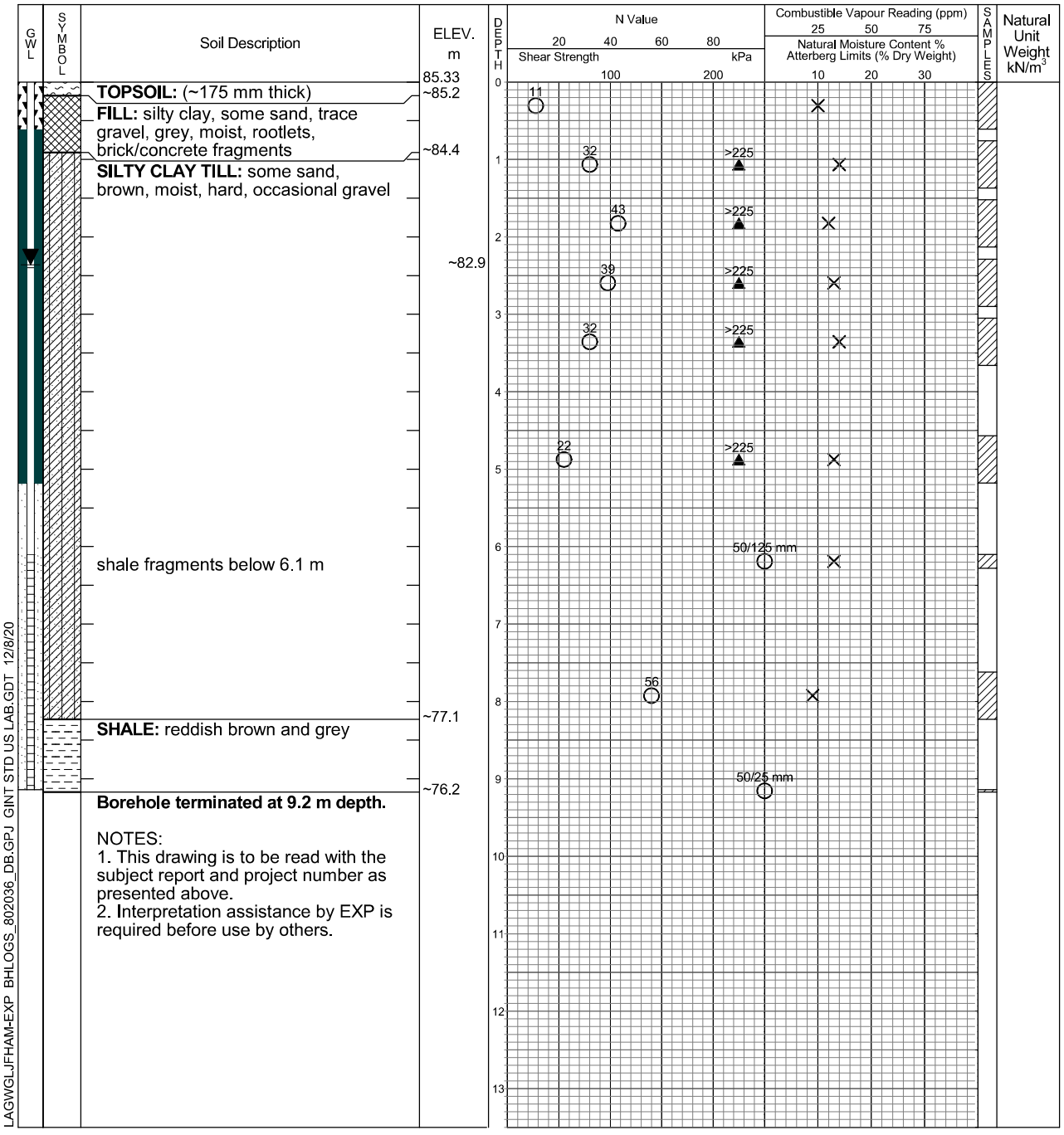
Date Drilled: November 9, 2020

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.

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	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

