STARLIGHT GROUP PROPERTY HOLDINGS INC.

1485 WILLIAMSPORT DR. & 3480 HAVENWOOD DR.
CITY OF MISSISSAUGA

SITE SERVICING AND STORMWATER MANAGEMENT REPORT

LEA Project No.18298

REV 4: May 23, 2024

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1 INTRODUCTION

1.1 SCOPE OF THE SWM AND SERVICING REPORT

Starlight Group Property Holdings Inc. is proposing to redevelop a portion of an existing residential site located at 1485 Williamsport Drive and 3480 Havenwood Drive in the City of Mississauga, Ontario. LEA Consulting Ltd. has been retained by Starlight Investment to prepare a Site Servicing and Stormwater Management Report for their proposed purpose-built rental residential infill building ("rental infill building") in the City of Mississauga. This servicing and stormwater management report shall:

- Examine the potential water quality and quantity impacts of the proposed tower and summarize how each will be addressed in accordance with the City of Mississauga and Toronto Region Conservation Authority (TRCA) stormwater management requirements.
- Review the adequacy of the existing water supply, storm and sanitary services, and propose a site servicing plan.

1.2 SITE LOCATION AND PROPOSED DEVELOPMENT

The proposed development site is located at the northeast quadrant of Bloor Street West and Dixie Road, within the Little Etobicoke Creek watershed and under the jurisdiction of Toronto Region Conservation Authority (TRCA).

The existing site is approximately 22,203.6 m2 (5.48 acres), based on a review of the Site statistics on the latest site plan as provided by Architecture Unfolded. The existing Site is flat and currently occupied by two (2) existing residential towers with associated at-grade and underground parking lots, landscaped area and a swimming pool.

It is understood the existing pool will be demolished to facilitate construction of 10-storey rental infill building with one basement level. The proposed development will also include a driveway from Williamsport Drive south of the development, expansion of surface parking north of the existing parking structure, expansion of the existing underground parking garage, as well as landscaping and proposed paved pathways throughout the site. Improvements to the landscaping, driveway, and sidewalk for existing properties at 3480 Havenwood Drive and 1485 Williamsport Drive will also be undertaken.

1.3 STORMWATER MANAGEMENT PLAN OBJECTIVES

The objectives of the stormwater management plan are to determine site specific stormwater management requirement, review the stormwater environment impact by the proposed residential development, and address the City's and TRCA's requirements for stormwater quantity control and quality control as required. A preliminary stormwater management design documenting the strategy along with the technical information necessary for the sizing of the proposed stormwater management practices will be prepared.

1.4 SWM DESIGN CRITERIA – TORONTO REGION CONSERVATION AUTHORITY

Toronto and Region Conservation Authority, in partnership with the Credit Valley Conservation Authority (CVC), has issued the Storm Water Management Criteria (August 2012) to provide direction on how to manage rainfall and runoff within TRCA's jurisdiction. A summary of the storm water management criteria applied for this project, is provided below:

- Storm Water Quality Control – Etobicoke Creek is classified as requiring an Enhanced level of protection (80% TSS removal) by TRCA quality control criteria.
- Flood Control (Water Quantity Control) – Control of post-development peak flow rate to pre-development levels for all storms up to and including the 100-year storm is required by TRCA within Etobicoke Creek watershed.
- Water Balance Control – Maintain pre-development groundwater recharge rates and appropriate distribution, ensuring the protection of related hydrologic and ecologic functions.
- Erosion Control – On-site detention of 5mm within Etobicoke Creek watershed.

2 EXISTING CONDITIONS

2.1 GENERAL

The existing site is bounded by Havenwood Drive to the east and Williamsport Drive to the north, west and south. The existing Site is flat and currently occupied by two (2) existing residential buildings with associated at-grade and underground parking lots, landscaped area, and a swimming pool.

Figure 1 in **Appendix E** illustrates the existing drainage conditions and existing sub catchments within the site. There are three separate existing catchments, EC1 (Existing site draining to Havenwood Drive), EC2 (Portion of the existing site draining to Williamsport Drive south of the proposed development) and EC3 (Portion of the existing site draining to Williamsport Drive north of the proposed development). During more frequent rainfall events, surface rainfall runoff from the site is captured via existing catchbasins located in the existing surface parking lot and along the existing driveway between the parking structure and 1485 Williamsport drive, while major flow from the parking area and driveway is conveyed out of the site to Havenwood Drive and Williamsport Drive.

Based on our review of the topographic survey, there is no on-site stormwater management facility under existing conditions for any of the existing catchment areas.

2.2 ALLOWABLE PEAK FLOW RATES UNDER EXISTING CONDITION

Based on the existing site condition and rainfall parameters, the Unit Flow Rates for Little Etobicoke Creek is adopted to calculate peak flows at different design storm events as per Table 6 in the City of Mississauga's Storm Drainage Design Requirements.

The peak flow rate for the pre-development site condition is calculated using the following equation:

$$Q = I \times A$$

Where; I = unit runoff rate in (L/s/ha),

A = development site area (ha)

The parameters for, I, recommended for use in the Little Etobicoke Creek watershed is defined in Table 6 of the City of Mississauga Storm Drainage Design Requirements, and is summarized in **TABLE 1**.

TABLE 1: UNIT FLOW RATES (LITTLE ETOBICOKE CREEK)

Return Period	2 - Yr	5 - Yr	10 - Yr	25 - Yr	50 - Yr	100 - Yr
Unit Runoff Rate (L/s/ha)	35.75	47.46	55.46	65.69	73.15	80.75

The calculated peak flow rates for the existing site and respective existing catchments in the pre-development condition are summarized below in **TABLE 2**. Detailed calculations are provided in **Appendix A**.

TABLE 2: PRE-DEVELOPMENT PEAK FLOW RATES (L/s)

Return Period (Year)	Catchment EC-1 (Draining to Havenwood) Peak Flow Rates (L/s)	Catchment EC-2 (Draining to Williamsport South of Site) Peak Flow Rates (L/s)	Catchment EC-3 (Draining to Williamsport North of Site) Peak Flow Rates (L/s)
2	35.51	4.10	2.29
5	47.15	5.44	3.04
10	55.09	6.36	3.55
25	65.16	7.52	4.20
50	72.67	8.38	4.68
100	80.22	9.25	5.17

3 POST-DEVELOPMENT CONDITIONS

3.1 GENERAL

The proposed development consists of the construction of a 10-storey rental infill building with one basement level. The proposed development will also include a driveway from Williamsport Drive south of the development, expansion of surface parking north of the existing parking structure, expansion of the existing underground parking garage, as well as landscaping and proposed paved pathways throughout the site. Improvements to the landscaping, driveway, and sidewalk for existing properties at 3480 Havenwood Drive and 1485 Williamsport Drive will also be undertaken. The proposed development will include soft landscaping courtyards and paved sidewalks/pathways.

Refer to **Figure 2** in **Appendix E** for details of post-development drainage conditions. Sub Catchment Area PC-1 is representative of the proposed residential development and new surface parking areas north of the existing parking structure that will be collected by a proposed storm sewer system and drained to the existing storm sewers along Havenwood Drive. Sub catchment area PC-2 is representative of the proposed south driveway extension and south building entrance portion of the proposed site that will be collected by a proposed storm sewer network and drained to the existing storm sewers along Williamsport Drive south of the site. PC-3 is representative of the north proposed landscaped and paved pathway portion of the proposed site that will mimic existing drainage conditions and have surface runoff collected by existing parking lot area drains in the 3480 Havenwood Drive existing parking lot and drained to the existing storm sewers along Williamsport Drive north of the site. Sub catchments UC 1 and UC 2 are portions of the proposed site that will be left as uncontrolled drainage to Havenwood Drive. The proposed runoff within UC1 and UC2 will be left uncontrolled and captured via existing catch basins located in the existing surface parking lot and along the existing driveway between the parking structure and 1485 Williamsport Drive mimicking existing drainage conditions.

Stormwater generated within the sub catchments PC1 (containing the proposed residential development and new surface parking lot) and PC2 (containing the proposed south driveway extension and south building entrance) will be retained and detained in two separate underground stormwater storage tanks, conveyed to stormwater quality treatment manholes and then discharged into the City's storm sewers on Havenwood Drive and Williamsport Drive at calculated allowable release rates.
For Quantity control of Sub-Catchment PC1 containing the proposed rental infill building and proposed surface parking areas, a SWM tank [Tank 1] controlling the flow rate from the proposed condominium PC-1 will be controlled to the pre-development flow rates of existing catchment areas EC1 that currently drains to Havenwood Drive. For Quantity control of Sub-Catchment PC2 containing the proposed condominium south entrance and driveway, a SWM [Tank 2] tank controlling the flow rate from the proposed sub catchment PC-2 will be controlled to the pre-development flow rates of existing catchment areas EC2 that currently drains to Williamsport Drive South of the proposed development.

The land use is provided below in**TABLE 3** for comparison between existing and proposed conditions for all sub catchments.

TABLE 3: LAND-USE AREA BREAKDOWN

Catchment	Impervious Area (m^2)		Pervious Area (m^2)	
	Existing	Proposed	Existing	Proposed
EC-1	5389.0	-	4545.0	-
EC-2	68.5	-	1077.5	-
EC-3	0.0	-	640.0	-
TOTAL (EXISTING CONDITIONS)	5457.5		6262.5	
PC-1	-	4086.1	-	1604.6
UC-1	-	3538.8	-	564.0
UC-2	-	47.2	-	203.8
PC-2	-	415.8	-	719.0
PC-3	-	95.7	-	522.3
UC-4	-	28.6	-	169.0
TOTAL (PROPOSED CONDITIONS)		8212.2		3782.8
% CHANGE	50.5% Increase		39.5% Decrease	

TABLE 3 demonstrates that the impervious area will be increased by 50.5% after the proposed construction of the new rental infill building, parking lot and proposed landscaped and hardscaped features.

3.2 RAINFALL INFORMATION

The rainfall intensity for the post-development site conditions was calculated using the following equation:

$$I = A / (T_c + B)^{0.78}$$

Where; I = rainfall intensity in mm/hr,

T_c = time of concentration in minutes,

A, B = constant parameters (see below)

The parameters (A and B) recommended for use in the City of Mississauga are defined in City Standard

Drawing No. 2111.010 and are summarized in **TABLE 4**.

TABLE 4: RAINFALL INTENSITY PARAMETERS

Return Period (Year)	2 - Yr	5 - Yr	10 - Yr	25 - Yr	50 - Yr	100 - Yr
A	610	820	1010	1160	1300	1450
B	4.6	4.6	4.6	4.6	4.7	4.9

An initial time of concentration, T_C, of 15 minutes is recommended in the City's Development Requirements Manual.

3.3 PEAK FLOW RATES UNDER PROPOSED CONDITION

Based on the proposed site condition and rainfall parameters, the Rational Method is adopted to calculate peak flow rates at different design storm events.

The calculated peak flow rates for the proposed site area in the post-development conditions are tabulated below for all proposed sub catchments in **TABLE 5**. Detailed calculations are provided in **Appendix A**.

TABLE 5: POST-DEVELOPMENT UNCONTROLLED PEAK FLOW RATES (L/s)

Return Period (Year)	Rainfall Intensity (mm/hr)	Catchment PC-1 Peak Flow Rates (L/s)	Catchment UC-1 Peak Flow Rates (L/s)	Catchment UC-2 Peak Flow Rates (L/s)	Catchment PC-2 Peak Flow Rates (L/s)	Catchment PC-3 Peak Flow Rates (L/s)	Catchment UC-4 Peak Flow Rates (L/s)
2	59.89	67.86	55.34	1.55	9.22	3.61	1.13
5	80.51	91.22	74.39	2.09	12.39	4.85	1.52
10	99.17	112.36	91.62	2.57	15.26	5.97	1.87
25	113.89	129.05	105.23	2.96	17.53	6.86	2.15
50	127.64	144.62	117.93	3.31	19.64	7.68	2.41
100	140.69	159.41	129.99	3.65	21.65	8.47	2.66

3.4 IMPACT ON WATER ENVIRONMENT

Based on the review and analysis of existing and proposed site conditions, **TABLE 6** summarizes the key hydrologic parameters under existing and proposed conditions for the full site.

TABLE 6: KEY HYDROLOGIC PARAMETERS (FULL SITE)

Sub-catchment	EC1	EC2	EC3	PC1	UC1	UC2	PC2	PC3	UC4
% Imperviousness	54.2	6.0	0.0	71.8	86.3	18.8	36.6	15.5	14.5
Composite Runoff Coefficient	0.60 (0.5 Max allowable)	0.29 (0.5 Max allowable)	0.25 (0.5 Max allowable)	0.72	0.81	0.37	0.49	0.35	0.34
2-year Peak Flow (L/s)	35.51	4.10	2.29	67.86	55.34	1.55	9.22	3.61	1.13
5-year Peak Flow (L/s)	47.15	5.44	3.04	91.22	74.39	2.09	12.39	4.85	1.52
10-year Peak Flow (L/s)	55.09	6.36	3.55	112.36	91.62	2.57	15.26	5.97	1.87
25-year Peak Flow (L/s)	65.16	7.52	4.20	129.05	105.23	2.96	17.53	5.97	2.15
50-year Peak Flow (L/s)	72.67	8.38	4.68	144.62	117.93	3.31	19.64	7.68	2.41
100-year Peak Flow (L/s)	80.22	9.25	5.17	159.41	129.99	3.65	21.65	8.47	2.66

The actual pre-development runoff coefficients are shown as calculated and as indicated the maximum runoff coefficient of 0.50 will be considered under pre-development condition in accordance with City's design criteria.

4 PROPOSED SWM PLAN

4.1 WATER BALANCE REQUIREMENTS

Based on the water balance criteria, the minimum on-site runoff retention requires retaining all runoff of the first 5mm from each rainfall through infiltration and evapo-transpiration, etc. To satisfy the water balance criteria for the two sub catchments PC1 and PC2 that will be quantity controlled, approximately 28.45 m^3 on-site storage volume within Tank 1 and approximately 5.67m^3 on-site storage volume within Tank 2 will be provided in the underground storage tanks respectively. Refer to **Appendix A** for detailed calculations.

The potential methods to address the water balance criteria are outlined as follows:

- Infiltration from the bottom of the proposed storm tanks.
- Irrigation of trees and plants on the property.
- Rainwater harvesting: Re-use of rainwater as grey water for toilet flushing, and

The exact application and consumption rates will be determined in the next design stage in consultation with project design team architect and mechanical engineers.

4.2 WATER QUANTITY CONTROL REQUIREMENTS

According to the TRCA's stormwater quantity control criteria for Etobicoke Creek and as per Table 2 in the City of Mississauga's Storm Drainage Design Requirements for the Little Etobicoke Creek watershed, it is required to control post-development peak flow rates to pre-development levels for all storms up to and including 100-year storm. Therefore, the required on-site stormwater storage volumes for different design storm events have been calculated. Stormwater generated within the sub catchments PC1 (containing the proposed residential development and new surface parking lot) and PC2 (containing the proposed south driveway extension and south building entrance) will be retained and detained in two separate underground stormwater storage tanks, conveyed to stormwater quality treatment manholes and then discharged into the City's storm sewers on Havenwood Drive and Williamsport Drive at calculated allowable release rates. Based on the post-development condition and allowable release rates calculated, the uncontrolled and controlled 100-year discharge rates for sub catchments PC 1 and PC 2 have been summarized in **Table 7** below. Detailed calculations are provided in **Appendix A**.

TABLE 7 COMPARISON OF 100 YEAR PRE & POST DEVELOMENT CONTROLLED PEAK FLOW RATES

	Pre-Development Conditions		Post-Development Conditions	
Sub-Catchment	**EC1**	**EC2**	**PC 1**	**PC 2**
Pre-Development 100-year Peak Flow Rate [L/s]	80.22	9.25	-	-
Post-Development (Uncontrolled 100 Year Peak Flow Rate) [L/s]	-	-	159.41	21.65
Post-Development Allowable Release Rate [L/s]	-	-	80.22	9.25

For Quantity control of Sub-Catchment PC1 containing the proposed rental infill building and proposed surface parking areas, a SWM tank [Tank 1] controlling the flow rate from the proposed condominium PC-1 will be controlled to the pre-development flow rates of existing catchment area EC1 that currently drains to Havenwood Drive. For Quantity control of Sub-Catchment PC2 containing the proposed condominium south entrance and driveway, a SWM [Tank 2] tank controlling the flow rate from the proposed sub catchment PC-2 will be controlled to the pre-development flow rates of existing catchment area EC2 that currently drains to Williamsport Drive South of the proposed development. Based on the post-development conditions, the discharge rates and stormwater detention requirements for both proposed SWM Tank 1 and SWM Tank 2 are summarized in **TABLE** below.

TABLE 8: REQUIRED ON-SITE STORAGE VOLUMES (m^3)

Tank 1 (Quantity Control for PC-1)						
Return Period (Year)	**2 - Year**	**5 - Year**	**10 - Year**	**25 - Year**	**50 - Year**	**100 - Year**
Required Storage Volume (m^3)	29.11	39.67	51.54	57.50	64.24	71.24
Tank 2 (Quantity Control for PC-2)						
Return Period (Year)	**2 - Year**	**5 - Year**	**10 - Year**	**25 - Year**	**50 - Year**	**100 - Year**
Required Storage Volume (m^3)	4.61	6.25	8.01	9.01	10.07	11.16

Based on the proposed site condition and on-site Stormwater retention & detention requirement, an underground stormwater storage tank (Tank 1) with a 250 mm orifice tube will be provided for quantity control of PC-1. For quantity control of PC-2 an underground stormwater storage tank (Tank 2) with a 85 mm orifice tube will be provided. However, since this is less than the minimum required orifice tube size of 100mm, a 200 m PVC STM pipe with an inlet control device will be provided on OGS MH 12 as an alternative to the 85 mm orifice tube.

The proposed stormwater tank 1 is a Layfield Aquabox Module underground storage tank and will provide 78.62m3 of module storage volume as well as 22.78m3 of additional storage volume by granular stone surrounding the tank. Overall, the total underground storage system will provide 101.40m3 of storage volume as per the manufacturer specifications as provided in the specifications. The manufacturer has provided shop drawings and specifications for the tank and these details have been provided in **Appendix A**. The overall storage volume provided by the system is higher than the calculated required 100-year storage volume and will meet quantity control requirements for this catchment area.

The proposed stormwater tank 2 will also be a Layfield Aquabox Module underground storage tank and will provide 15.55m3 of module storage volume as well as 6.12m3 of additional storage volume by granular stone surrounding the tank. Overall, the total underground storage system will provide 21.67m3 of storage volume as per the manufacturer specifications as provided in the specifications. The manufacturer has provided shop drawings and specifications for the tank and these details have been provided in **Appendix A**. The overall storage volume provided by the system is higher than the calculated required 100-year storage volume and will meet quantity control requirements for this catchment area.

Detailed storage volume and orifice size calculations are provided in **Appendix A**.

4.3 WATER QUALITY CONTROL REQUIREMENT

In order to achieve the long-term average removal of 80% of Total Suspended Solids (TSS) on an annual basis from all runoff leaving the site, the following quality control measures will be provided:

- Clean building roofs;
- Landscaped Area;
- Oil Grit Separator.

Based on the SWM design criteria, the building rooftop area is not subject to vehicular traffic, and the application of sand and de-icing salt constituents, petroleum hydrocarbons, and heavy metals. As such, runoff from the roof surface is generally considered to be clean. Therefore, roof water is considered to be clean. **TABLE 8** provides a preliminary estimate of TSS removal level of stormwater leaving the site for sub catchments PC-1 and PC-2. Detailed calculations are provided in **Appendix A.**

TABLE 8: TSS REMOVAL ASSESSMENT

Land Use	Area (m^2)	TSS Removal Efficiency (%)	Composite TSS Removal Efficiency (%)
Sub Catchment PC-1 (Containing Proposed Rental Infill Building)			
Roof	1223.9	80	17.2
Soft Landscaped Area	1604.6	80	22.6
Oil/Grit Separator	5690.7	50	50.0
Total	5690.7	-	**>80.0**
Sub Catchment PC-2 (South Driveway Extension)			
Roof	0	80	0.0
Soft Landscaped Area	719.0	80	50.7
Oil/Grit Separator	1134.8	50	50.0
Total	1134.8	-	**>80.0**

To achieve a TSS removal of 80%, two Stormwater quality treatment facilities are proposed. Two Oil Grit Separator Units (OGS), Forterra Stormceptor EFO4 will be utilized for stormwater quality treatment for both subcatchments PC-1 and PC-2 (or an approved equivalent product). The Stormceptor EF04 has been sized by the manufacturer to treat the stormwater runoff from the entire site to provide at least 80% TSS removal. Information regarding the Stormceptor systems, sizing details and performance specifications have been provided by the manufacturer in **Appendix A**. Sizing details are provided in **Appendix A**.

These quality treatment units will be installed downstream of the underground storage tanks to reduce the risk of backwater impacts and reduced effectiveness of the filtration units.

4.4 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

During site construction, it is recommended that all Erosion and Sediment Control Best Management

Practices (BMPs) shall be installed and maintained in accordance with the TRCA *Erosion & Sediment Control Guide for Urban Construction* (2019). In brief, the measures below are anticipated to be provided on site during the entire period of construction:

- Siltation control fence along the perimeter of the construction site before commencement of construction;
- Sediment control measures to prevent silt entry at all the existing area drains and catch basins;
- Granular mud-mats at all construction ingress / egress locations; and
- An inspection and monitoring program following the TRCA Erosion & Sediment Control Guide for Urban Construction (2019).

An erosion and sediment control plan reflective of temporary measures has been prepared and can be found in **Appendix E-Drawing C-105**. The detailed erosion and sediment control plan will be approved by the City of Mississauga prior to any site alteration being undertaken. The detailed plan will address phasing, inspection and monitoring aspects of erosion and sediment control. All reasonable measures will be taken to ensure sediment loading to adjacent properties and storm sewers is minimized both during and following construction.

5 SITE SERVICING

The purpose of this site servicing report is to review the site servicing requirement of the proposed new development, and propose a site servicing plan, including water supply, sanitary and storm services. Refer to **Appendix E-Dwg. C102**-Site Servicing Plan for details of the proposed site service connections.

5.1 EXISTING MUNICIPAL SERVICES

Existing underground municipal services/utilities on Havenwood Drive adjacent to the proposed development site are summarized below:

a) 675mm dia. and 750mm dia. concrete storm sewer;

b) 250mm dia. concrete sanitary sewer; and

c) 300mm dia. PVC watermain

Existing underground municipal services/utilities on Williamsport Drive south of the proposed development site are summarized below:

d) 525mm dia. storm sewer;

e) 250mm dia. sanitary sewer; and

f) 300mm dia. PVC watermain.

5.2 PROPOSED SITE SERVICE CONNECTIONS

Based on the project statistics of proposed development provided by the architect, City of Mississauga and Peel Region’s design criteria, sanitary flow and water demand are calculated in **Appendix B** and

Appendix C. This information is summarized in **TABLE 9**. Details regarding site storm flow discharge rates have been provided in the previous section of this report.

TABLE 9: SITE SERVICING REQUIREMENT

100 year- Storm Discharge Rate *[Sub catchment PC-1 Containing the proposed building]* (L/s)	100 year- Storm Discharge Rate *[Sub catchment PC-2 Containing the proposed building]* (L/s)	Actual Sanitary Discharge Rate (L/s)	Sanitary Discharge Rate (L/s)	Water Demand *[Domestic and Fire Flow]* (L/s)
80.22	9.25	4.75	13.44	135.38

Through discussion with design team mechanical engineers, the locations and sizes of the proposed site service connections have been determined to satisfy the requirements of the City of Mississauga, Peel Region and Ontario Building Code (OBC). In summary:

a) Sanitary Service: A proposed 200mm Sanitary service connection will be installed to discharge sanitary flow to the exiting 250mm concreate sanitary sewer on Williamsport Drive south of the proposed development at Proposed MH3A which is also connected to proposed sanitary control manhole MH2A and sanitary manhole MH 1A within the site.

b) Storm Service: Storm flow within sub catchment PC-1 will be discharged at the allowable release rate to the proposed storm manhole MH9 and existing 675mm Storm Sewer on Havenwood Drive via a 375mm dia. storm service connection. Storm flow within sub catchment PC-2 will be discharged at the allowable release rate to the proposed storm manhole MH14 and existing 525mm Storm Sewer on Williamsport Drive south of the proposed development via a 250mm dia. storm service connection.

c) Water service:

- Domestic Water Service: A 150mm dia. domestic water service connection will be installed to service the proposed rental infill building and connected to the proposed 200mm dia. fire protection water service connection with a cut-in Tee.
- Fire Protection Service: A 200mm fire protection PVC water service will be installed.
- The 300mm watermain on Williamsport Drive will be utilized to service the proposed development site.

Refer to **Dwg. C102 and Dwg. C104** for details and cross sections of proposed service connections.

Adequacy of Existing Municipal Services

Based on the design criteria and the design records, assessment of existing 250mm sanitary sewer along Williamsport Drive, the existing 675mm and 750mm storm sewers along Havenwood drive, and the existing 525mm storm sewer Williamsport Drive are reviewed below:

250mm Sanitary Sewer:

The full flow capacity of the existing 250mm sanitary sewer on Williamsport Drive south of the proposed development is estimated at 32.80 L/s based on Region's record drawing and anticipated to be adequate to accommodate the actual sanitary flow (4.75 L/s) and the proposed sanitary flow for developments with less than 1000 people (13.44 L/s).

Detailed calculations are provided in **Appendix B.**

675mm and 750mm Storm Sewers along Havenwood Drive:

The existing 675mm and 750mm storm sewers along Havenwood Drive, as shown on the City's record drawings are designed based on City of Mississauga 10-year design storm peak flow rate.

Under the proposed condition, SWM plan is implemented in accordance with TRCA's design criteria, i.e. control the post-development discharge flow rate to pre-development peak flow rate.

Under pre-development conditions, the Peak flow rates are calculated based on the flow rates for catchment No. 208 of Etobicoke watershed which are smaller than the 10-year design storm flow rate of the City's storm sewers.

In comparison, original design flow and controlled discharge flow rate from the development are provided below. Calculations are provided in **Appendix A**.

- City of Mississauga maximum allowable discharge rate for EC-1 (10-year flow based on the rational method with maximum runoff coefficient of 0.5): 136.83 L/s
- Controlled 100-yr discharge flow from site PC-1 controlled to 100-year pre development flow rate of EC-1 (based on the TRCA's flow rates): 80.22 L/s
- Decrease in discharge flow: 56.61 L/s

Therefore, the capacity of the existing 675mm and 750mm storm sewers on Havenwood Drive are adequate to accommodate the proposed development. Additionally, with the implementation of SWM plan, it is expected that the proposed development will not worsen the existing hydraulic conditions or add any additional flows and, therefore, will not contravene the Ministry of Environment Procedure F-5-5. Detailed calculations are provided in **Appendix A**.

525mm Storm Sewer along Williamsport Drive:

Under the proposed condition, SWM plan is implemented in accordance with TRCA's design criteria, i.e. control the post-development discharge flow rate to pre-development peak flow rate.

Under pre-development conditions, the Peak flow rates are calculated based on the flow rates for catchment No. 208 of Etobicoke watershed which are smaller than the 10-year design storm flow rate of the City's storm sewers.

The flows from the 750mm storm sewer along Havenwood Drive will combine with the flows from the 525mm storm sewer along Williamsport Drive at the intersection of Havenwood Drive and Williamsport Drive east of the site. In the existing condition, catchment EC-2 drains towards Williamsport Drive and is collected via catchbasin to the 525mm storm.

In comparison, original design flow and controlled discharge flow rate from the development are provided below. Calculations are provided in **Appendix A**.

- City of Mississauga maximum allowable discharge rate for EC-1 (10-year flow based on the rational method with maximum runoff coefficient of 0.5): 136.83 L/s
- City of Mississauga maximum allowable discharge rate for EC-2 (10-year flow based on the rational method with maximum runoff coefficient of 0.5): 15.79 L/s
- Controlled 100-yr discharge flow from site PC-1 controlled to 100-year pre development flow rate of EC-1 (based on the TRCA's flow rates):80.22 L/s
- Controlled 100-yr discharge flow from site PC-2 controlled to 100-year pre development flow rate of EC-2 (based on the TRCA's flow rates): 9.25 L/s
- Combined 100-yr discharge flow from site PC-1 and PC-2 controlled to 100-year pre development flow rate of EC-1 and EC-2, respectively (based on the TRCA's flow rates): 89.47 L/s
- Combined decrease in discharge flow: 47.36 L/s

Therefore, the capacity of the existing 525mm storm sewer on Williamsport Drive is adequate to accommodate the proposed development. The combined flow downstream of both PC-1 and PC-2 are both less than the existing 10-year maximum allowable discharge rate. Additionally, with the implementation of SWM plan, it is expected that the proposed development will not worsen the existing hydraulic conditions or add any additional flows and, therefore, will not contravene the Ministry of Environment Procedure F-5-5. Detailed calculations are provided in **Appendix A**.

<u>300mm Watermain:</u>

The design water demand is estimated as 135.38 L/s or 2145.69 US GPMs for the proposed development based on the project statistics. In order to evaluate the adequacy of the 300mm watermain located on Williamsport Drive, a hydrant flow test was conducted on September 8, 2022 by Classic Fire Protection. Test results are included in **Appendix D**.

As shown by the test readings, the available water pressure ranges from 75 psi with a flow of 1443 US GPM to 80 psi with a flow of 748 US GPM during the flow tests with a static pressure of 84. ClassicFLS also provided a pressure flow chart with an interpolated flow of 4162.1 USGPM at the minimum required residual pressure of 20psi. After reviewing the hydrant test results in conjunction with the calculated design water demand, an interpolated graph of the residual pressure and flow was developed as shown in **Appendix D**. At the design water demand of 134.38 L/s (or 2145.69 USGPM), the interpolated flow test results show an available residual pressure of 60.8 psi available along the 300mm Williamsport Drive watermain (**Appendix D**), which is greater than the minimum requirement of 20 psi (150 kpa). Therefore, adequate water supply and pressure are available to service the proposed residential development.

6 GROUNDWATER DISCHARGE

A hydrogeological investigation for the proposed development has been carried out by Terraprobe Inc. for the previous ZBA submission in 2018 as well as an updated investigation consisting of five boreholes (Boreholes 101-105) during the period of September 12-15 2022. Three of the new boreholes (BH 102, 103 and 105) and one existing borehole (BH 10) were affixed with monitoring wells to determine existing groundwater conditions. A map of the borehole investigations from the Terraprobe report has been provided in **Appendix E** of this report for reference.

Based on the investigation and 5 boreholes, the existing groundwater table was encountered at depths ranging between 9.07m and 8.82m below the existing grade at the locations of the boreholes with ground monitoring wells. The following **Table 10** has been prepared to summarize the groundwater information obtained from the hydrogeological investigation and summarizes the groundwater levels observed at the four boreholes with monitoring wells. A map showing the borehole locations can be found within in Appendix F.

TABLE 10: SUMMARY OF GROUNDWATER MONITORING

Borehole No./Well ID	Ground Surface Elevation, GSE (m)	Screening Depth-Below GSE (m)	Highest Groundwater Table Encountered-Depth from Surface (m)	Highest Groundwater Table Encountered -Elevation (m)	Date Observed
BH 10	140.3	8.8 - 11.9	8.78	131.52	Sept 30, 2022
BH 102	140.3	13.9 - 16.9	8.78	131.52	Sept 30, 2022
BH 103	140.5	7.7 - 10.7	9.05	131.45	Oct 13, 2022
BH 105	139.9	5.6 - 8.6	Dry	Dry	-

Based on the results from the investigation the highest groundwater elevation was found at an elevation of 131.52m above sea level (masl).

Based on the proposed site plan, the residential redevelopment proposed for the Site includes a 10-storey rental infill building with one basement level. The Finish Floor Elevation (FFE) of the proposed basement is set at El. 137.55 metres above sea level (masl). The approximate base of excavation is anticipated to be 137.05 metres (masl) and the approximate proposed elevator pit/foundation is anticipated to be 135.75 metres (masl). The proposed underground parking expansion will be at a similar elevation as the existing parking garage at 136.35 metres (masl).

Based on the proposed development depths, the proposed elevation of the base of the excavation (drainage layer), and the base of the elevator pit will be higher than the highest recorded groundwater level. As per the recommendations in the hydrogeological report, groundwater seepage is not anticipated for short-term construction and long-term foundation drainage. However, there will be stormwater and infiltration from precipitation for short-term construction and long-term foundation drainage. Due to this there will be requirements for short term and long-term groundwater discharge.

6.1 CONSTRUCTION DEWATERING

As per the proposed lowest footing and excavation elevation and the highest observed groundwater table elevation, the hydrogeological investigation has indicated that there is no concern regarding the short term/construction dewatering with respect to groundwater. However, the report has indicated that limited perched water is anticipated and that the short-term control of groundwater should take into account storm water management from rainfall events. The collection system should account for a typical 2-year design storm event. Significant rainfall events could generate 30,500 L/day from the Site during a 2-year storm event.

According to O. Reg. 63/16, a plan for discharge must consider the conveyance of storm water from a 100-year storm. The anticipated flow reaches up to 113,000 L/day during a 100-year storm event during construction.

Groundwater dewatering is not anticipated during construction. Collected surface water due to storm events will need to be discharged. Due to this, the investigation has recommended that a water quality assessment should be conducted prior to discharging storm fall/surface water during construction.

The estimated short term/construction dewatering rates from storm events would be below the MECP pumping limit of 50,000 - 400,000 L/day thus the submission of an Environmental Activity and Sector Registration (EASR) to the Ministry of the Environment, Conservation and Parks (MECP) will not be required for construction dewatering. A short-term groundwater discharge permit will be required from the City of Mississauga if the groundwater will be discharged to the existing sewer systems, these details will be coordinated in the next stage of the design.

6.2 LONG TERM DEWATERING

As per the proposed lowest footing and excavation elevation and the highest observed groundwater table elevation, the hydrogeological investigation has indicated that there is no concern regarding the long-term dewatering with respect to groundwater however the report has indicated that there may be anticipated infiltration flow from precipitation. The report has indicated that long-term foundation drainage flow rates could reach 2,000 L/day during a 2-year storm event.

The estimated long term/construction dewatering rates from storm events would be below the MECP pumping limit of 50,000 - 400,000 L/day thus the submission of an Environmental Activity and Sector Registration (EASR) to the Ministry of the Environment, Conservation and Parks (MECP) will not be required for construction dewatering. However, obtaining a long-term groundwater discharge agreement from the City of Mississauga is recommended as per the hydrogeological report.

6.3 GROUNDWATER QUALITY

The hydrogeological investigation report had indicated that the groundwater quality monitored at Borehole BH-10 exceeded the Peel Region and City of Mississauga sewer use by-law limits for total suspended solids (TSS), chloroform, total copper, total manganese, total phosphorus and total zinc. Since the report has indicated that discharge of the groundwater will not be required, no further action is required to control the concentration of TSS and other associated metals in exceedance of the regional/municipal bylaws.

7 CONCLUSIONS

Stormwater Management Plan

- Under existing conditions, there are no existing on-site stormwater management facilities.
- Stormwater generated within the sub catchments PC1 (containing the proposed residential development and new surface parking lot) and PC2 (containing the proposed south driveway extension and south building entrance) will be retained and detained in two separate underground stormwater storage tanks, conveyed to stormwater quality treatment manholes and then discharged into the City's storm sewers on Havenwood Drive and Williamsport Drive at calculated allowable release rates
- For Quantity control of Sub-Catchment PC1 containing the proposed rental infill building and proposed surface parking areas, a SWM tank [Tank 1] controlling the flow rate from the proposed condominium PC-1 will be controlled to the pre-development flow rates of existing catchment area EC1 that currently drains to Havenwood Drive. For Quantity control of Sub-Catchment PC2 containing the proposed condominium south entrance and driveway, a SWM [Tank 2] tank controlling the flow rate from the proposed sub catchment PC-2 will be controlled to the pre-development flow rates of existing catchment area EC2 that currently drains to Williamsport Drive South of the proposed development
- Based on the water balance criteria, the minimum on-site runoff retention requires retaining all runoff of the first 5mm from each rainfall through infiltration and evapo-transpiration. To satisfy the water balance criteria for the two sub catchments PC1 and PC2 that will be quantity controlled, approximately 28.45 m^3 on-site storage volume within Tank 1 and approximately 5.67m^3 on-site storage volume within Tank 2 will be provided in the underground storage tanks respectively.
- Based on the proposed site condition and on-site Stormwater retention & detention requirements, a 101.40 m^3 stormwater storage tank (Tank 1) with a 250 mm orifice tube will be provided for quantity control of PC-1. For quantity control of PC-2 a 21.67 m^3 stormwater storage tank (Tank 2) with an inlet control device on OGS MH 12 will be provided. These tanks will control post-development 100-year stormwater peak flows to pre-development level and provide the 5mm stormwater retention volumes required.
- To satisfy the City's 80% TSS removal, two oil/grit separators will be provided for sub catchments

PC 1 and PC 2 located downstream of SWM Tanks 1 and 2.

Temporary Erosion & Sediment Control Measures:

Temporary erosion and sediment control measures will be provided before construction and maintained during construction in accordance with GGHA CA's *Erosion & Sediment Control Guideline for Urban Construction* (December 2006). An erosion and sediment control plan reflective of temporary measures has been prepared and can be found in **Appendix E-Drawing C-105**

Site Servicing

The proposed site service connections for the proposed development site are summarized below:

- Building Rooftop Drainage leader: 250 mm dia. PVC Pipe;
- Storm service from PC1 to Havenwood Dr. Sewer: 375mm dia. PVC pipe;
- Storm service from PC2 to Williamsport Dr. Sewer: 250mm dia. PVC pipe;
- Sanitary service: 200mm dia. PVC pipe to Williamsport Dr. Sewer;
- Water service: 150mm dia. PVC pipe for domestic water supply & 200mm dia PVC pipe for Fire Line, Combined 200mm PVC Service connection to Williamsport Dr. Watermain;

8 NEXT STEPS/COORDINATION

The following items will be addressed in the next stage of design and will be further coordinated as required.

- Confirming depths of all existing public utilities (Gasmain, Alectra, Telecommunication, etc.) and municipal services (watermains, sewers) that cross proposed service connections via SUE investigations Quality Level-A test pits to confirm constructability.
- Further SUE investigation of existing area drains within the existing parking lot and existing driveway in sub-catchment UC-1 to confirm the drainage and ensure that this area can be drained as per existing conditions.
- Further coordination of provide water balance measures including; Proposed Green Roof details, Rainwater harvesting for irrigation of plants on the property and implementation of permeable pavers for capture of runoff on the property. Additional LID measures and implementation will be investigated in the next stage of design.
- Confirmation of water meter, double check valve backflow preventer, Stormwater storage tank details and related discharge system (pumps, valves, etc.), and backflow check valves.
- Short term and long-term groundwater discharge methods and impacts as discussed in the report and as per hydrogeological report recommendations.

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Appendix A

Stormwater Calculations, Manufacturer Details for Storage Tanks and OGS Units

LEA Consulting Ltd. Consulting Engineers and Planners	Land Use			
	Prepared:	G.B.	Page No.	A-01
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	May.14-24		

EXISTING CONDITIONS:

Existing Land Use	Area (m^2)
Catchment EC-1 (Draining to Havenwood)	
Building & Paved Area	5389.0
Landscape	4545.0
Total Catchment Area:	**9934.0**
Catchment EC-2 (Draining to Williamsport South of Site)	
Building & Paved Area	68.5
Landscape	1077.5
Total Catchment Area:	**1146.0**
Catchment EC-3 (Draining to Williamsport North of Site)	
Building & Paved Area	0.0
Landscape	640.0
Total Catchment Area:	**640.0**

PROPOSED DEVELOPMENT:

Proposed Land Use	Area (m^2)
Catchment PC-1 (Proposed Site-Draining to Havenwood)	
Building & Paved Area	4086.1
Landscape	1604.6
Total Catchment Area:	**5690.7**
Catchment UC-1 (Uncontrolled Draining to Havenwood)	
Building & Paved Area	3538.8
Landscape	564.0
Total Catchment Area:	**4102.8**
Catchment UC-2 (Uncontrolled Draining to Havenwood)	
Building & Paved Area	47.2
Landscape	203.8
Total Catchment Area:	**251.0**
Catchment PC-2 (Draining to Williamsport South of Site)	
Building & Paved Area	415.8
Landscape	719.0
Total Catchment Area:	**1134.8**
Catchment PC-3 (Draining to Williamsport North of Site)	
Building & Paved Area	95.7
Landscape	522.3
Total Catchment Area:	**618.0**
Catchment UC-4 (Uncontrolled Draining to Williamsport South of Site)	
Building & Paved Area	28.6
Landscape	169.0
Total Catchment Area:	**197.6**

LEA Consulting Ltd. Consulting Engineers and Planners	Composite "C" Calculation			
	Prepared:	G.B.	Page No.	A-02
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

Pre-Development Composite Runoff Coefficients "C"

Catchment EC-1 (Draining to Havenwood)

Location	Area (ha)	C	Composite "C"	
Building & Paved Area	0.539	0.90		
Landscape	0.455	0.25		
Total Catchment Area:	**0.99**			
			0.60	
			0.50	Max. allowable by City of Mississauga
Imperviousness Percent:			**54.2**	**%**

Catchment EC-2 (Draining to Williamsport South of Site)

Location	Area (ha)	C	Composite "C"	
Building & Paved Area	0.007	0.90		
Landscape	0.108	0.25		
Total Catchment Area:	**0.11**			
			0.29	
			0.50	Max. allowable by City of Mississauga
Imperviousness Percent:			**6.0**	**%**

Catchment EC-3 (Draining to Williamsport North of Site)

Location	Area (ha)	C	Composite "C"	
Building & Paved Area	0.000	0.90		
Landscape	0.064	0.25		
Total Catchment Area:	**0.06**			
			0.25	
			0.50	Max. allowable by City of Mississauga
Imperviousness Percent:			**0.0**	**%**

Post-Development Composite Runoff Coefficients "C"

Catchment PC-1 (Proposed Site-Draining to Havenwood)

Location	Area (ha)	C	Composite "C"	Imperviousness Percent:	
Building & Paved Area	0.409	0.90			
Landscape	0.160	0.25			
Total Catchment Area:	**0.57**		**0.72**	**71.8**	**%**

Catchment UC-1 (Uncontrolled Draining to Havenwood)

Location	Area (ha)	C	Composite "C"	Imperviousness Percent:	
Building & Paved Area	0.354	0.90			
Landscape	0.056	0.25			
Total Catchment Area:	**0.41**		**0.81**	**86.3**	**%**

Catchment UC-2 (Uncontrolled Draining to Havenwood)

Location	Area (ha)	C	Composite "C"	Imperviousness Percent:	
Building & Paved Area	0.005	0.90			
Landscape	0.020	0.25			
Total Catchment Area:	**0.03**		**0.37**	**18.8**	**%**

Catchment PC-2 (Draining to Williamsport South of Site)

Location	Area (ha)	C	Composite "C"	Imperviousness Percent:	
Building & Paved Area	0.042	0.90			
Landscape	0.072	0.25			
Total Catchment Area:	**0.11**		**0.49**	**36.6**	**%**

Catchment PC-3 (Draining to Williamsport North of Site)

Location	Area (ha)	C	Composite "C"	Imperviousness Percent:	
Building & Paved Area	0.010	0.90			
Landscape	0.052	0.25			
Total Catchment Area:	**0.06**		**0.35**	**15.5**	**%**

Catchment UC-4 (Uncontrolled Draining to Williamsport South of Site)

Location	Area (ha)	C	Composite "C"	Imperviousness Percent:	
Building & Paved Area	0.003	0.90			
Landscape	0.017	0.25			
Total Catchment Area:	**0.02**		**0.34**	**14.5**	**%**

LEA Consulting Ltd. Consulting Engineers and Planners	Pre-Development Peak Flow Rates Calculation			
	Prepared:	G.B.	Page No.	A-03
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

Pre-Development Peak Flow Rates

Rational Formulae: Q = I x A (L/s)

Catchment EC-1 (Draining to Havenwood)

Area 0.993 ha

Catchment EC-2 (Draining to Williamsport South of Site)

Area 0.115 ha

Catchment EC-3 (Draining to Williamsport North of Site)

Area 0.064 ha

Time of Concentration: 15 minutes as per City Guidelines

Runoff Coefficient : 0.50 Pre-development condition

Unit Runoff Rates (L/s/ha): City of Mississauga - Table 6: Etobicoke Creek Unit Flows
Little Etobicoke Creek

Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Unit Runoff Rates (L/s/ha):	35.75	47.46	55.46	65.59	73.15	80.75

Peak Flow Rates (L/s):

Catchment EC-1 (Draining to Havenwood)

	Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under Existing Site Conditions	(L/s):	35.51	47.15	55.09	65.16	72.67	80.22

Allowable discharge rate into municipal storm sewer (based on Rational Method):

Rainfall Intensity @ 10-year storm: 99.17 mm/hr

Runoff flow @ 10-year storm: 136.83 L/s

Catchment EC-2 (Draining to Williamsport South of Site)

	Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under Existing Site Conditions	(L/s):	4.10	5.44	6.36	7.52	8.38	9.25

Allowable discharge rate into municipal storm sewer (based on Rational Method):

Rainfall Intensity @ 10-year storm: 99.17 mm/hr

Runoff flow @ 10-year storm: 15.79 L/s

Catchment EC-3 (Draining to Williamsport North of Site)

	Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under Existing Site Conditions	(L/s):	2.29	3.04	3.55	4.20	4.68	5.17

Allowable discharge rate into municipal storm sewer (based on Rational Method):

Rainfall Intensity @ 10-year storm: 99.17 mm/hr

Runoff flow @ 10-year storm: 8.82 L/s

LEA Consulting Ltd. Consulting Engineers and Planners	Post-Development Peak Flow Rates Calculation (Uncontrolled)			
	Prepared:	G.B.	Page No.	A-04
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

Post-Development Peak Flow Rates

Rational Formulae: Q = 2.78 CIA (L/s)

Catchment PC-1 (Proposed Site-Draining to Havenwood)
Area 0.569 ha Composite Runoff Coefficient : 0.72

Catchment UC-1 (Uncontrolled Draining to Havenwood)
Area 0.410 ha Composite Runoff Coefficient : 0.81

Catchment UC-2 (Uncontrolled Draining to Havenwood)
Area 0.025 ha Composite Runoff Coefficient : 0.37

Catchment PC-2 (Draining to Williamsport South of Site)
Area 0.113 ha Composite Runoff Coefficient : 0.49

Catchment PC-3 (Draining to Williamsport North of Site)
Area 0.062 ha Composite Runoff Coefficient : 0.35

Catchment UC-4 (Uncontrolled Draining to Williamsport South of Site)
Area 0.020 ha Composite Runoff Coefficient : 0.34

Time of Concentratior 15 minutes as per City Guidelines
Runoff Coefficient : Composite Post-development

Rainfall Intensity: I = a/(Tc+b)^{c} (City Std. 2111.010)

Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Rainfall Intensity (mm/hr):	59.89	80.51	99.17	113.89	127.64	140.69

Peak Flow Rates (L/s):

Catchment PC-1 (Proposed Site-Draining to Havenwood)

Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under post-development conditions (L/s):	67.86	91.22	112.36	129.05	144.62	159.41

Catchment UC-1 (Uncontrolled Draining to Havenwood)

Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under post-development conditions (L/s):	55.34	74.39	91.62	105.23	117.93	129.99

Catchment UC-2 (Uncontrolled Draining to Havenwood)

Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under post-development conditions (L/s):	1.55	2.09	2.57	2.96	3.31	3.65

Catchment PC-2 (Draining to Williamsport South of Site)

Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under post-development conditions (L/s):	9.22	12.39	15.26	17.53	19.64	21.65

Catchment PC-3 (Draining to Williamsport North of Site)

Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under post-development conditions (L/s):	3.61	4.85	5.97	6.86	7.68	8.47

Catchment UC-4 (Uncontrolled Draining to Williamsport South of Site)

Return Period:	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Under post-development conditions (L/s):	1.13	1.52	1.87	2.15	2.41	2.66

LEA Consulting Ltd. Consulting Engineers and Planners	Allowable Release Rates			
	Prepared:	G.B.	Page No.	A-05
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

Quantity Control-Proposed Condominium Site (PC1)

Sub Catchment Area PC-1 is representative of the proposed condominium block and parking areas draining to Havenwood Drive, PC-2 is representative of the south driveway and south entrance portion of the proposed site draining to Williamsport Drive south of the site, PC-3 is representative of the north pathway portion of the proposed site draining to Williamsport Drive north of the site. Subcatchments UC 1 and UC 2 are portions of the proposed site that will be left as uncontrolled drainage to Havenwood Drive

For Quantity control of Sub-Catchment PC1 containing the proposed condominium building and proposed surface parking areas, a SWM tank [Tank 1] controlling the flow rate from the proposed condominium PC-1 will be controlled to the pre-development flow rates of existing catchment areas EC1 that currently drains to Havenwood Drive.

Calculations on Pages no. *A-07 to 11* is used to calculate the 100 year storage volume required for 100 year-storm storage utilizing the Pre Development Peak 100 year flow rate for Existing Subcachment EC1 (Pre development catchment draining to Havenwood Drive) as the maximum allowable release rate from the SWM tank.

Max Allowable release rates from the SWM tank 1 for Subcatchment PC1

@ 100-year storm: $= (Q_{ex\ [EC1](100\text{-}yr)})$

$= 80.2$

$= 80.2$ **L/s**

Quantity Control-Proposed Condominium South Driveway (PC2)

For Quantity control of Sub-Catchment PC2 containing the proposed condominium south entrance and driveway, a SWM [Tank 2] tank controlling the flow rate from the proposed subcatchment PC-2 will be controlled to the pre-development flow rates of existing catchment areas EC2 that currently drains to Williamsport Drive South of the proposed development

Calculations on Pages no. *A-13 to 17* is used to calculate the 100 year storage volume required for 100 year-storm storage utilizing the Pre Development Peak 100 year flow rate for Existing Subcachment EC2 (Pre development catchment draining to Williamsport Drive South of development) as the maximum allowable release rate from the SWM tank.

Max Allowable release rates from the SWM tank 2 for Subcatchment PC1

@ 100-year storm: $= (Q_{ex\ [EC2](100\text{-}yr)})$

$= 9.3$

$= 9.3$ **L/s**

LEA Consulting Ltd. Consulting Engineers and Planners	**5mm Rainfall Retention Volume (Water Balance) - PC 1**			
	Prepared:	G.B.	Page No.	A-06
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

5mm Rainfall Retention Volume(Water Balance) - PC 1

According to the TRCA Guidelines, in order to achieve the water balance target, it is required to retain all runoff from a small event - typically 5mm (in Mississauga, storms with 24 hour volumes of 5mm or less contribute about 50% of the total average annual rainfall volume) through infiltration, evapotranspiration & rainwater reuse.

Site Area (PC1-Proposed Site):	0.569	ha
Runoff Coefficient :	0.72	Post-development site conditions

Runoff volume from 5mm rainfall event on site:

V = 0.569 x 10 x 5 =28.45 m^3

Required on-site retention volume for 5mm rainfall event: 28.45 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (2-Year Storm)-Tank 1		
	Prepared: G.B.	Page No.	A-07
	Checked: F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. # 18298		
	Date: 14-May-24		

On-Site Storage Calculation(2-Year Storm)-Tank 1

Total Drainage Area (ha) = 0.569 ha

Drainage Area Composite C = 0.72

Allowable Release Rate (2-year) = 35.51 L/s

Return Period = 2 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	59.89	67.86	61.07	35.51	31.96	29.11
20	50.16	56.84	68.21	35.51	42.62	25.59
25	43.42	49.20	73.80	35.51	53.27	20.53
30	38.45	43.56	78.41	35.51	63.93	14.48
35	34.60	39.21	82.34	35.51	74.58	7.76
40	31.54	35.73	85.76	35.51	85.23	0.53
45	29.03	32.89	88.81	35.51	95.89	-7.08
50	26.94	30.52	91.56	35.51	106.54	-14.98
55	25.16	28.50	94.06	35.51	117.20	-23.14
60	23.62	26.77	96.36	35.51	127.85	-31.49
65	22.29	25.25	98.49	35.51	138.50	-40.01
70	21.12	23.92	100.48	35.51	149.16	-48.68
75	20.07	22.74	102.35	35.51	159.81	-57.46
80	19.14	21.69	104.10	35.51	170.47	-66.37
85	18.30	20.74	105.77	35.51	181.12	-75.35
90	17.54	19.88	107.34	35.51	191.78	-84.44
95	16.85	19.10	108.84	35.51	202.43	-93.59
100	16.22	18.38	110.28	35.51	213.08	-102.80
105	15.64	17.72	111.65	35.51	223.74	-112.09
110	15.11	17.12	112.97	35.51	234.39	-121.42

Required Storage Volume = 29.11 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (5-Year Storm)-Tank 1			
	Prepared:	G.B.	Page No.	A-08
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(5-Year Storm)-Tank 1

Total Drainage Area (ha) = 0.569 ha
Drainage Area Composite C = 0.72
Allowable Release Rate (5-year) = 47.15 L/s
Return Period = 5 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	80.51	91.22	82.10	47.15	42.43	39.67
20	67.43	76.41	91.69	47.15	56.58	35.11
25	58.37	66.14	99.21	47.15	70.72	28.49
30	51.68	58.56	105.40	47.15	84.86	20.54
35	46.52	52.71	110.68	47.15	99.01	11.67
40	42.40	48.04	115.29	47.15	113.15	2.14
45	39.02	44.22	119.38	47.15	127.30	-7.92
50	36.21	41.02	123.07	47.15	141.44	-18.37
55	33.82	38.31	126.44	47.15	155.58	-29.14
60	31.76	35.98	129.53	47.15	169.73	-40.20
65	29.96	33.95	132.40	47.15	183.87	-51.47
70	28.38	32.16	135.07	47.15	198.02	-62.95
75	26.98	30.57	137.58	47.15	212.16	-74.58
80	25.73	29.15	139.94	47.15	226.30	-86.36
85	24.60	27.88	142.18	47.15	240.45	-98.27
90	23.58	26.72	144.30	47.15	254.59	-110.29
95	22.66	25.67	146.32	47.15	268.74	-122.42
100	21.81	24.71	148.24	47.15	282.88	-134.64
105	21.03	23.82	150.09	47.15	297.02	-146.93
110	20.31	23.01	151.86	47.15	311.17	-159.31

Required Storage Volume = 39.67 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (10-Year Storm)-Tank 1			
	Prepared:	G.B.	Page No.	A-09
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(10-Year Storm)-Tank 1

Total Drainage Area (ha) = 0.569 ha
Drainage Area Composite C = 0.72
Allowable Release Rate (10-year) = 55.09 L/s
Return Period = 10 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	99.17	112.36	101.12	55.09	49.58	51.54
20	83.06	94.11	112.93	55.09	66.11	46.82
25	71.90	81.46	122.19	55.09	82.64	39.55
30	63.66	72.13	129.83	55.09	99.17	30.66
35	57.30	64.92	136.33	55.09	115.70	20.63
40	52.22	59.17	142.00	55.09	132.23	9.77
45	48.07	54.46	147.05	55.09	148.75	-1.70
50	44.60	50.53	151.59	55.09	165.28	-13.69
55	41.65	47.19	155.74	55.09	181.81	-26.07
60	39.11	44.32	159.55	55.09	198.34	-38.79
65	36.91	41.81	163.08	55.09	214.87	-51.79
70	34.96	39.61	166.37	55.09	231.39	-65.02
75	33.24	37.66	169.46	55.09	247.92	-78.46
80	31.69	35.91	172.37	55.09	264.45	-92.08
85	30.31	34.34	175.12	55.09	280.98	-105.86
90	29.05	32.91	177.73	55.09	297.51	-119.78
95	27.90	31.62	180.22	55.09	314.04	-133.82
100	26.86	30.43	182.59	55.09	330.56	-147.97
105	25.90	29.34	184.86	55.09	347.09	-162.23
110	25.01	28.34	187.04	55.09	363.62	-176.58

Required Storage Volume = 51.54 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (25-Year Storm)-Tank 1			
	Prepared:	G.B.	Page No.	A-010
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(25-Year Storm)-Tank 1

Total Drainage Area (ha) = 0.569 ha
Drainage Area Composite C = 0.72
Allowable Release Rate (25-year) = 65.16 L/s
Return Period = 25 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	113.89	129.05	116.14	65.16	58.64	57.50
20	95.40	108.09	129.70	65.16	78.19	51.51
25	82.58	93.56	140.34	65.16	97.74	42.60
30	73.11	82.84	149.11	65.16	117.28	31.83
35	65.80	74.56	156.57	65.16	136.83	19.74
40	59.98	67.95	163.09	65.16	156.38	6.71
45	55.21	62.55	168.88	65.16	175.92	-7.04
50	51.22	58.04	174.11	65.16	195.47	-21.36
55	47.84	54.20	178.86	65.16	215.02	-36.16
60	44.92	50.90	183.24	65.16	234.57	-51.33
65	42.39	48.02	187.30	65.16	254.11	-66.81
70	40.15	45.50	191.08	65.16	273.66	-82.58
75	38.17	43.25	194.63	65.16	293.21	-98.58
80	36.40	41.24	197.97	65.16	312.75	-114.78
85	34.81	39.44	201.13	65.16	332.30	-131.17
90	33.36	37.80	204.13	65.16	351.85	-147.72
95	32.05	36.31	206.98	65.16	371.40	-164.42
100	30.85	34.95	209.71	65.16	390.94	-181.23
105	29.74	33.70	212.32	65.16	410.49	-198.17
110	28.73	32.55	214.82	65.16	430.04	-215.22

Required Storage Volume = 57.50 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (50-Year Storm)-Tank 1			
	Prepared:	G.B.	Page No.	A-011
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(50-Year Storm)-Tank 1

Total Drainage Area (ha) = 0.569 ha

Drainage Area Composite C = 0.72

Allowable Release Rate (50-year) = 72.67 L/s

Return Period = 50 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	127.13	144.05	129.64	72.67	65.40	64.24
20	106.57	120.75	144.90	72.67	87.20	57.70
25	92.30	104.58	156.87	72.67	109.00	47.87
30	81.75	92.63	166.73	72.67	130.80	35.93
35	73.60	83.39	175.13	72.67	152.60	22.53
40	67.10	76.02	182.46	72.67	174.40	8.06
45	61.77	69.99	188.97	72.67	196.20	-7.23
50	57.32	64.95	194.84	72.67	218.00	-23.16
55	53.54	60.66	200.19	72.67	239.80	-39.61
60	50.28	56.97	205.11	72.67	261.60	-56.49
65	47.45	53.76	209.67	72.67	283.40	-73.73
70	44.95	50.93	213.92	72.67	305.20	-91.28
75	42.74	48.42	217.90	72.67	327.00	-109.10
80	40.76	46.18	221.66	72.67	348.80	-127.14
85	38.97	44.16	225.21	72.67	370.60	-145.39
90	37.36	42.33	228.57	72.67	392.40	-163.83
95	35.89	40.66	231.78	72.67	414.20	-182.42
100	34.54	39.14	234.84	72.67	436.00	-201.16
105	33.31	37.74	237.78	72.67	457.80	-220.02
110	32.17	36.45	240.59	72.67	479.60	-239.01

Required Storage Volume = 64.24 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (100-Year Storm)-Tank 1			
	Prepared:	G.B.	Page No.	A-012
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(100-Year Storm)-Tank 1

Total Drainage Area (ha) = 0.569 ha
Drainage Area Composite C = 0.72
Allowable Release Rate (100-year) = 80.22 L/s
Return Period = 100 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	140.69	159.41	143.47	80.22	72.20	71.27
20	118.12	133.84	160.60	80.22	96.26	64.34
25	102.41	116.03	174.05	80.22	120.33	53.72
30	90.77	102.85	185.13	80.22	144.39	40.74
35	81.77	92.65	194.57	80.22	168.46	26.11
40	74.58	84.50	202.80	80.22	192.52	10.28
45	68.68	77.82	210.12	80.22	216.59	-6.47
50	63.75	72.23	216.70	80.22	240.65	-23.95
55	59.56	67.49	222.71	80.22	264.72	-42.01
60	55.95	63.40	228.23	80.22	288.78	-60.55
65	52.81	59.83	233.34	80.22	312.85	-79.51
70	50.03	56.69	238.10	80.22	336.91	-98.81
75	47.58	53.90	242.57	80.22	360.98	-118.41
80	45.38	51.41	246.78	80.22	385.04	-138.26
85	43.39	49.17	250.76	80.22	409.11	-158.35
90	41.60	47.14	254.53	80.22	433.17	-178.64
95	39.97	45.28	258.12	80.22	457.24	-199.12
100	38.47	43.59	261.55	80.22	481.30	-219.75
105	37.10	42.04	264.83	80.22	505.37	-240.54
110	35.84	40.60	267.98	80.22	529.43	-261.45

Required Storage Volume = 71.27 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	Orifice Tube Size Calculation (Water Tank Outlet)-Tank 1			
	Prepared:	G.B.	Page No.	A-013
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	15-May-24		

Orifice Tube Size Calculation(Water Tank Outlet)-Tank 1

Orifice Discharge Formula: Q = CA x sqrt(2gh)

Calculate Approximate Diameter			Calculate Flows		
Controlled. Flow:	0.08	m3/S	Diameter:	250	mm
Max. Depth:	0.57	m	Area:	0.049	m^2
Req'd Area:	0.049	m^2	Coeff:	0.80	
Req'd Dia.:	250	mm	Gravitational Accel:	9.81	m/s^2
Orifice C/L Elev.:	134.86	m	Orifice Inv.	134.74	
Water Level	135.31	m			

Depth (m)	Head (m)	Q (m^3/s)	Elevation (m)	Remarks
0.13	0.00	0.000	134.86	**Center Elev. of Orifice**
0.18	0.05	0.039	135.04	
0.23	0.10	0.055	135.09	
0.28	0.15	0.067	135.14	
0.33	**0.20**	**0.078**	**135.19**	**HWL**
0.38	0.25	0.087	135.24	
0.43	0.30	0.095	135.29	

LEA Consulting Ltd. Consulting Engineers and Planners	Water Quality Treatment-PC 1			
	Prepared:	G.B.	Page No.	A-014
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

Water Quality Treatment-PC 1

As perCity and MECP Guidelines the site is required to provide a long-term removal of 80% Total Suspended Solids (TSS) on an average annual basis.

PC1 Subcatchment Area:	5690.7	m^2
Captured Site Area by OGS:	5690.7	m^2
Building Rooftop	1223.9	m^2
Total Landscaped Area:	1604.6	m^2
Impervious Roof TSS Removal Efficiency:	80	%
Landscaped Area TSS Removal Efficiency:	80	%
Oil Grit Separator TSS Removal Efficiency:	50	%

Composite TSS Removal Efficiency:

Building Roof Top	= 1223.9 x 80% / m2
	= 17.2%
Landscaped Area	= 1604.6 x 80% / m2
	= 22.6%
Oil Grit Separator	= 5690.7 x 50% / m2
	= 50.0%

Stormwater Quality Treatment Provided: 89.8 %

		5mm Rainfall Retention Volume (Water Balance) - PC 2			
	LEA Consulting Ltd. Consulting Engineers and Planners	Prepared:	G.B.	Page No.	A-015
		Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive		Proj. #	18298		
		Date:	14-May-24		

5mm Rainfall Retention Volume(Water Balance) - PC 2

According to the TRCA Guidelines, in order to achieve the water balance target, it is required to retain all runoff from a small event - typically 5mm (in Mississauga, storms with 24 hour volumes of 5mm or less contribute about 50% of the total average annual rainfall volume) through infiltration, evapotranspiration & rainwater reuse.

Site Area (PC2-Proposed Site South Entrance & Driveway):	0.113	ha
Runoff Coefficient :	0.49	Post-development site conditions

Runoff volume from 5mm rainfall event on site:

$$V = 0.113 \times 10 \times 5 \quad = 5.67 \quad m^3$$

Required on-site retention volume for 5mm rainfall event: 5.67 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (2-Year Storm)-Tank 2			
	Prepared:	G.B.	Page No.	A-016
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(2-Year Storm)-Tank 2

Total Drainage Area (ha) = 0.113 ha
Drainage Area Composite C = 0.49
Allowable Release Rate (2-year) = 4.10 L/s
Return Period = 2 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	59.89	9.22	8.30	4.10	3.69	4.61
20	50.16	7.72	9.26	4.10	4.92	4.34
25	43.42	6.68	10.02	4.10	6.15	3.87
30	38.45	5.92	10.65	4.10	7.37	3.28
35	34.60	5.33	11.18	4.10	8.60	2.58
40	31.54	4.85	11.65	4.10	9.83	1.82
45	29.03	4.47	12.06	4.10	11.06	1.00
50	26.94	4.15	12.44	4.10	12.29	0.15
55	25.16	3.87	12.77	4.10	13.52	-0.75
60	23.62	3.64	13.09	4.10	14.75	-1.66
65	22.29	3.43	13.38	4.10	15.98	-2.60
70	21.12	3.25	13.65	4.10	17.21	-3.56
75	20.07	3.09	13.90	4.10	18.44	-4.54
80	19.14	2.95	14.14	4.10	19.67	-5.53
85	18.30	2.82	14.37	4.10	20.89	-6.52
90	17.54	2.70	14.58	4.10	22.12	-7.54
95	16.85	2.59	14.78	4.10	23.35	-8.57
100	16.22	2.50	14.98	4.10	24.58	-9.60
105	15.64	2.41	15.16	4.10	25.81	-10.65
110	15.11	2.32	15.34	4.10	27.04	-11.70

Required Storage Volume = 4.61 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (5-Year Storm)-Tank 2			
	Prepared:	G.B.	Page No.	A-017
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(5-Year Storm)-Tank 2

Total Drainage Area (ha) = 0.113 ha
Drainage Area Composite C = 0.49
Allowable Release Rate (5-year) = 5.44 L/s
Return Period = 5 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	80.51	12.39	11.15	5.44	4.90	6.25
20	67.43	10.38	12.45	5.44	6.53	5.92
25	58.37	8.98	13.47	5.44	8.16	5.31
30	51.68	7.95	14.32	5.44	9.79	4.53
35	46.52	7.16	15.03	5.44	11.42	3.61
40	42.40	6.52	15.66	5.44	13.05	2.61
45	39.02	6.01	16.21	5.44	14.69	1.52
50	36.21	5.57	16.72	5.44	16.32	0.40
55	33.82	5.20	17.17	5.44	17.95	-0.78
60	31.76	4.89	17.59	5.44	19.58	-1.99
65	29.96	4.61	17.98	5.44	21.21	-3.23
70	28.38	4.37	18.35	5.44	22.84	-4.49
75	26.98	4.15	18.69	5.44	24.48	-5.79
80	25.73	3.96	19.01	5.44	26.11	-7.10
85	24.60	3.79	19.31	5.44	27.74	-8.43
90	23.58	3.63	19.60	5.44	29.37	-9.77
95	22.66	3.49	19.87	5.44	31.00	-11.13
100	21.81	3.36	20.13	5.44	32.63	-12.50
105	21.03	3.24	20.38	5.44	34.27	-13.89
110	20.31	3.13	20.63	5.44	35.90	-15.27

Required Storage Volume = 6.25 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (10-Year Storm)-Tank 2		
	Prepared: G.B.	Page No.	A-018
	Checked: F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. # 18298		
	Date: 14-May-24		

On-Site Storage Calculation(10-Year Storm)-Tank 2

Total Drainage Area (ha) = 0.113 ha
Drainage Area Composite C = 0.49
Allowable Release Rate (10-year) = 6.36 L/s
Return Period = 10 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	99.17	15.26	13.73	6.36	5.72	8.01
20	83.06	12.78	15.34	6.36	7.63	7.71
25	71.90	11.06	16.60	6.36	9.53	7.07
30	63.66	9.80	17.63	6.36	11.44	6.19
35	57.30	8.82	18.52	6.36	13.35	5.17
40	52.22	8.04	19.29	6.36	15.25	4.04
45	48.07	7.40	19.97	6.36	17.16	2.81
50	44.60	6.86	20.59	6.36	19.07	1.52
55	41.65	6.41	21.15	6.36	20.97	0.18
60	39.11	6.02	21.67	6.36	22.88	-1.21
65	36.91	5.68	22.15	6.36	24.79	-2.64
70	34.96	5.38	22.60	6.36	26.69	-4.09
75	33.24	5.11	23.02	6.36	28.60	-5.58
80	31.69	4.88	23.41	6.36	30.51	-7.10
85	30.31	4.66	23.78	6.36	32.41	-8.63
90	29.05	4.47	24.14	6.36	34.32	-10.18
95	27.90	4.29	24.48	6.36	36.23	-11.75
100	26.86	4.13	24.80	6.36	38.13	-13.33
105	25.90	3.99	25.11	6.36	40.04	-14.93
110	25.01	3.85	25.40	6.36	41.95	-16.55

Required Storage Volume = 8.01 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (25-Year Storm)-Tank 2			
	Prepared:	G.B.	Page No.	A-019
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(25-Year Storm)-Tank 2

Total Drainage Area (ha) = 0.113 ha
Drainage Area Composite C = 0.49
Allowable Release Rate (25-year) = 7.52 L/s
Return Period = 25 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	113.89	17.53	15.77	7.52	6.76	9.01
20	95.40	14.68	17.62	7.52	9.02	8.60
25	82.58	12.71	19.06	7.52	11.27	7.79
30	73.11	11.25	20.25	7.52	13.53	6.72
35	65.80	10.13	21.27	7.52	15.78	5.49
40	59.98	9.23	22.15	7.52	18.04	4.11
45	55.21	8.50	22.94	7.52	20.29	2.65
50	51.22	7.88	23.65	7.52	22.55	1.10
55	47.84	7.36	24.29	7.52	24.80	-0.51
60	44.92	6.91	24.89	7.52	27.06	-2.17
65	42.39	6.52	25.44	7.52	29.31	-3.87
70	40.15	6.18	25.95	7.52	31.57	-5.62
75	38.17	5.87	26.43	7.52	33.82	-7.39
80	36.40	5.60	26.89	7.52	36.08	-9.19
85	34.81	5.36	27.32	7.52	38.33	-11.01
90	33.36	5.13	27.72	7.52	40.59	-12.87
95	32.05	4.93	28.11	7.52	42.84	-14.73
100	30.85	4.75	28.48	7.52	45.10	-16.62
105	29.74	4.58	28.84	7.52	47.35	-18.51
110	28.73	4.42	29.18	7.52	49.61	-20.43

Required Storage Volume = 9.01 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (50-Year Storm)-Tank 2			
	Prepared:	G.B.	Page No.	A-020
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(50-Year Storm)-Tank 2

Total Drainage Area (ha)	=	0.113	ha
Drainage Area Composite C	=	0.49	
Allowable Release Rate (50-year)	=	8.38	L/s
Return Period	=	50	Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	127.13	19.56	17.61	8.38	7.54	10.07
20	106.57	16.40	19.68	8.38	10.06	9.62
25	92.30	14.20	21.31	8.38	12.57	8.74
30	81.75	12.58	22.64	8.38	15.09	7.55
35	73.60	11.33	23.79	8.38	17.60	6.19
40	67.10	10.33	24.78	8.38	20.12	4.66
45	61.77	9.51	25.67	8.38	22.63	3.04
50	57.32	8.82	26.46	8.38	25.15	1.31
55	53.54	8.24	27.19	8.38	27.66	-0.47
60	50.28	7.74	27.86	8.38	30.18	-2.32
65	47.45	7.30	28.48	8.38	32.69	-4.21
70	44.95	6.92	29.05	8.38	35.21	-6.16
75	42.74	6.58	29.60	8.38	37.72	-8.12
80	40.76	6.27	30.11	8.38	40.24	-10.13
85	38.97	6.00	30.59	8.38	42.75	-12.16
90	37.36	5.75	31.04	8.38	45.27	-14.23
95	35.89	5.52	31.48	8.38	47.78	-16.30
100	34.54	5.32	31.90	8.38	50.30	-18.40
105	33.31	5.13	32.29	8.38	52.81	-20.52
110	32.17	4.95	32.68	8.38	55.33	-22.65

Required Storage Volume = 10.07 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	On-Site Storage Calculation (100-Year Storm)-Tank 2			
	Prepared:	G.B.	Page No.	A-021
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

On-Site Storage Calculation(100-Year Storm)-Tank 2

Total Drainage Area (ha) = 0.113 ha

Drainage Area Composite C = 0.49

Allowable Release Rate (100-year) = 9.25 L/s

Return Period = 100 Year

Site storage Requirement:

Time (minutes)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Storm Runoff Volume (m^3)	Release Rate (L/s)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
15	140.69	21.65	19.49	9.25	8.33	11.16
20	118.12	18.18	21.81	9.25	11.10	10.71
25	102.41	15.76	23.64	9.25	13.88	9.76
30	90.77	13.97	25.14	9.25	16.66	8.48
35	81.77	12.58	26.43	9.25	19.43	7.00
40	74.58	11.48	27.54	9.25	22.21	5.33
45	68.68	10.57	28.54	9.25	24.99	3.55
50	63.75	9.81	29.43	9.25	27.76	1.67
55	59.56	9.17	30.25	9.25	30.54	-0.29
60	55.95	8.61	31.00	9.25	33.31	-2.31
65	52.81	8.13	31.69	9.25	36.09	-4.40
70	50.03	7.70	32.34	9.25	38.87	-6.53
75	47.58	7.32	32.95	9.25	41.64	-8.69
80	45.38	6.98	33.52	9.25	44.42	-10.90
85	43.39	6.68	34.06	9.25	47.20	-13.14
90	41.60	6.40	34.57	9.25	49.97	-15.40
95	39.97	6.15	35.06	9.25	52.75	-17.69
100	38.47	5.92	35.52	9.25	55.52	-20.00
105	37.10	5.71	35.97	9.25	58.30	-22.33
110	35.84	5.51	36.40	9.25	61.08	-24.68

Required Storage Volume = 11.16 m^3

LEA Consulting Ltd. Consulting Engineers and Planners	Orifice Tube Size Calculation (Water Tank Outlet)-Tank 2		
	Prepared: G.B.	Page No.	A-022
	Checked: F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. # 18298		
	Date: 15-May-24		

Orifice Tube Size Calculation(Water Tank Outlet)-Tank 2

Orifice Discharge Formula: Q = CA x sqrt(2gh)

Calculate Approximate Diameter			**Calculate Flows**		
Controlled. Flow:	0.009	m3/S	Diameter:	85	mm
Max. Depth:	0.45	m	Area:	0.006	m^2
Req'd Area:	0.006	m^2	Coeff:	0.80	
Req'd Dia.:	85	mm	Gravitational Accel:	9.81	m/s^2
Orifice C/L Elev.:	136.88	m	Orifice Inv.	136.84	
Water Level	137.29	m			

Depth (m)	Head (m)	Q (m^3/s)	Elevation (m)	Remarks
0.04	0.00	0.000	136.88	**Center Elev. of Orifice**
0.09	0.05	0.004	136.98	
0.14	0.10	0.006	137.03	
0.19	0.15	0.008	137.08	
0.20	0.16	0.008	137.09	
0.25	0.21	0.009	137.14	
0.26	**0.22**	**0.009**	**137.15**	**HWL**

LEA Consulting Ltd. Consulting Engineers and Planners	**Water Quality Treatment-PC 2**			
	Prepared:	G.B.	Page No.	A-023
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	14-May-24		

Water Quality Treatment-PC 2

As perCity and MECP Guidelines the site is required to provide a long-term removal of 80% Total Suspended Solids (TSS) on an average annual basis.