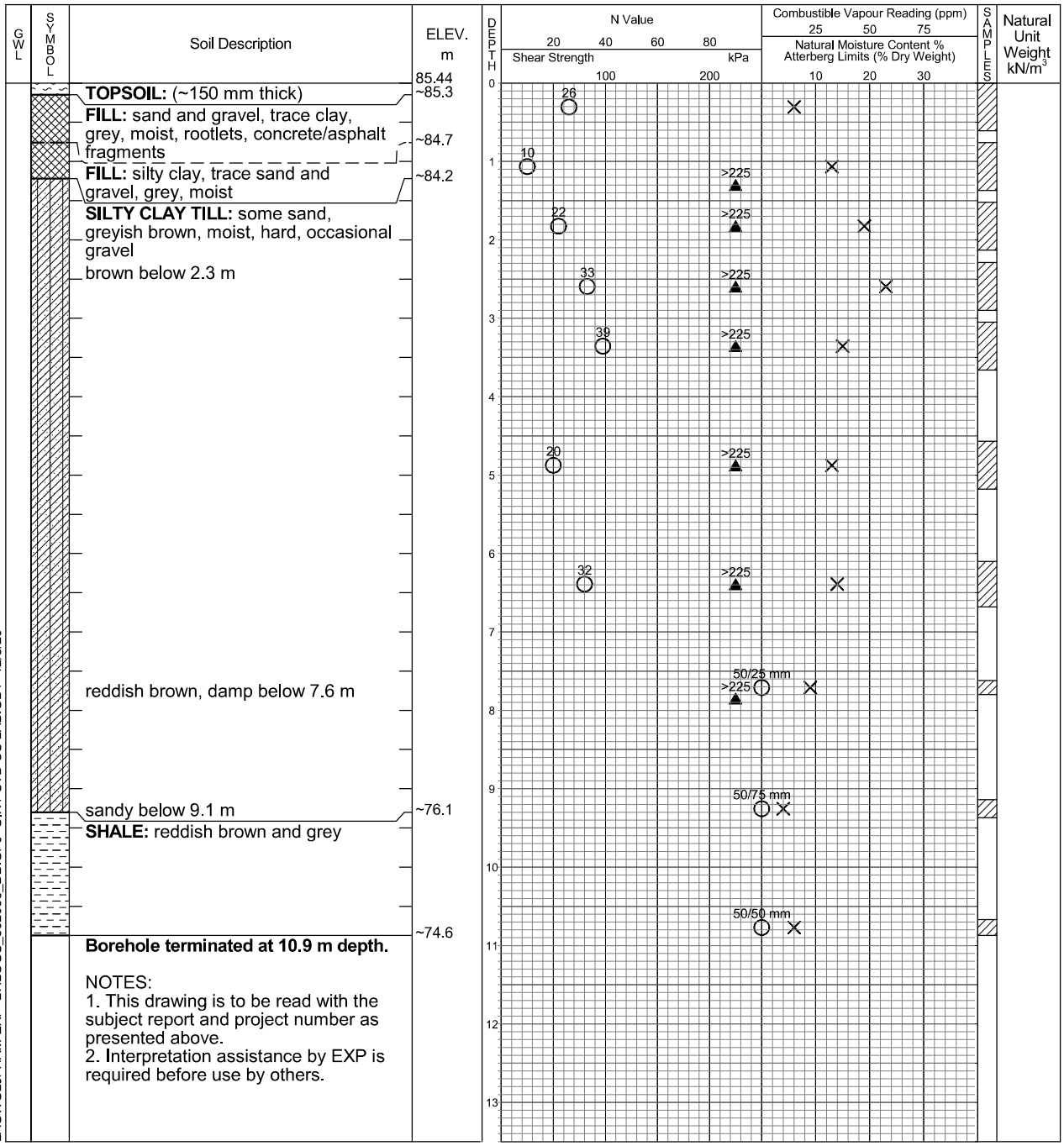
Date Drilled: November 10, 2020

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

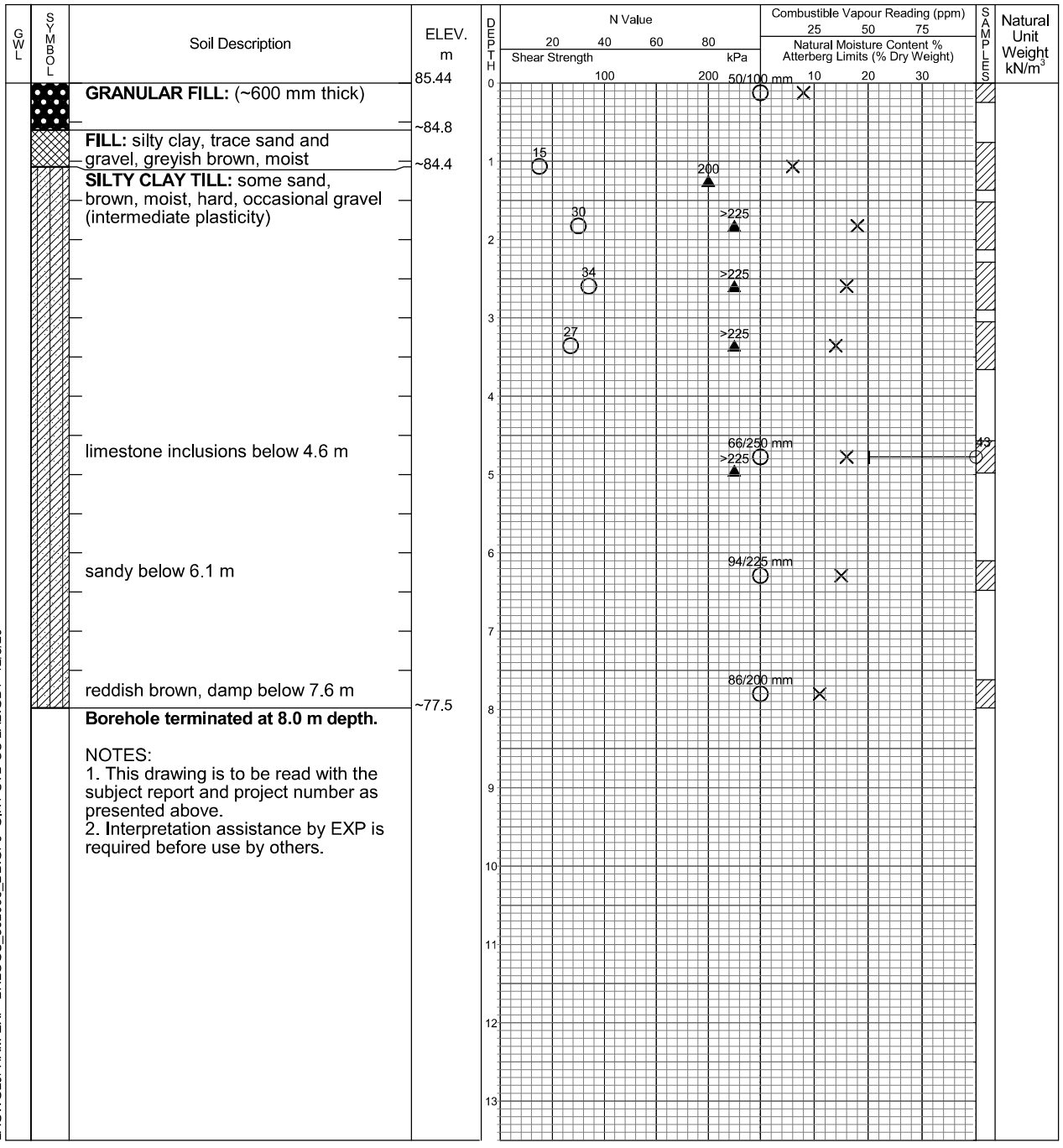
Date Drilled: November 11, 2020

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

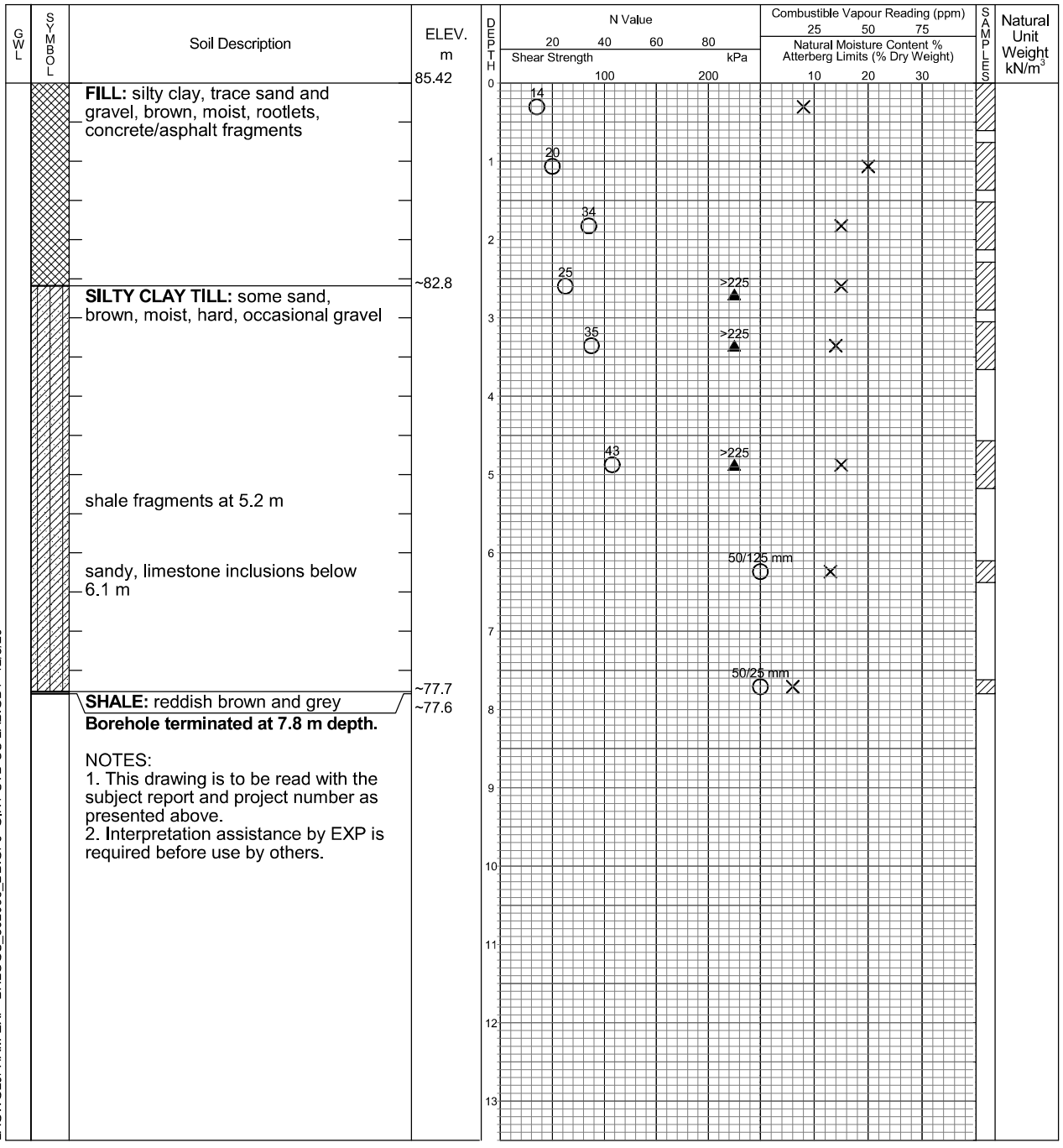
Date Drilled: November 9, 2020

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

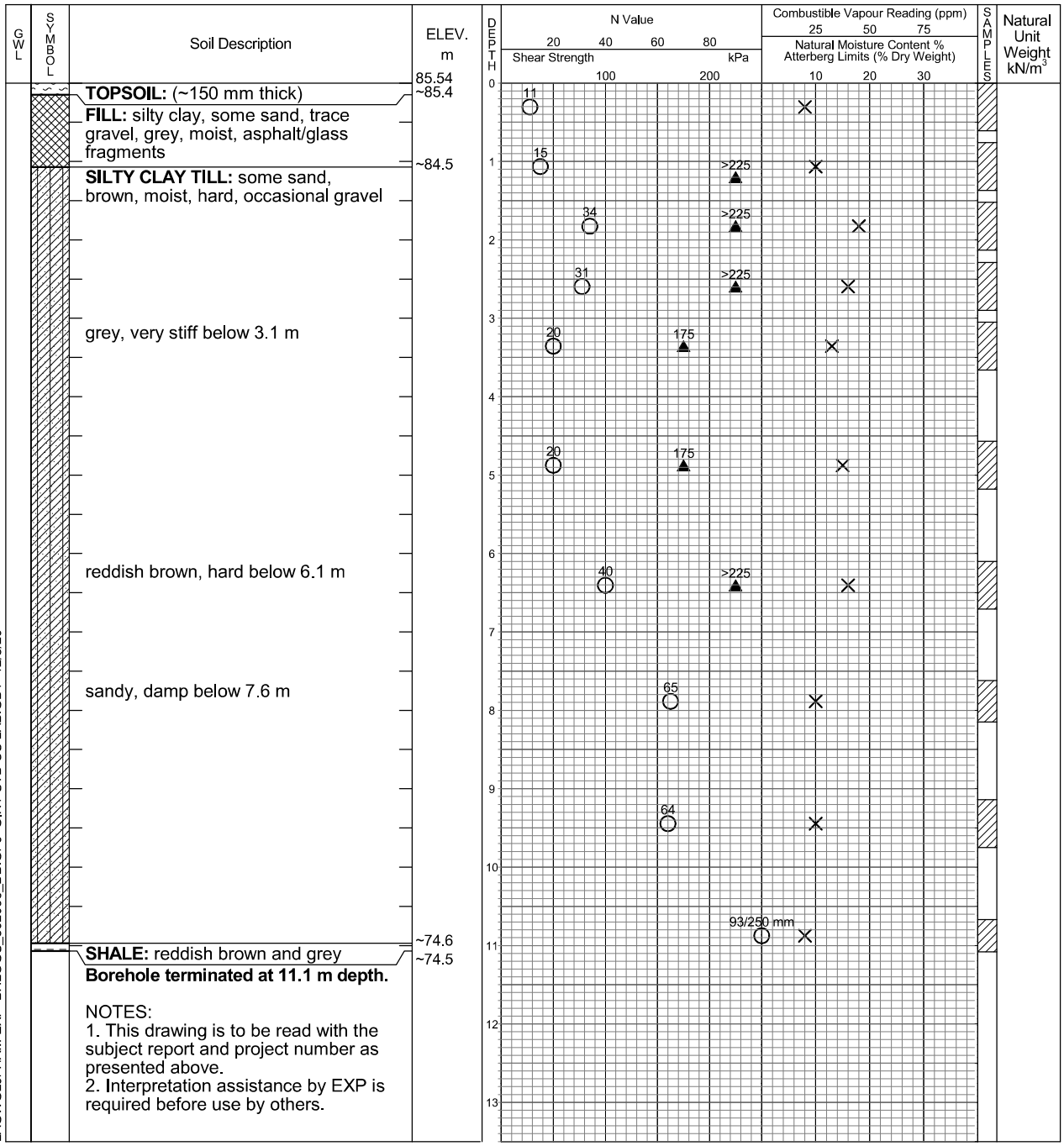
Date Drilled: November 11, 2020

Drill Type: CME-55 Track Mount. Solid Stem

Datum: Geodetic

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

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

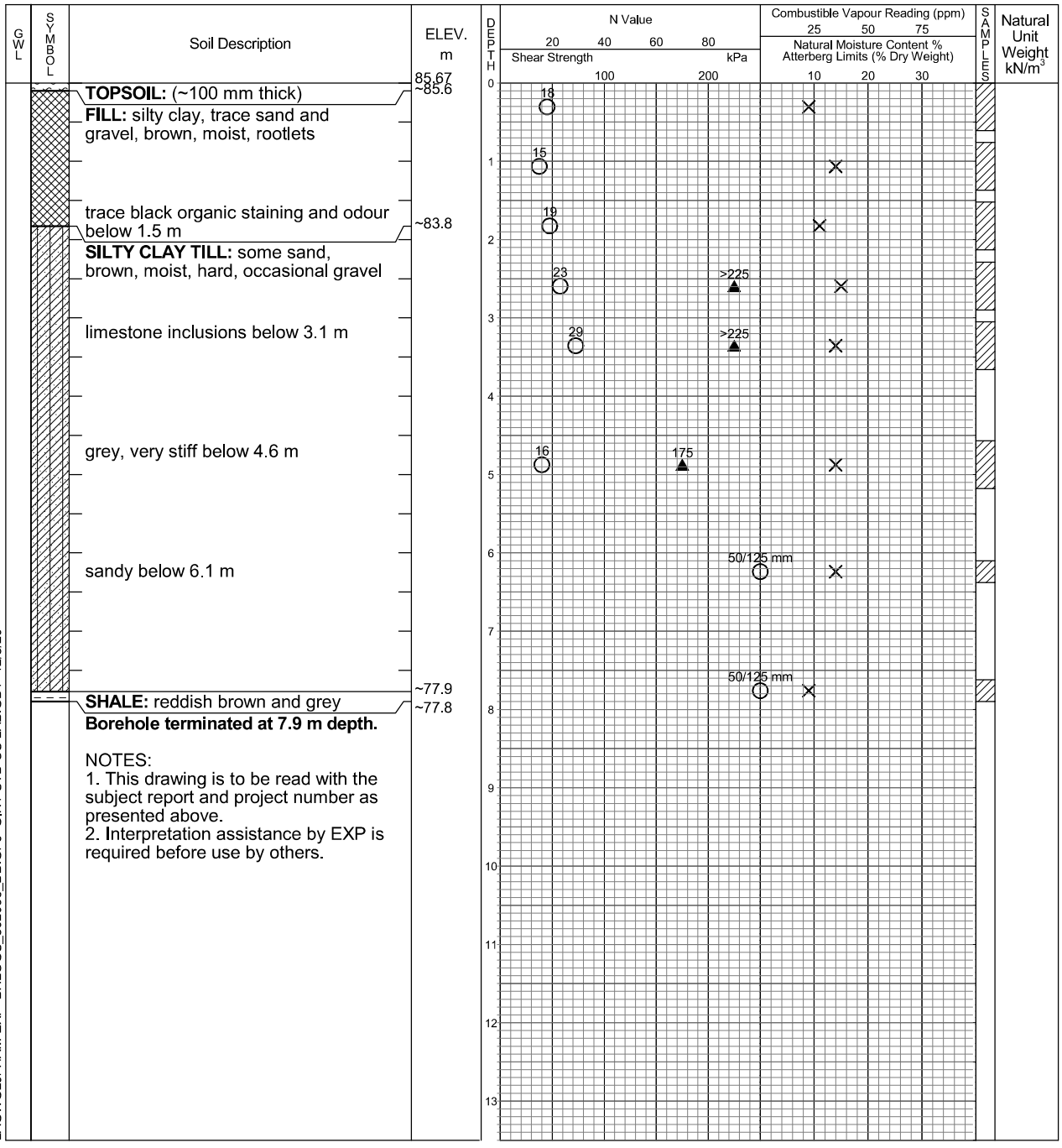
Date Drilled: November 11, 2020

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

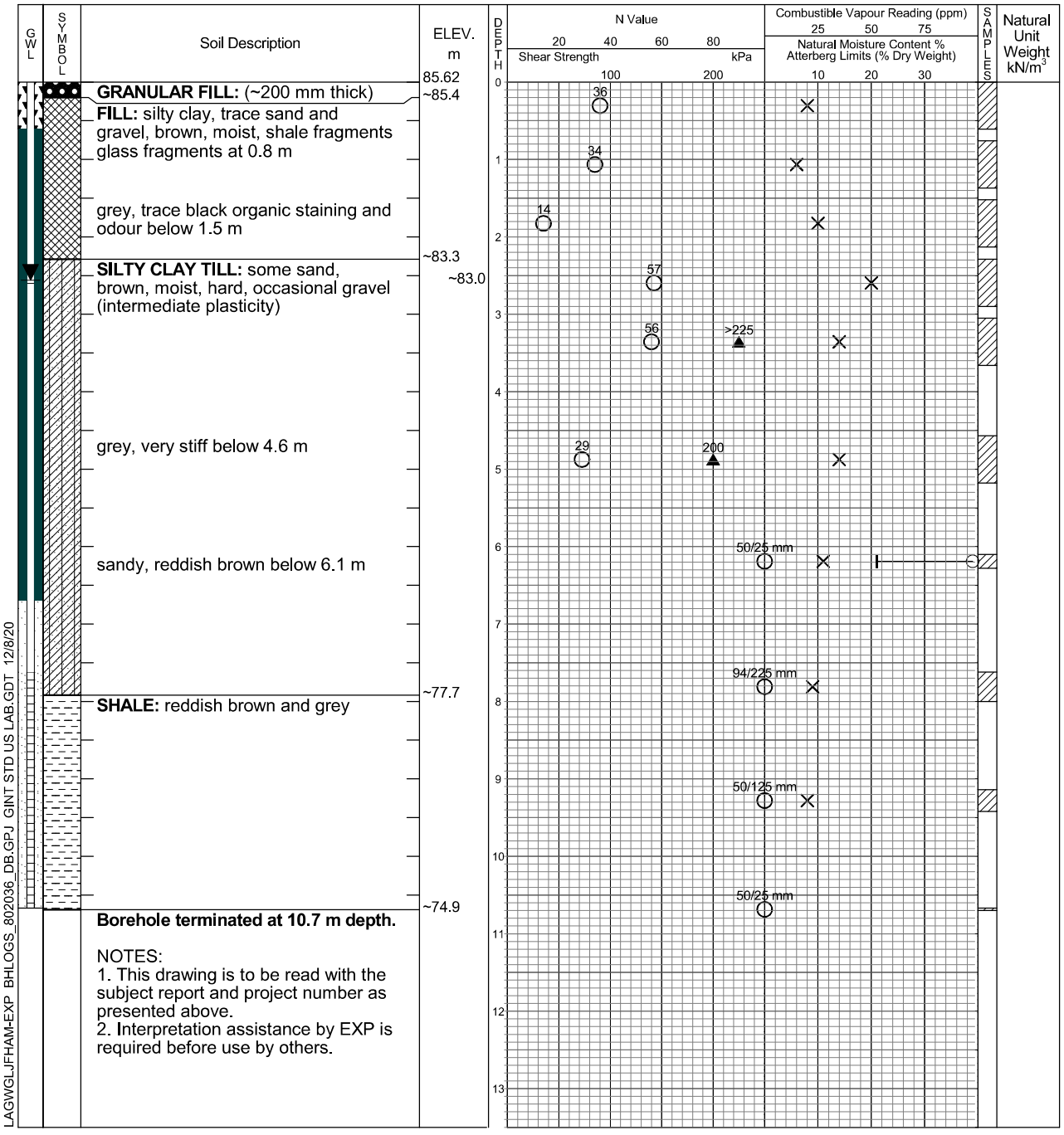
Date Drilled: November 11, 2020

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

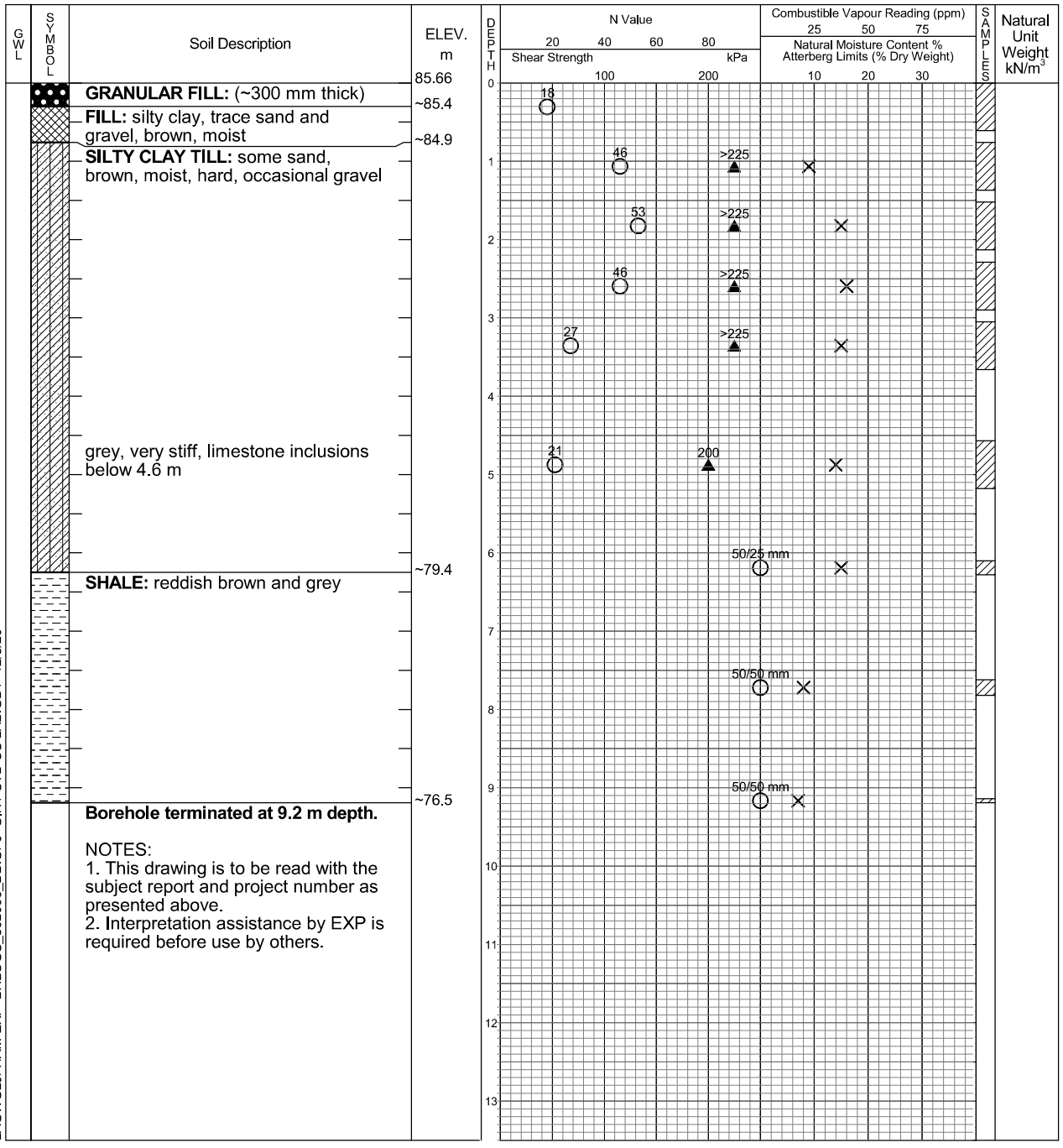
Date Drilled: November 9, 2020

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

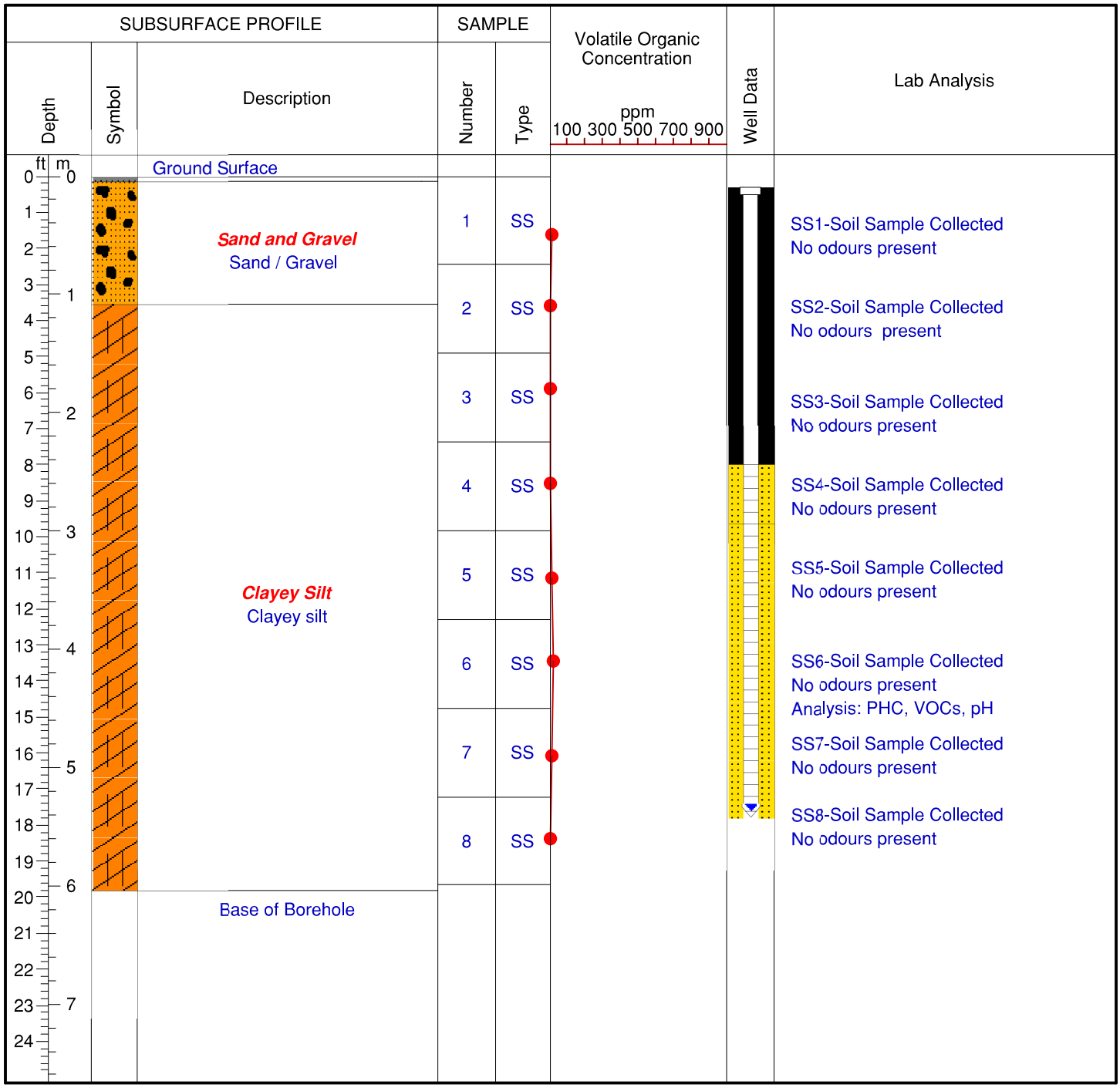
Log of: BH1/MW01

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

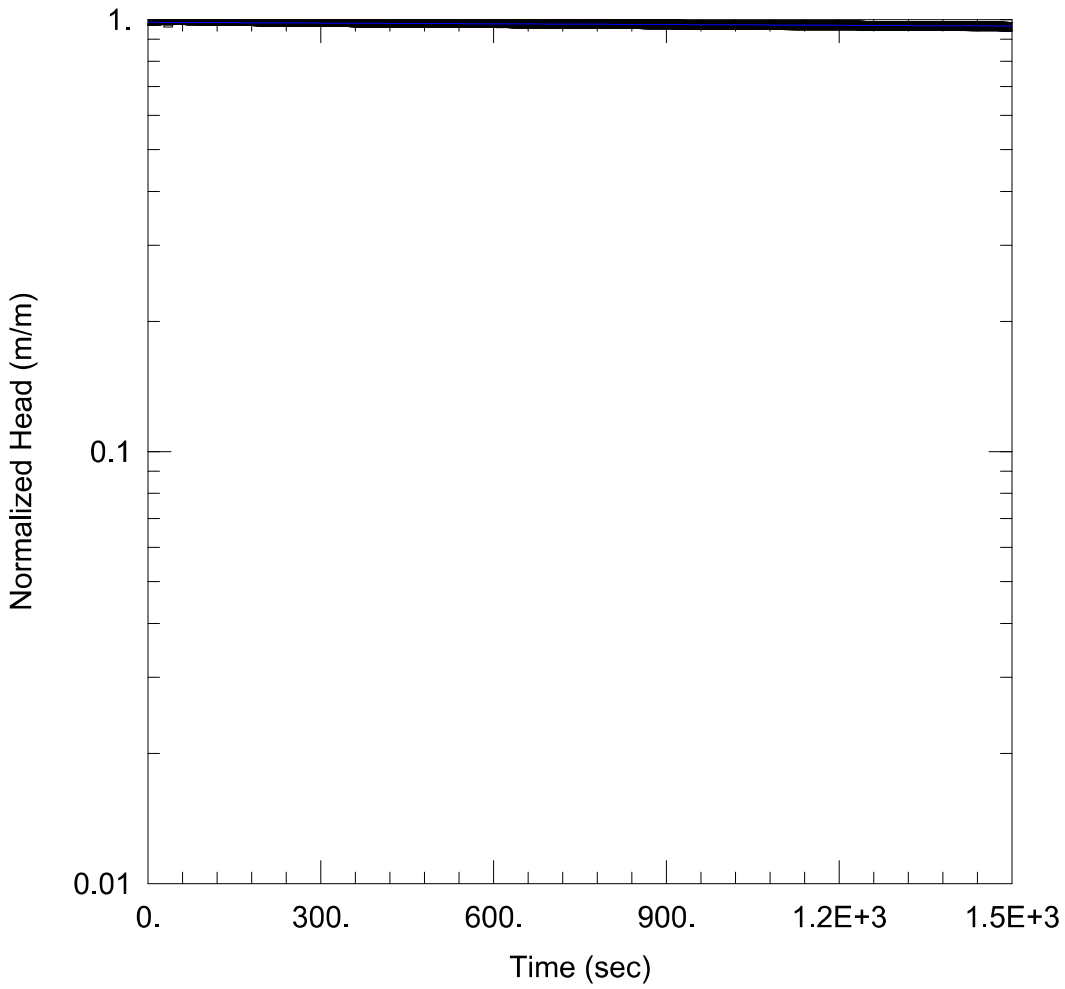
Drilled By: Rubicon Environmental (2008) Inc.

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

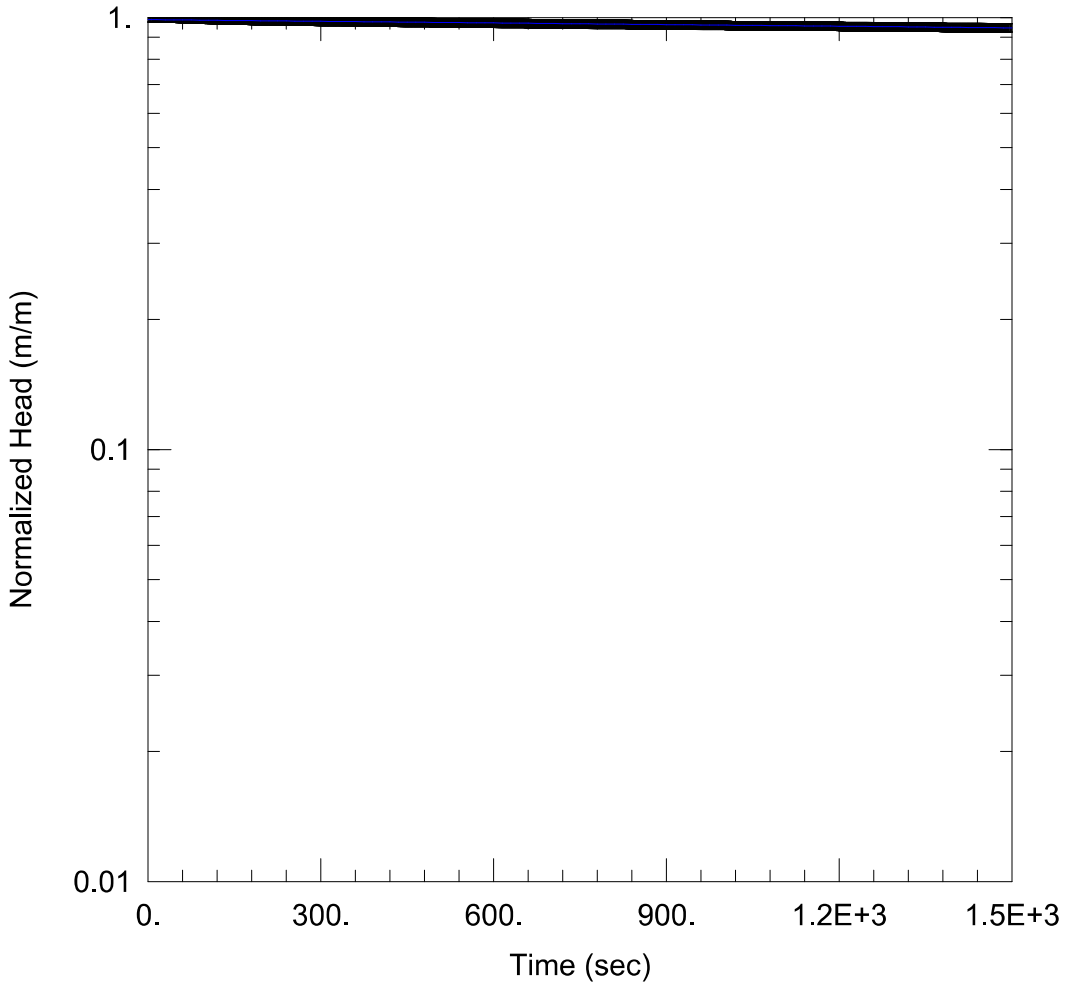
Saturated Thickness: 5.735 m Anisotropy Ratio (Kz/Kr): 1.