PC2 Subcatchment Area:	1134.8	m^2
Captured Site Area by OGS:	1134.8	m^2
Building Rooftop	0.0	m^2
Total Landscaped Area:	719.0	m^2
Impervious Roof TSS Removal Efficiency:	80	%
Landscaped Area TSS Removal Efficiency:	80	%
Oil Grit Separator TSS Removal Efficiency:	50	%

Composite TSS Removal Efficiency:

Building Roof Top	= 0.0 x 80% / m2
	= 0.0%
Landscaped Area	= 719.0 x 80% / m2
	= 50.7%
Oil Grit Separator	= 1134.8 x 50% / m2
	= 50.0%

Stormwater Quality Treatment Provided: 100.7 %

Stormceptor®

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/18/2022

Province:	Ontario
City:	Mississauga
Nearest Rainfall Station:	TORONTO INTL AP
Climate Station Id:	6158731
Years of Rainfall Data:	20

Project Name:	1485 Williamsport Dr.
Project Number:	18298
Designer Name:	Brandon O'Leary
Designer Company:	Forterra
Designer Email:	brandon.oleary@forterrabp.com
Designer Phone:	905-630-0359
EOR Name:	Faizan Dhalla
EOR Company:	LEA Consulting Ltd.
EOR Email:	fdhalla@lea.ca
EOR Phone:	289-451-1335

Site Name:	Catchment PC-1

Drainage Area (ha):	0.56582
Runoff Coefficient 'c':	0.73

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	90.0

Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	99.07
Peak Conveyance (maximum) Flow Rate (L/s):	99.07

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	86
EFO6	93
EFO8	97
EFO10	99
EFO12	100

Recommended Stormceptor EFO Model:	**EFO4**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**86**
Water Quality Runoff Volume Capture (%):	**> 90**

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

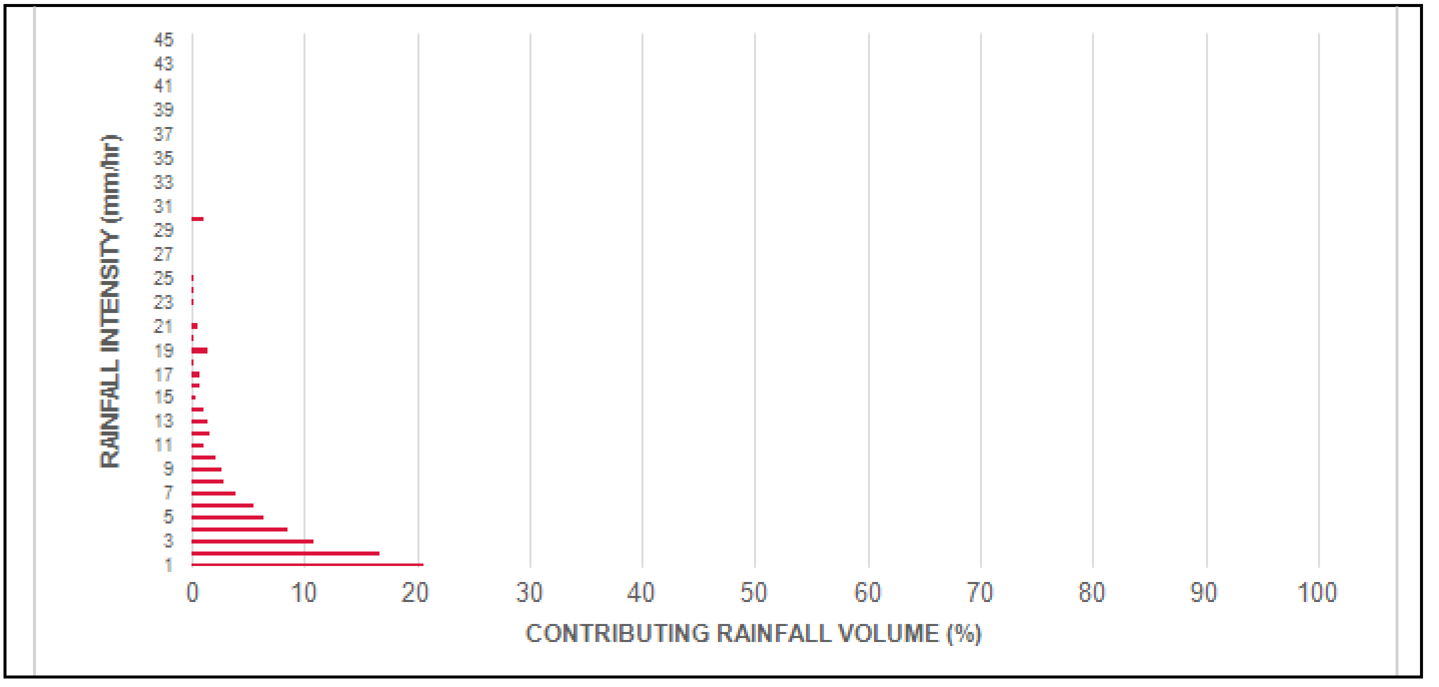
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Upstream Flow Controlled Results

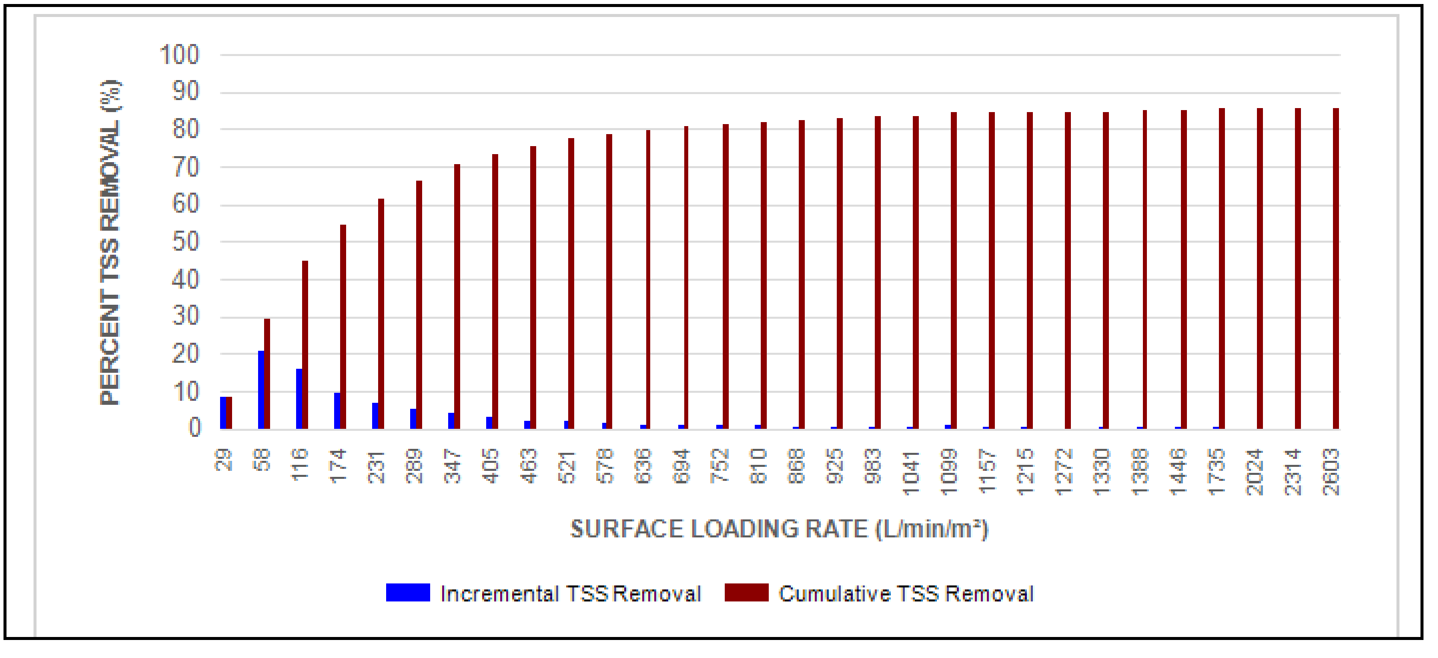
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	8.5	8.5	0.58	35.0	29.0	100	8.5	8.5
1	20.6	29.1	1.16	69.0	58.0	100	20.6	29.1
2	16.8	45.9	2.31	139.0	116.0	95	15.9	45.0
3	10.8	56.7	3.47	208.0	174.0	87	9.3	54.4
4	8.5	65.2	4.63	278.0	231.0	82	6.9	61.3
5	6.4	71.6	5.78	347.0	289.0	79	5.1	66.4
6	5.5	77.0	6.94	416.0	347.0	77	4.2	70.5
7	3.9	81.0	8.10	486.0	405.0	74	2.9	73.4
8	2.9	83.9	9.25	555.0	463.0	71	2.1	75.5
9	2.7	86.5	10.41	625.0	521.0	68	1.8	77.3
10	2.2	88.7	11.57	694.0	578.0	66	1.4	78.8
11	1.0	89.7	12.72	763.0	636.0	64	0.6	79.4
12	1.7	91.3	13.88	833.0	694.0	64	1.1	80.5
13	1.4	92.8	15.04	902.0	752.0	63	0.9	81.4
14	1.0	93.7	16.19	972.0	810.0	63	0.6	82.0
15	0.3	94.0	17.35	1041.0	868.0	63	0.2	82.2
16	0.8	94.8	18.51	1110.0	925.0	62	0.5	82.6
17	0.8	95.7	19.66	1180.0	983.0	62	0.5	83.2
18	0.2	95.8	20.82	1249.0	1041.0	61	0.1	83.3
19	1.5	97.3	21.98	1319.0	1099.0	59	0.9	84.2
20	0.2	97.5	23.14	1388.0	1157.0	58	0.1	84.3
21	0.6	98.2	24.29	1458.0	1215.0	57	0.3	84.6
22	1.8	100.0	25.45	1527.0	1272.0	55	1.0	85.6
23	0.2	100.2	26.61	1596.0	1330.0	54	0.1	85.8
24	0.2	100.5	27.76	1666.0	1388.0	53	0.1	85.9
25	0.2	100.7	28.92	1735.0	1446.0	51	0.1	86.0
30	1.1	101.8	34.70	2082.0	1735.0	42	0.5	86.5
35	-1.8	100.0	40.49	2429.0	2024.0	36	0.0	85.8
40	0.0	100.0	46.27	2776.0	2314.0	32	0.0	85.8
45	0.0	100.0	52.05	3123.0	2603.0	28	0.0	85.8
Estimated Net Annual Sediment (TSS) Load Reduction =								**86 %**

Climate Station ID: 6158731 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO INTL AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

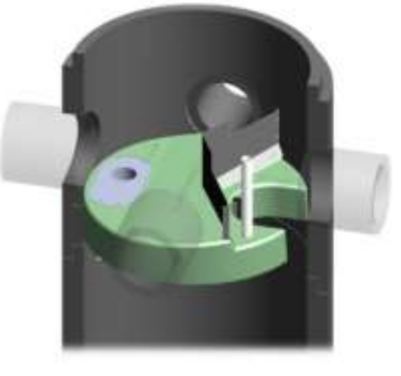
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

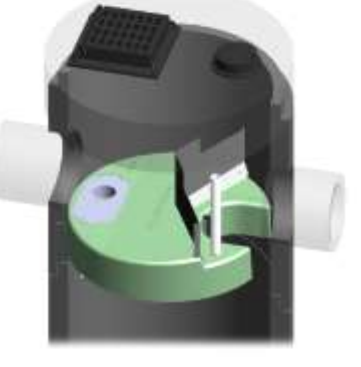
DESIGN FLEXIBILITY

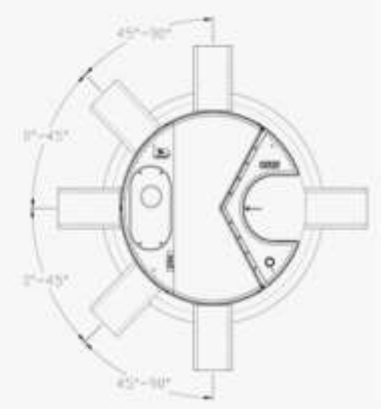
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

> 3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.
>
> 3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.
>
> 3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.
>
> 3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/18/2022

Province:	Ontario
City:	Mississauga
Nearest Rainfall Station:	TORONTO INTL AP
Climate Station Id:	6158731
Years of Rainfall Data:	20
Site Name:	Catchment PC-2
Drainage Area (ha):	0.10900
Runoff Coefficient 'c':	0.47
Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	90.0
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	11.43
Peak Conveyance (maximum) Flow Rate (L/s):	11.43

Project Name:	1485 Williamsport Dr.
Project Number:	18298
Designer Name:	Brandon O'Leary
Designer Company:	Forterra
Designer Email:	brandon.oleary@forterrabp.com
Designer Phone:	905-630-0359
EOR Name:	Faizan Dhalla
EOR Company:	LEA Consulting Ltd.
EOR Email:	fdhalla@lea.ca
EOR Phone:	289-451-1335

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	99
EFO6	100
EFO8	100
EFO10	100
EFO12	100

Recommended Stormceptor EFO Model:	**EFO4**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**99**
Water Quality Runoff Volume Capture (%):	**> 90**

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

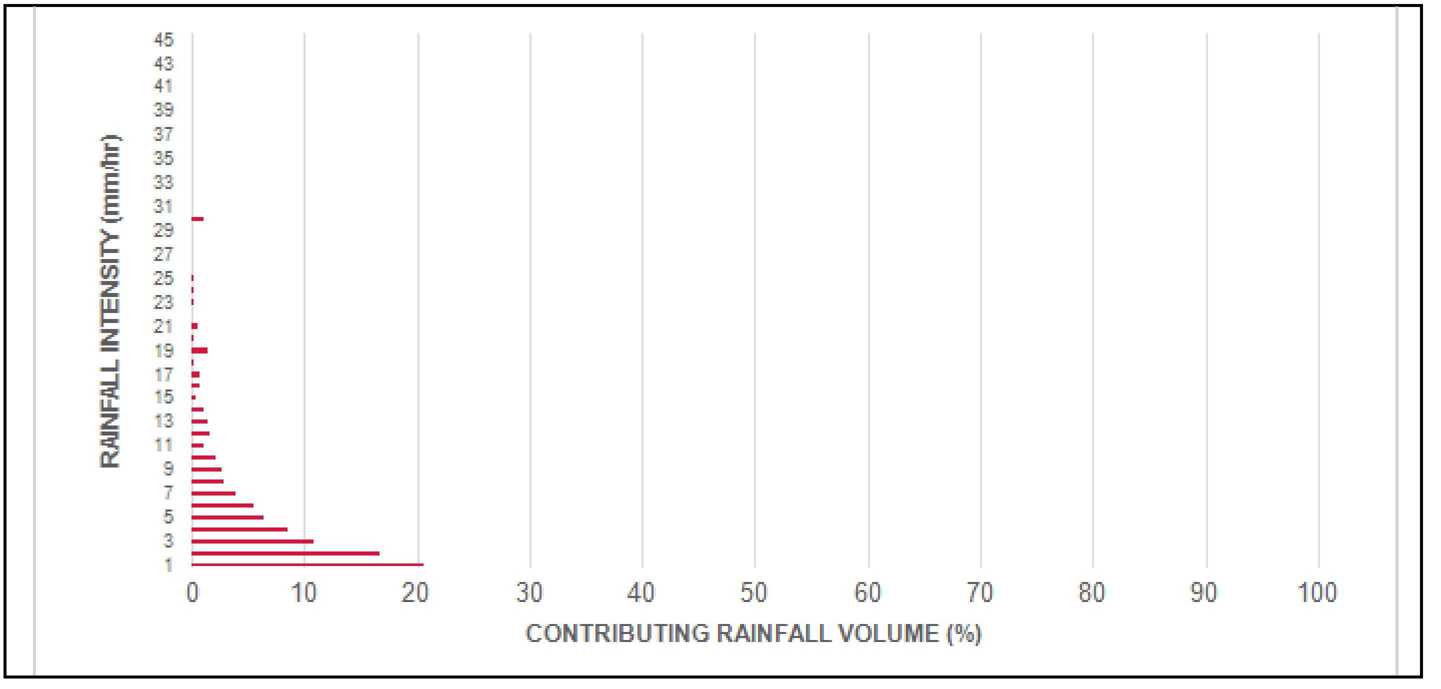
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Upstream Flow Controlled Results

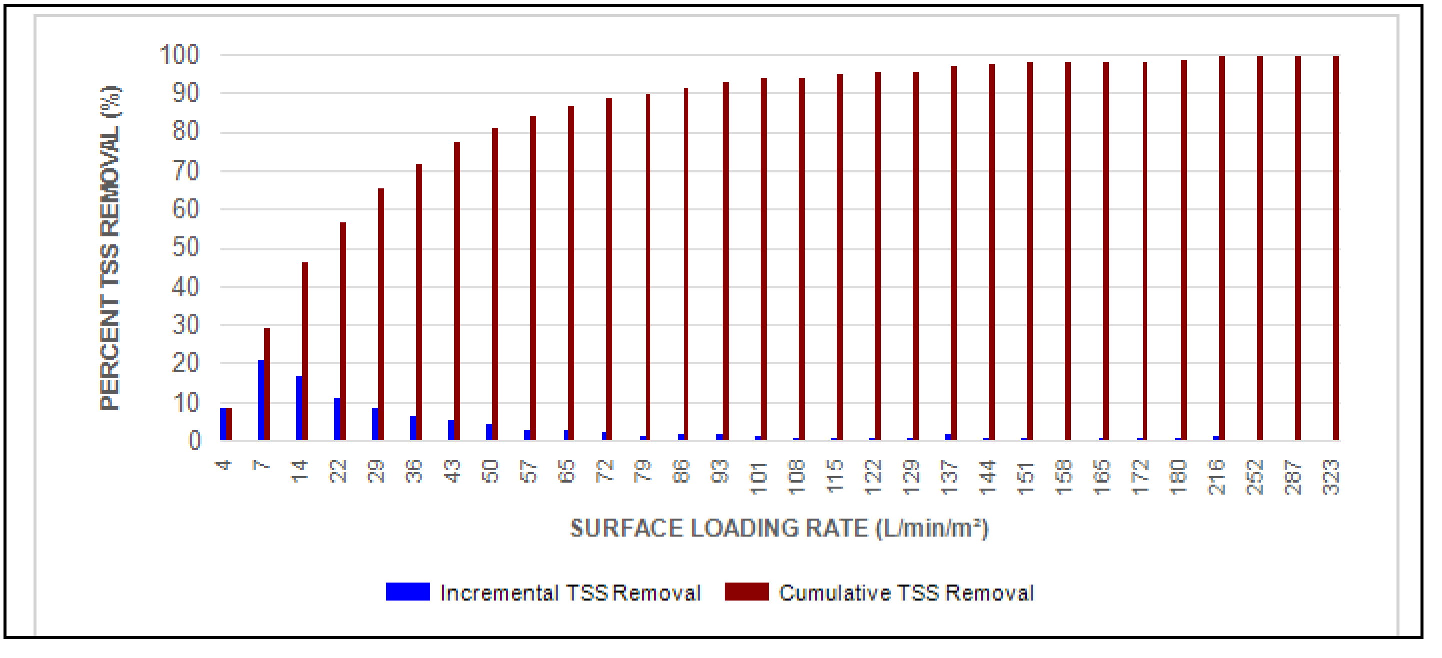
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	8.5	8.5	0.07	4.0	4.0	100	8.5	8.5
1	20.6	29.1	0.14	9.0	7.0	100	20.6	29.1
2	16.8	45.9	0.29	17.0	14.0	100	16.8	45.9
3	10.8	56.7	0.43	26.0	22.0	100	10.8	56.7
4	8.5	65.2	0.57	34.0	29.0	100	8.5	65.2
5	6.4	71.6	0.72	43.0	36.0	100	6.4	71.6
6	5.5	77.0	0.86	52.0	43.0	100	5.5	77.0
7	3.9	81.0	1.01	60.0	50.0	100	3.9	81.0
8	2.9	83.9	1.15	69.0	57.0	100	2.9	83.9
9	2.7	86.5	1.29	78.0	65.0	100	2.7	86.5
10	2.2	88.7	1.44	86.0	72.0	100	2.2	88.7
11	1.0	89.7	1.58	95.0	79.0	98	1.0	89.7
12	1.7	91.3	1.72	103.0	86.0	98	1.6	91.3
13	1.4	92.8	1.87	112.0	93.0	97	1.4	92.7
14	1.0	93.7	2.01	121.0	101.0	96	0.9	93.6
15	0.3	94.0	2.16	129.0	108.0	96	0.3	93.9
16	0.8	94.8	2.30	138.0	115.0	95	0.7	94.6
17	0.8	95.7	2.44	147.0	122.0	93	0.8	95.4
18	0.2	95.8	2.59	155.0	129.0	92	0.2	95.6
19	1.5	97.3	2.73	164.0	137.0	92	1.4	97.0
20	0.2	97.5	2.87	172.0	144.0	91	0.2	97.2
21	0.6	98.2	3.02	181.0	151.0	89	0.6	97.7
22	1.8	100.0	3.16	190.0	158.0	89	1.7	99.4
23	0.2	100.2	3.31	198.0	165.0	88	0.2	99.6
24	0.2	100.5	3.45	207.0	172.0	87	0.2	99.8
25	0.2	100.7	3.59	216.0	180.0	86	0.2	100.0
30	1.1	101.8	4.31	259.0	216.0	83	0.9	100.9
35	-1.8	100.0	5.03	302.0	252.0	81	0.0	99.4
40	0.0	100.0	5.75	345.0	287.0	79	0.0	99.4
45	0.0	100.0	6.47	388.0	323.0	78	0.0	99.4
Estimated Net Annual Sediment (TSS) Load Reduction =								**99 %**

Climate Station ID: 6158731 *Years of Rainfall Data*: 20

RAINFALL DATA FROM TORONTO INTL AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

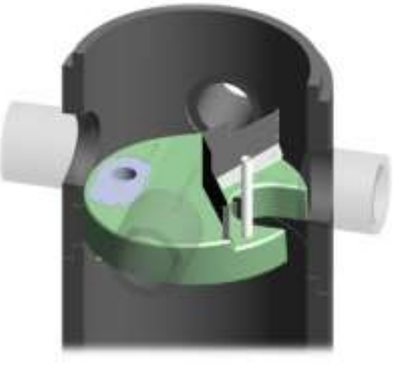
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

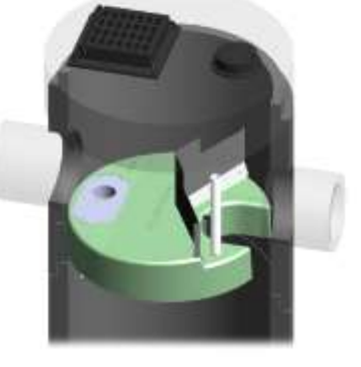
DESIGN FLEXIBILITY

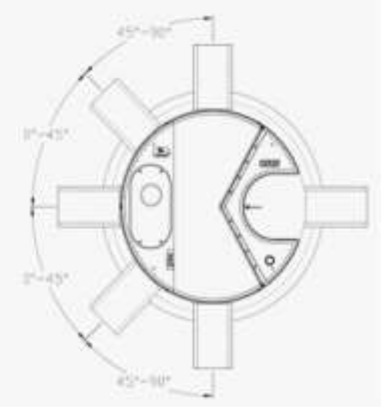
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP
Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS
The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS
For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef
STANDARD STORMCEPTOR EF/EFO SPECIFICATION
For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR
"OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

STANDARD PERFORMANCE SPECIFICATION FOR
“OIL GRIT SEPARATOR” (OGS) STORMWATER QUALITY TREAMENT DEVICE

PART 1 – GENERAL

1.1 <u>WORK INCLUDED</u>

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 <u>REFERENCE STANDARDS & PROCEDURES</u>

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1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

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The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 <u>SIZING METHODOLOGY</u>

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing shall be determined using historical rainfall data and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 <u>CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING</u>

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 <u>LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING</u>

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**, with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

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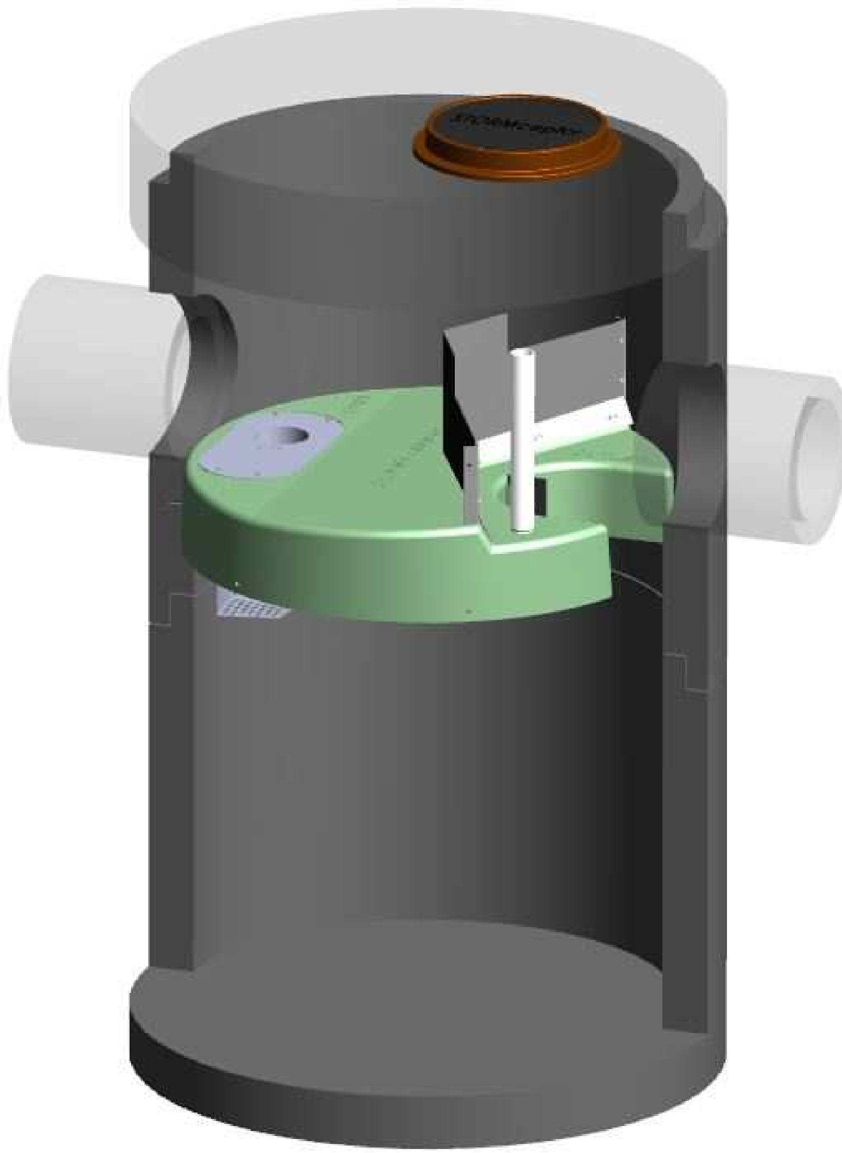
Stormceptor® EF

Owner's Manual



Stormceptor is protected by one or more of the following patents:

Canadian Patent No. 2,137,942
Canadian Patent No. 2,180,305
Canadian Patent No. 2,327,768
Canadian Patent No. 2,694,159
Canadian Patent No. 2,697,287
U.S. Patent No. 6,068,765
U.S. Patent No. 6,371,690
U.S. Patent No. 7,582,216
U.S. Patent No. 7,666,303
Australia Patent No. 693.164
Australia Patent No. 729,096
Australia Patent No. 2008,279,378
Australia Patent No. 2008,288,900
Japanese Patent No. 5,997,750
Japanese Patent No. 5,555,160
Korean Patent No. 0519212
Korean Patent No. 1451593
New Zealand Patent No. 583,008
New Zealand Patent No. 583,583
South African Patent No. 2010/00682
South African Patent No. 2010/01796
Patent pending

Table of Contents:

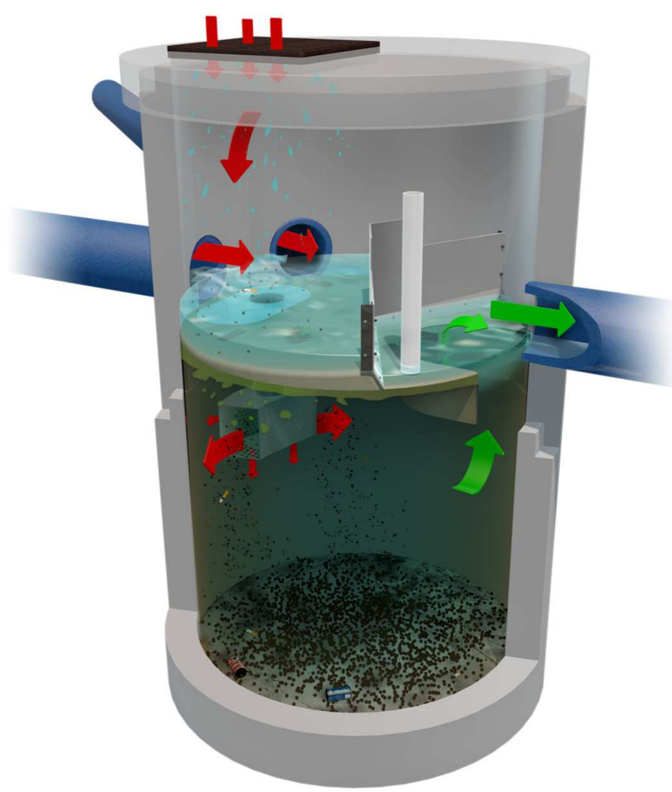
OVERVIEW

Stormceptor® EF is a continuation and evolution of the most globally recognized oil grit separator (OGS) stormwater treatment technology - ***Stormceptor®***. Also known as a hydrodynamic separator, the enhanced flow Stormceptor EF is a high performing oil grit separator that effectively removes a wide variety of pollutants from stormwater and snowmelt runoff at flow rates higher than the original Stormceptor. Stormceptor EF captures and retains sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's patent-pending treatment and scour prevention platform ensures sediment is retained during all rainfall events.

Stormceptor EF offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe, multiple inlet pipes, and/or from the surface through an inlet grate. Stormceptor EF can also serve as a junction structure, accommodate a 90-degree inlet to outlet bend angle, and be modified to ensure performance in submerged conditions. With its scour prevention and internal bypass, Stormceptor EF can be installed online, eliminating the need for costly additional bypass structures.

OPERATION

- Stormwater enters the Stormceptor upper chamber through the inlet pipe(s) or a surface inlet grate. A specially designed insert reduces the influent velocity by creating a pond upstream of the insert's weir. Sediment particles immediately begin to settle. Swirling flow sweeps water, sediment, and floatables across the sloped surface of the insert to the inlet opening of the drop pipe, where a strong vortex draws water, sediment, oil, and debris down the drop pipe cone.
- Influent exits the cone into the drop pipe duct. The duct has two large rectangular outlet openings as well as perforations in the backside and floor of the duct. Influent is diffused through these various opening in multiple directions and at low velocity into the lower chamber.
- Free oils and other floatables rise up within the channel surrounding the central riser pipe and are trapped beneath the insert, while sediment settles to the sump. Pollutants are retained for later removal during maintenance cleaning.
- Treated effluent enters the outlet riser, moves upward, and discharges to the top side of the insert downstream of the weir, where it flows out the outlet pipe.
- During intense storm events with very high influent flow rates, the pond height on the upstream side of the weir may exceed the height of the weir, and the excess flow passes over the top of the weir to the downstream side of the insert, and exits through the outlet pipe. This internal bypass feature allows for in-line installation, avoiding the cost of additional bypass structures. During bypass, the pond separates sediment from all incoming flows, while full treatment in the lower chamber continues at the maximum flow rate.
- Stormceptor EF's patent-pending enhanced flow and scour prevention technology ensures pollutants are captured and retained, allowing excess flows to bypass during infrequent, high intensity storms.



COMPONENTS

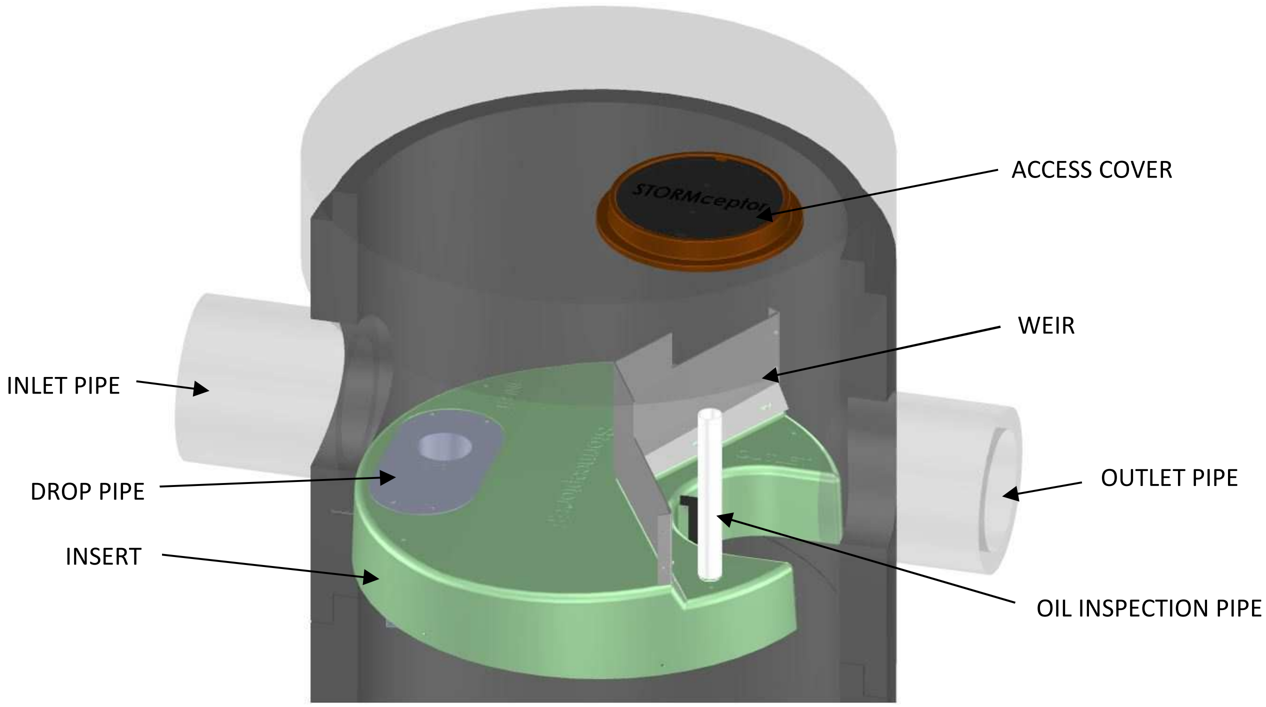


Figure 1

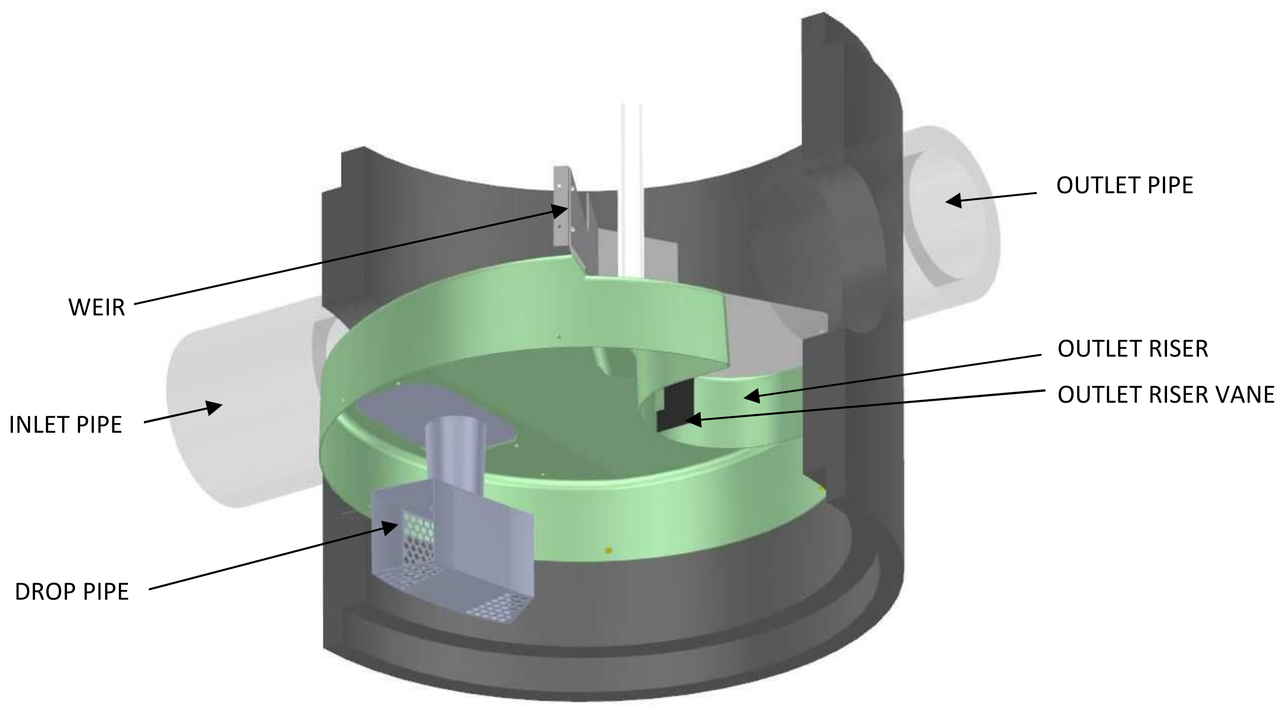


Figure 2

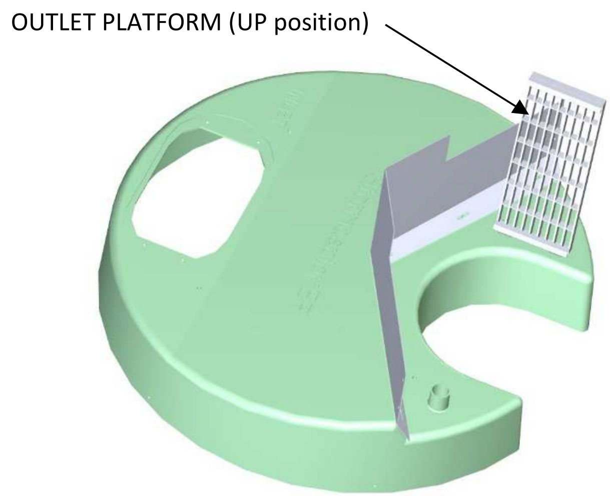


Figure 3A

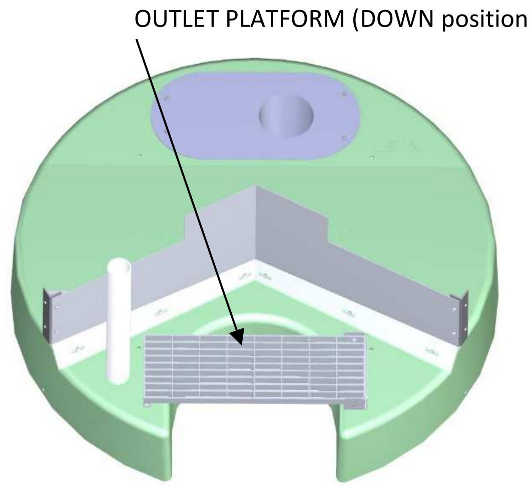


Figure 3B

- **Insert** – separates vessel into upper and lower chambers, and provides double-wall containment of hydrocarbons
- **Weir** – creates stormwater ponding and driving head on top side of insert
- **Drop pipe** – conveys stormwater and pollutants into the lower chamber
- **Outlet riser** – conveys treated stormwater from the lower chamber to the outlet pipe, and provides primary inspection and maintenance access into the lower chamber
- **Outlet riser vane** – prevents formation of a vortex in the outlet riser during high flow rate conditions
- **Outlet platform (optional)** – safety platform in the event of manned entry into the unit
- **Oil inspection pipe** – primary access for measuring oil depth

PRODUCT DETAILS

METRIC DIMENSIONS AND CAPACITIES

Table 1

Stormceptor Model	Inside Diameter (m)	Minimum Surface to Outlet Invert Depth (mm)	Depth Below Outlet Pipe Invert (mm)	Wet Volume (L)	Sediment Capacity [1] (m^3)	Hydrocarbon Storage Capacity [2] (L)	Maximum Flow Rate into Lower Chamber [3] (L/s)	Peak Conveyance Flow Rate [4] (L/s)
EF4 / EFO4	1.22	915	1524	1780	1.19	265	22.1 / 10.4	425
EF6 / EFO6	1.83	915	1930	5070	3.47	610	49.6 / 23.4	990
EF8 / EFO8	2.44	1219	2591	12090	8.78	1070	88.3 / 41.6	1700
EF10 / EFO10	3.05	1219	3251	23700	17.79	1670	138 / 65	2830
EF12 / EFO12	3.66	1524	3886	40800	31.22	2475	198.7 / 93.7	2830

[1] Sediment Capacity is measured from the floor to the bottom of the drop pipe cone. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[2] Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[3] EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 1135 L/min/m^2.
EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 535 L/min/m^2.
[4] Peak Conveyance Flow Rate is limited by a maximum velocity of 1.5 m/s.

U.S. DIMENSIONS AND CAPACITIES

Table 2

Stormceptor Model	Inside Diameter (ft)	Minimum Surface to Outlet Invert Depth (in)	Depth Below Outlet Pipe Invert (in)	Wet Volume (gal)	Sediment Capacity [1] (ft^3)	Hydrocarbon Storage Capacity [2] (gal)	Maximum Flow Rate into Lower Chamber [3] (cfs)	Peak Conveyance Flow Rate [4] (cfs)
EF4 / EFO4	4	36	60	471	42	70	0.78 / 0.37	15
EF6 / EFO6	6	36	76	1339	123	160	1.75 / 0.83	35
EF8 / EFO8	8	48	102	3194	310	280	3.12 / 1.47	60
EF10 / EFO10	10	48	128	6261	628	440	4.87 / 2.30	100
EF12 / EFO12	12	60	153	10779	1103	655	7.02 / 3.31	100

[1] Sediment Capacity is measured from the floor to the bottom of the drop pipe cone. Sediment Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[2] Hydrocarbon Storage Capacity is measured from the bottom of the outlet riser to the underside of the insert. Hydrocarbon Storage Capacity can be increased to accommodate specific site designs and pollutant loads. Contact your local representative for assistance.
[3] EF Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 27.9 gpm/ft^2.
EFO Maximum Flow Rate into Lower Chamber is based on a maximum surface loading rate (SLR) into the lower chamber of 13.1 gpm/ft^2.
[4] Peak Conveyance Flow Rate is limited by a maximum velocity of 5 fps.

IDENTIFICATION

Each Stormceptor EF/EFO unit is easily identifiable by the trade name ***Stormceptor®*** embossed on the access cover at grade as shown in **Figure 3**. The tradename ***Stormceptor®*** is also embossed on the top of the insert upstream of the weir as shown in **Figure 3**.

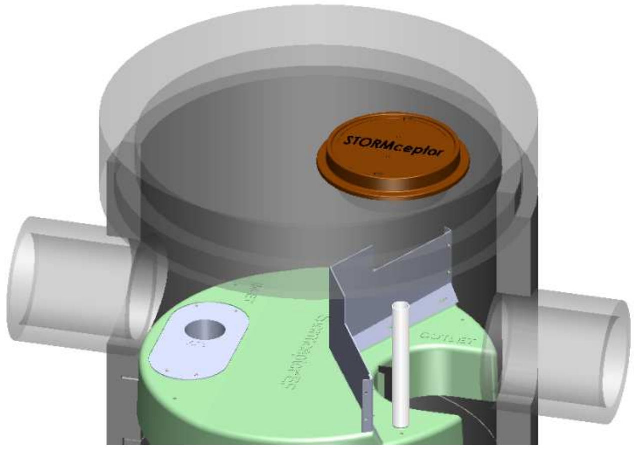


Figure 4

The specific Stormceptor EF/EFO model number is identified on the top of the aluminum Drop Pipe as shown in **Figure 4**. The unit serial number is identified on the top of the insert upstream of the weir as shown in **Figure 4**.