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

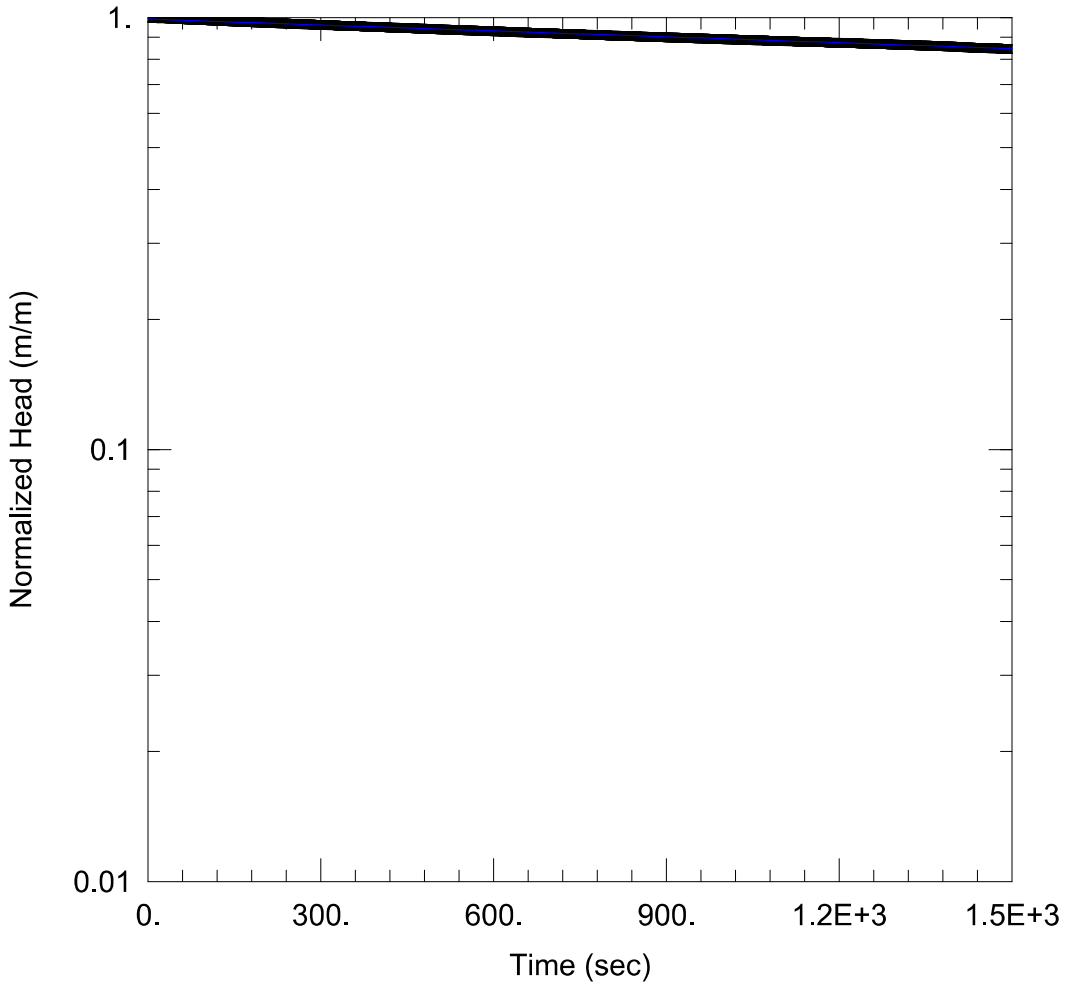
Saturated Thickness: 6.565 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH 3)

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

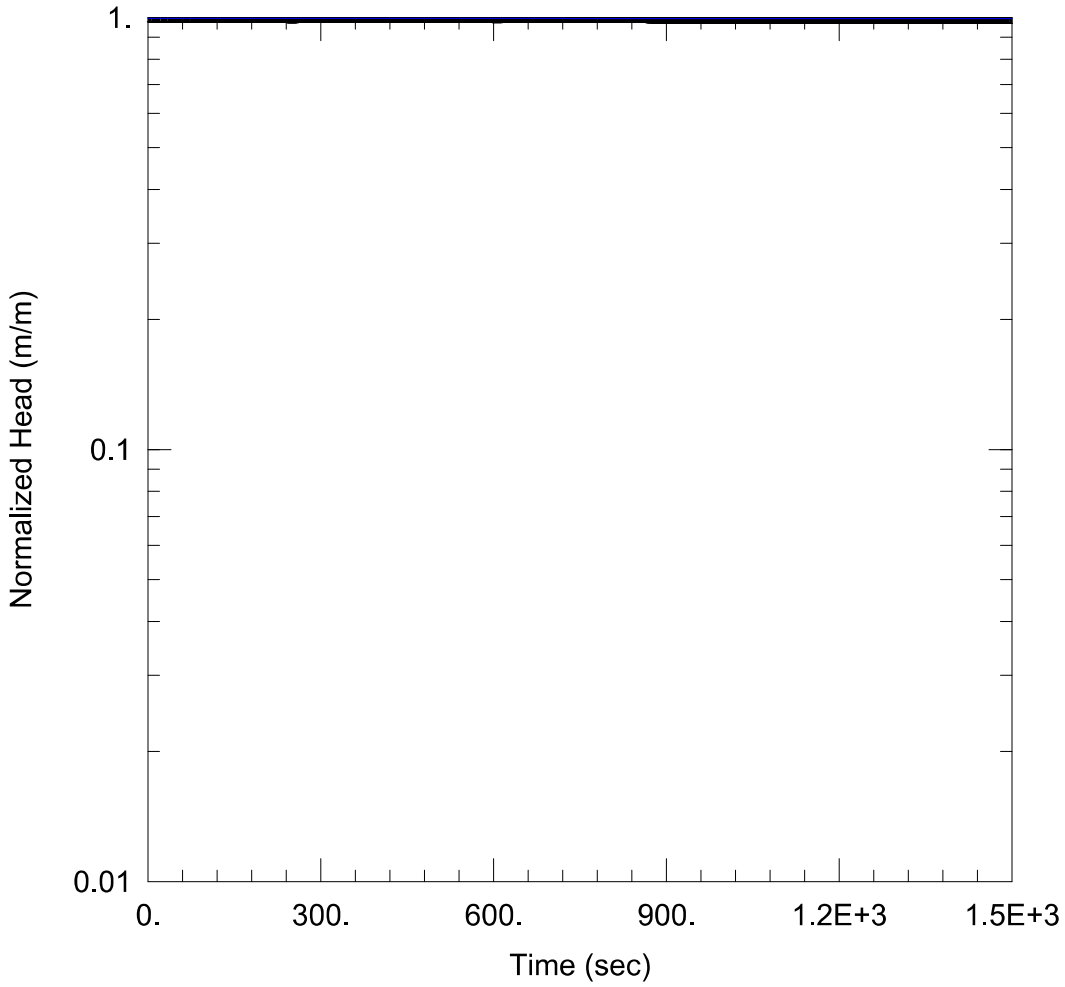
Saturated Thickness: 7.6 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BHMW 9)

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

SOLUTION

Aquifer Model: Unconfined
K = 4.6E-8 m/sec
Solution Method: Hvorslev
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

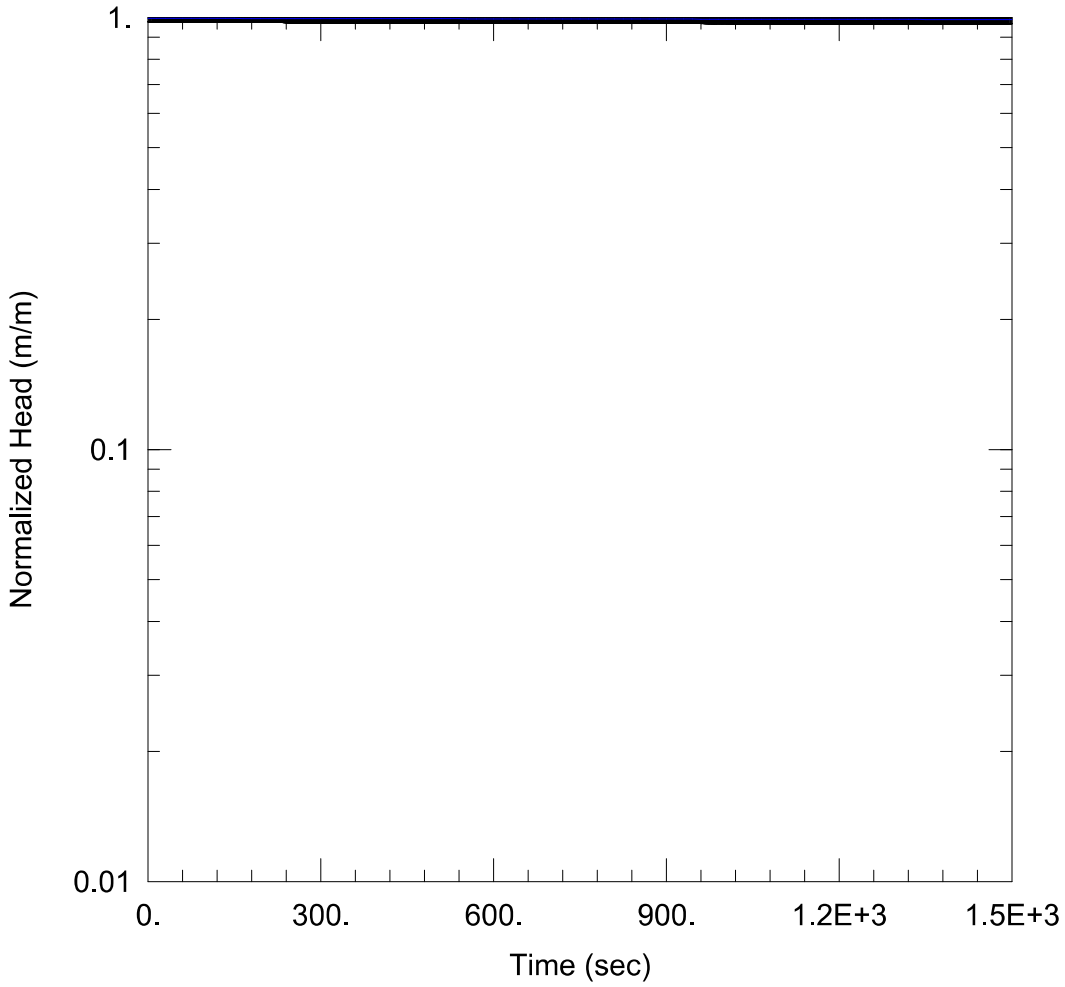
Saturated Thickness: 1.4 m Anisotropy Ratio (Kz/Kr): 1.

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

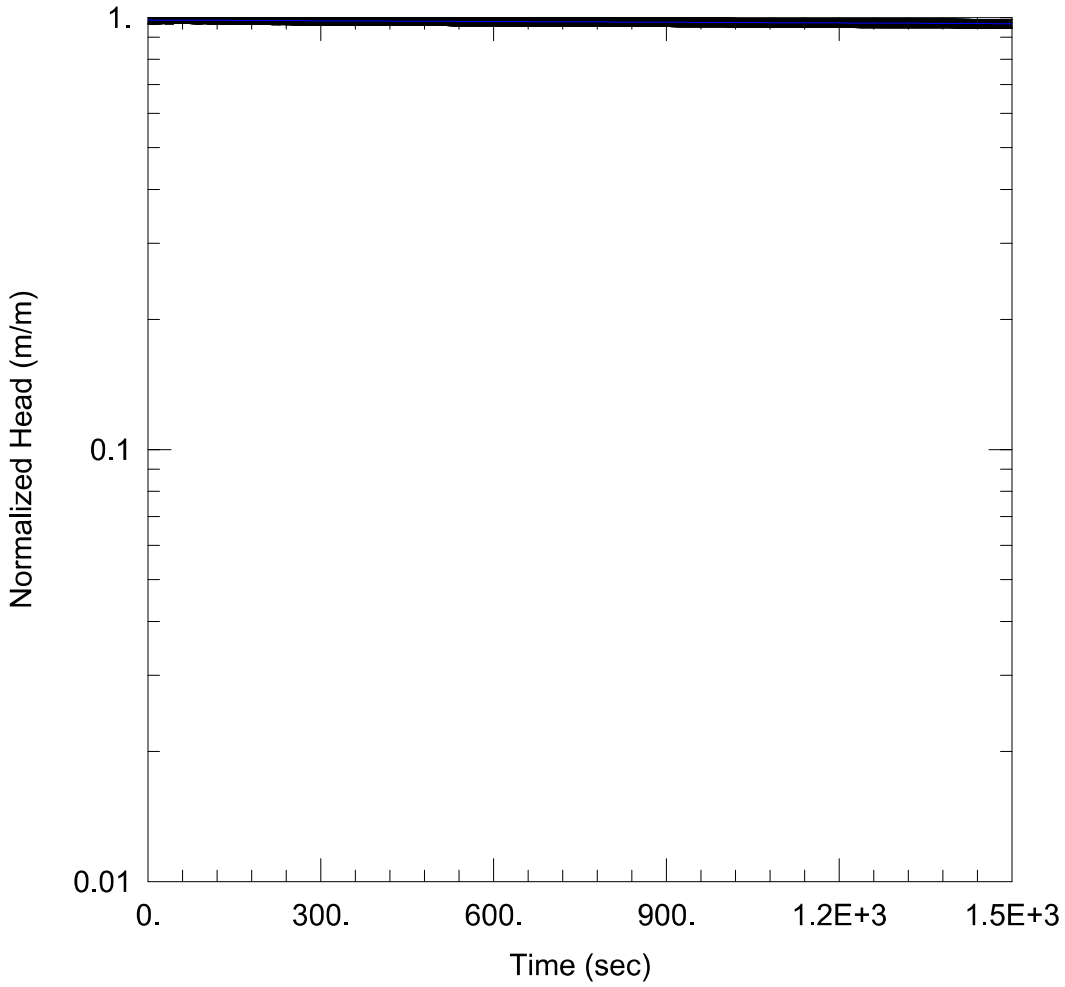
Saturated Thickness: 1.93 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW 02)

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

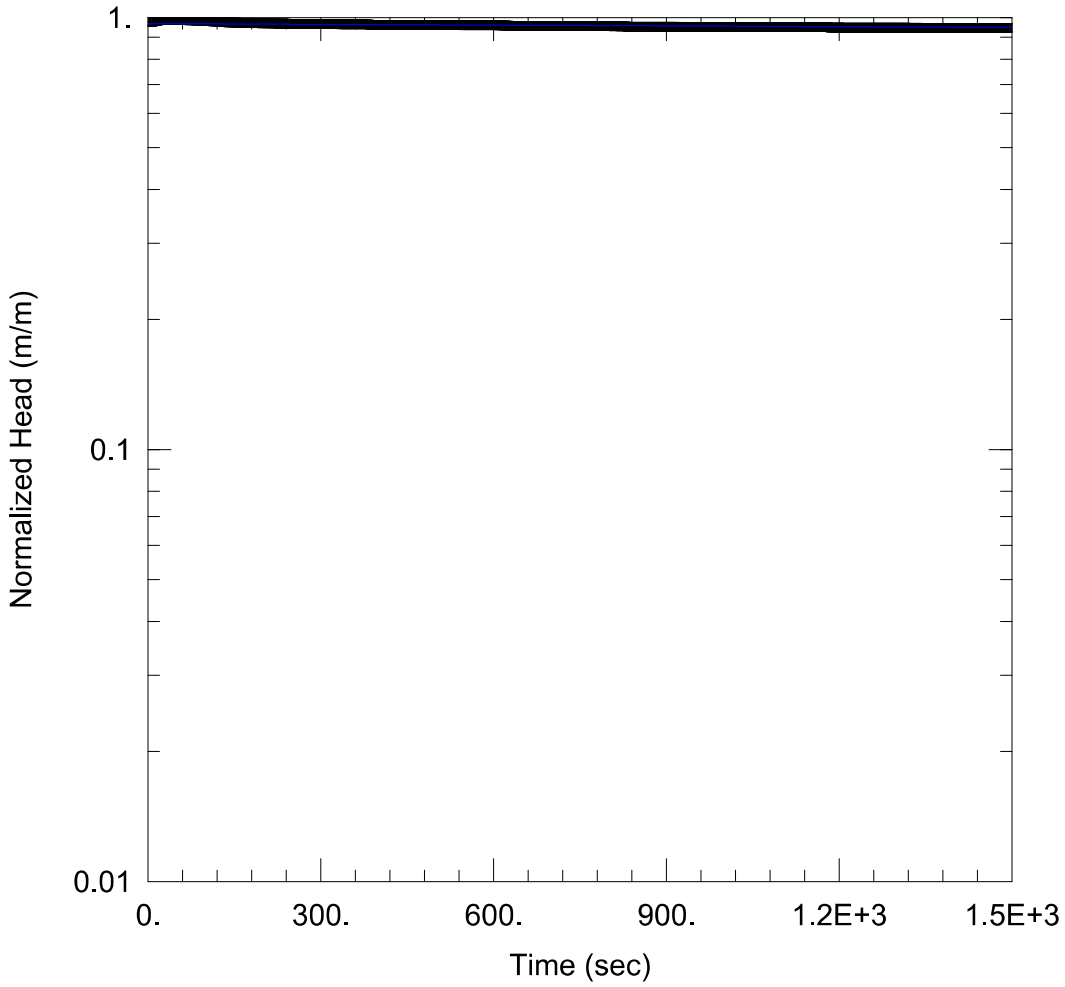
Saturated Thickness: 2.56 m
Anisotropy Ratio (Kz/Kr): 1.

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

SOLUTION

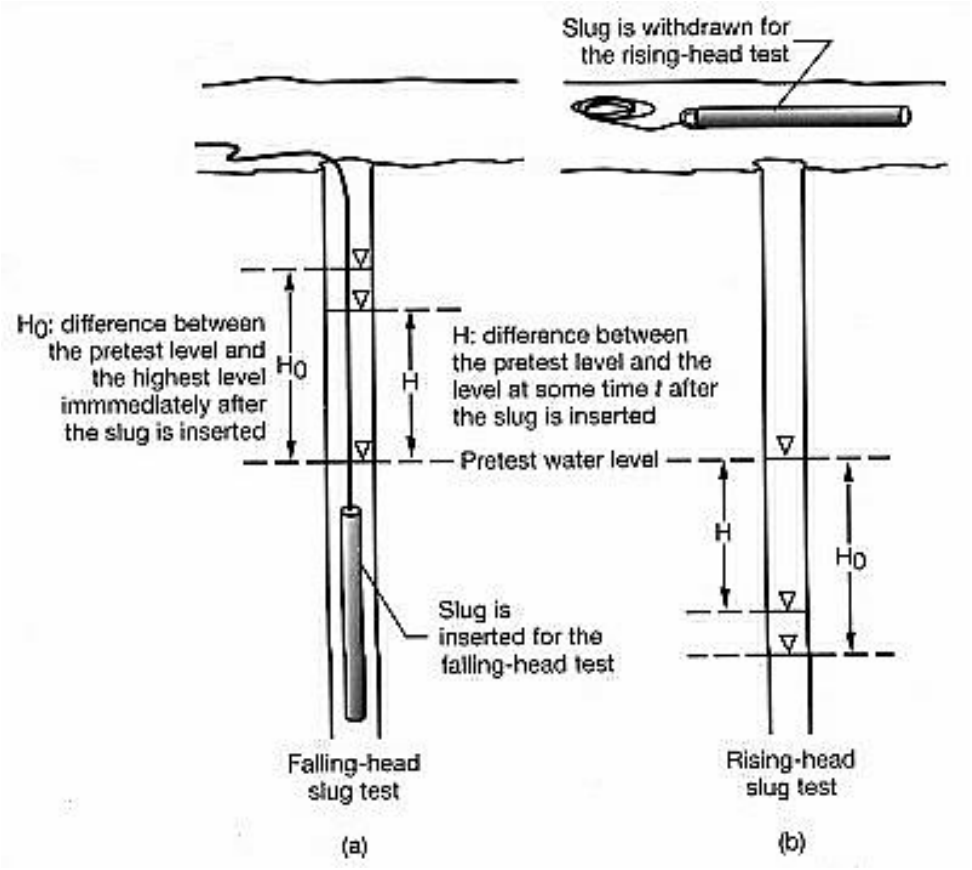
Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.33E-8 m/sec
y0 = 1.609 m

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.

Initials ___

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

Your P.O. #: Env-brm
Your Project #: HAM-00802036 -A0
Site Location: 2481 Baron St, Hamilton
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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.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
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

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

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.
Criteria-2: Hamilton-Wentworth Storm Sewer Discharge.
ND = Not detected

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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

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
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exp Services Inc
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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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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

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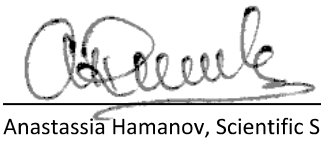
BV Labs Job #: C0V7932
Report Date: 2020/12/07

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)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine	☐ CCME ☒ Sanitary Sewer Bylaw	
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ Reg 558. ☒ Storm Sewer Bylaw	
☐ Table 3 ☐ Agri/Other ☐ For RSC	☐ MISA Municipality HAMILTON	
☐ Table ___	☐ PWQO ☐ Reg 406 Table ___	
	☐ Other ___	

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

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	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																	

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

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 #)*

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	Laboratory Use Only ON ICE				
Chantel Simon	20/11/30	14:45	[illegible]	2020/11/30	14:30		Time Sensitive	Temperature (°C) on Recei 9.9	Custody Seal Present	Yes ✓	No
									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	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)	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)

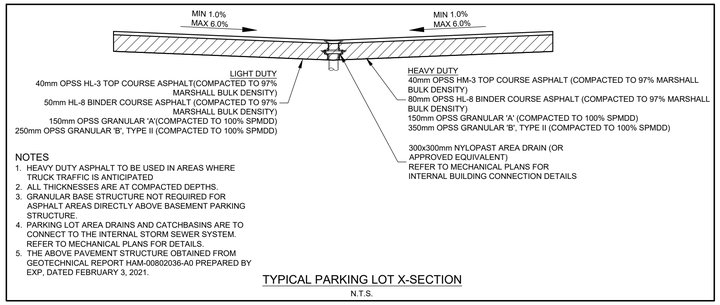
R_o=Radius of influence (m)

re=Equivalent perimeter (m)

DRAWINGS

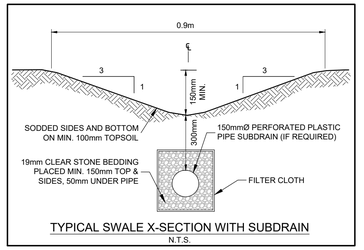
GENERAL NOTES:

1. ALL WORK INVOLVED IN THE CONSTRUCTION, RELOCATION, REPAIR OF MUNICIPAL SERVICES FOR THE PROJECT SHALL BE TO THE SATISFACTION OF THE DIRECTOR, DEVELOPMENT DIVISION, PLANNING AND DEVELOPMENT DEPARTMENT.
2. FIRE ROUTE SIGNS AND 3-WAY FIRE HYDRANTS SHALL BE ESTABLISHED TO THE SATISFACTION OF THE CITY FIRE DEPARTMENT AND AT THE EXPENSE OF THE OWNER
3. MAIN DRIVEWAY DIMENSIONS AT THE PROPERTY LINE BOUNDARIES ARE PLUS OR MINUS 7.5m UNLESS OTHERWISE STATED.
4. ALL DRIVEWAYS FROM PROPERTY LINES FOR THE FIRST 7.5m SHALL BE WITHIN 5% MAXIMUM GRADE, THEREAFTER, ALL DRIVEWAYS SHALL BE WITHIN 10% MAXIMUM GRADE.
5. THE APPROVAL OF THIS PLAN DOES NOT EXEMPT THE OWNER'S BONDED CONTRACTOR FROM THE REQUIREMENTS TO OBTAIN THE VARIOUS PERMITS/APPROVALS NORMALLY REQUIRED TO COMPLETE A CONSTRUCTION PROJECT, SUCH AS, BUT NOT LIMITED TO THE FOLLOWING:
   - ROAD CUT PERMITS
   - SEWER PERMITS
6. - APPROACH APPROVAL PERMITS
   - RELOCATION OF SERVICES
7. - COMMITTEE OF ADJUSTMENT
   - ENCROACHMENT AGREEMENTS
8. (IF REQUIRED)
9. ABANDONED ACCESSES MUST BE REMOVED AND THE CURB AND BOULEVARD RESTORED WITH SOD AT THE OWNER'S EXPENSE TO THE SATISFACTION OF THE TRAFFIC ENGINEERING SECTION, TRANSPORTATION, OPERATIONS AND ENVIRONMENT DEPARTMENT.
10. 3 METER BY 3 METER VISABILTY TRIANGLES IN WHICH THE MAXIMUM HEIGHT OF ANY OBJECTS OR MATURE VEGETATION IS NOT TO EXCEED A HEIGHT OF 0.60 METERS ABOVE THE CORRESPONDING PERPENDICULAR CENTERLINE ELEVATION OF THE ADJACENT STREET.
11. SILTATION CONTROL DEVICES SHALL BE INSTALLED PRIOR TO WORKS COMMENCING ON THE SITE AND SHALL BE MAINTAINED FOR THE DURATION OF CONSTRUCTION, TO THE SATISFACTION OF THE CITY. SEE SHEET C7-1 FOR DETAILS.
12. THE SUB-GRADE SOILS EXPOSED AFTER EXCAVATION SHALL BE INSPECTED AND CERTIFIED BY A QUALIFIED REGISTERED PROFESSIONAL SOILS ENGINEER AND A COPY OF THE REPORT SHALL BE FORWARDED TO THE CITY OF HAMILTON BUILDING DIVISION. WHERE THE FOOTING WILL BE SITUATED ON FILL MATERIAL, THE FOOTINGS SHALL BE DESIGNED AND APPROVED BY QUALIFIED REGISTERED PROFESSIONAL ENGINEER.
13. ALL FILL PLACED ON THE SITE SHALL BE COMPACTED TO A MINIMUM OF 98% STANDARD PROCTOR DENSITY IN MINIMUM LIFTS AS PER GEOTECHNICAL ENGINEER'S RECOMMENDATIONS. A SUFFICIENT NUMBER OF TESTS SHALL BE TAKEN AT VARIOUS LEVELS SATISFACTORY TO THE DIRECTOR OF ENGINEERING. TEST RESULTS SHALL BE SENT TO THE CITY WITH A LETTER, SIGNED AND STAMPED BY THE SOILS ENGINEER, STATING THAT A SUFFICIENT NUMBER OF TESTS HAVE BEEN TAKEN AND THE MINIMUM DEGREE OF COMPACTION HAS BEEN REACHED.
14. APPROVAL OF THIS DRAWING IS FOR MATERIAL ACCEPTABILITY AND COMPLIANCE WITH MUNICIPAL AND PROVINCIAL SPECIFICATIONS AND STANDARDS ONLY. APPROVAL AND INSPECTION BY THE CITY OF THE WORKS DOES NOT CERTIFY THE LINE AND GRADE OF THE WORKS AND IT IS THE OWNER'S RESPONSIBILITY TO HAVE THEIR ENGINEER CERTIFY THIS ACCORDINGLY.
15. ALL RETAINING WALLS, WALKWAYS, CURBS, ETC. SHALL BE PLACED A MIN. OF 0.45m OFF THE PROPERTY LINE. ALL WALLS 1.0m OR HIGHER SHALL BE DESIGNED BY A P.ENG.
16. SHOULD A RETAINING WALL BE REQUIRED, THE TOP OF WALL ELEVATIONS SHALL BE SET 150mm ABOVE THE PROPOSED SIDE YARDS SWALES.
17. RETAINING WALLS 0.6m IN HEIGHT OR GREATER REQUIRE CONSTRUCTION OF A FENCE OR GUARD RAIL AT THE TOP OF THE REAR OF THE WALL. GUARDS FOR RETAINING WALLS SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF EXTERIOR GUARDS AS CONTAINED IN THE ONTARIO BUILDING CODE.
18. THE WRITTEN PERMISSION REQUIRED FROM THE ADJACENT LANDOWNER SHALL BE OBTAINED PRIOR TO ENTERING THE LANDS. SHOULD PERMISSION NOT BE OBTAINED OR IS WITHDRAWN PRIOR TO COMMENCING THE WORK, THEN THE DEVELOPER SHALL LIMIT ACTIVITIES TO THE LIMITS OF THE DEVELOPMENT SITE.
19. ***THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING THE CONSULTING ENGINEER 72 HOURS PRIOR TO COMMENCING THE SITE WORKS TO REQUEST INSPECTION. THE CONSULTING ENGINEER SHALL DETERMINE THE EXTENT OF INSPECTION AND TESTING REQUIRED FOR CERTIFICATION ON THE UNDERGROUND SERVICE INSTALLATION AS MANDATED BY THE ONTARIO BUILDING CODE DIVISION C, PART 1, SECTION 1.2.2, GENERAL REVIEW. FAILURE TO MAKE SUITABLE ARRANGEMENTS FOR INSPECTION WILL LEAD TO POST CONSTRUCTION TESTING AND INSPECTION AS DETERMINED BY THE ENGINEER. ALL COSTS ASSOCIATED WITH ANY REQUIRED POST CONSTRUCTION TESTING AND INSPECTION SHALL BE BORNE BY THE CONTRACTOR, INCLUDING ANY DELAYS TO CONSTRUCTION, NECESSARY REWORK AND RESTORATION OF DISTURBED WORKS. FINAL CERTIFICATION OF THE WORKS WILL BE WITHHELD UNTIL ALL POST CONSTRUCTION INSPECTION OF THE UN-INSPECTED WORKS IS COMPLETE TO THE SATISFACTION OF THE CONSULTING ENGINEER. FULL PAYMENT FOR UN-INSPECTED WORKS MAY BE WITHHELD UNTIL.***