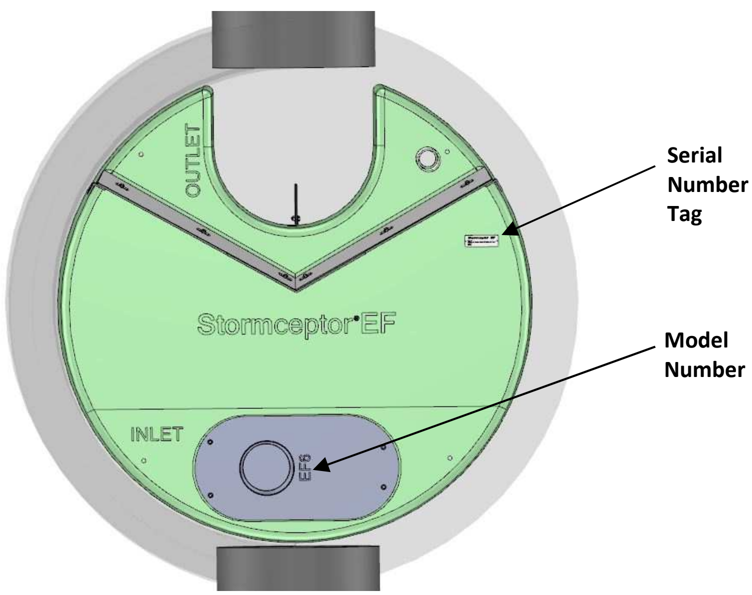


Figure 5

INSPECTION AND MAINTENANCE

It is very important to perform regular inspection and maintenance. Regular inspection and maintenance ensures maximum operation efficiency, keeps maintenance costs low, and provides continued of natural waterways.

Quick Reference

- Typical inspection and maintenance is performed from grade
- Remove manhole **cover(s)** or **inlet grate** to access insert and lower chamber
  NOTE: EF4/EFO4 requires the removal of a **flow deflector** beneath inlet grate
- Use Sludge Judge® or similar sediment probe to check sediment depth through the **outlet riser**
- Oil dipstick can be inserted through the **oil inspection pipe**
- Visually inspect the **insert** for debris, remove debris if present
- Visually inspect the **drop pipe** opening for blockage, remove blockage if present
- Visually inspect **insert** and **weir** for damage, schedule repair if needed
- Insert vacuum hose and jetting wand through the outlet riser and extract sediment and floatables
- Replace flow deflector (EF4/EFO4), inlet grate, and cover(s)
- **NOTE:** If the unit has an **outlet platform**, the outlet platform is typically in the UP position (see Figure 3A) for normal treatment conditions, and for inspection and maintenance. If manned entry into the unit is required, the outlet platform must first be placed in the DOWN position (see Figure 3B). After manned entry is completed, return the outlet platform to the UP position for treatment.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess pollutant accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

What equipment is typically required for inspection?

- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

When is maintenance cleaning needed?

- If the post-construction inspection indicates presence of construction sediment of a depth greater than a few inches, maintenance is recommended at that time.
- For optimum performance and normal operation the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, see **Table 3**.
- Maintain immediately after an oil, fuel, or other chemical spill.

Table 3

Recommended Sediment Depths for Maintenance Service*	
MODEL	Sediment Depth (in/mm)
EF4 / EFO4	8 / 203
EF6 / EFO6	12 /305
EF8 / EFO8	24 / 610
EF10 / EFO10	24 / 610
EF12 / EFO12	24 / 610

* Based on a minimum distance of 40 inches (1,016 mm) from bottom of outlet riser to top of sediment bed

The frequency of inspection and maintenance may need to be adjusted based on site conditions to ensure the unit is operating and performing as intended. Maintenance costs will vary based on the size of the unit, site conditions, local requirements, disposal costs, and transportation distance.

What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required (adhere to all OSHA / CCOSH standards)

What conditions can compromise Stormceptor performance?

- Presence of construction sediment and debris in the unit prior to activation
- Excessive sediment depth beyond the recommended maintenance depth
- Oil spill in excess of the oil storage capacity
- Clogging or restriction of the drop pipe inlet opening with debris
- Downstream blockage that results in a backwater condition

Maintenance Procedures

- Maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is maintained from grade through a standard surface manhole access cover or inlet grate.
- In the case of submerged or tailwater conditions, extra measures are likely required, such as plugging the inlet and outlet pipes prior to conducting maintenance.
- Inspection and maintenance of upstream catch basins and other stormwater conveyance structures is also recommended to extend the time between future maintenance cycles.

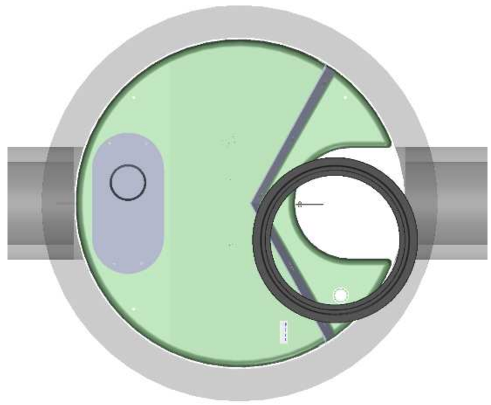


Figure 6

- Sediment depth inspections are performed through the **Outlet Riser** and oil presence can be determined through the **Oil Inspection Pipe**.
- Oil presence and sediment depth are determined by inserting a Sludge Judge® or measuring stick to quantify the pollutant depths.

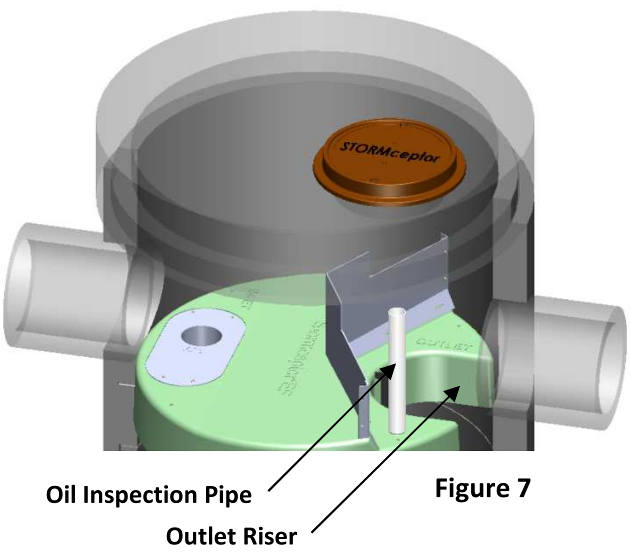


Figure 7

Figure 8

- Visually inspect the insert, weir, and drop pipe inlet opening to ensure there is no damage or blockage.
- **NOTE:** If the unit has an **outlet platform**, the outlet platform is typically in the UP position (see Figure 3A) for normal treatment conditions, and for inspection and maintenance. If manned entry into the unit is required, the outlet platform must first be placed in the DOWN position (see Figure 3B). After manned entry is completed, return the outlet platform to the UP position for treatment.

- When maintenance is required, a standard vacuum truck is used to remove the pollutants from the lower chamber of the unit through the **Outlet Riser**.

Figure 9

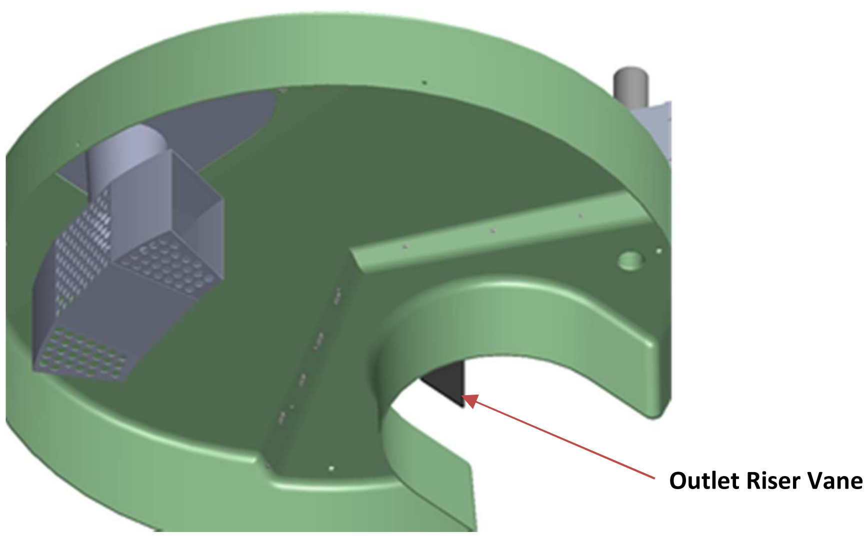


Figure 10

NOTE: The Outlet Riser Vane is durable and flexible and designed to allow maintenance activities with minimal, if any, interference.

Removable Flow Deflector

- Top grated inlets for the Stormceptor EF4/EFO4 model requires a removable flow deflector staged underneath a 24-inch x 24-inch (600 mm x 600 mm) square inlet grate to direct flow towards the inlet side of the insert, and avoid flow and pollutants from entering the outlet side of the insert from grade. The EF6/EFO6 and larger models do not require the flow deflector.

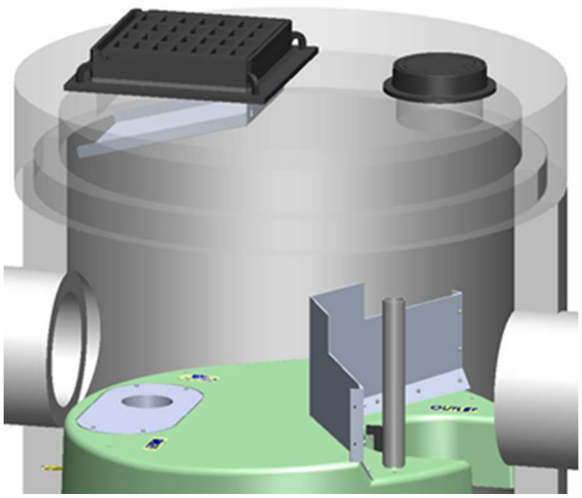
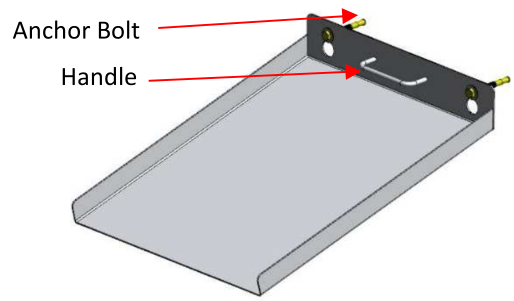


Figure 11

How to Remove:

1. Loosen anchor bolts
2. Pull up and out using the handle



Removable Flow Deflector

Hydrocarbon Spills

Stormceptor is often installed on high pollutant load hotspot sites with vehicular traffic where hydrocarbon spill potential exists. Should a spill occur, or presence of oil be identified within a Stormceptor EF/EFO, it should be cleaned immediately by a licensed liquid waste hauler.

Disposal
Maintenance providers are to follow all federal, state/ provincial, and local requirements for disposal of material.

Oil Sheens
When oil is present in stormwater runoff, a sheen may be noticeable at the Stormceptor outlet. An oil rainbow or sheen can be noticeable at very low oil concentrations (< 10 mg/L). Despite the appearance of a sheen, Stormceptor EF/EFO may still be functioning as intended.

Oil Level Alarm
To mitigate spill liability with 24/7 detection, an electronic monitoring system can be employed to trigger a visual and audible alarm when a pre-set level of oil is captured within the lower chamber or when an oil spill occurs. The oil level alarm is available as an optional feature to include with Stormceptor EF/EFO as shown in **Figure 11**. For additional details about the Oil Level Alarm please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-systems.

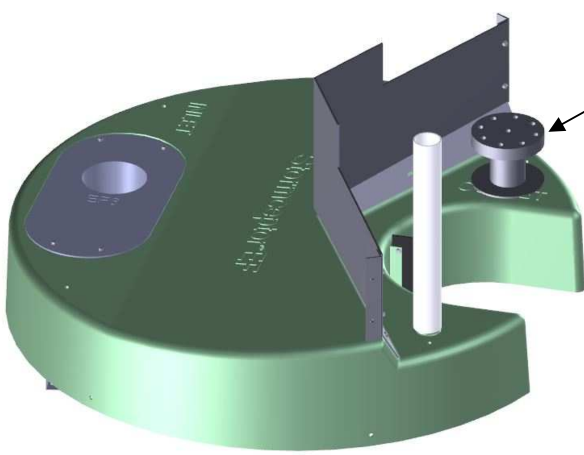


Figure 12

Replacement Parts

Stormceptor has no moving parts to wear out. Therefore inspection and maintenance activities are generally focused on pollutant removal. Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. However, if replacement parts are necessary, they may be purchased by contacting your local Stormceptor representative.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: ______________________

Serial Number: ______________________

Installation Date: ______________________

Location Description of Unit: ______________________

Recommended Sediment Maintenance Depth: ______________________

DATE	SEDIMENT DEPTH (inch or mm)	OIL DEPTH (inch or mm)	SERVICE REQUIRED (Yes / No)	MAINTENANCE PERFORMED	MAINTENANCE PROVIDER	COMMENTS

Other Comments:

Contact Information

Questions regarding Stormceptor EF/EFO can be addressed by contacting your local Stormceptor representative or by visiting our website at **www.stormceptor.com**.

Imbrium Systems Inc. & Imbrium Systems LLC

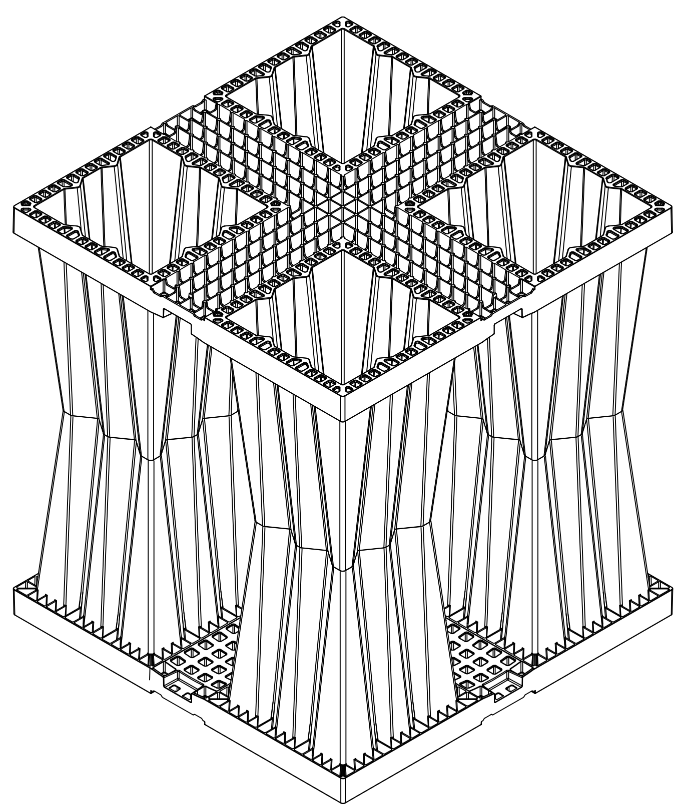
Canada	1-416-960-9900 / 1-800-565-4801
United States	1-301-279-8827 / 1-888-279-8826
International	+1-416-960-9900 / +1-301-279-8827

www.imbriumsystems.com
www.stormceptor.com
info@imbriumsystems.com

AQUABOX MODULE
LAYOUT DRAWINGS

1485 WILLIAMSPORT DRIVE TANK 1

MISSISSAUGA, ON



Pages:

LAYFIELD
117 Basaltic Rd,
Concord, ON L4K 1G4 Canada
Ph: (905) 761-9123
www.layfieldgroup.com

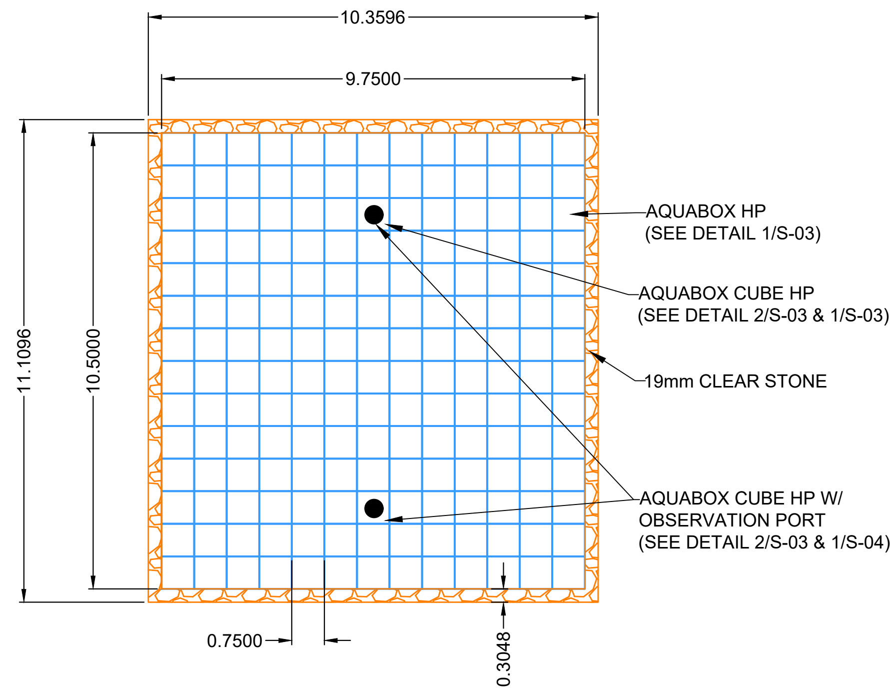
Total Storage Volume		101.40 m^3
Module Storage Volume		78.62 m^3
Stone Storage Volume		22.78 m^3
System Footprint		115 m^2
Estimated Geotextile Fabric	NuBarrier	900 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		57 m^3
Excavation Required		174 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 1
MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109	
Page Name: Cover Page	
Drawn by: AW	Checked By: XX
Scale: NTS	Date: 23NOV2022

THIS LAYOUT DRAWING WAS PREPARED TO SUPPORT THE ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE RESPONSIBILITY OF THE ENGINEER OF RECORD TO REVIEW THE INFORMATION AND ENSURE THAT THE LAYOUT AND DESIGN IS IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS AND THAT THE AQUABOX SYSTEM HAS BEEN DESIGNED IN ACCORDANCE WITH GEOPLAST'S REQUIREMENTS. LAYFIELD DOES NOT REVIEW OR APPROVE PLANS, SIZING OR DESIGNS.



2 S-02 MODULE LAYOUT SCALE: NTS

NOTES:

a. All dimensions are measured in meters unless noted otherwise.
b. Reference Aquabox standard drawings and notes for detailed information.
c. Reference current Aquabox Module installation instructions for proper installation practices.
https://www.geoplastglobal.com/en/downloads/aquabox
d. Engineer of record to confirm conformance to manufacturer's allowable proximity to other structures and slopes.
e. All inlet and pipe locations and designs by others.
f. The sub-grade and side backfill needs to be compacted to 97%, unless noted otherwise.
g. During and after installation, the AquaBox Module area should be clearly marked and roped off to prevent unauthorized construction and equipment trafficking over the modules.
h. Top of Ground water is to be maintained 610 mm (2 ft) below the module to prevent buoyancy, unless otherwise noted by engineer.
i. The quantities related to stone and geosynthetics are estimated values as the roll size, overlaps, waste, ect. may vary.
j. Materials must be stored in a manner to prevent prolonged exposure to UV light.

1 S-02 NOTES

Material Quantity (AQUABOX HP)

AquaBox HP	360
Sidewall Grid HP	54
Top Cap HP	728
Single Joint	674
Double Joint	8

Material Quantity (AQUABOX CUBE HP)

AquaBox Cube HP	8
Circular Cap D400 HP	2
Surface Grate	2

Elevations

Leveling Stone Bottom	135.6684
Module Invert	135.7700
Top of Module	136.5700
Top of Stone Backfill	136.8748
Minimum Finished Grade	137.1796
Maximum Finished Grade	138.4700

Contractor to confirm that quantities shipped to site match those listed above. Please report any discrepancy or damage to Layfield immediately.

LAYFIELD
117 Basaltic Rd,
Concord, ON L4K 1G4 Canada
Ph: (905) 761-9123
www.layfieldgroup.com

Total Storage Volume		101.40 m^3
Module Storage Volume		78.62 m^3
Stone Storage Volume		22.78 m^3
System Footprint		115 m^2
Estimated Geotextile Fabric	NuBarrier	900 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		57 m^3
Excavation Required		174 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 1
MISSISSAUGA, ON

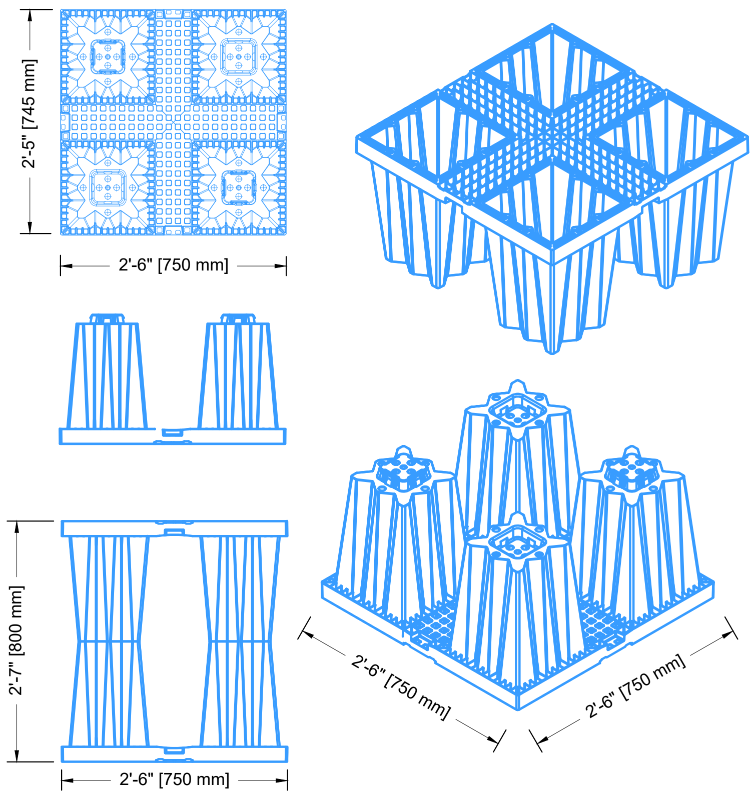
REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

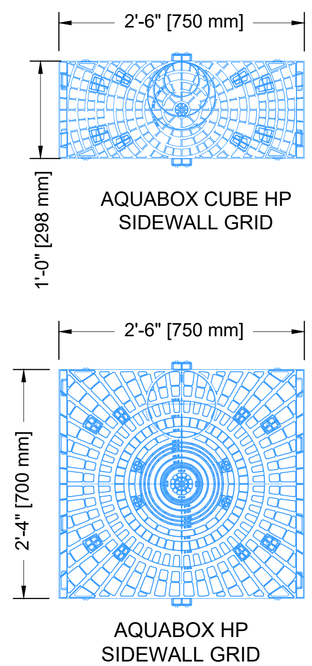
Page Name: Module Layout

Drawn by: AW	Checked By: XX
Scale: NTS	Date: 23NOV2022

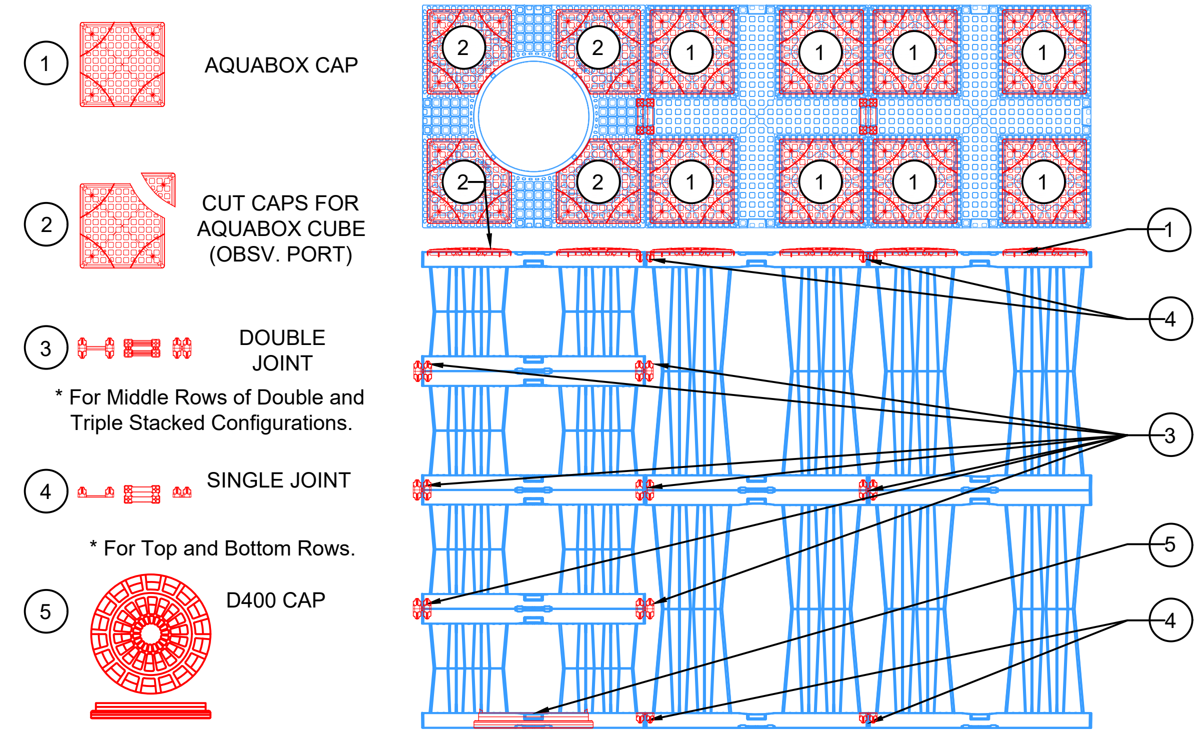
ANSI B Size Page (Horizontal)



1 S-03 **AQUABOX HP**

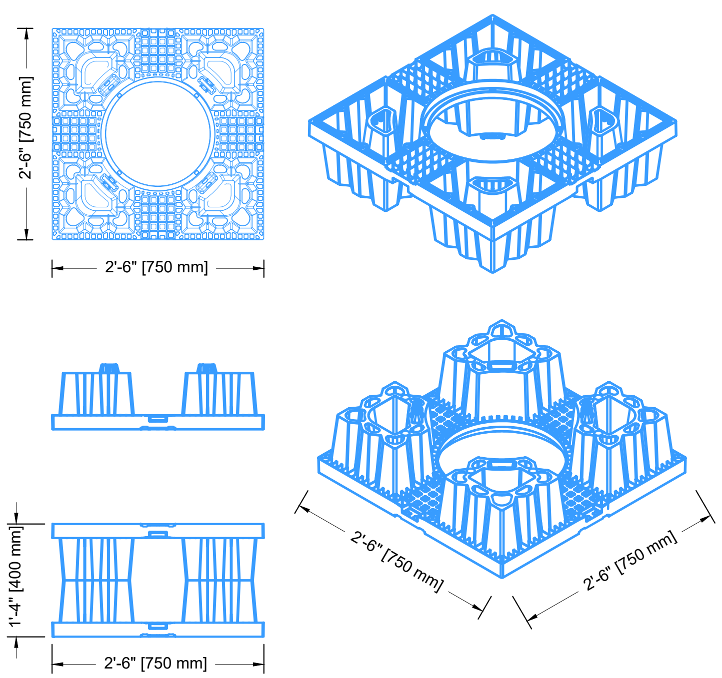


3 S-03 **AQUABOX SIDEWALL GRID**

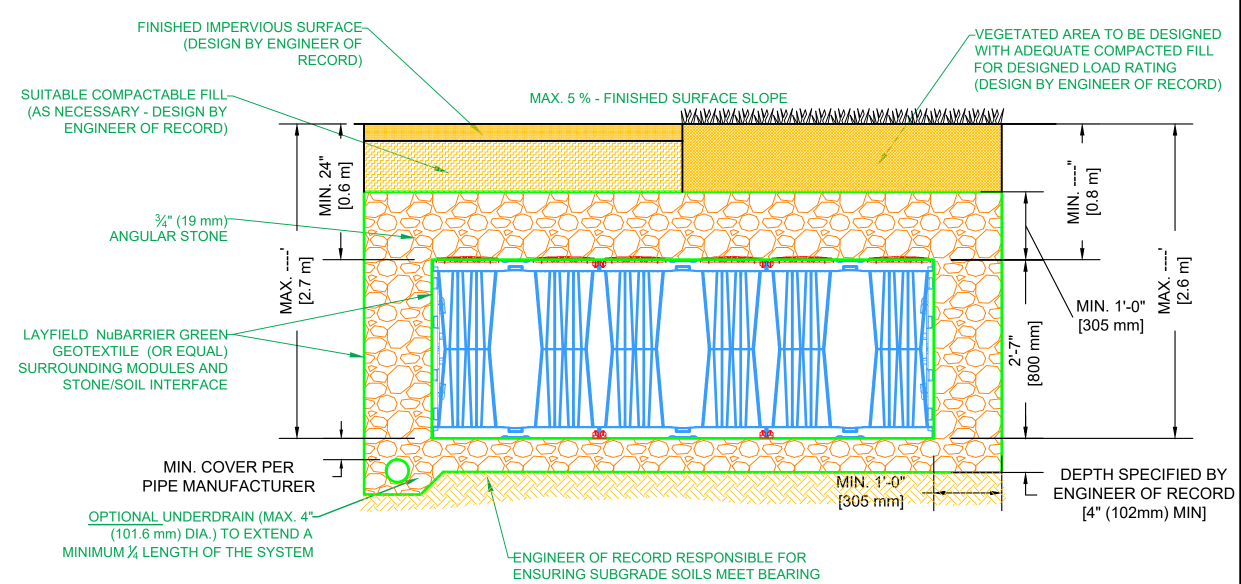


NOTE: THIS DETAIL DEPICTS ONLY THE LOCATION OF AQUABOX ACCESSORIES (CAPS/ CONNECTORS) AND DOES **NOT** REPRESENT THE PROJECT-SPECIFIC STACKING CONFIGURATION. REFER TO DETAIL 5/S-03 FOR STACKING CONFIGURATION AND CROSS-SECTIONAL DETAILS.

4 S-03 **AQUABOX ACCESSORIES CAPS AND JOINTS**



2 S-03 **AQUABOX CUBE HP**



5 S-03 **TYPICAL SYSTEM CROSS SECTION**

LAYFIELD
117 Basaltic Rd,
Concord, ON L4K 1G4 Canada
Ph: (905) 761-9123
www.layfieldgroup.com

Total Storage Volume		101.40 m^3
Module Storage Volume		78.62 m^3
Stone Storage Volume		22.78 m^3
System Footprint		115 m^2
Estimated Geotextile Fabric	NuBarrier	900 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		57 m^3
Excavation Required		174 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 1
MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

Page Name: TYP. Construction Details

Drawn by: AW	Checked By: XX
Scale: NTS	Date: 23NOV2022

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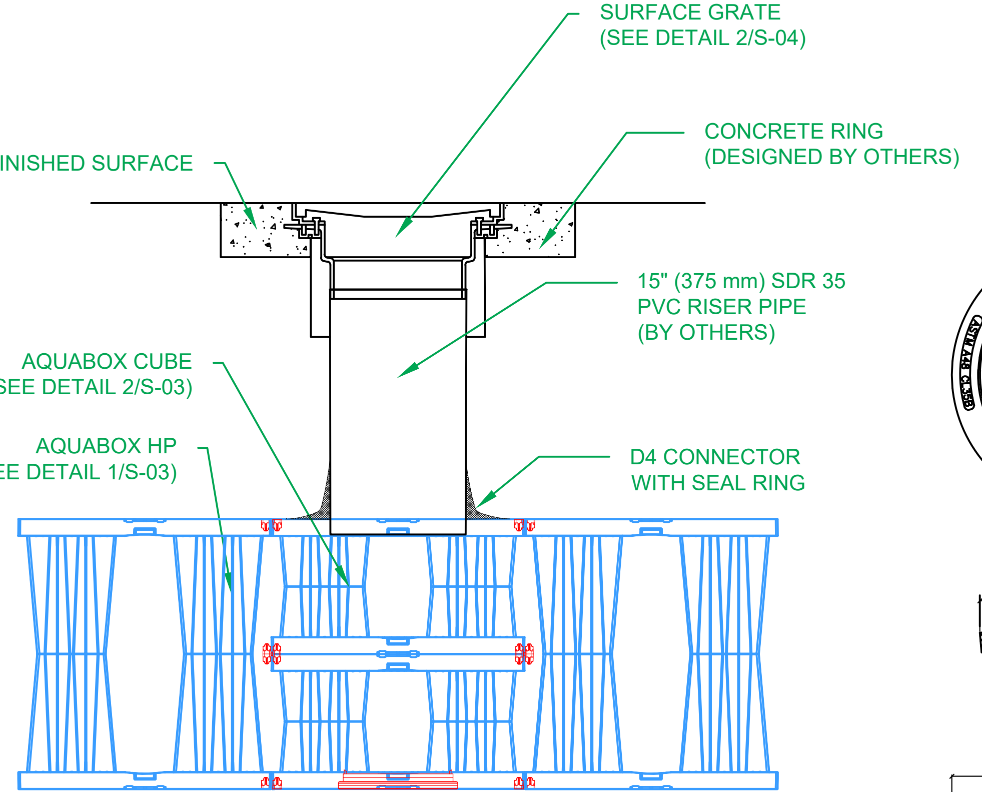
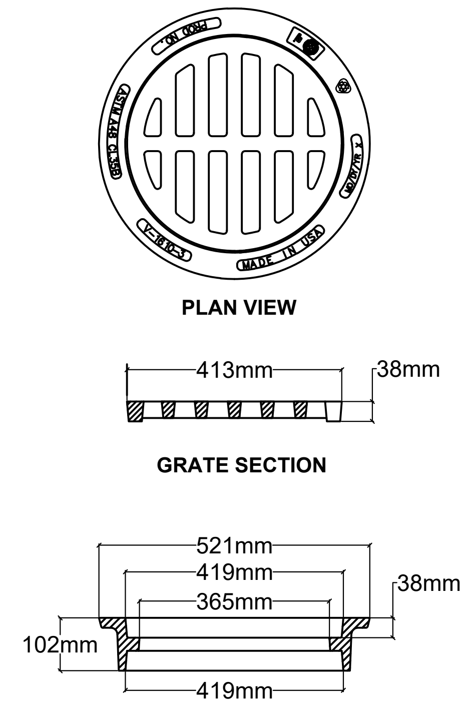


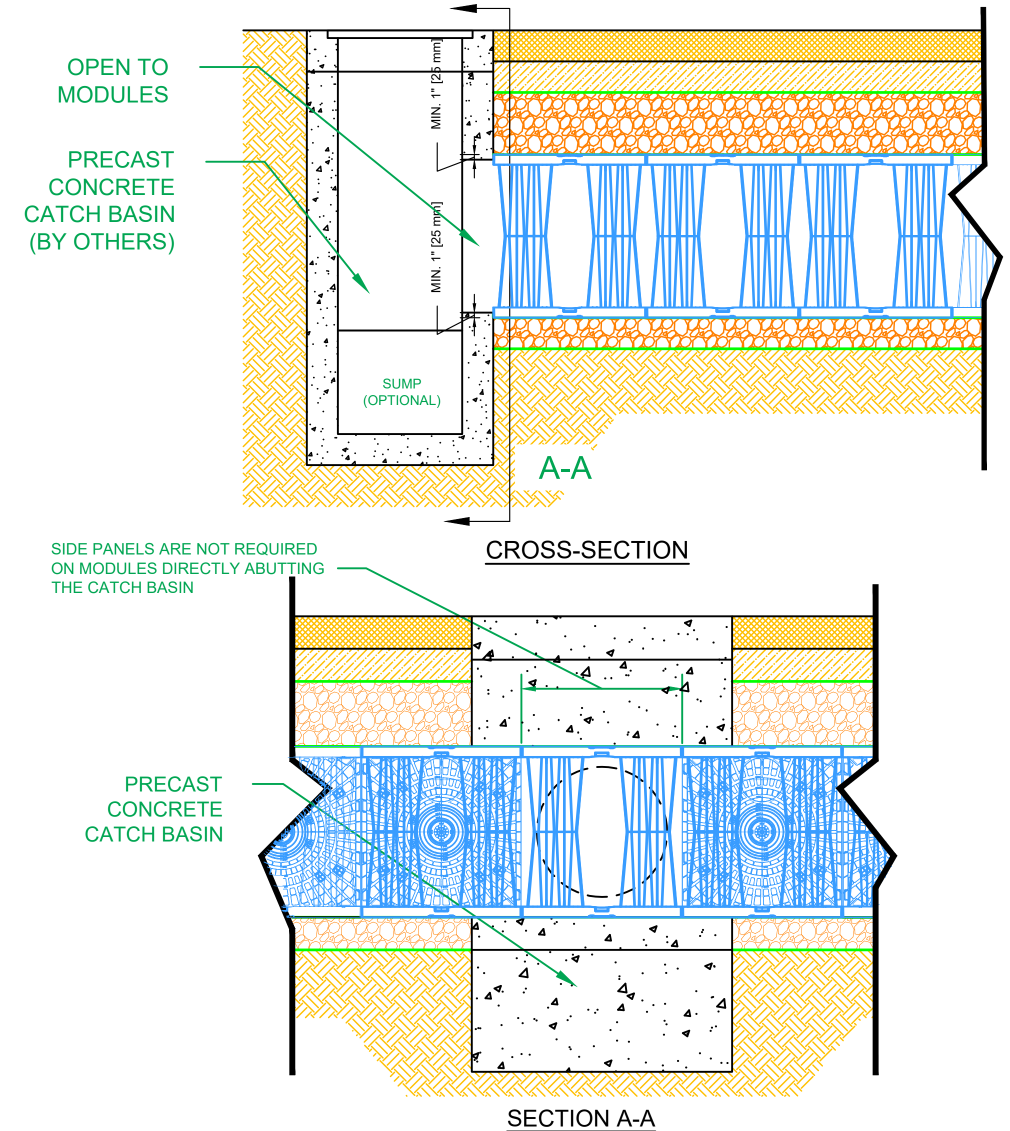
INSTALLATION SEQUENCE:

1. D4 CONNECTOR WITH SEAL RING
2. 15" (375 mm) SDR 35 PVC PIPE
3. SURFACE GRATE AT FINISHED GRADE

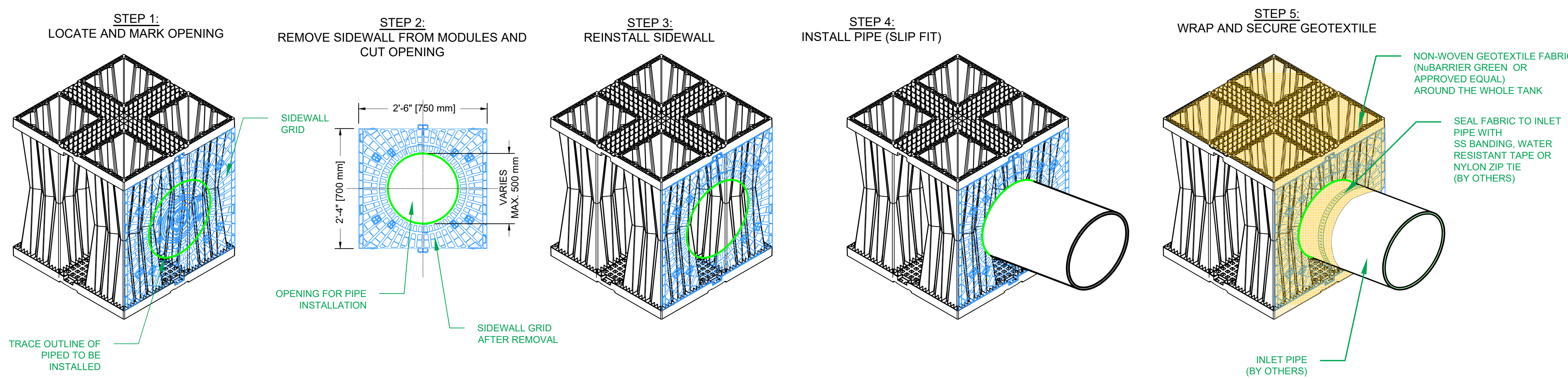
1 / S-04 **AQUABOX OBSERVATION PORT**



2 / S-04 **OBSERVATION PORT SURFACE GRATE**



3 / S-04 **AQUABOX CATCHBASIN ABUTMENT (IF APPLICABLE)**



4 / S-04 **PIPE CONNECTION DETAIL**

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www.layfieldgroup.com

Total Storage Volume			101.40 m^3
Module Storage Volume			78.62 m^3
Stone Storage Volume			22.78 m^3
System Footprint			115 m^2
Estimated Geotextile Fabric		NuBarrier	900 m^2
Estimated Geotextile Fabric		LP8	N/A m^2
Estimated Liner			N/A m^2
Estimated GeoGrid			N/A m^2
Estimated Stone Volume			57 m^3
Excavation Required			174 m^3
Excavation Depth			1.5 m
Stone Type			19mm Clear Stone
Stone Void Space			40%
Number of Layers			1
Allowable Loading			HS25
Surface	Paved Surface		Vegetated/ Unpaved
Minimum Top Cover	0.6 m		0.8 m
Maximum Tank Depth	2.7 m		2.6 m