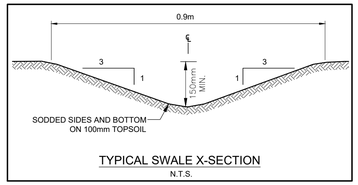


NOTES
1. HEAVY DUTY ASPHALT TO BE USED IN AREAS WHERE TRUCK TRAFFIC IS ANTICIPATED
2. ALL THICKNESSES ARE AT COMPACTED DEPTHS.
3. GRANULAR BASE STRUCTURE NOT REQUIRED FOR ASPHALT AREAS DIRECTLY ABOVE BASEMENT PARKING STRUCTURE.
4. PARKING LOT AREA DRAINS AND CATCHBASINS ARE TO CONNECT TO THE INTERNAL STORM SEWER SYSTEM. REFER TO MECHANICAL PLANS FOR DETAILS.
5. THE ABOVE PAVEMENT STRUCTURE OBTAINED FROM GEOTECHNICAL REPORT HAM-00802036-A0 PREPARED BY EXP, DATED FEBRUARY 3, 2021.

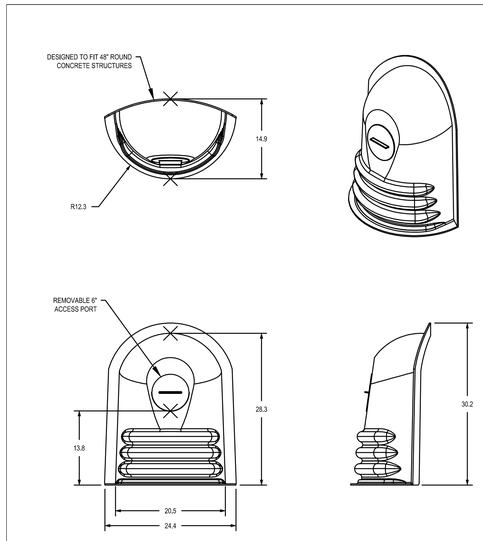
TYPICAL PARKING LOT X-SECTION
N.T.S.



TYPICAL SWALE X-SECTION WITH SUBDRAIN
N.T.S.



TYPICAL SWALE X-SECTION
N.T.S.



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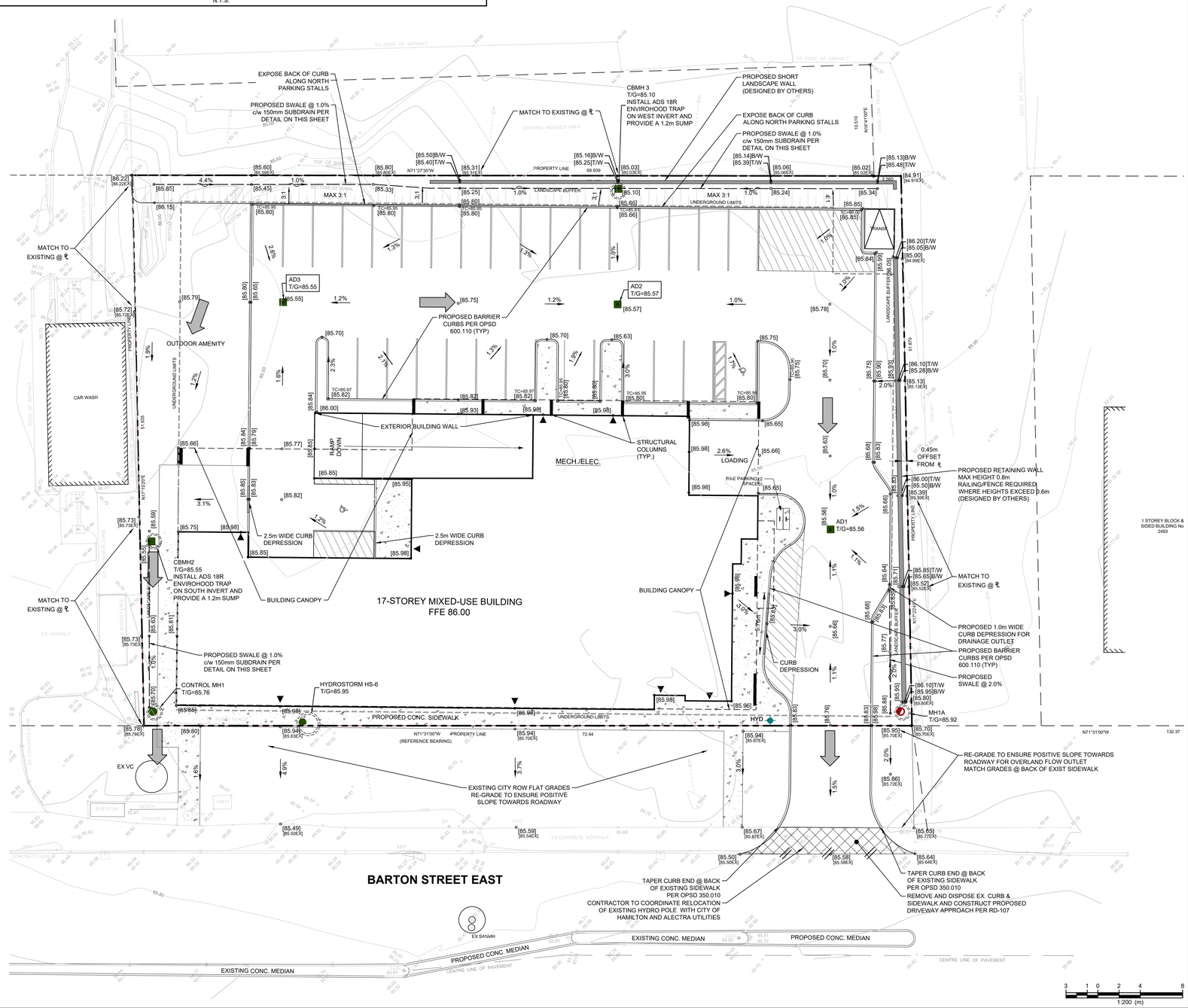


SEE SHEET C4-1 FOR EROSION & SEDIMENT CONTROL PLAN

PREMIER GROUP REALTY INC

North

DATE	ISSUANCE	NO.
2022.12.12	ISSUED FOR REZONING	1

LEGEND

∘[85.00]	PROPOSED ELEVATION
∘[85.60]EX.	MATCH TO EXISTING GRADE
2.0%	PROPOSED DRAINAGE ARROW/SLOPE
	PROPOSED SWALE
	EXISTING DRAINAGE ARROW/SLOPE
	PROPOSED OVERLAND FLOW ROUTE
85.0	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR
	EXISTING DITCH CENTRELINE
	EXISTING DECIDUOUS TREE
	REMOVALS
	PROPOSED CONCRETE AREAS

TOPO SURVEY INFORMATION:
TOPOGRAPHIC SURVEY OBTAINED BY A.T. McLAREN LTD. DWG NO. 36450, DATED SEPTEMBER 24, 2020.

BENCHMARK:
ELEV. = 85.971m
MONUMENT #07720100034
ROUND IRON BAR WITH BRASS CAP
MONUMENT IS LOCATED 27m WEST OF THE CENTRELINE OF LINCOLN ROAD AND 26m NORTH OF HAZELWOOD DRIVE, NORTHEAST CORNER OF EASTDALE PARK.