1485 WILLIAMSPORT DRIVE TANK 1
MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

Page Name: TYP. Pipe Penetration Details

Drawn by: AW | Checked By: XX

Scale: NTS | Date: 23NOV2022

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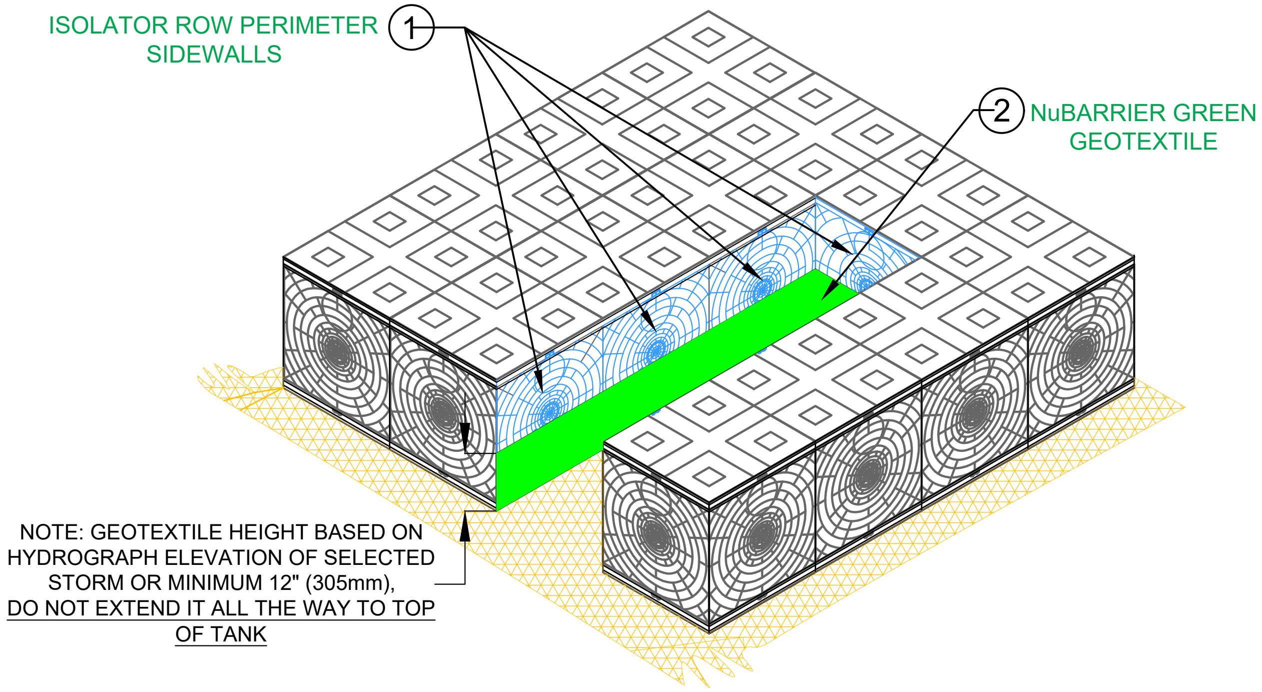
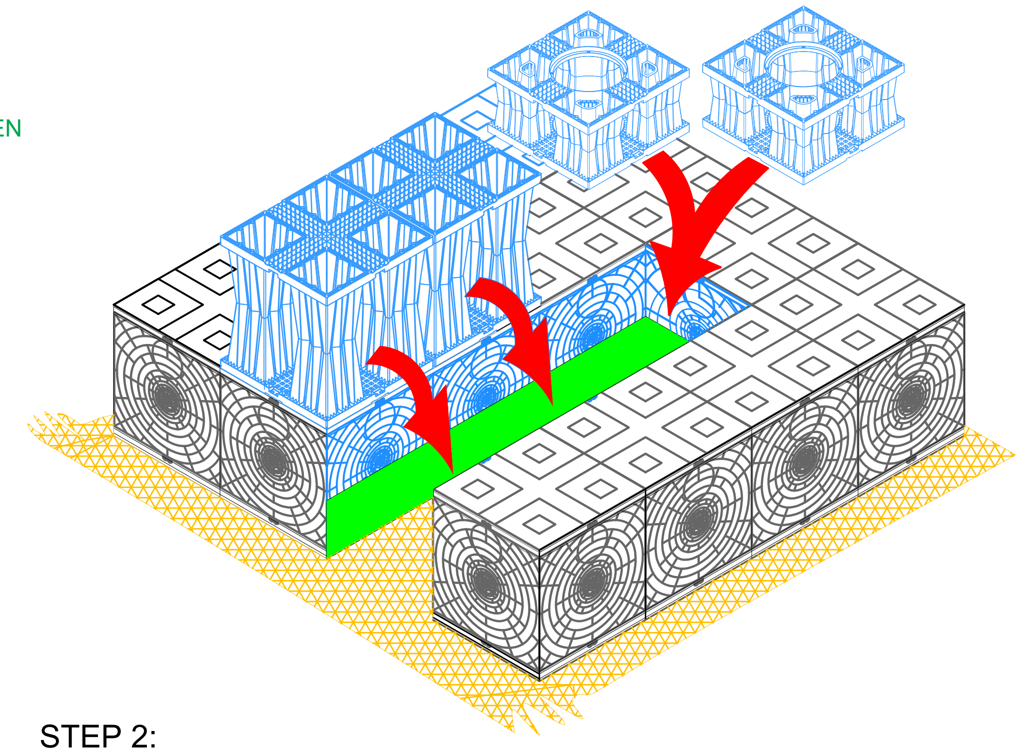
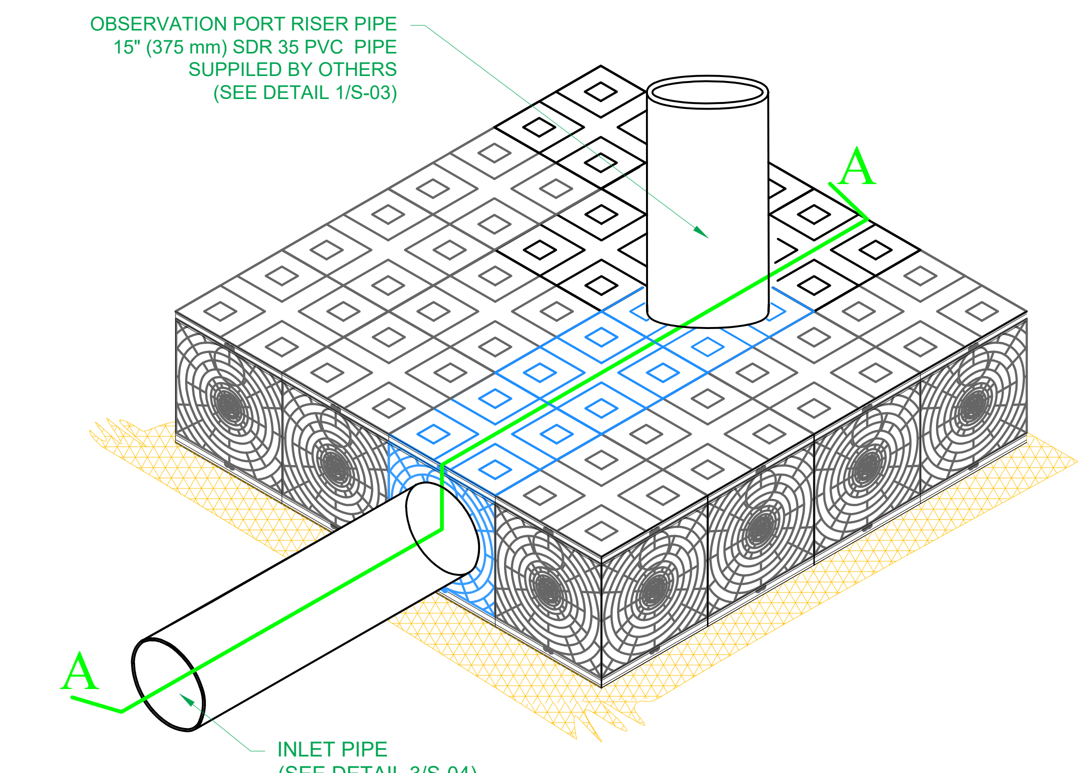
ANSI B Size Page (Horizontal)



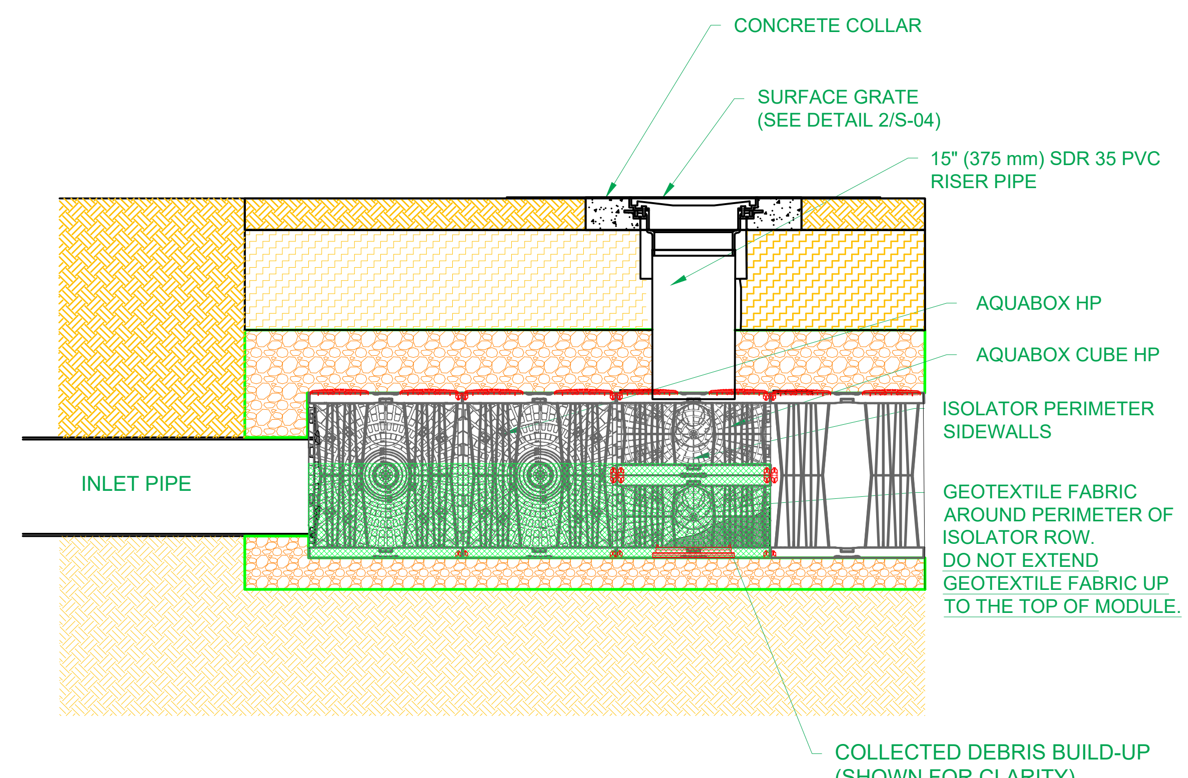
STEP 1:
INSTALL ISOLATER ROW PERIMETER SIDEWALLS AND ATTACH GEOTEXTITLE TO THEM.



STEP 2:
PLACE AQUABOX HP AND AQUABOX HP CUBE MODULES IN THE ISOLATER ROW AS PER MODULE LAYOUT 2/S-02



STEP 3:
INSTALL INLET PIPE AS PER DETAIL 4/S-04 AND CONNECTOR PIPE FOR OBSERVATION PORT AS PER DETAIL 1/S-04



SECTION A-A

1
S-05
ISOLATOR ROW INSTALLATION DETAIL

LAYFIELD
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Stone Storage Volume		22.78 m^3
System Footprint		115 m^2
Estimated Geotextile Fabric	NuBarrier	900 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		57 m^3
Excavation Required		174 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 1
MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

Page Name: TYP. Isolater Row Details

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Sheet:

ANSI B Size Page (Horizontal)

General Conditions

- Review installation procedures and coordinate the installation with other construction activities, such as grading, excavation, utilities, construction access, erosion control, etc.
- Engineered Contract Drawings supersede all provided documentation, as the information furnished in this document is based on a typical installation.
- Coordinate the installation with the manufacturer's representative/distributor to be on-site to review start-up procedures and installation instructions.
- Components shall be unloaded, handled and stored in an area protected from traffic and in a manner to prevent damage.
- Assembled modules may be walked on, but vehicular traffic is prohibited until backfilled per the Manufacturer's requirements. Protect the installation against damage with highly visible construction tape, fencing, or other means until construction is complete.
- Ensure all construction occurs in accordance with Federal, Provincial and Local Laws, Ordinances, Regulations, and Safety Requirements.
- Extra care and caution should be taken when temperatures are at or below -5.0° C.

NOT FOR CONSTRUCTION

These drawings shall not be used for construction until they have been reviewed for all design aspects (structural, geotechnical, stormwater) and approved by the Engineer of Record for the Project.

It is the Buyer's responsibility to ensure that the design into which the Product will be used has been approved by the Engineer of Record (not Layfield) with a review that may include, but not be limited to, Inlet and outlet configurations including inverts and pipe connections, storage volume, system footprint, Aquabox elevations including cover soil requirements, and proximity to structures and slopes.

Site design/engineering elements may include but not be limited to the following:

- Review elevations and if necessary adjust grading to ensure the chamber cover requirements are met.
- Evaluating site-specific information on soil conditions and/or bearing capacity.
- Assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and the depth of foundation stone with consideration for the range of expected soil moisture conditions.

1.0 Basin Excavation

1. Stake out and excavate to elevations per approved plans. Excavation Requirements:
   a. Sub-grade excavation must be a minimum of 4" (102 mm) below the designed AquaBox Module invert.
   b. The excavation should extend a minimum of 12" (305 mm) beyond the AquaBox dimensions in each length and width (an additional 24" [610 mm] in total length and total width) to allow for adequate placement of side backfill material.
   c. Remove objectionable material encountered within the excavation, including protruding material from the walls.
   d. Furnish, install, monitor, and maintain excavation support (e.g., shoring, bracing, trench boxes, etc.) as required by Federal, Provincial and Local Laws, Ordinances, Regulations, and Safety Requirements.

2.0 Sub-Grade Requirements

1. Sub-grade shall be unfrozen, level (plus or minus 1%), and free of lumps, or debris with no standing water, mud or muck. Do not use materials nor mix with materials that are frozen and/or coated with ice or frost.
2. Unstable, unsuitable, and/or compromised areas should be brought to the Engineer's attention and mitigating efforts determined prior to compacting the sub-grade.
3. Sub-grade must be compacted to 97% Standard Proctor Density or as approved by the Engineer of Record. If code requirements restrict subgrade compaction, it is the requirement of the geotechnical engineer to verify that the bearing capacity and settlement criteria for support of the system are met.

* The Engineer of Record shall confirm minimum soil bearing capacity required based on Load Rating and top cover depth. Minimum soil bearing capacity is required so that settlements are less than 1" through the entire sub-grade and do not exceed long-term 1/2" differential settlement between any two adjacent units within the system. Sub-grade must be designed to ensure soil bearing capacity is maintained throughout all soil saturation levels.

3.0 Leveling Bed Installation

1. Install geotextile fabric and/or liner material, as specified.
   a. Geotextile fabric shall be placed per the manufacturer's recommendations.
   b. Additional material to be utilized for wrapping above the system must be protected from damage until use.
2. After the geotextile is secured, place a minimum 4" (102 mm) Leveling Bed.
   a. Material should be a 3/4" (19 mm) angular stone meeting AASTHO #56, 57, 67, 68 Material specifications.
   b. Material should be raked free of voids, lumps, debris, sharp objects, and plate vibrated to a level with a maximum 1% slope.
3. Correct any unsatisfactory conditions.

4.0 AquaBox Module Assembly and Placement

1.0 AquaBox Assembly

AquaBox modules are delivered to the site as palletized components requiring simple assembly. No special equipment, tools or bonding agents are required; only a rubber mallet. The modules can be pre-assembled either inside or outside the trench. The pre-assembled modules must then be organized according to the design specifications.

ASSEMBLY INSTRUCTIONS:

1. Each AquaBox features plug and socket connections which makes assembling the modules quick and easy. Simply lay one element on the ground and join it to another by applying some pressure on the top.

GENERAL NOTES:

- Remove packaging material and check for any damage. Report any damaged components to an AquaBox Distributor or Layfield personnel.
- AquaBox components are backed by a 50 year warranty when installed per the manufacturer's recommendations.

2.0 AquaBox Placement

1. Install geotextile fabric and/or liner material, as specified.
   a. Geotextile fabric shall be placed per the manufacturer's recommendations.
   b. Additional material to be utilized for wrapping above the system must be protected from damage until use.
2. Mark the footprint of the modules for placement.
   a. Ensure module perimeter outline is square or similar prior to Module placement.
   b. Care should be taken to note any connections, ports or other irregular units to be placed.
3. Install the individual modules by hand, as detailed below.
   a. The modules should be installed as shown in the AquaBox submittal drawings. Place AquaBox Cubes at the location of observation ports.
   b. Modules are connected horizontally to adjacent modules with Single or Double Joints.
   c. Use Single Joints for Bottom and Top rows while Double Joints are used for middle rows in Double or Triple stacking configuration.
   d. For double/ triple stack configurations:
      i. Use the Single Joints for the first bottom row.
      ii. Install Double Joints on all the middle rows.
      iii. Place the upper module directly on top of the bottom module in the same direction.

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Total Storage Volume		101.40 m^3
Module Storage Volume		78.62 m^3
Stone Storage Volume		22.78 m^3
System Footprint		115 m^2
Estimated Geotextile Fabric	NuBarrier	900 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		57 m^3
Excavation Required		174 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 1
MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

Page Name: Supplementary Notes

Drawn by: AW | Checked By: XX

Scale: NTS | Date: 23NOV2022

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4. Install the modules to completion, taking care to avoid damage to the geotextile and/or liner material.
5. Once all the modules have been placed, Install SIDEWALLS on the perimeter and CAPS on the top.
6. Locate any ports or other penetration of the AquaBox.
   a. Install ports/penetrations in accordance with the approved submittals, contract documents, and manufacturer's recommendations.
6. Upon completion of module installation, wrap the modules in geotextile fabric and/or liner.
   a. Geotextile fabric shall be wrapped and secured per the manufacturer's recommendations.
   b. Seal any ports/penetrations per the Manufacturer's requirements

Notes:

- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations

6.0 Side Backfill

1. Inspect all geotextiles, ensuring that no voids or damage exists; which will allow sediment into the AquaBox system.
2. Adjust the stone/soil interface geotextile along the side of the native soil to ensure the geotextile is taught to the native soil.
3. Once the geotextile is secured, begin to place the Side Backfill.
   a. Material should be a 3/4" (19 mm) angular stone meeting AASTHO #56, 57, 67, 68 Material specifications.
   b. Backfill sides "evenly" around the perimeter without exceeding single 12" (305 mm) lifts.
   c. Place material utilizing an excavator, dozer, or conveyor boom.
   d. Utilize a plate vibrator to settle the stone and provide uniform distribution.

Notes:

- Do not apply vehicular load to the modules during placement of side backfill. All material placement should occur with equipment located on the native soil surrounding the system.
- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations

7.0 Top Backfill (Stone)

1. Begin to place the Top Backfill.
   a. Material should be a 3/4" (19 mm) angular stone meeting AASTHO #56, 57, 67, 68 Material specifications.
   b. Place material utilizing an excavator, dozer, or conveyor boom and use a walk-behind plate vibrator to settle the stone and provide even distribution.

DO NOT DRIVE ON THE MODULES WITHOUT REQUIRED MINIMUM COVER.

2. Upon completion of Top Backfilling, wrap the system in geotextile fabric and/or liner per the manufacturer's recommendations.
3. Install metallic tape around the perimeter of the system to mark the area for future utility detection.

Notes:

- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations.
- Only Low Ground Pressure tracked equipment can be used during construction with at least 300 mm suitably compacted covering created over the AquaBox System. Abrupt maneuvers such as steering should be avoided at this stage.
- The passage of heavy goods vehicles with a wheel load of more than 50 kN over the basin is possible if the thickness of the covering is adequately compacted and not less than 600 mm. When dumping the backfill material, the load per wheel shall not exceed 50 kN.

8.0 Suitable Compactable Fill

Following Top Backfill placement and geotextile fabric wrapping; complete the installation as noted below.

Vegetated Area

1. Place fill onto the geotextile.
   a. Maximum 12" (305 mm) lifts, compacted with a vibratory plate or walk behind roller to a minimum of 90% Standard Proctor Density.
   b. The minimum top cover to finished grade should not be less than ----" (0.8 m) and the maximum depth from final grade to the bottom of the lowest module should not exceed ----' (2.6 m).
2. Finish to the surface and complete with vegetative cover.

Impervious Area

1. Place fill onto the geotextile.
   a. Maximum 12" (305 mm) lifts, compacted with a vibratory plate or walk behind roller to a minimum of 90% Standard Proctor Density.
   b. The minimum top cover to finished grade should not be less than 24" (0.6 m) and the maximum depth from final grade to the bottom of the lowest module should not exceed ----' (2.7 m).
2. Finish to the surface and complete with asphalt, concrete, etc.

Notes:

- A vibratory roller may only be utilized after a minimum cover has been placed or for the installation of the asphalt wearing course.
- If damage occurs to the geotextile fabric, repair the material in accordance with the geotextile Manufacturer's recommendations.
- For most recent installation guidelines visit: https://www.geoplastglobal.com/en/downloads/aquabox

9.0 Inspection and Maintenance

If the following inspections and maintenance procedures are not followed as specified below then the end-user is responsible for the performance of the modules. This maintenance procedure must be performed after termination of site operations, heavy rainfall, flooding, or any incident that will vary the flow of water drastically.

Inspection

1. Inspect all observation ports, inflow, and outflow connection and the discharge area
2. Identify and log any sediment and debris accumulation, system backup, or discharge rate changes.
3. If there is a sufficient need for a cleanout, contact a local cleaning company for assistance.

Cleaning:

1. If a pre-treatment device is installed, follow manufacturer recommendations.
2. Using a vacuum pump truck, evacuate debris from the inflow and outflow points.
3. Flush the system with clean water, forcing debris from the system.
4. Repeat steps 2 and 3 until no debris is evident

Notes:

- For spray probe cleaning, the use of a 90° rotating nozzle with a 45° water jet is recommended. The nozzles used should have a pressure of 80 to 120 bar; higher pressures may damage the geotextile.

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Stone Storage Volume		22.78 m^3
System Footprint		115 m^2
Estimated Geotextile Fabric	NuBarrier	900 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		57 m^3
Excavation Required		174 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 1
MISSISSAUGA, ON

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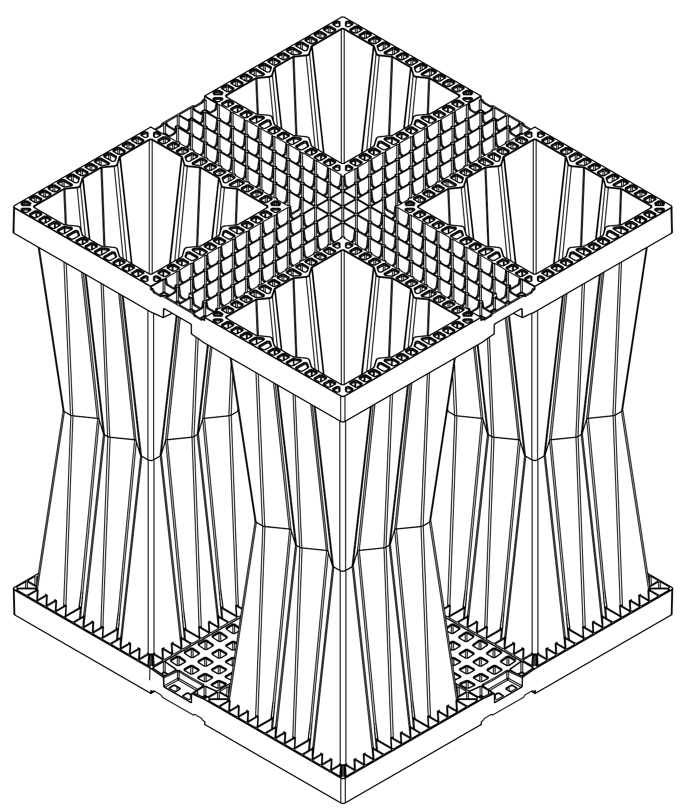
Scale: NTS | Date: 23NOV2022

LAYFIELD

AQUABOX MODULE
LAYOUT DRAWINGS

1485 WILLIAMSPORT DRIVE TANK 2

MISSISSAUGA, ON



Pages:

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Total Storage Volume		21.67 m^3
Module Storage Volume		15.55 m^3
Stone Storage Volume		6.12 m^3
System Footprint		26 m^2
Estimated Geotextile Fabric	NuBarrier	340 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		16 m^3
Excavation Required		40 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 2
MISSISSAUGA, ON

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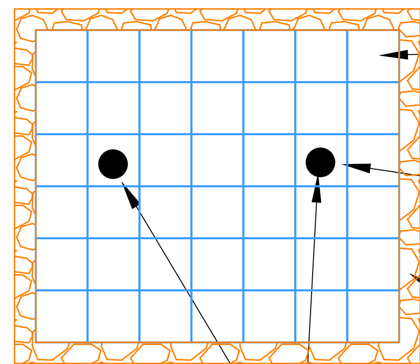

2 S-02 MODULE LAYOUT SCALE: NTS

NOTES:

a. All dimensions are measured in meters unless noted otherwise.
b. Reference Aquabox standard drawings and notes for detailed information.
c. Reference current Aquabox Module installation instructions for proper installation practices.
https://www.geoplastglobal.com/en/downloads/aquabox
d. Engineer of record to confirm conformance to manufacturer's allowable proximity to other structures and slopes.
e. All inlet and pipe locations and designs by others.
f. The sub-grade and side backfill needs to be compacted to 97%, unless noted otherwise.
g. During and after installation, the AquaBox Module area should be clearly marked and roped off to prevent unauthorized construction and equipment trafficking over the modules.
h. Top of Ground water is to be maintained 610 mm (2 ft) below the module to prevent buoyancy, unless otherwise noted by engineer.
i. The quantities related to stone and geosynthetics are estimated values as the roll size, overlaps, waste, ect. may vary.
j. Materials must be stored in a manner to prevent prolonged exposure to UV light.

1 S-02 NOTES

Material Quantity (AQUABOX HP)

AquaBox HP	68
Sidewall Grid HP	24
Top Cap HP	144
Single Joint	120
Double Joint	8

Material Quantity (AQUABOX CUBE HP)

AquaBox Cube HP	8
Circular Cap D400 HP	2
Surface Grate	2

Elevations

Leveling Stone Bottom	136.5384
Module Invert	136.6400
Top of Module	137.4400
Top of Stone Backfill	137.7448
Minimum Finished Grade	138.0496
Maximum Finished Grade	139.3400

Contractor to confirm that quantities shipped to site match those listed above. Please report any discrepancy or damage to Layfield immediately.

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Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		16 m^3
Excavation Required		40 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

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Page Name: Module Layout

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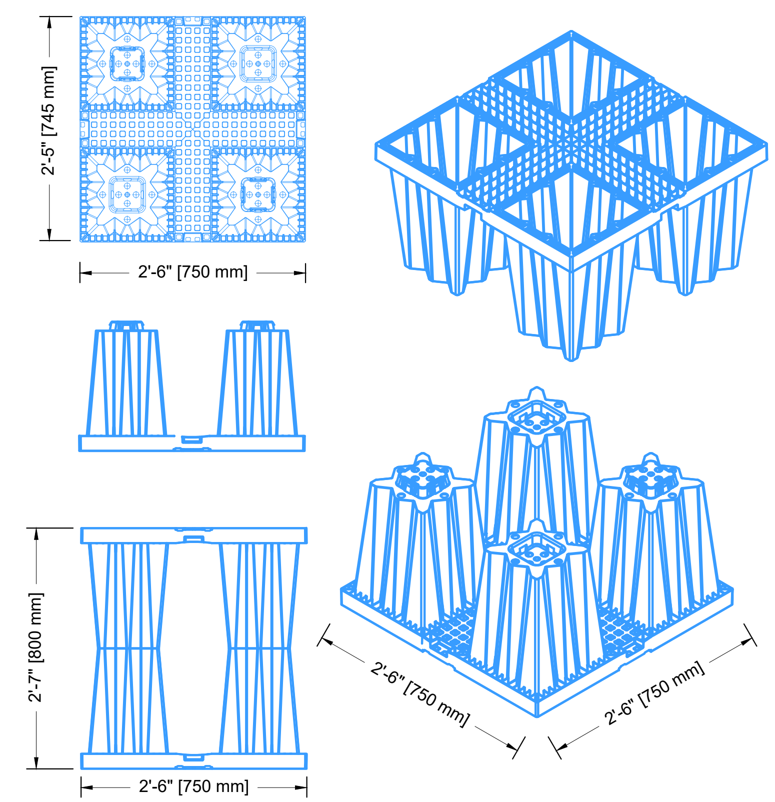
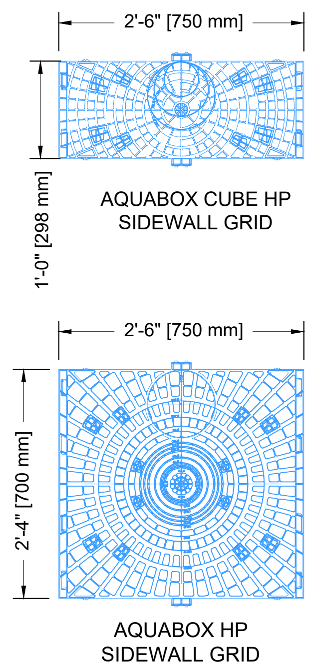
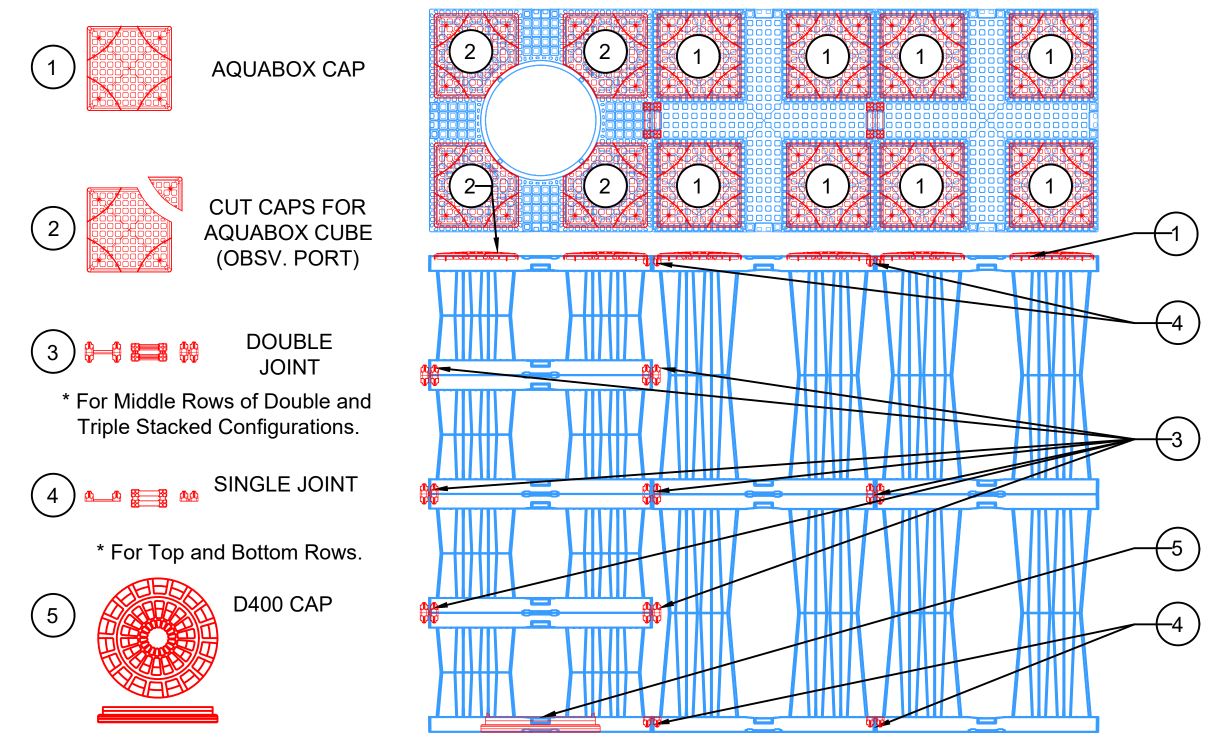


1 S-03 AQUABOX HP

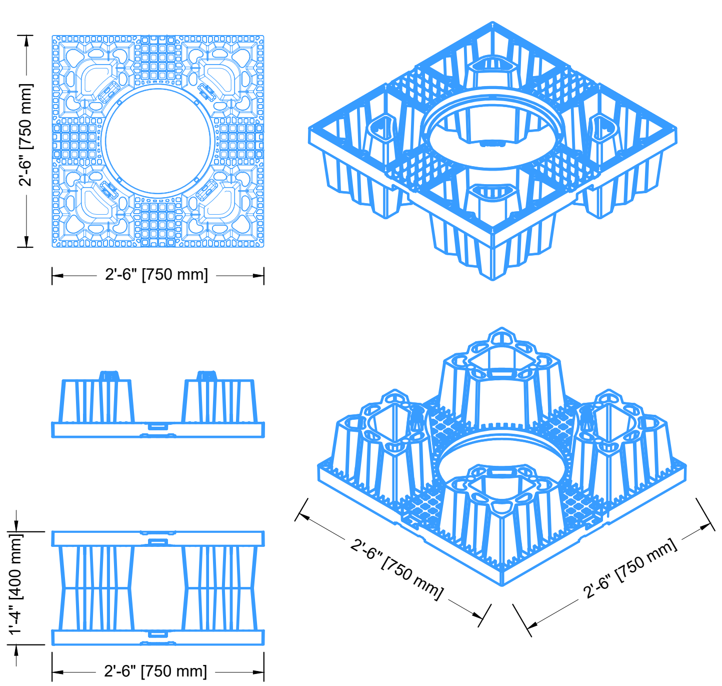


3 S-03 AQUABOX SIDEWALL GRID

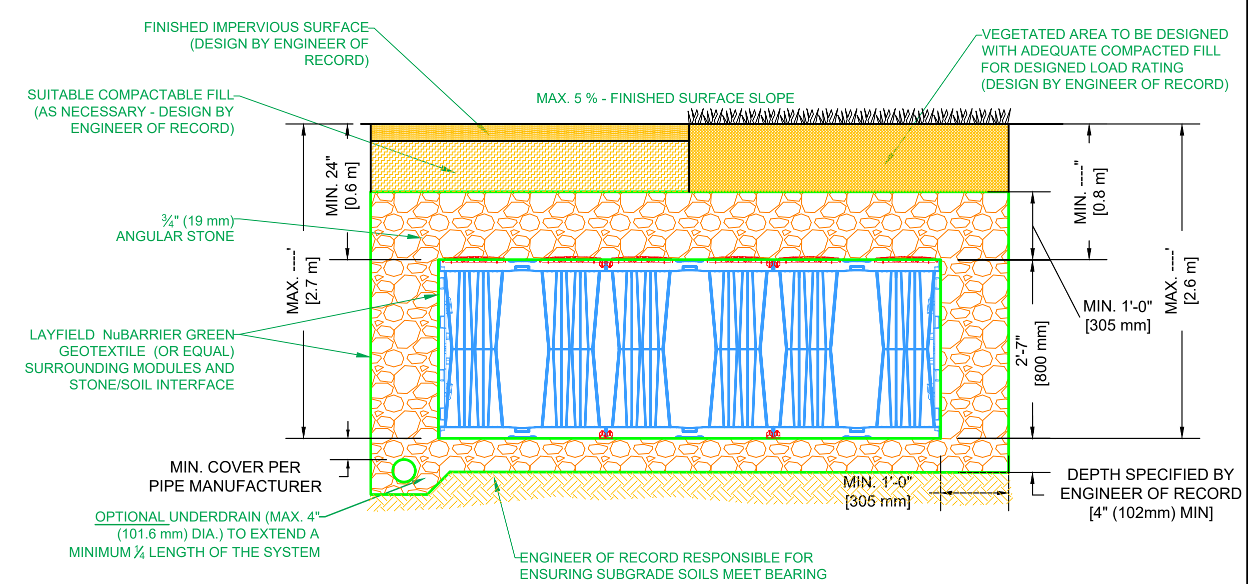


NOTE: THIS DETAIL DEPICTS ONLY THE LOCATION OF AQUABOX ACCESSORIES (CAPS/ CONNECTORS) AND DOES **NOT** REPRESENT THE PROJECT-SPECIFIC STACKING CONFIGURATION. REFER TO DETAIL 5/S-03 FOR STACKING CONFIGURATION AND CROSS-SECTIONAL DETAILS.