CLIENT
PREMIER GROUP REALITY INC.
12 CHIAVATTI DRIVE, MARKHAM, ON

PROJECT
2481 BARTON STREET EAST
HAMILTON, ON

TITLE
PROPOSED GRADING PLAN

WALTERFEDY
KITCHENER | HAMILTON | TORONTO
800.685.1378 walterfedy.com

LICENSED PROFESSIONAL ENGINEER 12-Dec-2022 J. G. ORESKOVIC PROVINCE OF ONTARIO

SCALE:	1:200
DATE:	2022-09-08
PROJECT NO.:	2022-0171-10
DRAWN BY:	MPB
CHECKED BY:	JO

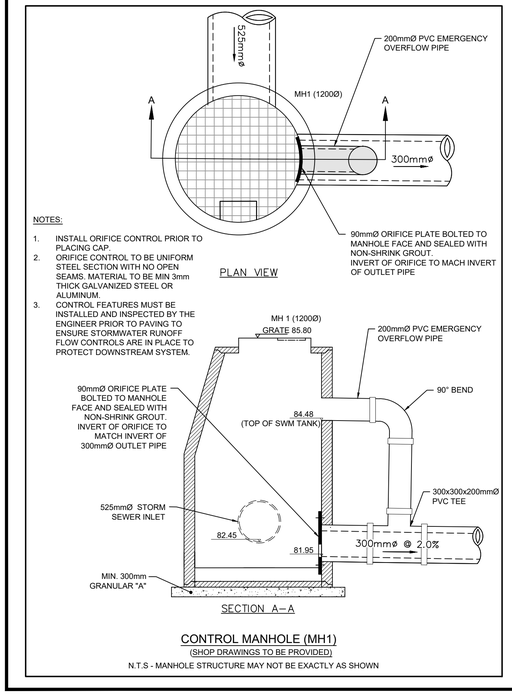
SHEET NO.: C2-1

SEWER SERVICING

1. ALL PROPOSED SEWERS, THROUGHOUT THEIR LENGTH FROM THE MAIN SEWER TO THE BUILDING OR PLACE TO BE DRAINED IS TO BE LAID, AS NEARLY AS PRACTICAL, IN A STRAIGHT LINE IN A TRENCH AT A RIGHT ANGLE TO THE MAIN SEWER.
2. SEWERS TO BE INSTALLED WITH A MINIMUM COVER OF 2.75m BELOW THE CENTRELINE OF THE ROAD AND MINIMUM 2.2m AT THE PROPERTY LINE BELOW THE FINAL ROAD GRADE OR AT SUCH HIGHER ELEVATION ONLY AS MAY BE NECESSITATED BY THE ELEVATION OF THE MAIN SEWER. ON PRIVATE PROPERTY THE MINIMUM COVER IS TO BE NO LESS THAN 1.2m.
3. STORM AND SANITARY FLOWS MUST BE SEPARATED WHEREVER POSSIBLE, AND THE INSTALLATION OF NEW COMBINED STORM AND SANITARY SEWERS IS NOT PERMITTED. REFER TO ITEM 'M' BELOW FOR DETAILS RESPECTING THE CONNECTION OF SEPARATE STORM AND SANITARY SEWERS FOR A DEVELOPMENT TO A COMBINED MUNICIPAL SEWER.
4. MINIMUM HORIZONTAL SEPARATION BETWEEN SEWERS AND WATERMAINS SHALL BE 2.5m. VERTICAL CLEARANCE BETWEEN SEWERS AND WATERMAINS THAT CROSS TO BE 500mm BETWEEN THE OUTSIDE OF THE WATERMAIN AND OUTSIDE OF THE SEWER. THE LENGTH OF WATER PIPE SHOULD BE CENTERED AT THE POINT OF CROSSING SUCH THAT JOINTS IN THE WATERMAIN WILL BE EQUIDISTANT AND AS FAR AS POSSIBLE FROM THE SEWER, CROSSING PERPENDICULAR IF POSSIBLE.
5. PROPOSED SANITARY AND STORM SEWERS SHALL BE EITHER; (a) PVC SDR 28 FOR 150mm DIAMETER AND SDR 35 FOR OTHER SIZES; (b) CLASS 3 CONCRETE (CSA A257.1-M92).
   RIBBED OR PROFILE PIPE IS NO LONGER PERMITTED FOR SANITARY OR STORM USE, INCLUDING PRIVATE DRAINS AND CATCH BASIN LEADS.
   IT IS RECOMMENDED THAT PVC PIPE NOT BE USED WHERE IT WILL BE EXPOSED TO CONTAMINATED SOILS AND IN INDUSTRIAL/HEAVY COMMERCIAL AREAS WHERE IT MAY COME INTO CONTACT WITH MATERIALS DETRIMENTAL TO THE PVC MATERIAL.
6. SEWER BEDDING, COVER AND BACKFILL FOR FLEXIBLE PIPE TO BE AS PER OPSD 802.010 WITH GRANULAR "A" FOR BOTH THE BEDDING AND COVER. REFERENCE HOWEVER SHOULD BE MADE TO THE OPSD STANDARDS FOR ALTERNATE BEDDING AND BACKFILL SPECIFICATIONS AS DETERMINED BY THE PROPOSED PIPE MATERIAL AND EXCAVATION CONDITIONS.
7. MINIMUM SIZE OF STORM AND SANITARY DRAINS LOCATED WITHIN THE ROAD ALLOWANCE TO BE 150mm IN THE ORIGINAL CITY OF HAMILTON AND 125mm IN THE OTHER AREA MUNICIPALITIES NOW COMPRISING THE NEW CITY. NOTE: EXISTING SEWER TO BE REUSED MUST BE IN GOOD WORKING CONDITION AND OF ADEQUATE CAPACITY TO MEET THE REQUIREMENTS OF THE SITE. THE APPLICANT/OWNER OR THEIR CONTRACTOR IS RESPONSIBLE FOR HAVING THE SEWER TO BE REUSED VIDEO INSPECTED WHILE THE CITY OF HAMILTON SEWER INSPECTOR IS PRESENT. CONTACT PLANNING AND ECONOMIC DEVELOPMENT DEPARTMENT, DEVELOPMENT ENGINEERING DIVISION AT (905) 546-2424 X7860 TO ARRANGE FOR AN INSPECTION.
8. MAINTENANCE HOLES ARE REQUIRED AT ALL CHANGES IN PIPE SIZE, CHANGES IN PIPE DIRECTION, ENDS OF PIPE RUNS, AND AS CLEANOUTS. MAXIMUM SPACING OF MAINTENANCE HOLES ID 120 m FOR PIPES 200 mm TO 1050 mm AND 150 m FOR PIPES 1200 mm AND LARGER. IN ACCORDANCE WITH THE "ONTARIO BUILDING CODE," A MAINTENANCE HOLE IS ALSO REQUIRED WITHIN THE FIRST 30 m AFTER THE PIPE EXITS THE BUILDING.
9. A DROP STRUCTURE IS REQUIRED AT ALL MANHOLES WHERE THERE IS A DROP OF GREATER THAN 600 mm BETWEEN THE INVERT OF THE UPSTREAM PIPE AND THE INVERT OF THE DOWNSTREAM PIPE AND IS TO BE AS PER OPSD 1003.010. GENERALLY THE SIZE OF THE DROP PIPE SHALL BE ONE SIZE SMALLER THAN THE CONNECTING SEWER, MINIMUM SIZE 200 mm.
10. CATCH BASINS WITHIN THE CITY OF HAMILTON, EXCLUDING THOSE WITHIN RESIDENTIAL REAR YARDS, MUST BE AS PER OPSD 705.010 (SINGLE) OR OPSD 705.020 (DOUBLE) AND MUST BE MODIFIED WITH A GOSS TRAP AS PER SEW-304. ALL PRIVATE PROPERTY CATCH BASINS ARE TO HAVE A MINIMUM LEAD SIZE OF 250 mm FOR A SINGLE AND 250 mm FOR A DOUBLE CATCH BASIN. RESIDENTIAL REAR YARD CATCH BASINS, i.e. SUBDIVISIONS ETC., ARE TO BE AS PER THE APPLICABLE OPSD STANDARD, BUT DO NOT REQUIRE THE GOSS TRAPS AND ARE TO BE SUMPLESS.
11. EVERY SEWER CONNECTION TO A CITY MAIN SEWER MUST BE MADE USING PROPER "T" OR "Y" FITTINGS. SADDLES MAY ONLY BE USED WHERE APPROVED BY THE DIRECTOR OF DEVELOPMENT, PLANNING AND ECONOMIC DEVELOPMENT DEPARTMENT.
    FOR PROPOSED SEWERS THAT ARE GREATER THAN OR EQUAL TO 300 mm, A MANHOLE MUST BE PROVIDED AT THE JUNCTION WITH THE MAIN SEWER. FOR SEWERS LESS THAN 300 mm, CONNECTION SHOULD BE MADE DIRECTLY TO THE MAIN SEWER AND NOT TO A MANHOLE.
12. EXISTING STORM AND SANITARY SERVICES THAT ARE NO LONGER IN USE ARE TO BE REMOVED UP TO THE PROPERTY LINE. THE SECTION OF THE SERVICE WITHIN THE PROPERTY MAY BE REMOVED OR PLUGGED AT BOTH ENDS WITH A MINIMUM 300 mm OF 0.5 MPa CONCRETE

WATERMAINS / SERVICES:

1. CONSTRUCTION OF WATERMAINS AND PRIVATE SERVICES SHALL BE IN ACCORDANCE WITH THE CITY OF HAMILTON CONSTRUCTION AND SPECIFICATIONS MANUAL (LATEST EDITION) AND MINISTRY OF ENVIRONMENT (MOE) GUIDELINES (LATEST EDITION).
2. WATERMAINS & SERVICES TO BE INSTALLED WITH A MINIMUM DEPTH OF COVER OF 1.6m.
3. WATERMAIN BEDDING AND COVER MATERIAL TO BE INSTALLED AS PER WM-200.01 WITH GRANULAR "A" FOR BOTH BEDDING AND COVER. BEDDING AND COVER FOR SMALL DIAMETER SERVICES (i.e. 50mm AND UNDER) TO BE AS PER WM-200.01 WITH GRANULAR "D" FOR BOTH BEDDING AND COVER.
4. HORIZONTAL SEPARATION BETWEEN SEWER DRAINS AND WATERMAINS OR WATER SERVICES SHALL BE A MINIMUM OF 2.5m. VERTICAL SEPARATION BETWEEN SEWER DRAINS AND WATERMAINS SHALL BE A MINIMUM 0.5m PER MINISTRY OF ENVIRONMENT (MOE) GUIDELINES.
5. ALL VALVE BOXES TO BE SET TO PROPOSED BOULEVARD GRADES.
6. WATER SERVICES ARE TO BE INSTALLED PERPENDICULAR TO THE PROPOSED WATERMAIN AND STRAIGHT INTO THE BUILDING.
10. A WATER METER MUST BE INSTALLED ON ALL DOMESTIC WATER SERVICES AT THE SERVICE POINT OF ENTRY TO THE BUILDING. INTERNAL WATER METER INSTALLATIONS TO BE AS PER WM-210 AND THE METER IS TO BE INSTALLED AT FLOOR LEVEL.
11. PVC WATERMAIN AND SERVICE LATERALS MUST BE INSTALLED WITH CATHODIC PROTECTION, TRACER WIRE, ETC. AS PER STANDARD FORM 400, PAGES 10 & 11.
12. ALL SYSTEM COMPONENTS ARE TO BE EITHER TO CITY OF HAMILTON STANDARDS OR ONTARIO PROVINCIAL STANDARD DRAWING (OPSD). WHERE A CITY STANDARD EXISTS, IT SHALL BE USED IN PLACE OF THE OPSD STANDARD.
13. ANCHOR OR THRUST BLOCKS ARE TO BE INSTALLED AT ALL WATER SERVICE ELBOWS, TEES PLUGS ETC. FOR 300mm DIAMETER WATER SERVICES AND SMALLER, ANCHOR BLOCKS ARE TO BE AS PER WM-204.01. FOR WATER SERVICES GREATER THAN 300mm, ANCHOR BLOCKS ARE TO BE AS PER WM-204.02 TO WM-204.13 AS APPLICABLE.



NOTES:

1. INSTALL ORIFICE CONTROL PRIOR TO PLACING CAP.
2. ORIFICE CONTROL TO BE UNIFORM STEEL SECTION WITH NO OPEN SEAMS. MATERIAL TO BE MIN 3mm THICK GALVANIZED STEEL OR ALUMINUM.
3. CONTROL FEATURES MUST BE INSTALLED AND INSPECTED BY THE ENGINEER PRIOR TO PAVING TO ENSURE STORMWATER RUNOFF FLOW CONTROLS ARE IN PLACE TO PROTECT DOWNSTREAM SYSTEM.

CONTROL MANHOLE (MH1)

(SHOP DRAWINGS TO BE PROVIDED)

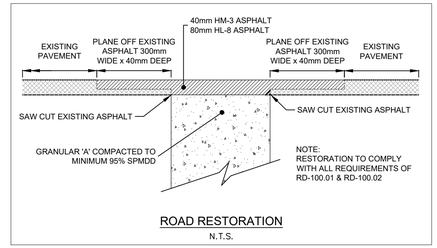
N.T.S - MANHOLE STRUCTURE MAY NOT BE EXACTLY AS SHOWN

BEFORE STARTING WORK

1. THE POSITION OF THE POLE LINES, CONDUITS, WATERMAINS, SEWERS, AND OTHER UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.
2. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, ALL BENCHMARKS, EXISTING INVERTS, DIMENSIONS, AND GRADES MUST BE CHECKED BY THE CONTRACTOR AND ANY DISCREPANCIES REPORTED TO THE ENGINEER.
3. ALL EXISTING UNDERGROUND UTILITIES WITHIN THE LIMITS OF CONSTRUCTION SHALL BE LOCATED, MARKED AND PROTECTED. ANY UTILITIES DAMAGED OR DISTURBED DURING CONSTRUCTION SHALL BE REPAIRED OR REPLACED TO THE SATISFACTION OF THE ENGINEER, AT THE CONTRACTOR'S EXPENSE.
4. AT LEAST TWO DIFFERENT BENCHMARKS MUST BE REFERRED TO AT ALL TIMES.
5. REPRODUCED PLANS SHALL AT NO TIMES BE SCALED AND ASSUMED ACCURATE.
6. ***THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING THE CONSULTING ENGINEER 72 HOURS PRIOR TO COMMENCING THE SITE WORKS TO REQUEST INSPECTION. THE CONSULTING ENGINEER SHALL DETERMINE THE EXTENT OF INSPECTION AND TESTING REQUIRED FOR CERTIFICATION ON THE UNDERGROUND SERVICE INSTALLATION AS MANDATED BY THE ONTARIO BUILDING CODE DIVISION C, PART 1, SECTION 1.2.2, GENERAL REVIEW. FAILURE TO MAKE SUITABLE ARRANGEMENTS FOR INSPECTION WILL LEAD TO POST CONSTRUCTION TESTING AND INSPECTION AS DETERMINED BY THE ENGINEER. ALL COSTS ASSOCIATED WITH ANY REQUIRED POST CONSTRUCTION TESTING AND INSPECTION SHALL BE BORNE BY THE CONTRACTOR, INCLUDING ANY DELAYS TO CONSTRUCTION, NECESSARY REWORK AND RESTORATION OF DISTURBED WORKS. FINAL CERTIFICATION OF THE WORKS WILL BE WITHHELD UNTIL ALL POST CONSTRUCTION INSPECTION OF THE UN-INSPECTED WORKS IS COMPLETE TO THE SATISFACTION OF THE CONSULTING ENGINEER. FULL PAYMENT FOR UN-INSPECTED WORKS MAY BE WITHHELD UNTIL.***

COMPACTION REQUIREMENTS

A. ALL BEDDING AND BACKFILL MATERIAL, ROAD SUB-GRADES AND GENERALLY ALL MATERIALS USED FOR LOT GRADING AND FILL SECTIONS, ETC., SHALL BE COMPACTED TO MIN. 95% SPD (UNLESS OTHERWISE RECOMMENDED BY THE GEOTECHNICAL ENGINEER). ALL MATERIAL SHALL BE PLACED IN LAYERS NOT EXCEEDING 300mm LIFTS.
B. ALL GRANULAR ROAD BASE MATERIALS SHALL BE COMPACTED TO 95% SPD.
C. FOR ALL SEWERS AND WATERMAINS IN FILL SECTIONS, THE COMPACTION SHALL BE CERTIFIED BY A GEOTECHNICAL ENGINEER PRIOR TO LAYING OF PIPE.