4 S-03 AQUABOX ACCESSORIES CAPS AND JOINTS



2 S-03 AQUABOX CUBE HP



5 S-03 TYPICAL SYSTEM CROSS SECTION

LAYFIELD
117 Basaltic Rd,
Concord, ON L4K 1G4 Canada
Ph: (905) 761-9123
www.layfieldgroup.com

Total Storage Volume		21.67 m^3
Module Storage Volume		15.55 m^3
Stone Storage Volume		6.12 m^3
System Footprint		26 m^2
Estimated Geotextile Fabric	NuBarrier	340 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		16 m^3
Excavation Required		40 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 2
MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

Page Name: TYP. Construction Details

Drawn by: AW	Checked By: XX
Scale: NTS	Date: 23NOV2022

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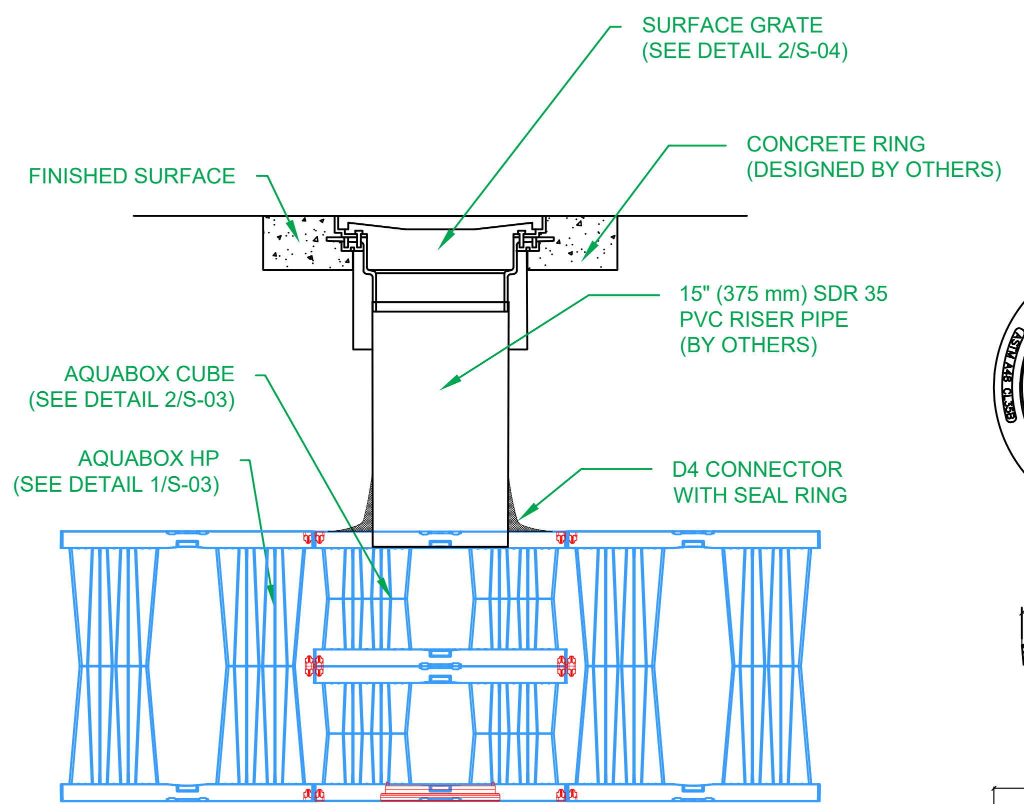
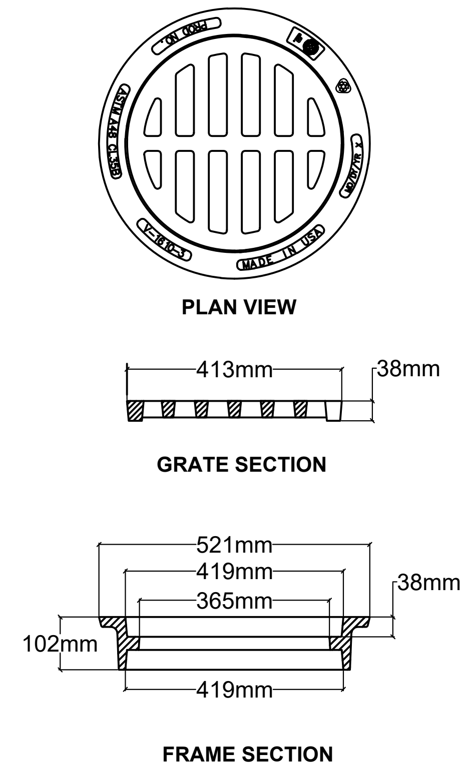
ANSI B Size Page (Horizontal)



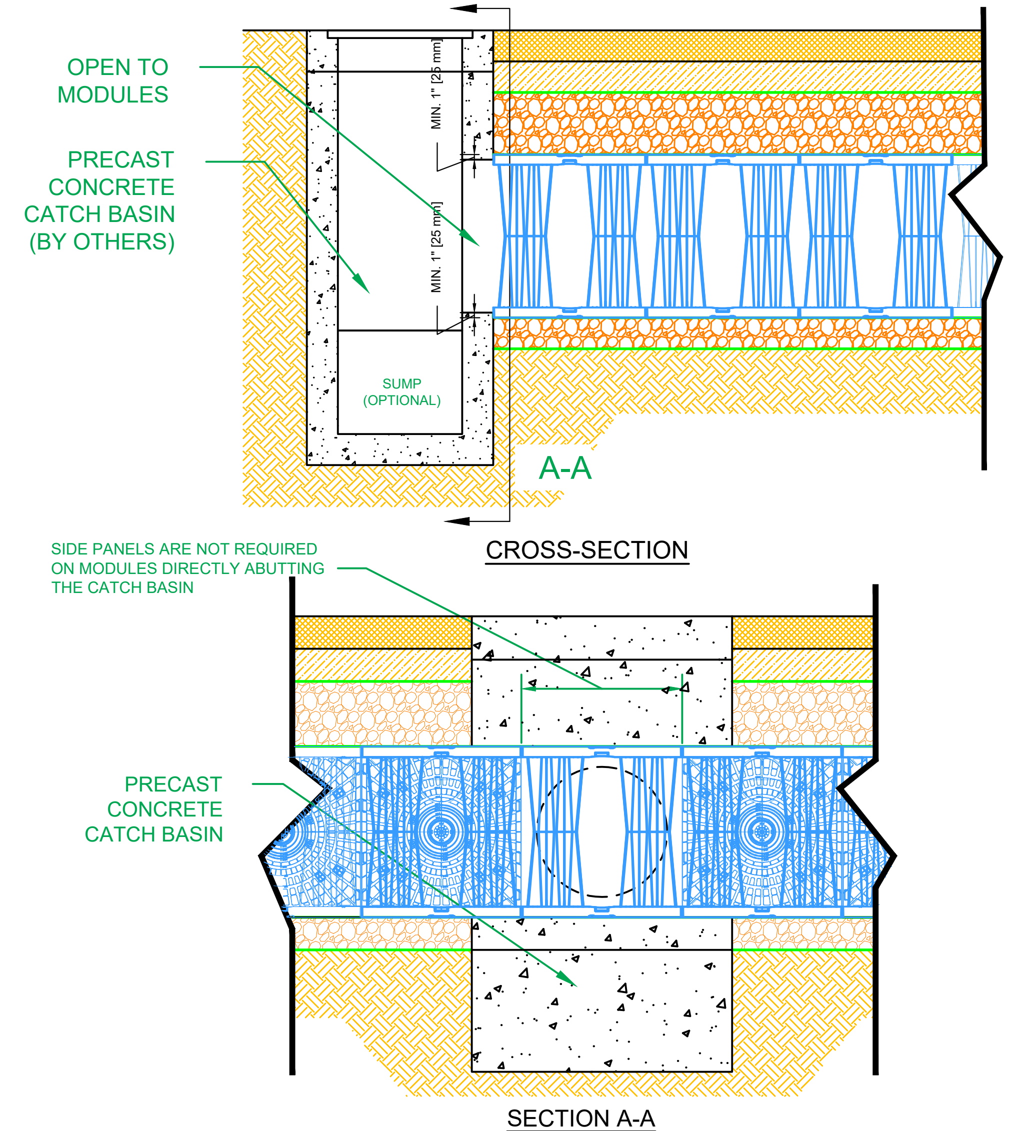
INSTALLATION SEQUENCE:

1. D4 CONNECTOR WITH SEAL RING
2. 15" (375 mm) SDR 35 PVC PIPE
3. SURFACE GRATE AT FINISHED GRADE

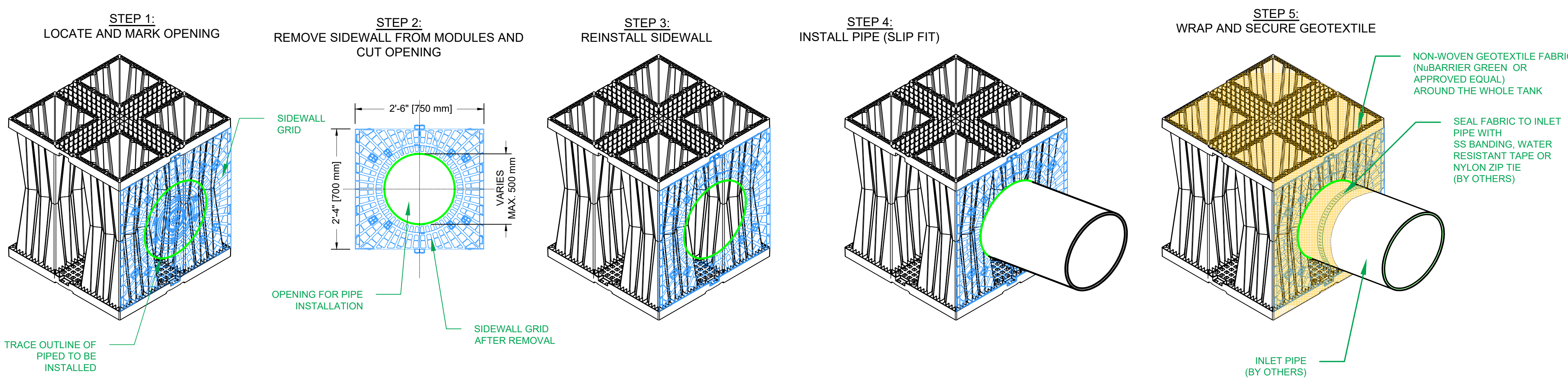
1 S-04 **AQUABOX OBSERVATION PORT**



2 S-04 **OBSERVATION PORT SURFACE GRATE**



3 S-04 **AQUABOX CATCHBASIN ABUTMENT (IF APPLICABLE)**



4 S-04 **PIPE CONNECTION DETAIL**

LAYFIELD
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Ph: (905) 761-9123
www.layfieldgroup.com

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Estimated GeoGrid		N/A m^2
Estimated Stone Volume		16 m^3
Excavation Required		40 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 2 MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

Page Name: TYP. Pipe Penetration Details

Drawn by: AW	Checked By: XX
Scale: NTS	Date: 23NOV2022

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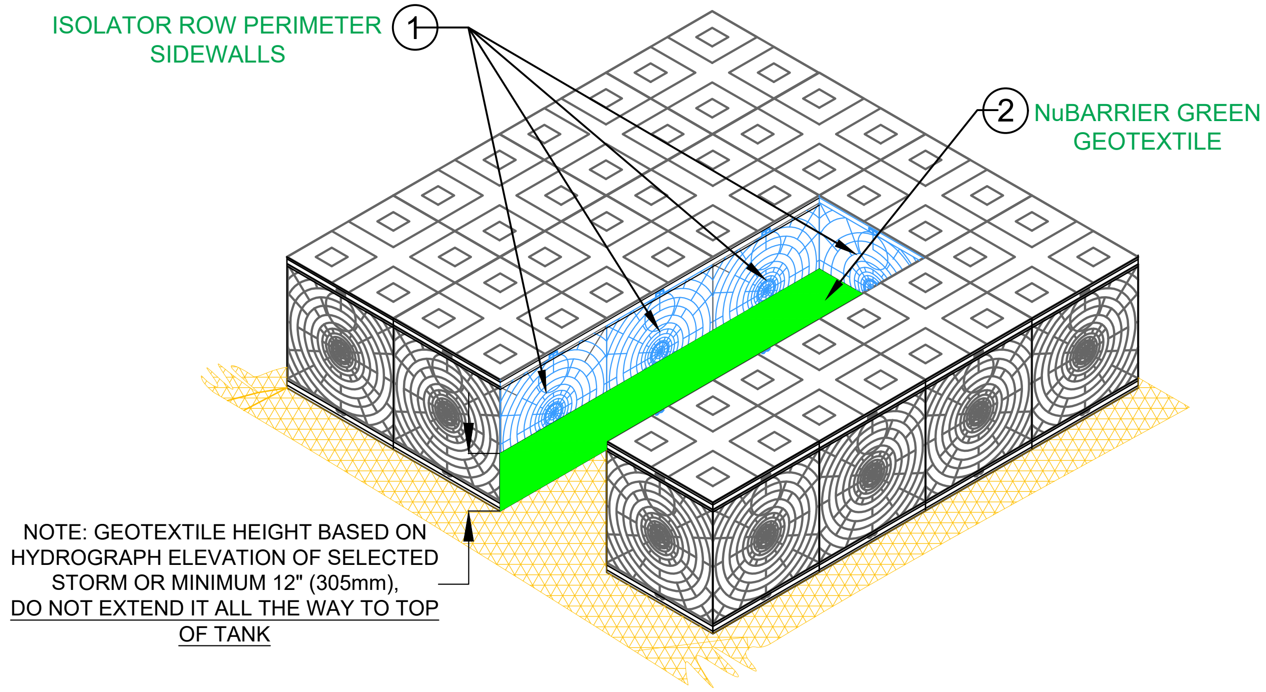
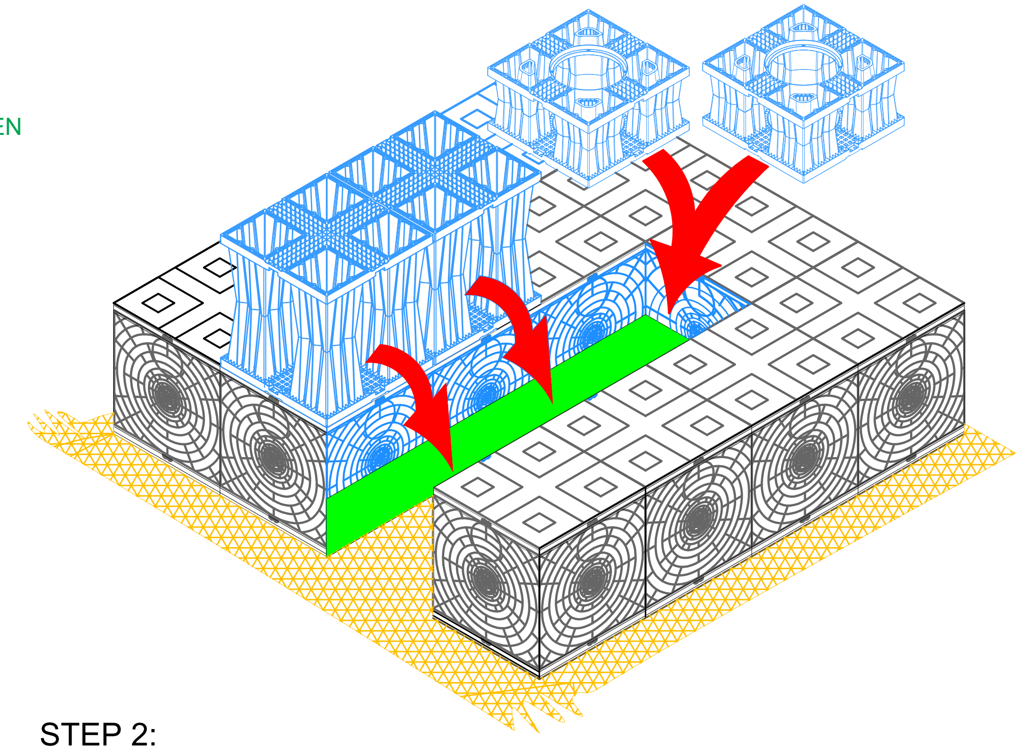
Sheet:

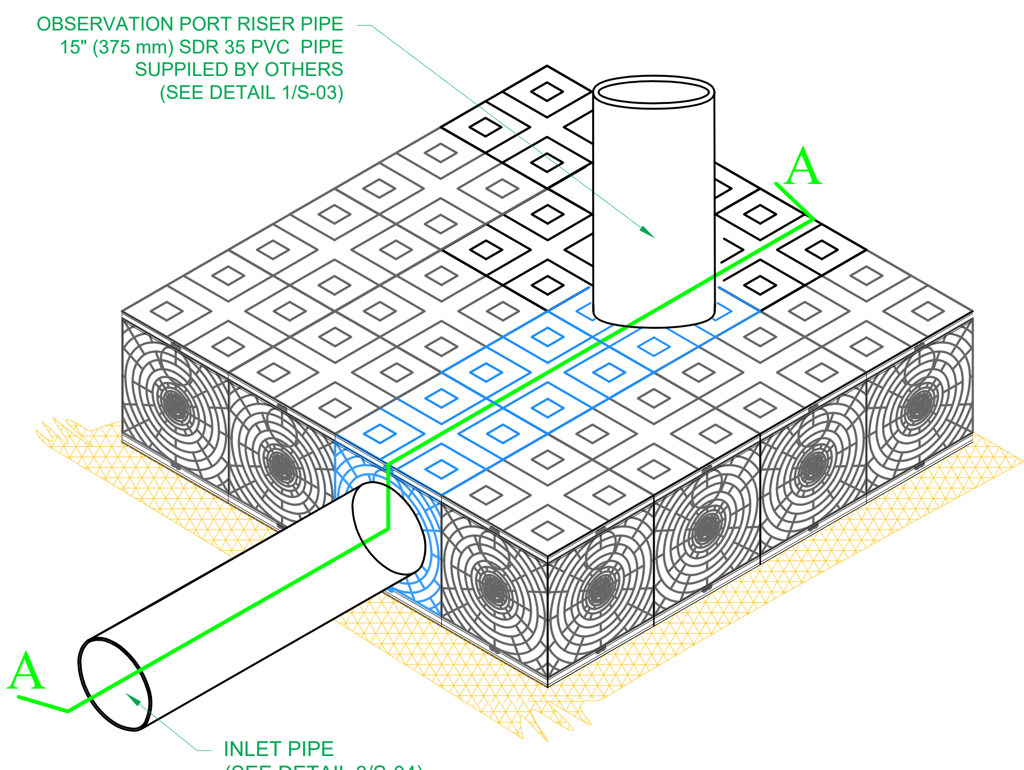
04 OF 07



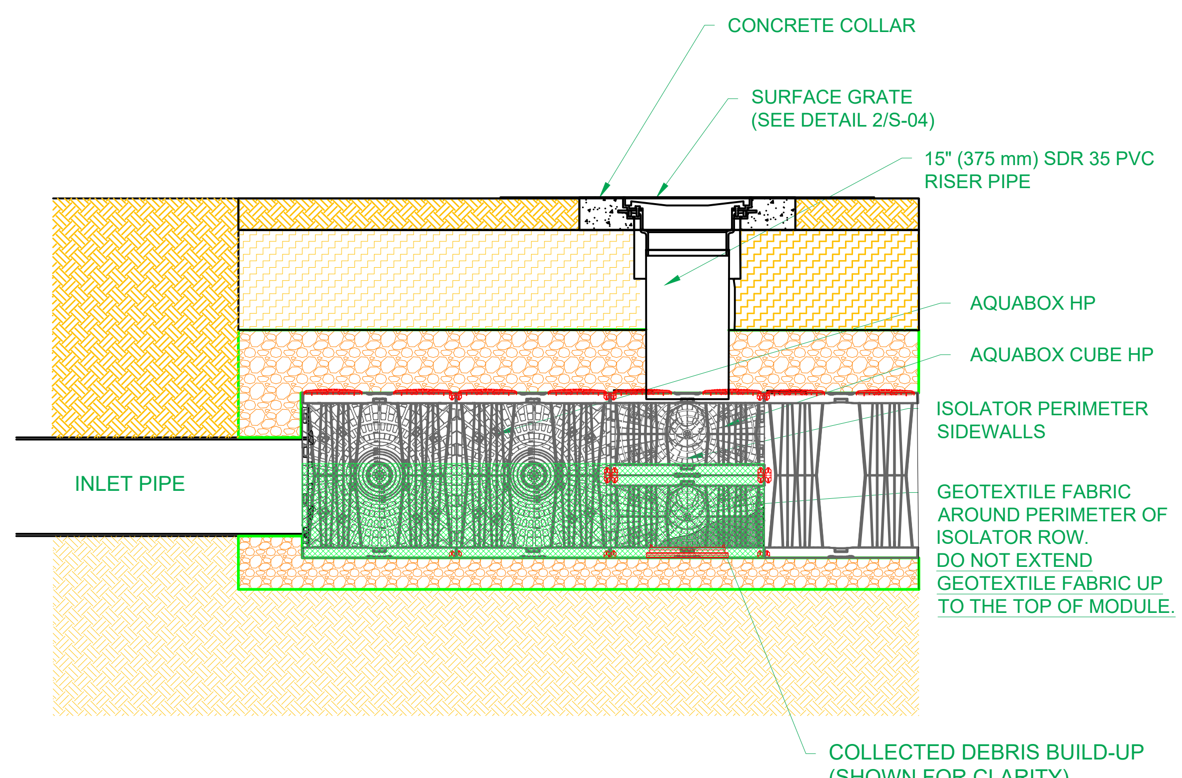
STEP 1:
INSTALL ISOLATER ROW PERIMETER SIDEWALLS AND ATTACH GEOTEXTITLE TO THEM.



STEP 2:
PLACE AQUABOX HP AND AQUABOX HP CUBE MODULES IN THE ISOLATER ROW AS PER MODULE LAYOUT 2/S-02



STEP 3:
INSTALL INLET PIPE AS PER DETAIL 4/S-04 AND CONNECTOR PIPE FOR OBSERVATION PORT AS PER DETAIL 1/S-04



SECTION A-A

1
S-05
ISOLATOR ROW INSTALLATION DETAIL

LAYFIELD
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www.layfieldgroup.com

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1485 WILLIAMSPORT DRIVE TANK 2
MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

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Drawn by: AW | Checked By: XX

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Sheet:
05 OF 07

General Conditions

- Review installation procedures and coordinate the installation with other construction activities, such as grading, excavation, utilities, construction access, erosion control, etc.
- Engineered Contract Drawings supersede all provided documentation, as the information furnished in this document is based on a typical installation.
- Coordinate the installation with the manufacturer's representative/distributor to be on-site to review start-up procedures and installation instructions.
- Components shall be unloaded, handled and stored in an area protected from traffic and in a manner to prevent damage.
- Assembled modules may be walked on, but vehicular traffic is prohibited until backfilled per the Manufacturer's requirements. Protect the installation against damage with highly visible construction tape, fencing, or other means until construction is complete.
- Ensure all construction occurs in accordance with Federal, Provincial and Local Laws, Ordinances, Regulations, and Safety Requirements.
- Extra care and caution should be taken when temperatures are at or below -5.0° C.

NOT FOR CONSTRUCTION

These drawings shall not be used for construction until they have been reviewed for all design aspects (structural, geotechnical, stormwater) and approved by the Engineer of Record for the Project.

It is the Buyer's responsibility to ensure that the design into which the Product will be used has been approved by the Engineer of Record (not Layfield) with a review that may include, but not be limited to, Inlet and outlet configurations including inverts and pipe connections, storage volume, system footprint, Aquabox elevations including cover soil requirements, and proximity to structures and slopes.

Site design/engineering elements may include but not be limited to the following:

- Review elevations and if necessary adjust grading to ensure the chamber cover requirements are met.
- Evaluating site-specific information on soil conditions and/or bearing capacity.
- Assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and the depth of foundation stone with consideration for the range of expected soil moisture conditions.

1.0 Basin Excavation

1. Stake out and excavate to elevations per approved plans. Excavation Requirements:
   a. Sub-grade excavation must be a minimum of 4" (102 mm) below the designed AquaBox Module invert.
   b. The excavation should extend a minimum of 12" (305 mm) beyond the AquaBox dimensions in each length and width (an additional 24" [610 mm] in total length and total width) to allow for adequate placement of side backfill material.
   c. Remove objectionable material encountered within the excavation, including protruding material from the walls.
   d. Furnish, install, monitor, and maintain excavation support (e.g., shoring, bracing, trench boxes, etc.) as required by Federal, Provincial and Local Laws, Ordinances, Regulations, and Safety Requirements.

2.0 Sub-Grade Requirements

1. Sub-grade shall be unfrozen, level (plus or minus 1%), and free of lumps, or debris with no standing water, mud or muck. Do not use materials nor mix with materials that are frozen and/or coated with ice or frost.
2. Unstable, unsuitable, and/or compromised areas should be brought to the Engineer's attention and mitigating efforts determined prior to compacting the sub-grade.
3. Sub-grade must be compacted to 97% Standard Proctor Density or as approved by the Engineer of Record. If code requirements restrict subgrade compaction, it is the requirement of the geotechnical engineer to verify that the bearing capacity and settlement criteria for support of the system are met.

* The Engineer of Record shall confirm minimum soil bearing capacity required based on Load Rating and top cover depth. Minimum soil bearing capacity is required so that settlements are less than 1" through the entire sub-grade and do not exceed long-term 1/2" differential settlement between any two adjacent units within the system. Sub-grade must be designed to ensure soil bearing capacity is maintained throughout all soil saturation levels.

3.0 Leveling Bed Installation

1. Install geotextile fabric and/or liner material, as specified.
   a. Geotextile fabric shall be placed per the manufacturer's recommendations.
   b. Additional material to be utilized for wrapping above the system must be protected from damage until use.
2. After the geotextile is secured, place a minimum 4" (102 mm) Leveling Bed.
   a. Material should be a 3/4" (19 mm) angular stone meeting AASTHO #56, 57, 67, 68 Material specifications.
   b. Material should be raked free of voids, lumps, debris, sharp objects, and plate vibrated to a level with a maximum 1% slope.
3. Correct any unsatisfactory conditions.

4.0 AquaBox Module Assembly and Placement

1.0 AquaBox Assembly

AquaBox modules are delivered to the site as palletized components requiring simple assembly. No special equipment, tools or bonding agents are required; only a rubber mallet. The modules can be pre-assembled either inside or outside the trench. The pre-assembled modules must then be organized according to the design specifications.

ASSEMBLY INSTRUCTIONS:

1. Each AquaBox features plug and socket connections which makes assembling the modules quick and easy. Simply lay one element on the ground and join it to another by applying some pressure on the top.

GENERAL NOTES:

- Remove packaging material and check for any damage. Report any damaged components to an AquaBox Distributor or Layfield personnel.
- AquaBox components are backed by a 50 year warranty when installed per the manufacturer's recommendations.

2.0 AquaBox Placement

1. Install geotextile fabric and/or liner material, as specified.
   a. Geotextile fabric shall be placed per the manufacturer's recommendations.
   b. Additional material to be utilized for wrapping above the system must be protected from damage until use.
2. Mark the footprint of the modules for placement.
   a. Ensure module perimeter outline is square or similar prior to Module placement.
   b. Care should be taken to note any connections, ports or other irregular units to be placed.
3. Install the individual modules by hand, as detailed below.
   a. The modules should be installed as shown in the AquaBox submittal drawings. Place AquaBox Cubes at the location of observation ports.
   b. Modules are connected horizontally to adjacent modules with Single or Double Joints.
   c. Use Single Joints for Bottom and Top rows while Double Joints are used for middle rows in Double or Triple stacking configuration.
   d. For double/ triple stack configurations:
      i. Use the Single Joints for the first bottom row.
      ii. Install Double Joints on all the middle rows.
      iii. Place the upper module directly on top of the bottom module in the same direction.

LAYFIELD
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Stone Storage Volume		6.12 m^3
System Footprint		26 m^2
Estimated Geotextile Fabric	NuBarrier	340 m^2
Estimated Geotextile Fabric	LP8	N/A m^2
Estimated Liner		N/A m^2
Estimated GeoGrid		N/A m^2
Estimated Stone Volume		16 m^3
Excavation Required		40 m^3
Excavation Depth		1.5 m
Stone Type		19mm Clear Stone
Stone Void Space		40%
Number of Layers		1
Allowable Loading		HS25
Surface	Paved Surface	Vegetated/ Unpaved
Minimum Top Cover	0.6 m	0.8 m
Maximum Tank Depth	2.7 m	2.6 m

1485 WILLIAMSPORT DRIVE TANK 2
MISSISSAUGA, ON

REV	Record of Changes	Date	By
△	Preliminary Drawing	23NOV2022	AW

Project Number: OP2022-00005109

Page Name: Supplementary Notes

Drawn by: AW | Checked By: XX

Scale: NTS | Date: 23NOV2022

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4. Install the modules to completion, taking care to avoid damage to the geotextile and/or liner material.
5. Once all the modules have been placed, Install SIDEWALLS on the perimeter and CAPS on the top.
6. Locate any ports or other penetration of the AquaBox.
   a. Install ports/penetrations in accordance with the approved submittals, contract documents, and manufacturer's recommendations.
6. Upon completion of module installation, wrap the modules in geotextile fabric and/or liner.
   a. Geotextile fabric shall be wrapped and secured per the manufacturer's recommendations.
   b. Seal any ports/penetrations per the Manufacturer's requirements

Notes:

- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations

6.0 Side Backfill

1. Inspect all geotextiles, ensuring that no voids or damage exists; which will allow sediment into the AquaBox system.
2. Adjust the stone/soil interface geotextile along the side of the native soil to ensure the geotextile is taught to the native soil.
3. Once the geotextile is secured, begin to place the Side Backfill.
   a. Material should be a 3/4" (19 mm) angular stone meeting AASTHO #56, 57, 67, 68 Material specifications.
   b. Backfill sides "evenly" around the perimeter without exceeding single 12" (305 mm) lifts.
   c. Place material utilizing an excavator, dozer, or conveyor boom.
   d. Utilize a plate vibrator to settle the stone and provide uniform distribution.

Notes:

- Do not apply vehicular load to the modules during placement of side backfill. All material placement should occur with equipment located on the native soil surrounding the system.
- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations

7.0 Top Backfill (Stone)

1. Begin to place the Top Backfill.
   a. Material should be a 3/4" (19 mm) angular stone meeting AASTHO #56, 57, 67, 68 Material specifications.
   b. Place material utilizing an excavator, dozer, or conveyor boom and use a walk-behind plate vibrator to settle the stone and provide even distribution.

DO NOT DRIVE ON THE MODULES WITHOUT REQUIRED MINIMUM COVER.

2. Upon completion of Top Backfilling, wrap the system in geotextile fabric and/or liner per the manufacturer's recommendations.
3. Install metallic tape around the perimeter of the system to mark the area for future utility detection.

Notes:

- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations.
- Only Low Ground Pressure tracked equipment can be used during construction with at least 300 mm suitably compacted covering created over the AquaBox System. Abrupt maneuvers such as steering should be avoided at this stage.
- The passage of heavy goods vehicles with a wheel load of more than 50 kN over the basin is possible if the thickness of the covering is adequately compacted and not less than 600 mm. When dumping the backfill material, the load per wheel shall not exceed 50 kN.

8.0 Suitable Compactable Fill

Following Top Backfill placement and geotextile fabric wrapping; complete the installation as noted below.

Vegetated Area

1. Place fill onto the geotextile.
   a. Maximum 12" (305 mm) lifts, compacted with a vibratory plate or walk behind roller to a minimum of 90% Standard Proctor Density.
   b. The minimum top cover to finished grade should not be less than ----" (0.8 m) and the maximum depth from final grade to the bottom of the lowest module should not exceed ----' (2.6 m).
2. Finish to the surface and complete with vegetative cover.

Impervious Area

1. Place fill onto the geotextile.
   a. Maximum 12" (305 mm) lifts, compacted with a vibratory plate or walk behind roller to a minimum of 90% Standard Proctor Density.
   b. The minimum top cover to finished grade should not be less than 24" (0.6 m) and the maximum depth from final grade to the bottom of the lowest module should not exceed ----' (2.7 m).
2. Finish to the surface and complete with asphalt, concrete, etc.

Notes:

- A vibratory roller may only be utilized after a minimum cover has been placed or for the installation of the asphalt wearing course.
- If damage occurs to the geotextile fabric, repair the material in accordance with the geotextile Manufacturer's recommendations.
- For most recent installation guidelines visit: https://www.geoplastglobal.com/en/downloads/aquabox

9.0 Inspection and Maintenance

If the following inspections and maintenance procedures are not followed as specified below then the end-user is responsible for the performance of the modules. This maintenance procedure must be performed after termination of site operations, heavy rainfall, flooding, or any incident that will vary the flow of water drastically.

Inspection

1. Inspect all observation ports, inflow, and outflow connection and the discharge area
2. Identify and log any sediment and debris accumulation, system backup, or discharge rate changes.
3. If there is a sufficient need for a cleanout, contact a local cleaning company for assistance.

Cleaning:

1. If a pre-treatment device is installed, follow manufacturer recommendations.
2. Using a vacuum pump truck, evacuate debris from the inflow and outflow points.
3. Flush the system with clean water, forcing debris from the system.
4. Repeat steps 2 and 3 until no debris is evident

Notes:

- For spray probe cleaning, the use of a 90° rotating nozzle with a 45° water jet is recommended. The nozzles used should have a pressure of 80 to 120 bar; higher pressures may damage the geotextile.

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Drawn by: AW | Checked By: XX

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Appendix B

Sanitary Demand Calculations

LEA Consulting Ltd. Consulting Engineers and Planners	Sanitary Flow Rate Calculation			
	Prepared:	G.B.	Page No.	B-01
	Checked:	F.F.		
Project: 1485 Williamsport Drive & 3480 Havenwood Drive	Proj. #	18298		
	Date:	May.14-24		

PROPOSED BUILDING & AMENITY BLOCK

POPULATION CALCULATION

(Based on Architect Statistics dated April 11, 2024)

Site Area	22204	m^2
Proposed Total Residential GFA of Proposed Building	7742	m^2
Proposed GFA of Basement and Ground Floor (Non-Residential)	521.5	m^2
Total Unit Count	154	Units

Proposed Building Type	Units	**Density** (P.P.U)	**Population**
Small Apt ≤1 BR	116	1.7	197
Large Apt >1 BR	38	3.1	118
Total	**154**		**315**

SANITARY FLOW CALCULATION

Harmon Peaking Factor: $M=1+14/(4+P^{0.5})$

Peaking Factor	4.07	
Average Daily Wastewater Flow	290	L/cap/day
Total Actual Domestic Flow	4.30	L/sec
Total Domestic Flow (For less than 1000 person shall be 13.0 L/sec)	13.00	L/sec
Infiltration Allowance (@ 0.2 L/sec/ha)	0.44	L/sec
Actual Design Flow	**4.75**	L/sec
Full Flow Capacity of proposed 200mm @ 1.0% service connection	**32.80**	L/sec
Velocity of Full Flow	**1.04**	m/s
Q/Q_f	**14.5**	%

Population	Peak Flow (m^3/sec)	Population	Peak Flow (m^3/sec)	Population	Peak Flow (m^3/sec)
1000	0.0130	4750	0.0542	13000	0.1292
1050	0.0139	5000	0.0569	14000	0.1376
1100	0.0145	5250	0.0594	15000	0.1459
1150	0.0151	5500	0.0618	16000	0.1540
1200	0.0157	5750	0.0640	17000	0.1620
1300	0.0169	6000	0.0666	18000	0.1700
1400	0.0181	6250	0.0691	19000	0.1779
1500	0.0193	6500	0.0710	20000	0.1857
1600	0.0204	6750	0.0737	25000	0.2236
1700	0.0217	7000	0.0762	30000	0.2601
1800	0.0228	7250	0.0784	35000	0.2955
1900	0.0239	7500	0.0809	40000	0.3298
2000	0.0251	7750	0.0830	45000	0.3634
2200	0.0273	8000	0.0854	50000	0.3963
2400	0.0296	8250	0.0878	55000	0.4286
2600	0.0318	8500	0.0898	60000	0.4603
2800	0.0340	8750	0.0922	65000	0.4915
3000	0.0361	9000	0.0945	70000	0.5224
3250	0.0387	9250	0.0968	75000	0.5528
3500	0.0415	9500	0.0981	80000	0.5828
3750	0.0441	9750	0.1010	85000	0.6126
4000	0.0467	10000	0.1033	90000	0.6420
4250	0.0492	11000	0.1120	95000	0.6711
4500	0.0518	12000	0.1210	100000	0.7000

Notes:
1. Domestic sewage flows are based upon a unit sewage flow of 302.8 Lpcd.
2. The flows in the above table include the Harmon Peaking Factor.
3. Domestic sewage flow for less than 1000 persons shall be $0.013 m^3$/sec.
4. Domestic sewage flow for greater than 100,000 persons shall be 7.0×10^{-6} m^3/sec per capita.
5. Lpcd = Litres per capita per day   1 Litre = 0.001 $metre^3$

Region of Peel
Working for you

Date: June 2005   Rev: 1

Approved:

SEWAGE FLOWS
(EXCLUDING INFILTRATION)

STD. DWG. ~~2-5-2~~ 2-9-2

Appendix C

Water Demand Calculations & Supporting Documentation

LEA Consulting Ltd. Consulting Engineers and Planners	**Water Demand Calculation**			
	Prepared:	G.B.	Page No.	C-01
	Checked:	F.F.		
Project: 1485 Williamsport Drive (Proposed Building)	Proj. #	18298		
	Date:	14-May-24		

Proposed Building		**Density**	**Population**
Type	Units	(P.P.U)	
Small Apt ≤1 BR	116	1.7	197
Large Apt >1 BR	38	3.1	118

Total Population in Proposed Building: **315**

Peak Hour Demand Calculation:

Residential Per Capita Demand	280	L/cap/day
Peaking Factor	3	
Peak Hour Demand	**3.06**	L/sec

Maximum Day Demand Calculation:

Residential Per Capita Demand	280	L/cap/day
Peaking Factor	2	
Maximum Day Demand	**2.04**	L/sec
Fire Flow for Residential:	133.33	L/sec
Max. Day Demand plus Fire Flow:	**135.38**	L/sec
Design Water Demand	**135.38**	L/sec
or	**2145.69**	**US GPM**

LEA Consulting Ltd. Consulting Engineers and Planners	Water Demand Calculation			
	Prepared:	G.B.	Page No.	C-02
	Checked:	F.F.		
Project: 1485 Williamsport Drive (Proposed Building)	Proj. #	18298		
	Date:	14-May-24		

This calculation is following the "Water Supply for Public Fire Protection" by Fire Underwriters Survey 2020.

Formula: $F = 220C\sqrt{A}$

where

F = the required fire flow in litres per minute

C = coefficient related to the type of construction.

= 0.8 for non-combustible construction

(Assuming Protected Verical Openings)

A = the total effective floor area in square metres. For fire resistive buildings, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors.

According the building stats,

		Area (m2)
Basement	adjoining	1279.4
Ground	largest	1279.4
2nd	adjoining	1138.3
A		1884

Therefore, F = 8000 **l/min**

Occupancy reduction:

For limited combustible occupancy, the reduction rate is 15%,

Therefore: F = 6800 l/min

Reduction for sprinkler protection:

Using the NFPA sprinkler system, a reduction rate of 30% is used.

Therefore: F = 4760 l/min

Separation charge:

Charge for the separations on each side:

Separation	Charge	
10.1 to 20 m	15%	North
3.1 to 10 m	20%	South
Over 45 m	0%	East
20.1 to 30 m	10%	West

Total charge in % 45%

Total charge in l/min 3060

Required Fire Flow:		8000	l/min
	or	133.33	l/s
	or	2113	US GPM

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Tuesday, December 06, 2022

LEA Consulting Ltd.
625 Cochrane Drive, 5th Floor
Markham, Ontario
L3R 9R9

Attention: Faizan Dhalla

Dear Mr Dhalla:

RE: 21-15 – Pacific Way

1485 Williamsport Drive & 3480 Havenwood Drive

Please be advised of the following:

- The proposed building will be of non-combustible construction.
- All structural elements will have a fire resistance rating of 1 hour.
- All vertical openings will be protected in accordance with the requirements of the Ontario Building Code.
- The proposed underground garage and 6 storey building will have full coverage of automatic fire sprinklers to meet NFPA 13.

Sincerely,

Mark Zwicker B.E.S., B. Arch., OAA, LEED AP

Appendix D

Hydrant Flow Test data

And

Watermain Adequacy Assessment Data

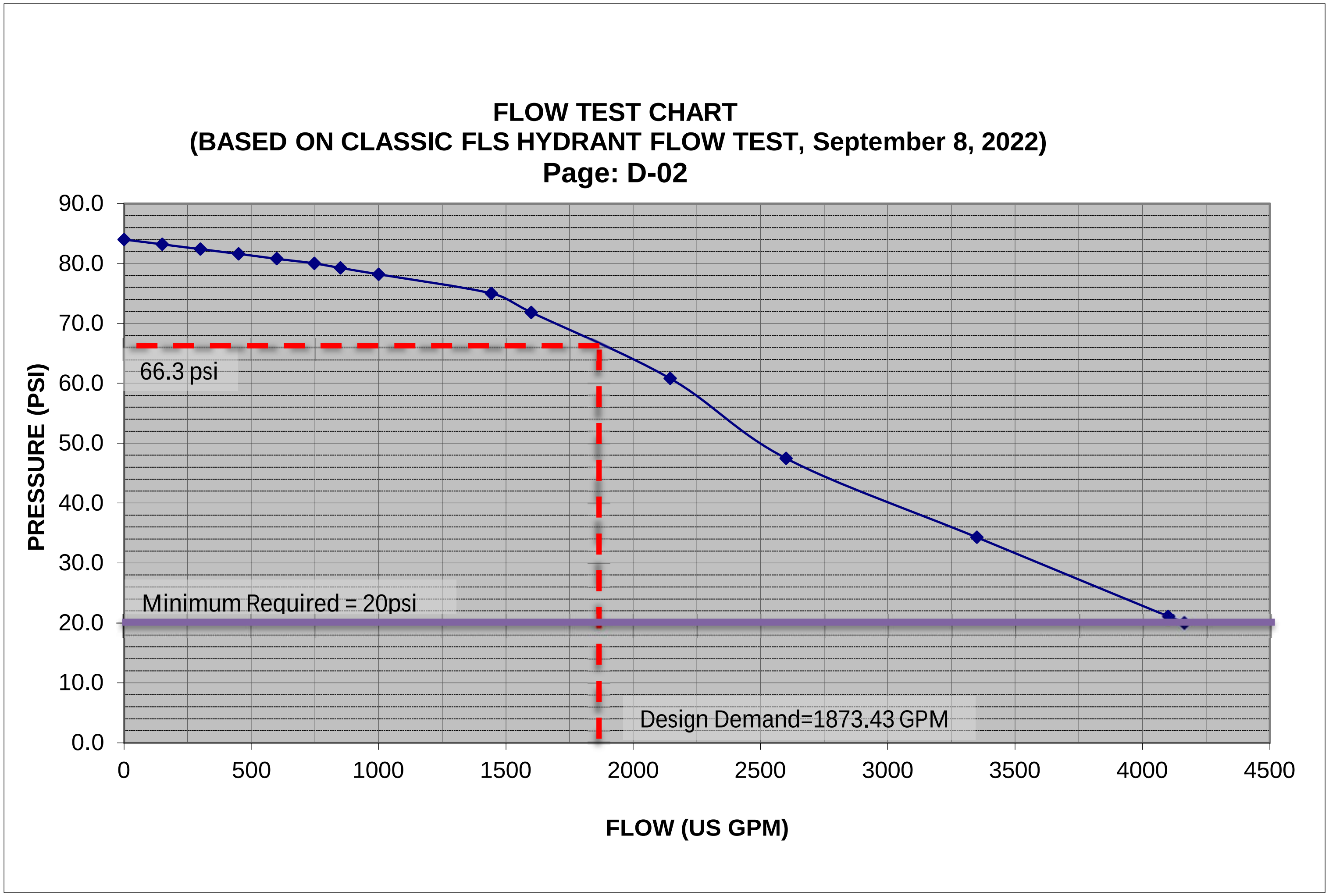
	LEA Consulting Ltd. Consulting Engineers and Planners	Watermain Adequacy & Residual Pressure Calculations			
		Prepared:	F.D.	Page No.	D-01
		Checked:	F.F.		
Project: 1485 Williamsport Drive (Proposed Building)		Proj. #	18298		
		Date:	14-May-24		

Hydrant Test Readings (12" PVC Watermain, 1485 Williamsport Drive)
Undertaken on September 8, 2022 by Classic FLS

Flow		Residual Pressure	
0	US GPM	84	psi
748	US GPM	80	psi
1443	US GPM	75	psi
4162.1	US GPM	20	psi

Interpolated

	Flow (US GPM)	Residual Pressure (psi)	
Recorded	**0**	**84.0**	
	150	83.2	
	300	82.4	
	450	81.6	
	600	80.8	
Recorded	**748**	**80.0**	
	850	79.3	
	1000	78.2	
Recorded	**1443**	**75.0**	
	1600	71.8	
Calculated Design Water Demand	**2145.7**	**60.8**	> Min. of 20PSI
	2600	47.5	
	3350	34.3	
	4100	21.1	
Provided by Classic FLS	**4162.1**	**20.0**	


FLOW TEST CHART
(BASED ON CLASSIC FLS HYDRANT FLOW TEST, September 8, 2022)
Page: D-02
PRESSURE (PSI)
FLOW (US GPM)
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
66.3 psi
Minimum Required = 20psi
Design Demand=1873.43 GPM

FLOW TEST REPORT

Form SD-003B RevDate: Nov 29, 2021

PROJECT INFORMATION			
Project Name:	1485 Williamsport Drive Flow Test	Const. Project #:	
Site Address:	1485 Williamsport Drive Mississauga ON	Design Project #:	2022-CFLS-553
City Contact:	Region of Peel	Phone #:	905-791-7800x183
CFLS Contact:		Phone #:	
Technical Contact:	**Andy Coghlin**	Phone #:	**519-476-0761**

SITE INFORMATION

SITE MAP

Note: If the main is a dead end, the flowing hydrant shall be closest to the dead end

ITEMS TO LABEL ON MAP	HYDRANTS USED	MAIN SIZE
☑ Static / Residual & Flow Hydrants	☑ City Hydrant(s)	City: 12" PVC
☐ Flow Direction (if the main is dead end)	☐ Site Hydrant(s)	Site:

SITE NOTES

CLASSIC FIRE + LIFE SAFETY

FLOW TEST REPORT

Form SD-003B RevDate: Nov 29, 2021

TEST INFORMATION

Minimum Required Flow:	NA	Min Ports:	2
CFLS Personnel Present:	Nathan F. & Robert. S.	Test Date:	SEPT.08.2022
City / External Company:	Region of Peel	Test Time:	13:00

TEST EQUIPMENT

☑ Hose Monsters with built in Pitot	Hose length used: 5ft.
☐ Hand held pitot gauge	☐ Pollard diffuser elbow with built in Pitot
☐ Other:	

TEST RESULTS

Number of Ports	Outlet Size (IN)	Discharge Coefficient	Pitot Reading (PSI)				Total Flow (GPM)	Static / Residual Pressure (PSI)
0 Ports	STATIC							84
1 Port	1.75	1.15	51				748	80
2 Ports	1.75	1.15	47	48			1443	75
3 Ports	2.5	0.9					0	
4 Ports	2.5	0.9					0	
0 Ports	STATIC RE-CHECK							

TEST NOTES

HYDRAULIC ADJUSTMENTS (FOR OFFICE USE ONLY)

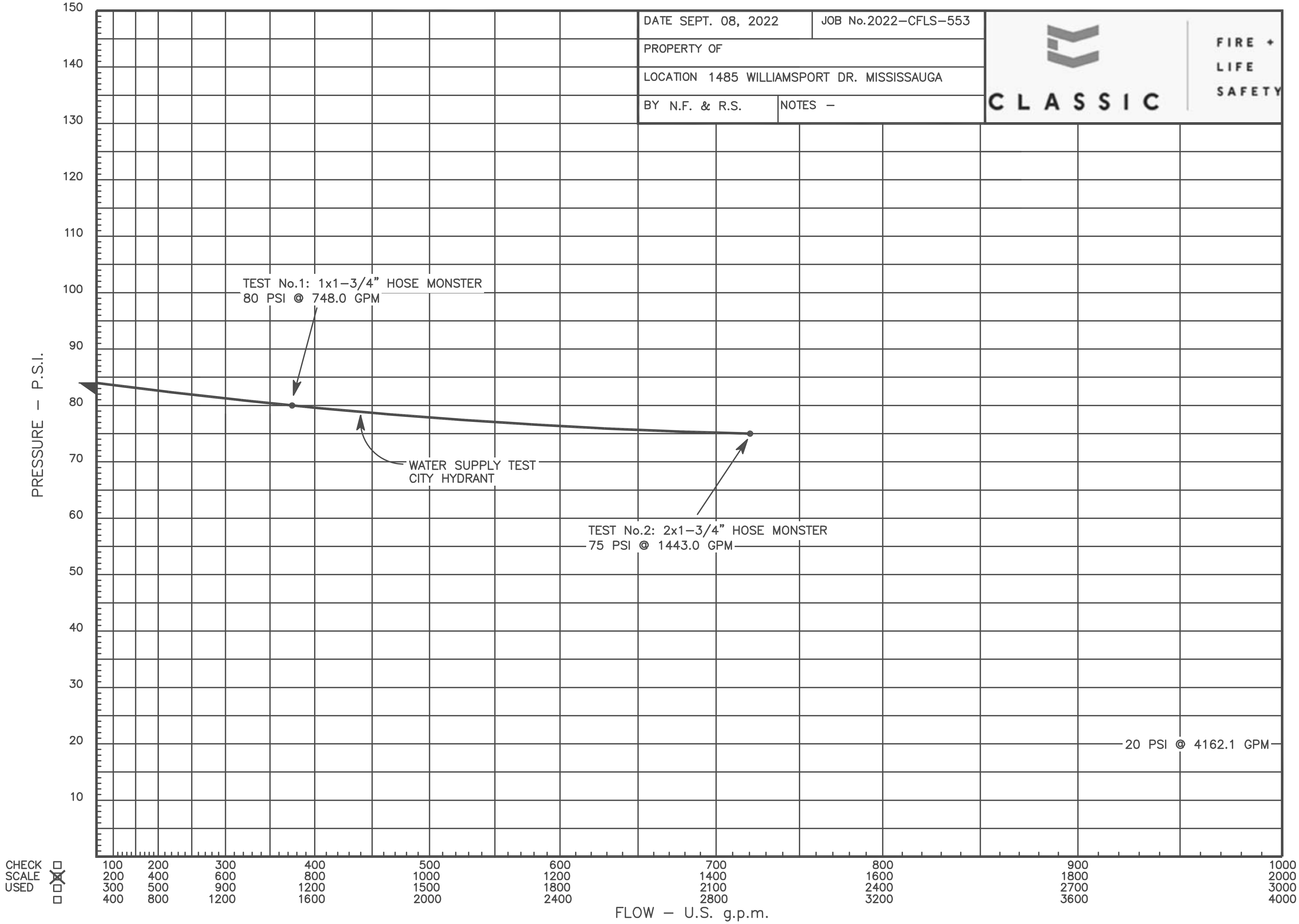
ADJUSTMENTS FOR HYDRAULIC GRADE LINE (HGL)

Reservoir HGL (m):		Site Elevation (m):	
Theoretical Static Head (PSI):	0	PSI to subtract from test pressures:	84

OTHER HYDRAULIC ADJUSTMENTS

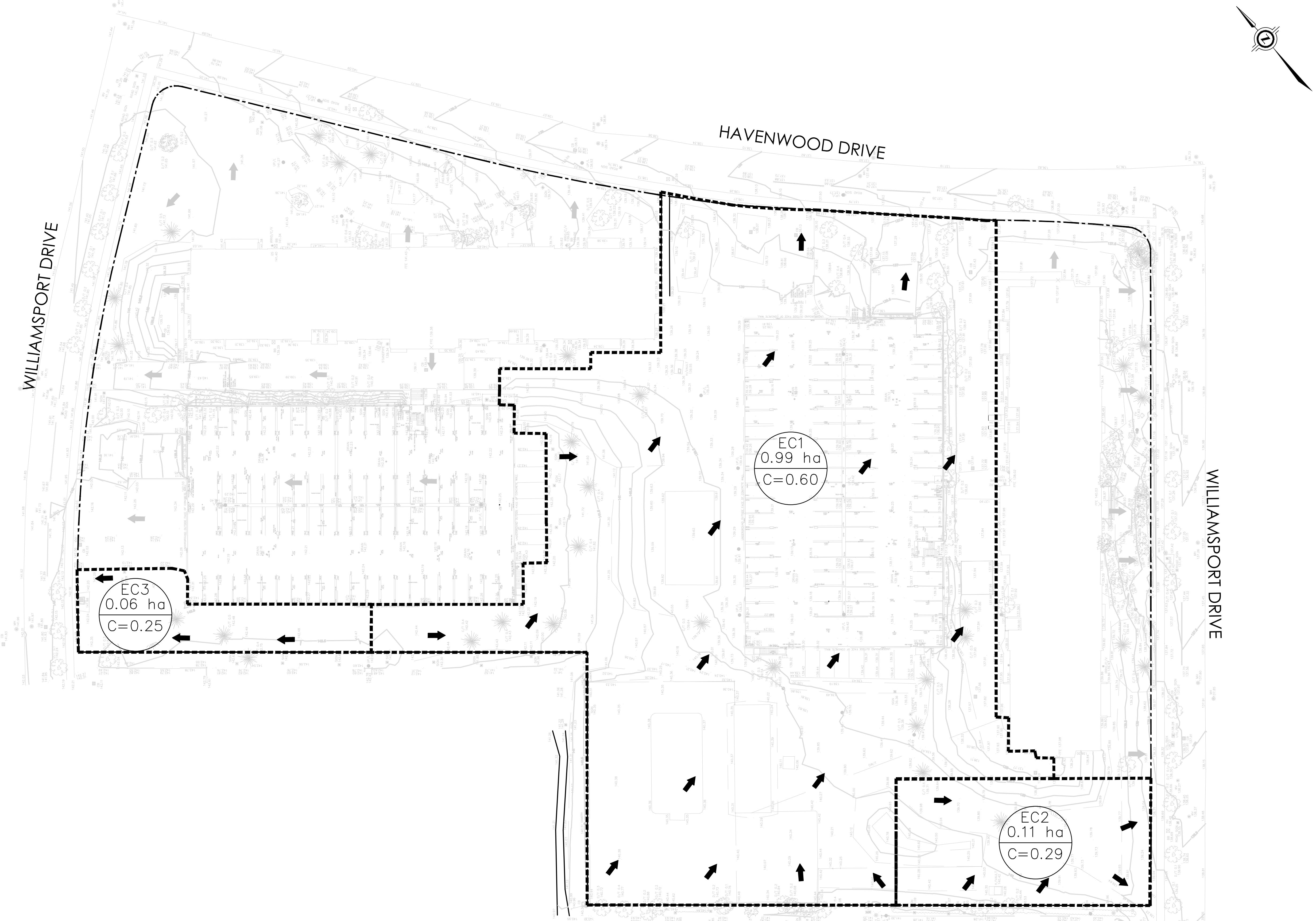
Other adjustment as required by the City / AHJ:	

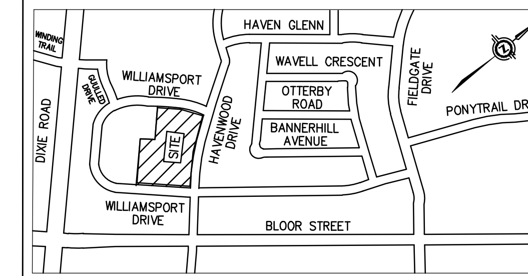
WATER SUPPLY GRAPH



Appendix E

Civil Figures and Drawings





LEGEND

MH	EXISTING MANHOLE
CB	EXISTING CATCHBASIN
	EXISTING BELL BOX
MH (TEL)	EXISTING TELEPHONE MANHOLE
WV	EXISTING WATER VALVE
	EXISTING DECIDUOUS TREE 0.10m dia.
	EXISTING CONIFEROUS TREE 0.10m dia.
FH	EXISTING FIRE HYDRANT
	PROPERTY LINE
	DRAINAGE AREA BOUNDARY
	EXISTING OVERLAND FLOW DIRECTION
	EXISTING EXTERNAL OVERLAND FLOW DIRECTION
2.22 ha C=0.62	DRAINAGE AREA RUNOFF COEFFICIENT

BENCHMARK:
ELEVATIONS ARE REFERRED TO THE CITY OF MISSISSAUGA BENCHMARK NO. 688, HAVING A PUBLISHED ELEVATION OF 143.902 AS PER MISSISSAUGA DATUM, REGISTERED PLAN 733.
CONTOUR INTERVAL 0.50m

MISSISSAUGA

CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

No.	DATE	DESCRIPTION
1	JUNE 01, 2018	ISSUED FOR FIRST ZBA SUBMISSION
2	DEC 2, 2022	ISSUED FOR OPA/ZBA RESUBMISSION
3	NOV 9, 2023	ISSUED FOR OPA/ZBA RESUBMISSION
4	MAY 23, 2024	ISSUED FOR OPA/ZBA RESUBMISSION

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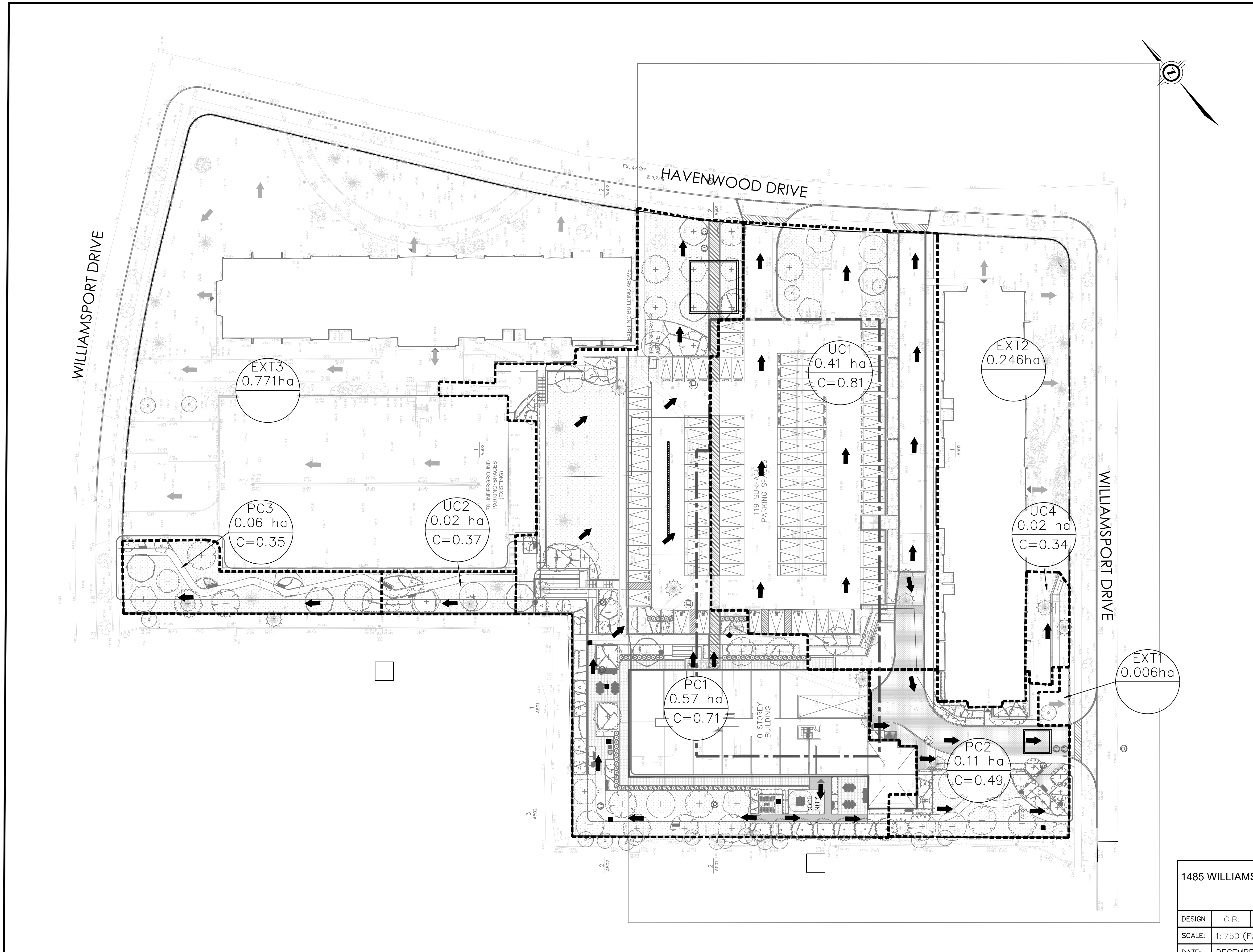
LICENSED PROFESSIONAL ENGINEER
G. SIVAKUMAR
100546565
23/05/2024
PROVINCE OF ONTARIO

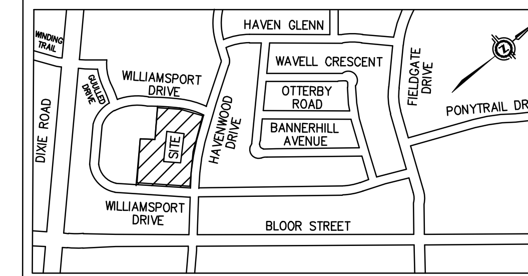
1485 WILLIAMSPORT DR & 3480 HAVENWOOD DR DEVELOPMENT

EXISTING DRAINAGE AREA PLAN

DESIGN	G.B.	DRAWN	G.B.	CHECKED	F.F.	CONTRACT No.	18298
SCALE:	1: 750 (FULL SIZE)			DRAWING NUMBER	FIG-01		
DATE:	DECEMBER 2, 2022						

DRAWING NAME: F:\18298 - 1485 William Spt Dr\Drafting\Contract Drawings\FIG01 - Existing Drainage Area.dwg May 23, 2024-3:04pm





LEGEND

PROPOSED TREE

PROPOSED TREE

PROPOSED TREE

PROPERTY LINE

PROPOSED DRAINAGE AREA BOUNDARY

PROPOSED OVERLAND FLOW DIRECTION

EXISTING DRAINAGE AREA BOUNDARY

EXISTING OVERLAND FLOW DIRECTION

x.xx ha / C=0.xx — DRAINAGE AREA RUNOFF COEFFICIENT

BENCHMARK:
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CONTOUR INTERVAL 0.50m

MISSISSAUGA

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PROVINCE OF ONTARIO

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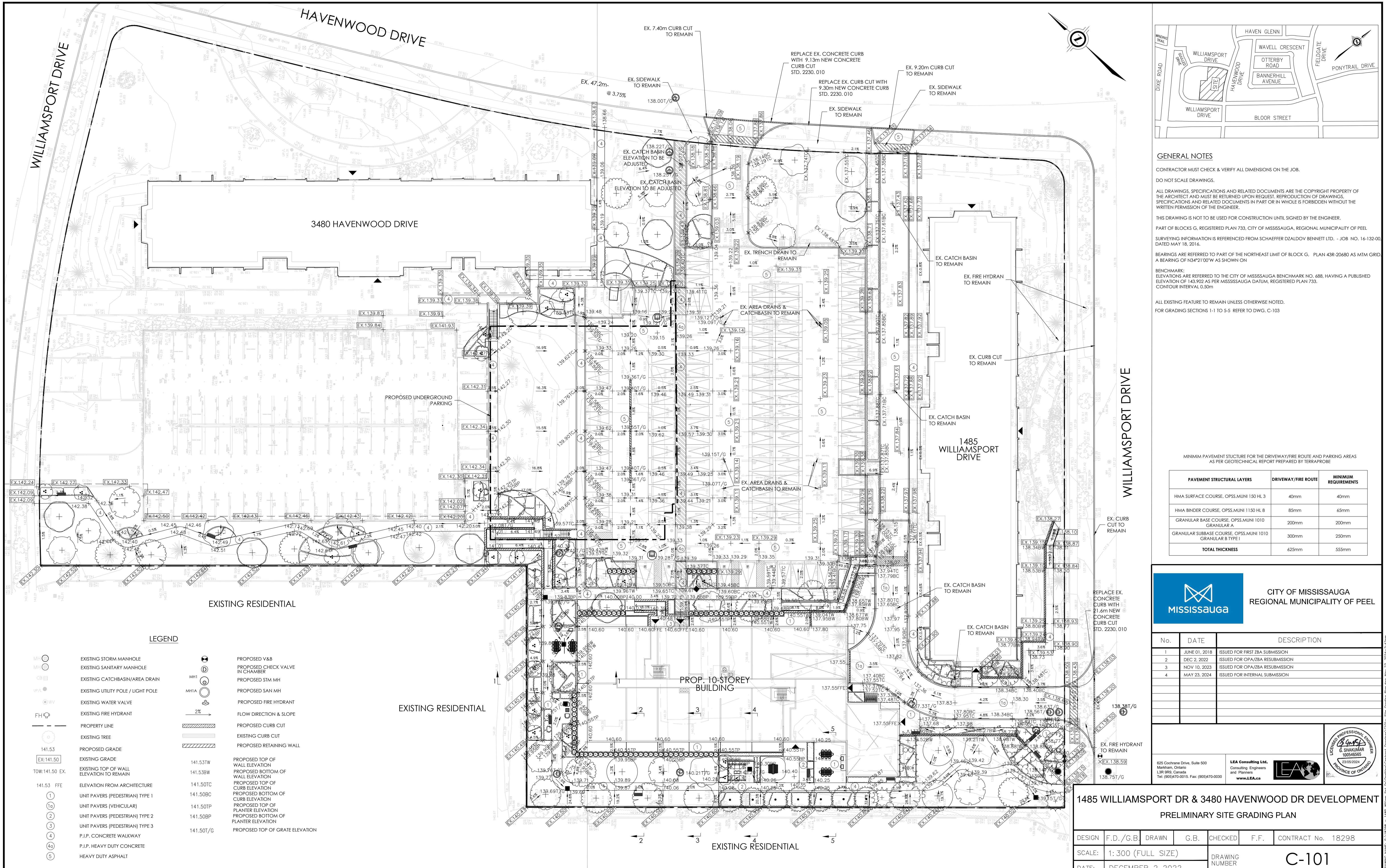
PROPOSED DRAINAGE AREA PLAN

DESIGN	G.B.	DRAWN	G.B.	CHECKED	F.F.	CONTRACT No.	18298
SCALE:	1:750 (FULL SIZE)			DRAWING NUMBER		FIG-02	
DATE:	DECEMBER 2 2022						



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SURVEYING INFORMATION IS REFERENCED FROM SCHAEFFER DZALDOV BENNETT LTD. - JOB NO. 16-132-00, DATED MAY 18, 2016.

BEARINGS ARE REFERRED TO PART OF THE NORTHEAST LIMIT OF BLOCK G, PLAN 43R-20680 AS MTM GRID. A BEARING OF N34°21'00"W AS SHOWN ON

BENCHMARK:
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CONTOUR INTERVAL 0.50m

ALL EXISTING FEATURE TO REMAIN UNLESS OTHERWISE NOTED.

FOR GRADING SECTIONS 1-1 TO 5-5 REFER TO DWG. C-103

MINIMIM PAVEMENT STUCTURE FOR THE DRIVEWAY/FIRE ROUTE AND PARKING AREAS AS PER GEOTECHNICAL REPORT PREPARED BY TERRAPROBE

PAVEMENT STRUCTURAL LAYERS	DRIVEWAY/FIRE ROUTE	MINIMUM REQUIREMENTS
HMA SURFACE COURSE, OPSS.MUNI 150 HL 3	40mm	40mm
HMA BINDER COURSE, OPSS.MUNI 1150 HL 8	85mm	65mm
GRANULAR BASE COURSE, OPSS.MUNI 1010 GRANULAR A	200mm	200mm
GRANULAR SUBBASE COURSE, OPSS.MUNI 1010 GRANULAR B TYPE I	300mm	250mm
TOTAL THICKNESS	625mm	555mm

CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

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3	NOV 10, 2023	ISSUED FOR OPA/ZBA RESUBMISSION
4	MAY 23, 2024	ISSUED FOR INTERNAL SUBMISSION

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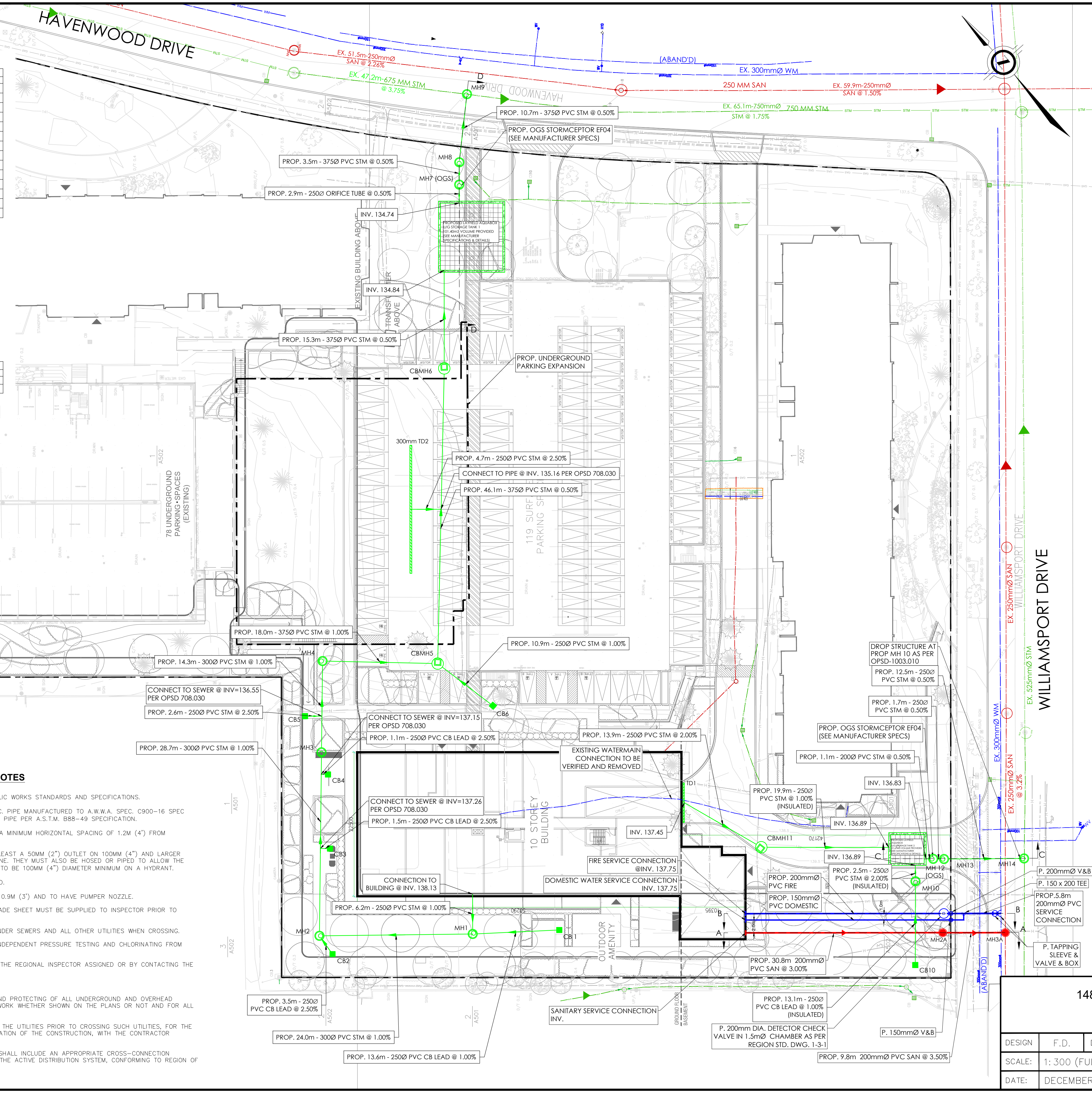
100546565
23/05/2024
PROVINCE OF ONTARIO

1485 WILLIAMSPORT DR & 3480 HAVENWOOD DR DEVELOPMENT

PRELIMINARY SITE GRADING PLAN

DESIGN	F.D./G.B.	DRAWN	G.B.	CHECKED	F.F.	CONTRACT No. 18298
SCALE:	1: 300 (FULL SIZE)	DRAWING NUMBER	C-101			
DATE:	DECEMBER 2 2022					

DRAWING NAME: F:\18298 – 1485 William Spt Dr\Drafting\Contract Drawings\C101– Site Grading Plan.dwg May 23, 2024–2:42pm



PROPOSED STORM SEWER MANHOLES

NO.	TOP. EL. (m)	INVERT (m)		STANDARD NUMBER	
		INV IN	INV OUT	FRAME/GRATE	STRUCTURE
MH1	140.45	138.07 SE 138.07 NE	138.00 NW	OPSD 401.010	OPSD 701.010
MH2	140.74	137.76 SE 137.85 S	137.35 NE	OPSD 401.010	OPSD 701.010
MH3	139.86	137.06 SW	136.56 NE	OPSD 401.010	OPSD 701.010
MH4	140.15	136.42 SW	135.92 SE	OPSD 401.010	OPSD 701.010
CBMH5	139.28	135.28 S 135.74 NW	135.16 NE	OPSD 401.010	OPSD 701.011
CBMH6	139.12	134.93 SW	134.91 NE	OPSD 401.010	OPSD 701.011
MH7 (OGS)	138.25	134.72 SW	134.62 NE	PER MANFUCATUER SPECS	
MH8	138.22	134.60 SW	134.58 NE	OPSD 401.010	OPSD 701.010
MH9	138.00	134.53 SW 134.48 NW	134.43 SE	OPSD 401.010	OPSD 701.010
MH10	139.15	137.58 SW	136.94 NE	OPSD 401.010	OPSD 701.010 OPSD 1003.010
CBMH11	138.73	137.17 N	137.09 SE	OPSD 400.010	OPSD 701.011
MH12 (OGS)	139.02	136.84 NW	136.81 SE	PER MANFUCATUER SPECS	
MH13	138.98	136.80 NW	136.77 SE	OPSD 400.010	OPSD 701.010
MH14	138.38	136.71 NW 135.26 SW	135.23 NE	OPSD 400.010	OPSD 701.010 OPSD 1003.010

PROPOSED STORM SEWER CATCHBASINS

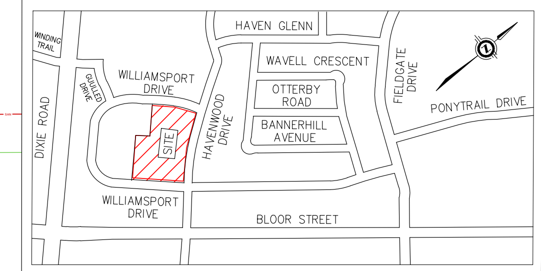
NO.	TOP. EL. (m)	INVERT (m)	STANDARD NUMBER	
		INV OUT	FRAME/GRATE	STRUCTURE
CB 1	140.20	138.21 NW	OPSD 400.010	OPSD 705.010
CB 2	139.69	137.94 N	OPSD 400.010	OPSD 705.010
CB 3	139.75	137.30 NW	OPSD 400.010	OPSD 705.010
CB 4	139.80	137.18 NW	OPSD 400.010	OPSD 705.010
CB 5	139.92	136.61 SE	OPSD 400.010	OPSD 705.010
CB 6	139.50	135.39 N	OPSD 400.010	OPSD 705.010
CB 10	139.15	137.72 N	OPSD 400.010	OPSD 705.010

PROPOSED SANITARY SEWER MANHOLES

NO.	TOP. EL. (m)	INVERT (m)		STANDARD NUMBER	
		INV IN	INV OUT	FRAME/GRATE	STRUCTURE
MH 2A	139.14	136.85 NW	136.74 SE	OPSD 401.010	OPSD 701.010
MH 3A	138.75	135.90 SW 136.45 NW	135.85 NE	OPSD 401.010	OPSD 701.010

REGION OF PEEL STANDARD NOTES

1. ALL MATERIALS AND CONSTRUCTION METHODS MUST CORRESPOND TO THE CURRENT PEEL PUBLIC WORKS STANDARDS AND SPECIFICATIONS.
2. WATERMAIN AND/OR WATER SERVICE MATERIALS 100MM (4") AND LARGER MUST BE DR18 P.V.C. PIPE MANUFACTURED TO A.W.W.A. SPEC. C900–16 SPEC COMPLETE WITH TRACER WIRE. SIZE 50MM (2") AND SMALLER MUST BE TYPE 'K' SOFT COPPER PIPE PER A.S.T.M. B88–49 SPECIFICATION.
3. WATERMAINS AND/OR WATER SERVICES ARE TO HAVE A MINIMUM COVER OF 1.7M (5'6") WITH A MINIMUM HORIZONTAL SPACING OF 1.2M (4') FROM THEMSELVES AND ALL OTHER UTILITIES.
4. PROVISIONS FOR FLUSHING WATER LINE PRIOR TO TESTING, ETC. MUST BE PROVIDED WITH AT LEAST A 50MM (2") OUTLET ON 100MM (4") AND LARGER LINES. COPPER LINES ARE TO HAVE FLUSHING POINTS AT THE END, THE SAME SIZE AS THE LINE. THEY MUST ALSO BE HOSED OR PIPED TO ALLOW THE WATER TO DRAIN ONTO A PARKING LOT OR DOWN A DRAIN. ON FIRE LINES, FLUSHING OUTLET TO BE 100MM (4") DIAMETER MINIMUM ON A HYDRANT.
5. ALL CURB STOPS TO BE 3.0M (10') OFF THE FACE OF THE BUILDING UNLESS OTHERWISE NOTED.
6. HYDRANT AND VALVE SET TO REGION STANDARDS 1–6–1 DIMENSION A AND B, 0.7M (2') AND 0.9M (3') AND TO HAVE PUMPER NOZZLE.
7. WATERMAINS TO BE INSTALLED TO GRADES AS SHOWN ON APPROVED SITE PLAN. COPY OF GRADE SHEET MUST BE SUPPLIED TO INSPECTOR PRIOR TO COMMENCEMENT OF WORK, WHERE REQUESTED BY INSPECTOR.
8. WATERMAINS MUST HAVE A MINIMUM VERTICAL CLEARANCE OF 0.3M (12") OVER/0.5M (20") UNDER SEWERS AND ALL OTHER UTILITIES WHEN CROSSING.
9. ALL PROPOSED WATER PIPING MUST BE ISOLATED FROM EXISTING LINES IN ORDER TO ALLOW INDEPENDENT PRESSURE TESTING AND CHLORINATING FROM EXISTING SYSTEMS.
10. ALL LIVE TAPPING AND OPERATION OF REGION WATER VALVES SHALL BE ARRANGED THROUGH THE REGIONAL INSPECTOR ASSIGNED OR BY CONTACTING THE OPERATIONS AND MAINTENANCE DIVISION.
11. LOCATION OF ALL EXISTING UTILITIES IN THE FIELD TO BE ESTABLISHED BY THE CONTRACTOR.
12. THE CONTRACTOR(S) SHALL BE SOLELY RESPONSIBLE FOR LOCATES, EXPOSING, SUPPORTING AND PROTECTING OF ALL UNDERGROUND AND OVERHEAD UTILITIES AND STRUCTURES EXISTING AT THE TIME OF CONSTRUCTION IN THE AREA OF THEIR WORK WHETHER SHOWN ON THE PLANS OR NOT AND FOR ALL REPAIRS AND CONSEQUENCES RESULTING FROM DAMAGE TO SAME.
13. THE CONTRACTORS(S) SHALL BE SOLELY RESPONSIBLE TO GIVE 72 HOURS WRITTEN NOTICE TO THE UTILITIES PRIOR TO CROSSING SUCH UTILITIES, FOR THE PURPOSE OF INSPECTION BY THE CONCERNED UTILITY. THIS INSPECTION WILL BE FOR THE DURATION OF THE CONSTRUCTION, WITH THE CONTRACTOR RESPONSIBLE FOR ALL COSTS ARISING FROM SUCH INSPECTIONS.
14. ALL PROPOSED WATER PIPING MUST BE ISOLATED THROUGH A TEMPORARY CONNECTION THAT SHALL INCLUDE AN APPROPRIATE CROSS–CONNECTION CONTROL DEVICE, CONSISTENT WITH THE DEGREE OF HAZARD, FOR BACKFLOW PREVENTION OF THE ACTIVE DISTRIBUTION SYSTEM, CONFORMING TO REGION OF PEEL STANDARDS 1–7–7 OR 1–7–8.



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SURVEYING INFORMATION IS REFERENCED FROM SCHAEFFER DZALDOV BENNETT LTD. - JO NO. 16-132-00. DATED MAY 18, 2016.

BEARINGS ARE REFERRED TO PART OF THE NORTHEAST LIMIT OF BLOCK G, PLAN 43R-20680 AS MTM GRID A BEARING OF N34°21'00"W AS SHOWN ON DRAWING

BENCHMARK:
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CONTOUR INTERVAL 0.50m

ALL EXISTING FEATURE TO REMAIN UNLESS OTHERWISE NOTED.