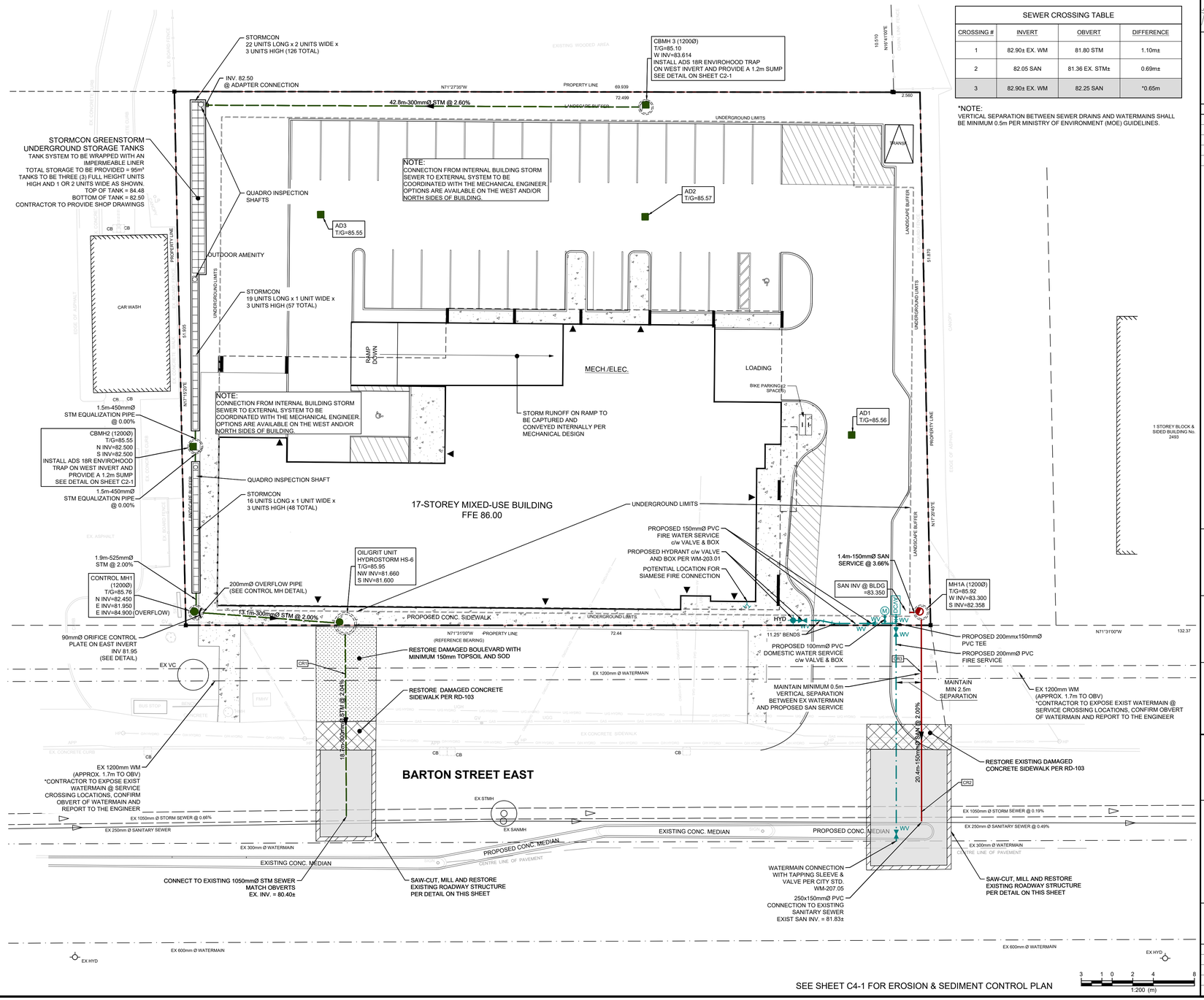


ROAD RESTORATION

N.T.S.

SEWER CROSSING TABLE			
CROSSING #	INVERT	OBVERT	DIFFERENCE
1	82.90± EX. WM	81.80 STM	1.10m±
2	82.05 SAN	81.36 EX. STM±	0.69m±
3	82.90± EX. WM	82.25 SAN	*0.65m

*NOTE:
VERTICAL SEPARATION BETWEEN SEWER DRAINS AND WATERMAINS SHALL BE MINIMUM 0.5m PER MINISTRY OF ENVIRONMENT (MOE) GUIDELINES.



SEE SHEET C4-1 FOR EROSION & SEDIMENT CONTROL PLAN

PREMIER GROUP REALTY INC

North

DATE	ISSUANCE	NO.
2022.12.12	ISSUED FOR REZONING	1

LEGEND

- PROPOSED SANITARY SEWER/SERVICE
- PROPOSED STORM SEWER/SERVICE
- PROPOSED WATERMAIN/SERVICE
- EXISTING SANITARY SERVICE
- EXISTING STORM SERVICE
- EXISTING WATERMAIN
- WV PROPOSED WATERMAIN VALVE
- M PROPOSED WATER METER
- MH PROPOSED STORM MANHOLE
- MHA PROPOSED SANITARY MANHOLE
- DCV PROPOSED DOUBLE CHECK VALVE ASSEMBLY
- BFP PROPOSED BACKFLOW PREVENTOR
- AD PROPOSED STORM AREA DRAIN
- EX CB EXISTING CATCHBASIN
- EX MH EXISTING STORM MANHOLE
- EX SAN MH EXISTING SANITARY MANHOLE
- EX HYD EXISTING FIRE HYDRANT
- CR2 SERVICE CROSSING LOCATION

TOPO SURVEY INFORMATION:
TOPOGRAPHIC SURVEY OBTAINED BY A.T. McLAREN LTD. DWG NO. 36450, DATED SEPTEMBER 24, 2020.

BENCHMARK:
ELEV. = 85.971m
MONUMENT #0772010034
ROUND IRON BAR WITH BRASS CAP
MONUMENT IS LOCATED 27m WEST OF THE CENTRELINE OF LINCOLN ROAD AND 26m NORTH OF HAZELWOOD DRIVE, NORTHEAST CORNER OF EASTDALE PARK.

CLIENT
PREMIER GROUP REALITY INC.
12 CHIAVATTI DRIVE, MARKHAM, ON

PROJECT
2481 BARTON STREET EAST
HAMILTON, ON

TITLE
GENERAL SERVICING PLAN

WALTERFEDY
KITCHENER | **HAMILTON** | TORONTO
800.685.1378 **walterfedy.com**

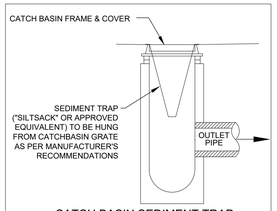
LICENSED PROFESSIONAL ENGINEER 12-Dec-2022 J. G. ORESKOVIC PROVINCE OF ONTARIO

SCALE:	1:200
DATE:	2022-09-08
PROJECT NO.:	2022-0171-10
DRAWN BY:	MPB
CHECKED BY:	JO

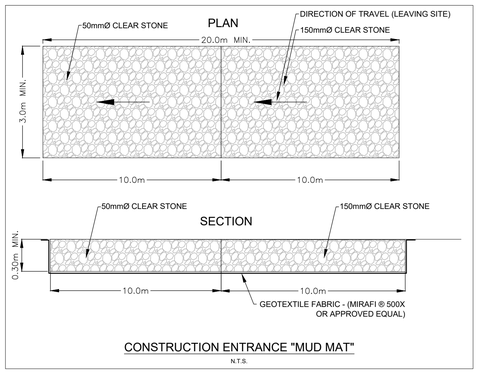
SHEET NO.: **C3-1**

SILTATION AND EROSION CONTROL

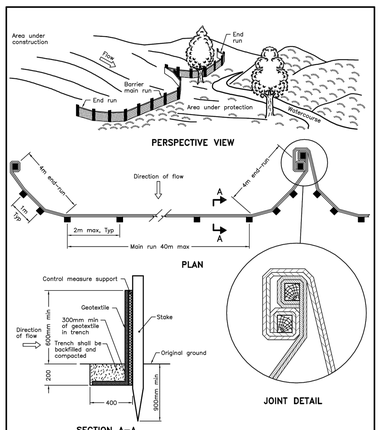
A. SILTATION CONTROL BARRIERS SHALL BE PLACED AS DETAILED.
B. ALL SILTATION CONTROL MEASURES SHALL BE CLEANED AND MAINTAINED AFTER EACH RAINFALL AS DIRECTED AND TO THE SATISFACTION OF THE CITY OF HAMILTON.
C. ADDITIONAL SILT CONTROL LOCATIONS MAY BE REQUIRED AS DETERMINED BY THE CITY OF HAMILTON.
D. ALL EROSION AND SEDIMENTATION CONTROL DEVICES SHOULD BE INSPECTED MINIMUM WEEKLY, AFTER EVERY RAINFALL AND MAINTAINED AND CLEANED AS REQUIRED
E. SILTATION CONTROL DEVICES ARE TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF WORKS AND REMAIN IN PLACE UNTIL FINAL COVER IS ESTABLISHED.



CATCH BASIN SEDIMENT TRAP
DETAIL 'A'
N.T.S.

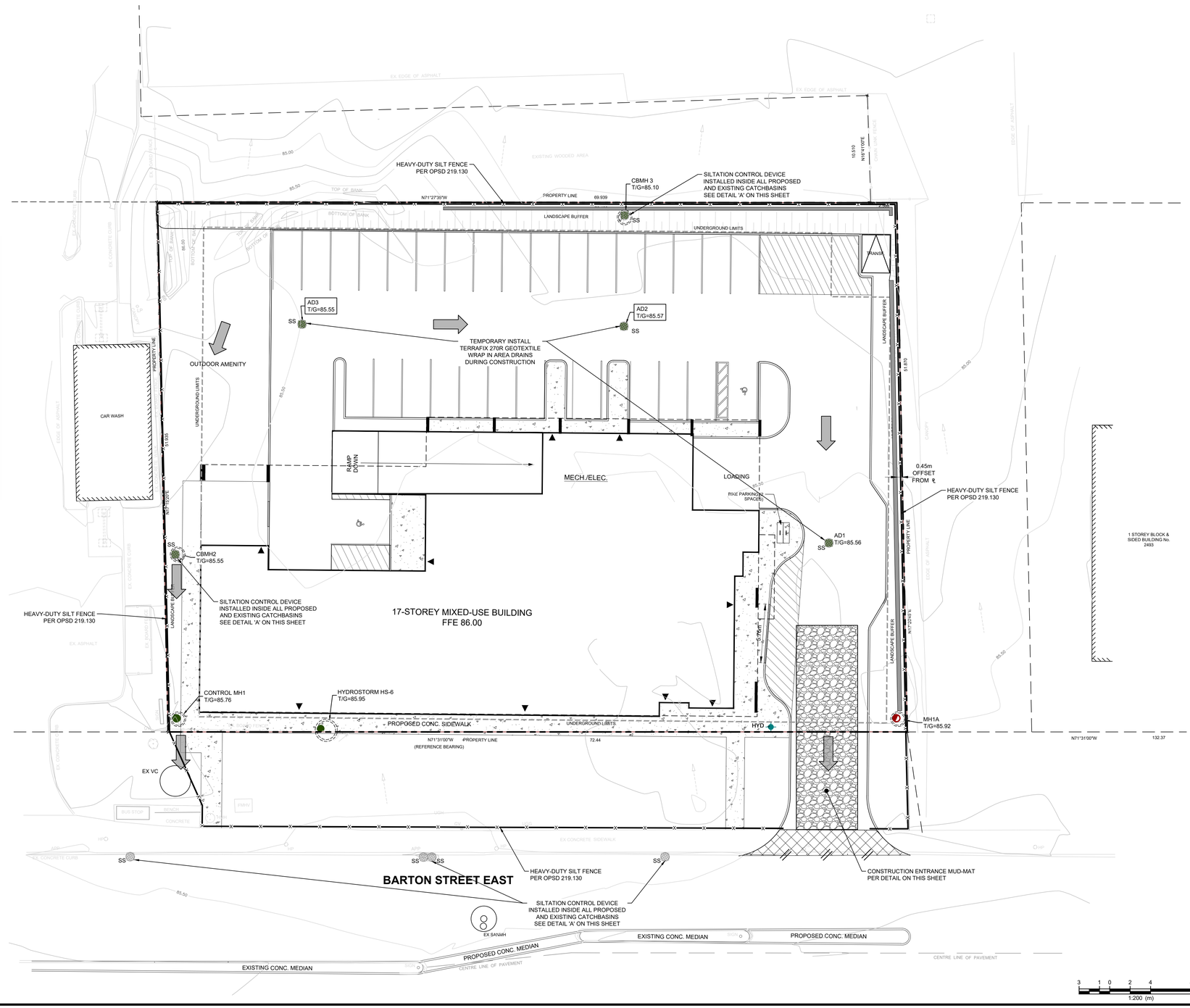


CONSTRUCTION ENTRANCE "MUD MAT"
N.T.S.



NOTE:
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev	2
HEAVY–DUTY SILT FENCE BARRIER			
	OPSD 219.130		



PREMIER GROUP
REALTY INC

North

DATE	ISSUANCE	NO.
2022.12.12	ISSUED FOR REZONING	1

LEGEND

- HEAVY DUTY SILT FENCE
- SS — CATCHBASIN SILT SACK
- EXISTING DRAINAGE ARROW/SLOPE
- PROPOSED OVERLAND FLOW ROUTE
- 86.0 — EXISTING GROUND CONTOURS
- MH — PROPOSED STORM MANHOLE
- MHA — PROPOSED SANITARY MANHOLE
- AD — PROPOSED STORM AREA DRAIN
- EX CB — EXISTING CATCHBASIN
- EX MH — EXISTING STORM MANHOLE

TOPO SURVEY INFORMATION:
TOPOGRAPHIC SURVEY OBTAINED BY A.T. McLAREN LTD. DWG NO. 36450, DATED SEPTEMBER 24, 2020.

BENCHMARK:
ELEV. = 85.971m
MONUMENT #07720100034
ROUND IRON BAR WITH BRASS CAP
MONUMENT IS LOCATED 27m WEST OF THE CENTRELINE OF LINCOLN ROAD AND 26m NORTH OF HAZELWOOD DRIVE, NORTHEAST CORNER OF EASTDALE PARK.

CLIENT
PREMIER GROUP REALITY INC.

12 CHIAVATTI DRIVE, MARKHAM, ON

PROJECT
2481 BARTON STREET EAST
HAMILTON, ON

TITLE
EROSION AND SEDIMENT CONTROL PLAN

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LICENSED PROFESSIONAL ENGINEER
12-Dec-2022
J. G. ORESKOVIC
PROVINCE OF ONTARIO

SCALE:	1:200
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C4-1