FOR SITE SERVICING SECTIONS AND NOTES REFER TO DWG. C-103

LEGEND

- EXISTING STORM MANHOLE
- EXISTING SANITARY MANHOLE
- EXISTING CATCHBASIN
- LS EXISTING LIGHT STANDARD
- WV EXISTING WATER VALVE
- FH EXISTING FIRE HYDRANT
- STM EXISTING STORM SEWER
- SAN EXISTING SANITARY SEWER
- WM EXISTING WATER MAIN
- B EXISTING UNDERGROUND BELL CABLE
- E EXISTING UNDERGROUND ELECTRICAL SERVICE
- TV EXISTING UNDERGROUND TV SERVICE
- GAS EXISTING GAS MAIN
- H EXISTING UNDERGROUND HYDRO
- PROPERTY LINE
- EXISTING TREE
- PROPOSED STORM SEWER
- PROPOSED SANITARY SEWER
- PROPOSED WATER MAIN
- MH PROPOSED STORM MANHOLE
- MH PROPOSED SANITARY MANHOLE
- CB PROPOSED CATCHBASIN
- CB PROPOSED CATCHBASIN MANHOLE

MISSISSAUGA

CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

No.	DATE	DESCRIPTION
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4	MAY 23, 2024	ISSUED FOR OPA/ZBA RESUBMISSION

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LICENSED PROFESSIONAL ENGINEER
G. SIVAKUMAR
100546565
23/05/2024
PROVINCE OF ONTARIO

1485 WILLIAMSPORT DR DEVELOPMENT

SITE SERVICING PLAN

DESIGN	F.D.	DRAWN	G.B.	CHECKED	F.F.	CONTRACT No.	18298
SCALE:	1: 300 (FULL SIZE)			DRAWING NUMBER		C-102	
DATE:	DECEMBER 2, 2022						

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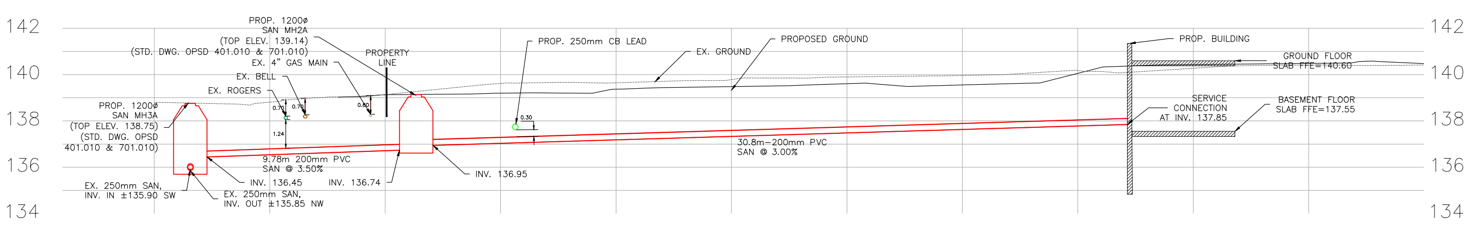

SANITARY SERVICE CONNECTION
SECTION A-A
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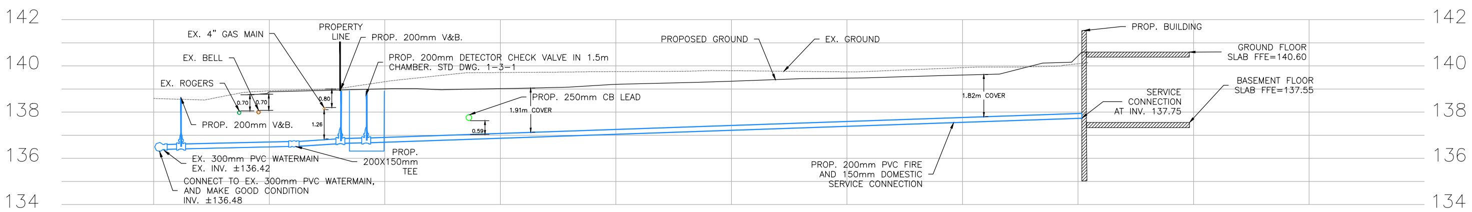

WATER SERVICE CONNECTION
SECTION B-B
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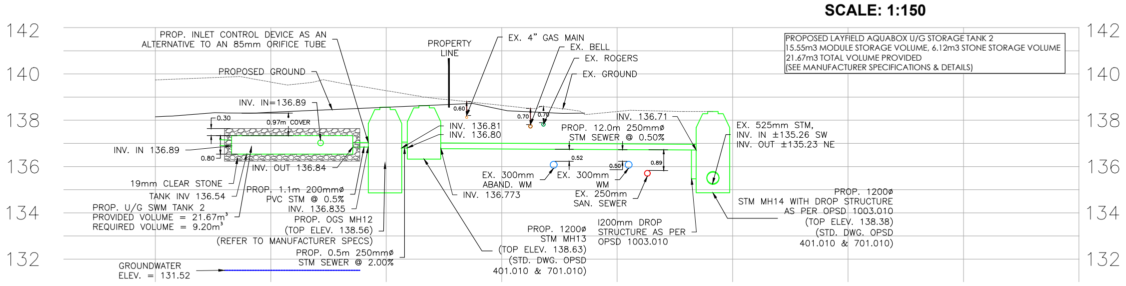
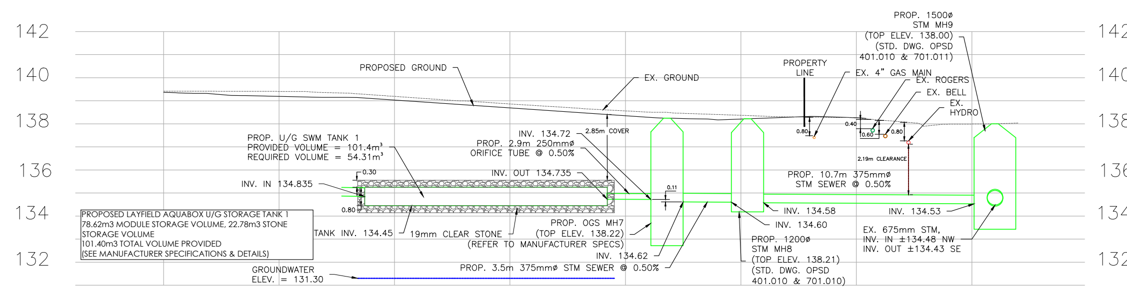
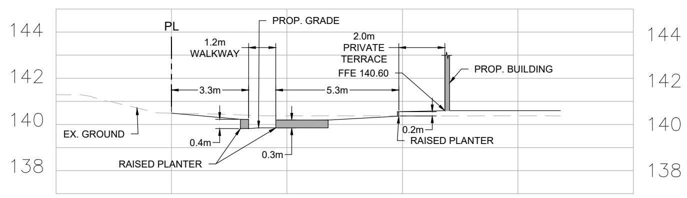


STORM SERVICE CONNECTION-WILLIAMSPORT
SECTION C-C
SCALE: 1:150



STORM SERVICE CONNECTION-HAVENWOOD
SECTION D-D
SCALE: 1:150



SECTION 1-1
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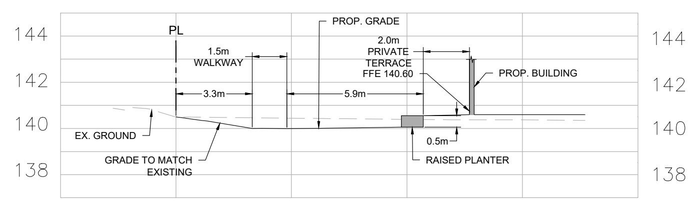

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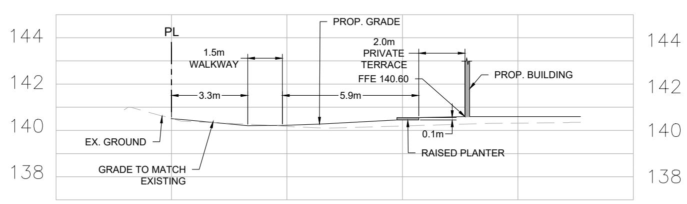

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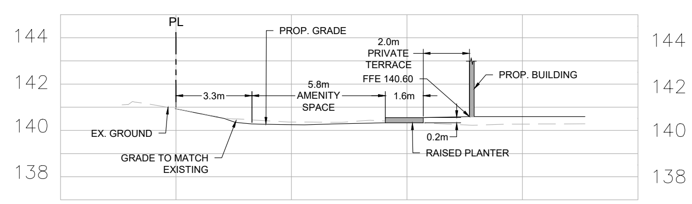

SECTION 4-4
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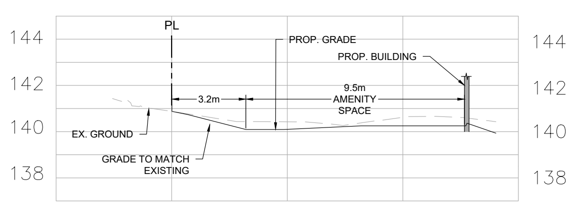
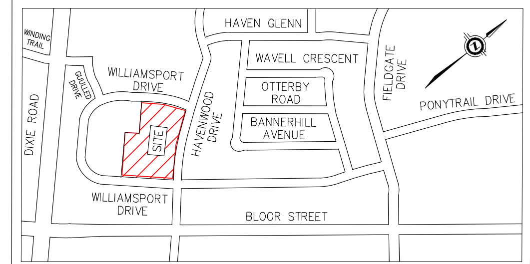


SECTION 5-5
SCALE: 1:150

SANITARY, STORM AND WATERMAIN NOTES

1. FULL LENGTH PERFORATED SUB-DRAIN PIPES OF 150mm DIA. TO BE INSTALLED AROUND THE PERIMETER OF PARKING LOT.
2. ALL UTILITY COMPANIES WILL BE NOTIFIED BY CONTRACTOR FOR LOCATES PRIOR TO THE INSTALLATION OF PROPOSED SERVICE CONNECTIONS.
3. ALL PIPE MATERIALS SHALL BE IN ACCORDANCE WITH THE CURRENT MANUFACTURERS APPROVED PRODUCT LIST, SANITARY SEWER AND APPURTENANCES.
4. ALL SANITARY MAINTENANCE HOLES SHALL CONFORM TO THE CURRENT MANUFACTURER'S APPROVED PRODUCT LIST, SANITARY SEWER AND APPURTENANCES, REGIONAL STANDARD DRAWING 2-1-1 WHICH MUST BE MODIFIED IN THE FIELD TO PREVENT INFLOW AND INFILTRATION.
5. SANITARY SERVICE CONNECTION MATERIAL MUST BE PVC SDR28.
6. STORM SERVICE CONNECTION MATERIAL MUST BE PVC DR35.
7. ALL MAINTENANCE HOLE ARE TO BE SUPPLIED OR CONSTRUCTED IN ACCORDANCE WITH OPSD 701 SERIES.
8. CATCH BASINS SHALL BE PRECAST AS PER OPSD 705 SERIES.
9. SANITARY SEWERS SHALL BE INSTALLED WITH BEDDING AS PER REGIONAL STANDARD DRAWING 2-3-1.
10. BEDDING FOR PVC STORM SEWER PIPE SHALL BE IN ACCORDANCE WITH CITY OF MISSISSAUGA STANDARD DRAWING NO. 2112.080.
11. SEWER BEDDING SHALL CONFORM WITH OPSS 1010 FOR GRANULAR "A" OR CITY STANDARD DRAWING NO. 2112.100 OR 2112.140.
12. ALL GRANULAR BEDDING AND BACKFILL MATERIAL SHALL CONFORM TO THE REQUIREMENTS OF OPSS 1010 AND MUST NOT CONTAIN RCM/RAP.
13. ALL VALVE 300MM DIAMETER AND SMALLER SHALL BE EQUIPPED WITH VALVE BOXES AND RESTRAINED AND VALVE FITTING WRAPPED IN CORROSION PROTECTION TAPE.
14. ALL APPROVED NATIVE MATERIAL SHALL BE FREE OF FROZEN LUMPS, CINDERS, ASHES, ASPHALT REFUSE, ORGANIC MATTER, ROCKS AND BOULDERS OR OTHER DELETERIOUS MATERIALS.
15. ALL WATERMAIN FITTINGS SHALL BE MECHANICALLY RESTRAINED. DETAILS OF RESTRAINTS SHALL BE DESIGNED, STAMPED AND SIGNED BY A PROFESSIONAL ENGINEER AS PART OF SHOP DRAWINGS BY THE CONTRACTOR.
16. THE CONTRACTOR SHALL RETAIN THE SERVICES OF A MOECC LICENSED CONTRACTOR SPECIALIZING IN THE PROVISION OF DISINFECTION SERVICES FOR ALL WATERMAIN TESTING REQUIRED IN THIS CONTRACT.
17. TRACER WIRE IS TO BE INSTALLED ON ALL NEW PVC WATERMAIN PIPES.
18. THE TOP OF VALVE BOX AND CHAMBER COVERS SHALL BE SET FLUSH WITH FINISHED GRADE AND REMAIN ACCESSIBLE AT ALL TIMES.
19. WATER SERVICES, A 12-GAUGE TWU STANDARD COPPER, LIGHT COLORED, PLASTIC COATED TRACER WIRE MUST BE INSTALLED WITH AND ALONG THE PIPE AND BROUGHT TO THE SURFACE AT EACH SERVICE BOX. TRACER WIRE IS TO BE ATTACHED TO THE PIPE AND OUTSIDE OF EACH SERVICE BOX BY MEANS OF TAPE OR RUBBER GROMMET.
20. CHAMBER AS PER REGION STANDARD DRAWING NUMBER 1-1-5.
21. DETECTOR CHECK VALVE AS PER REGION STANDARD DRAWING NUMBER 1-3-1.
22. PROPOSED WATER CONNECTION AS PER REGION STANDARD NUMBER 1-6-4 AND 1-8-3
23. FOR DETAILS OF THE PROPOSED TRENCH DRAIN, ROOF DRAIN, SERVICE CONNECTIONS, WATER METER AND BACKFLOW PREVENTER REFER TO MECHANICAL DRAWINGS.
24. ALL UTILITY LOCATES AND CLEARANCES ARE SCHEMATIC AND NEED TO BE VERIFIED IN THE LATER PHASE OF THE PROJECT.



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PART OF BLOCKS G, REGISTERED PLAN 733, CITY OF MISSISSAUGA, REGIONAL MUNICIPALITY OF PEEL

SURVEYING INFORMATION IS REFERENCED FROM SCHAEFFER DZALDOV BENNETT LTD. - JO NO. 16-132-00. DATED MAY 18, 2016.

BEARINGS ARE REFERRED TO PART OF THE NORTHEAST LIMIT OF BLOCK G, PLAN 43R-20680 AS MTM GRID A BEARING OF N34°21'00"W AS SHOWN ON DRAWING

BENCHMARK:
ELEVATIONS ARE REFERRED TO THE CITY OF MISSISSAUGA BENCHMARK NO. 688, HAVING A PUBLISHED ELEVATION OF 143.902 AS PER MISSSISSAUGA DATUM, REGISTERED PLAN 733.
CONTOUR INTERVAL 0.50m

ALL EXISTING FEATURE TO REMAIN UNLESS OTHERWISE NOTED.

FOR SITE SERVICING PLAN REFER TO DWG. C102.

CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

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LICENSED PROFESSIONAL ENGINEER
G. SIVAKUMAR
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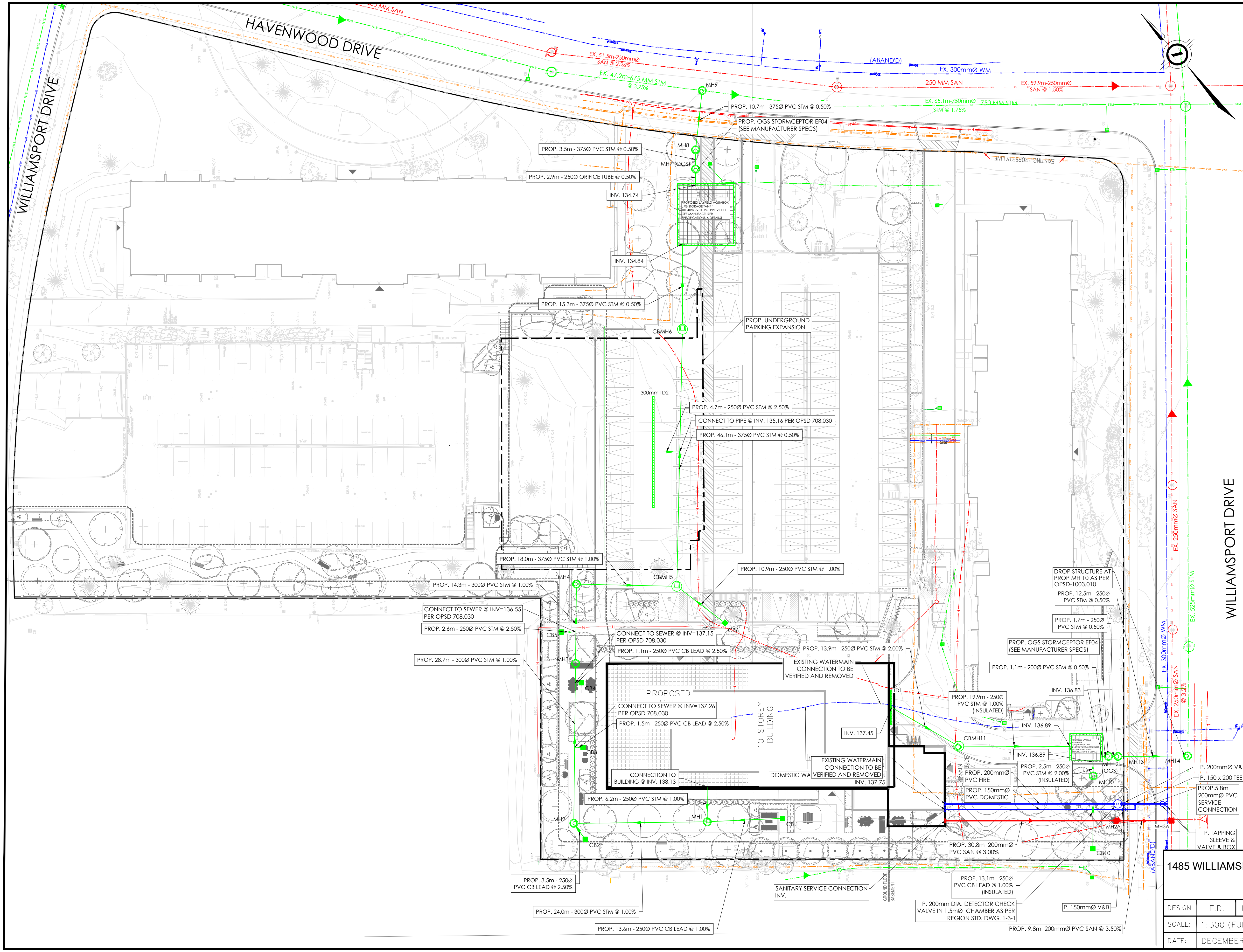
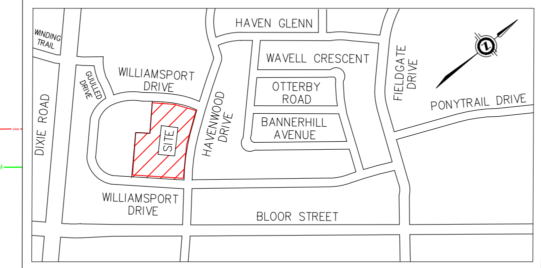
23/05/2024
PROVINCE OF ONTARIO

1485 WILLIAMSPORT DR & 3480 HAVENWOOD DR DEVELOPMENT
PRELIMINARY CROSS SECTIONS AND NOTES

DESIGN	F.D.	DRAWN	G.B.	CHECKED	F.F.	CONTRACT No. 18298
SCALE:	. (AS SHOWN)			DRAWING NUMBER		C-103
DATE:	DECEMBER 2 2022					

DRAWING NAME: F:\18298 - 1485 William Spt Dr\Drafting\Contract Drawings\C103- Sections.dwg May 23, 2024-2:45pm





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BEARINGS ARE REFERRED TO PART OF THE NORTHEAST LIMIT OF BLOCK G, PLAN 43R-20680 AS MTM GRID A BEARING OF N34°21'00"W AS SHOWN ON DRAWING

BENCHMARK:
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CONTOUR INTERVAL 0.50m

ALL EXISTING FEATURE TO REMAIN UNLESS OTHERWISE NOTED.

FOR SITE SERVICING SECTIONS AND NOTES REFER TO DWG. C-103

LEGEND

- EXISTING STORM MANHOLE
- EXISTING SANITARY MANHOLE
- EXISTING CATCHBASIN
- LS EXISTING LIGHT STANDARD
- WV EXISTING WATER VALVE
- FH EXISTING FIRE HYDRANT
- STM EXISTING STORM SEWER
- SAN EXISTING SANITARY SEWER
- EXISTING WATER MAIN
- B EXISTING UNDERGROUND BELL CABLE
- OH EXISTING UNDERGROUND HYDRO
- RG EXISTING UNDERGROUND ROGER SERVICE
- SL UES STREET LIGHT
- EL UES ELECTRICAL LIGHT
- UT UTILITY TUNNEL
- GAS EXISTING GAS MAIN
- X EXISTING FENCE
- PROPERTY LINE
- EXISTING TREE
- PROPOSED STORM SEWER
- PROPOSED SANITARY SEWER
- PROPOSED WATER MAIN
- MH PROPOSED STORM MANHOLE
- MH PROPOSED SANITARY MANHOLE
- CB PROPOSED CATCHBASIN
- CB PROPOSED CATCHBASIN MANHOLE

MISSISSAUGA

CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

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23/05/2024
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1485 WILLIAMSPORT DR & 3480 HAVENWOOD DR DEVELOPMENT

COMPOSITE UTILITY PLAN

DESIGN	F.D.	DRAWN	G.B.	CHECKED	F.F.	CONTRACT No.	18298
SCALE:	1: 300 (FULL SIZE)			DRAWING NUMBER		C-104	
DATE:	DECEMBER 2 2022						

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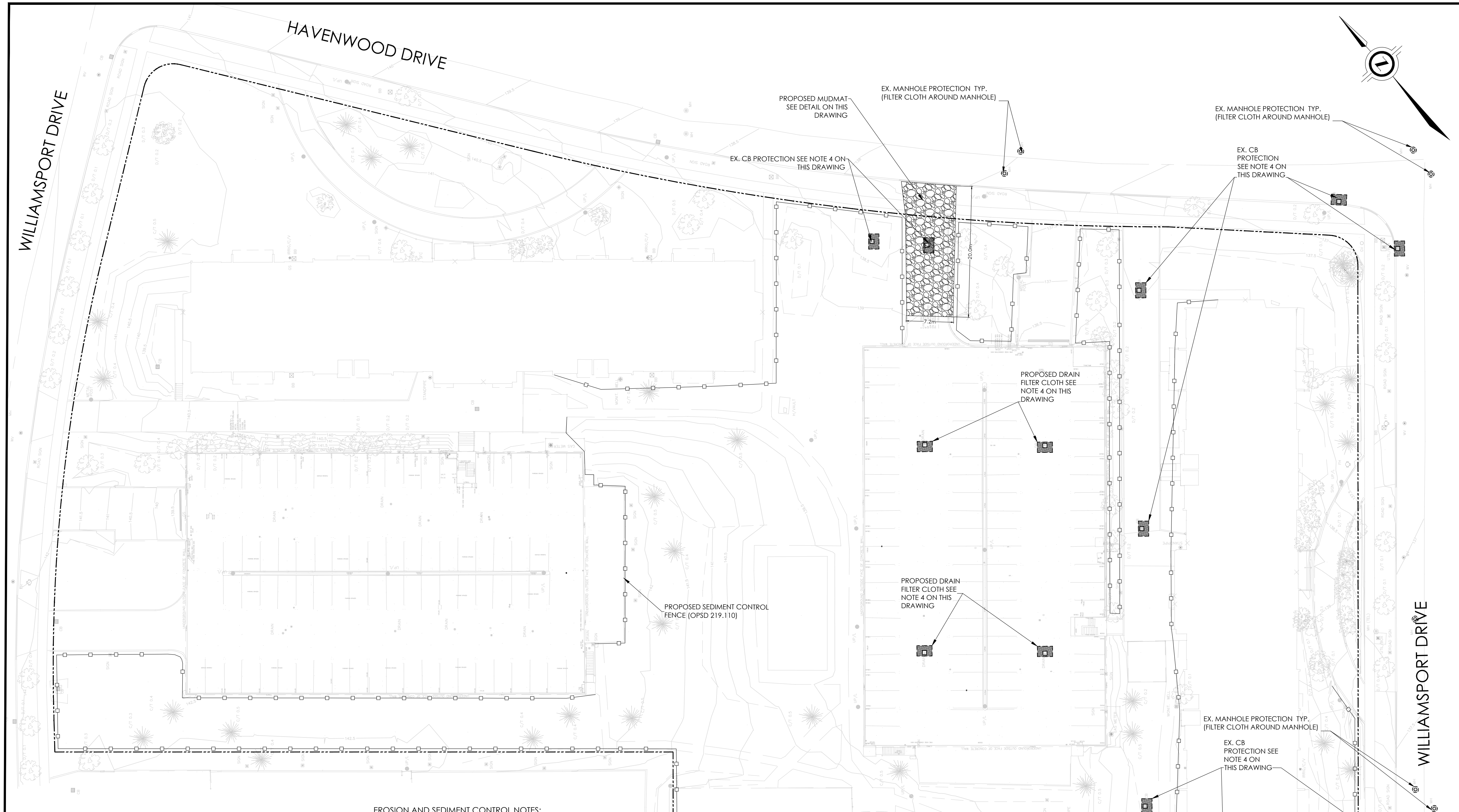

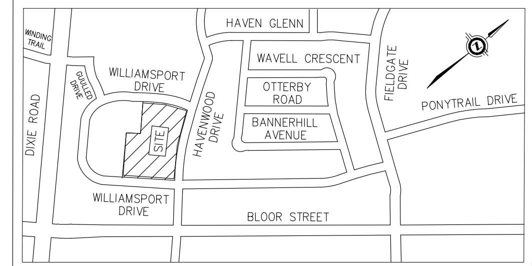

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CONTOUR INTERVAL 0.50m

ALL EXISTING FEATURE TO REMAIN UNLESS OTHERWISE NOTED.

FOR SITE SERVICING SECTIONS AND NOTES REFER TO DWG. C-103

LEGEND

PROPERTY LINE

PROPOSED BUILDING GROUND LEVEL OUTLINE

PROPOSED SEDIMENT CONTROL FENCE

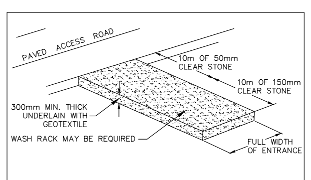
CB — CB TOP TO BE COVERED (SEE NOTE 4 ON C-03)

PROPOSED MUDMAT (SEE DETAIL ON THIS C-03)

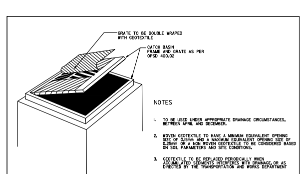
MANHOLE WITH FILTER CLOTH (WRAPPED AROUND MANHOLE)

EROSION AND SEDIMENT CONTROL NOTES:

1. EROSION AND SEDIMENT CONTROL (ESC) MEASURES WILL BE IMPLEMENTED PRIOR TO, AND MAINTAINED DURING CONSTRUCTION PHASES, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER. ALL DAMAGED EROSION AND SEDIMENT CONTROL MEASURES SHOULD BE REPAIRED OR REPLACED WITHIN 48 HOURS OF INSPECTION OR BOTH.
2. CHECK DAMS AND SILTATION CONTROL FENCES SHALL BE INSTALLED AND MAINTAINED AS REQUIRED TO PREVENT SILT FROM FLOWING ONTO THE ADJACENT LANDS.
3. HOARDING OR SNOW FENCING SHALL BE ERECTED AND MAINTAINED PRIOR TO ANY GRADING OR CONSTRUCTION AND SHALL REMAIN IN PLACE AND IN GOOD REPAIR THROUGHOUT THE CONSTRUCTION AND GRADING PHASE.
4. FILTER FABRIC SHALL BE PLACED UNDER ALL STREET CATCHBASINS GRATES. SILT TRAPS ARE TO BE CLEANED REGULARLY AND ARE NOT TO BE REMOVED UNTIL CURBS ARE CONSIDERED AND BOULEVARD AND BACKYARDS ARE GRADED AND SODDED. FILTER FABRIC USED FOR SILT CONTROL SHALL BE TERRA FIX 270R OR AN APPROVED EQUIVALENT.
5. THE CONTRACTOR SHALL ENDEAVOR TO PREVENT MUD TRACKING ONTO EXISTING RIGHT-OF-WAY AND SHALL PROVIDE FOR CLEANUP AT HIS OWN EXPENSE AS DIRECTED BY THE CITY. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE TO CONTROL DUST ON THE PROJECT AND SHALL PROVIDE, AT HIS OWN EXPENSE, CONTROLLING MEASURES AS DIRECTED BY THE CITY.
6. PROPOSED MUD MAT DETAIL SHALL BE IN ACCORDANCE TO "EROSION & SEDIMENT CONTROL GUIDELINE FOR URBAN CONSTRUCTION" DETAIL DECEMBER 2006.
7. THE EROSION AND SEDIMENT CONTROL STRATEGIES OUTLINED ON THE PLANS ARE NOT STATIC AND MAY NEED TO BE UPGRADED/AMENDED AS SITE CONDITIONS CHANGE TO MINIMIZE SEDIMENT LADEN RUNOFF FROM LEAVING THE WORK AREA. IF THE PRESCRIBED MEASURES ON THE PLANS ARE NOT EFFECTIVE IN PREVENTING THE RELEASE OF A DELETERIOUS SUBSTANCE, THEN ALTERNATIVE MEASURES MUST BE IMPLEMENTED IMMEDIATELY TO MINIMIZE POTENTIAL ECOLOGICAL IMPACTS AND A TORONTO REGION CONSERVATION AUTHORITY ENFORCEMENT OFFICE SHOULD BE IMMEDIATELY CONTACTED. ADDITIONAL ESC MEASURES TO BE KEPT ON SITE AND USED AS NECESSARY.
8. ALL PERIMETER SILT FENCE, STRAW BALES, SILT TRAP AND FILTRXX SILTSOXX TO REMAIN IN PLACE UNTIL SITE HAS BEEN FULLY STABILIZED. ALL EROSION SEDIMENT CONTROL DEVICES TO BE REGULARLY MAINTAINED DURING THE FULL DURATION OF CONSTRUCTION.
9. MUD MAT TO BE CONSTRUCTED PRIOR TO ANY SITE WORK. CONTRACTOR TO KEEP MUD MAT CLEAR OF MUD AND DEBRIS. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY MUD TRACKING ON MUNICIPAL ROADS.



MUD MAT DETAIL
N.T.S.



ROADWAY CATCH BASIN AND TRENCH DRAIN SEDIMENT CONTROL DEVICE
N.T.S.

CITY OF MISSISSAUGA
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1485 WILLIAMSPORT DR & 3480 HAVENWOOD DR DEVELOPMENT

TEMPORARY EROSION & SEDIMENT CONTROL PLAN

DESIGN	F.D.	DRAWN	G.B.	CHECKED	F.F.	CONTRACT No. 18298
SCALE:	1: 300 (FULL SIZE)			DRAWING NUMBER		C-105
DATE:	DECEMBER 2 2022					

DRAWING NAME: F:\18298 - 1485 William Spt Dr\Drafting\Contract Drawings\C105- Erosion Sediment Control Plan.dwg, May 23, 2024-2:48pm

Appendix F

Hydrogeological Investigation Borehole Information

Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

UPDATED
GEOTECHNICAL INVESTIGATION
RESIDENTIAL DEVELOPMENT
1485 WILLIAMSPORT DRIVE
MISSISSAUGA, ONTARIO

Prepared for: Starlight Investments
1400-3280 Bloor Street West, Centre Tower
Toronto, Ontario
M8X 2X3

Attention: Mr. Matthew Cesta

File No. 1-22-0531-01
Issued: September 11, 2023

Distribution

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ENCLOSURES

Figures

Appendices

1 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by Starlight Investments in 2018, to conduct a geotechnical investigation for a proposed residential development at 1485 Willamsport Drive, in the City of Mississauga, Ontario which consisted of advancing twelve (12) boreholes (Boreholes 1 to 12) extending to depths ranging from about 7.9 to 16.2 m below grade during the period of March 05 to 15, 2018. The scope of work was prepared for the original design plan, which included two infill buildings resting on 1 or 2-level underground parking structure.

Subsequent to the completion of the previous investigations, Terraprobe was provided with the updated design drawing prepared by Architecture Unfolded. The new design consisted of an infill development comprising a 6-storey building with one level of basement. Terraprobe was therefore requested to carry out a supplementary geotechnical investigation, consisting of advancing five (5) additional boreholes to about 8.1 to 18.5 m depth below grade to explore the potential deep foundation alternatives.

This report encompasses the results of the geotechnical investigations conducted for the proposed development site to determine the prevailing subsurface soil and ground water conditions, and on this basis, provides geotechnical engineering design advice and recommendations for the design of building foundations, earthquake and earth pressure design parameters, basement floor and drainage, shoring and pavement design. In addition, comments are also included on pertinent construction aspects including excavation, backfill and ground water control. The current report updates and supersedes previous geotechnical investigation report by combining the findings of the previous and new boreholes.

Terraprobe has also conducted a hydrogeological study for this project site. The findings of this investigation are reported under a separate cover (1-22-0531-46).

2 SITE AND PROJECT DESCRIPTION

The project site is located in the southwest quadrant of the intersection of Williamsport Drive and Havenwood Drive, in the City of Mississauga, with a municipal address of 1485 Williamsport Drive, Mississauga. The general location of the site is presented on Figure 1.

The project site is currently occupied by one (1) 8-storey building, parking lot, a swimming pool and landscaped area. It is proposed to demolish the existing swimming pool to facilitate the infill development to include a 6-storey building in the western portion of the site. The proposed building will have a basement.

Terraprobe was provided with the following architectural design drawing for review,

- "*2022.09.23_21-15_PacificWay*", dated September 23, 2022, prepared by Architecture Unfolded.

The above design drawing indicates that the finished floor elevation (FFE) for the single level of basement would be set at Elev. 137.55 m. The established site grade would be set at Elev. 140.80 m.

As noted before, Terraprobe previously advanced twelve (12) boreholes (Boreholes 1 to 12) extending to depths ranging from about 7.9 to 16.2 m below grade during the period of March 05 to 15, 2018. Terraprobe had submitted the following geotechnical report based on the results of the 2018 investigation.

- "*Geotechnical Engineering Report, 1485 Williamsport Drive and 3480 Havenwood Drive, Mississauga, Ontario*" dated April 12, 2018.

In the above report, the conventional spread footing foundations were recommended however, due to the new design scheme at revised location and relatively deep earth fill zone, the conventional spread footing were not deemed to be conducive for the project, and therefore, Terraprobe carried out a supplementary geotechnical investigation, consisting of advancing five (5) additional relatively deep boreholes (Boreholes 101 to 105) to about 8.1 to 18.5 m depth below grade during the period of September 12 to 15, 2022 to explore the potential deep foundation alternatives.

3 INVESTIGATION PROCEDURE

The original field investigation was conducted during the period of March 05 to 15, 2018 and consisted of drilling and sampling twelve (12) boreholes to depths ranging from 7.9 to 16.2 m below grade within the footprints of the proposed tower and the underground parking garage. Four (4) boreholes (Boreholes 8 to 11) are within or in a close proximity to the proposed footprint. These boreholes information will be incorporated into the new investigation.

The supplementary field investigation was conducted during the period of September 12 to 15, 2022 and consisted of drilling and sampling five (5) boreholes extending to depths of about 8.1 to 18.5 m below grade. The approximate locations of the boreholes are shown on the enclosed Borehole Location Plan (Figures 2A and 2B).

The boreholes were drilled by specialist drilling contractors using a track-mounted drill rig power auger. The borings were advanced using mud rotary and continuous flight solid stem augers, and were sampled with a conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D1586). The field work (drilling, sampling and testing) was observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into clean plastic jars and transported to our geotechnical testing laboratory for detailed inspection and testing. All borehole samples were examined (tactile) in detail by a geotechnical engineer and classified according to visual and index properties.

Laboratory tests consisted of moisture content determination on all samples, and a Sieve and Hydrometer analysis on selected native soil samples. The measured natural moisture contents of individual samples and the results of the Sieve and Hydrometer analysis are plotted on the enclosed Borehole Logs at respective sampling depths. The results of Sieve and Hydrometer analysis are also summarized in Section 4.2 of this report and appended.

Water levels were measured in open boreholes upon completion of drilling during the original investigation in 2018. However, ground water level and caving were not measured in the boreholes except Borehole 104 and 105 as the drilling mud/water was added during the supplementary investigation in 2022. Monitoring wells comprising 50 mm diameter PVC pipes were installed in Boreholes 10 and Boreholes 102, 103 and 105 to facilitate ground water monitoring and for the purpose of the Hydrogeological Study. The PVC tubing was fitted with a bentonite clay seal as shown on the accompanying Borehole Logs. Water levels in the monitoring wells were measured on March 23, April 3 2018; October 4, 2019, and September 19, 30 and October 13, 2022. The results of ground water monitoring are presented in Section 4.3 of this report.

The borehole ground surface elevations were surveyed by Terraprobe using a Trimble R10 GNSS System. The Trimble R10 system uses the Global Navigation Satellite System and the Can-Net reference system to determine target location and elevation. The Trimble R10 system is reported to have an accuracy of up to 10 mm horizontally and up to 30 mm vertically. It should be noted that the elevations provided on the Borehole Log are approximate, for the purpose of relating soil stratigraphy and should not be used or relied on for other purposes.

4 SUBSURFACE CONDITIONS

The specific soil conditions encountered at each borehole location are described in greater detail on the Borehole Logs, with a summary of the general subsurface soil conditions outlined below. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions at the site.

It should be noted that the subsurface conditions are confirmed at the borehole locations only, and may vary between and beyond the borehole locations. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.

4.1 Stratigraphy

The following stratigraphy is based on the borehole findings, as well as the geotechnical laboratory testing conducted on selected representative soil samples.
The summary provided below is for general guidance only. Detailed depths and elevations are given in the following subsections and appended borehole logs. In general, the five (5) main stratigraphic units are as follows:

- Surficial layers, consisting of topsoil and pavement structure, extending up to 0.6 m depth below grade, overlying;
- Earth fill zone, extending to 2.3 to 8.4 m depth below grade, overlying;
- Typically compact to very dense sandy silt deposit, extending to Elev. 126.4 to 129.6 m, overlying;
- Compact to very dense sand deposit, extending to Elev. 123.7 to 122.0 m, overlying;
- Shale bedrock of Georgian Bay Formation, extending to the full depth of the investigation.

4.1.1 Surficial Layers

A topsoil layer was encountered at the ground surface in Boreholes 8, 9 and 11 and Boreholes 103 and 104. The topsoil thickness ranged from 125 to 600 mm.

An asphalt pavement structure was encountered in Borehole 101, 102 and 105 consisted of 130 mm thick asphaltic concrete underlain by 150 mm thick granular base/subbase courses. A concrete structure was encountered in Borehole 10 and consisted of 125 mm thick cement concrete.

The above topsoil and pavement thicknesses were measured from the borehole drilling and are approximate. A shallow test pit investigation should be carried out to determine precise topsoil and pavement thickness present at the site for quantity estimation and costing purposes (if required).

4.1.2 Earth Fill

Earth fill materials, consisting of sand/silty sand/sand and silt/sandy silt were encountered beneath the surficial layer in each borehole and extended to depths of about 2.3 to 8.4 m below grade. The earth fill materials generally consist of trace to some amounts of gravel and clay.

Standard Penetration Test results (N-values) obtained from the earth fill zone ranged from 3 blows per 300 mm of penetration to 50 blows per 75 mm of penetration, indicating a very loose to very dense relative density. The in-situ moisture contents of the earth fill samples ranged from 3 to 22 percent by mass, indicating a moist condition.

4.1.3 Sandy Silt

The sandy silt deposit, with some amounts of clay and trace amounts of gravel were encountered beneath the earth fill zone in Borehole 101 and 102 and extended to the depth varying from 10.7 m to 13.9 m depth below grade (Elev. 126.4 to 129.6 m).

N-values obtained from the undisturbed sandy silt deposit ranged from 30 blows per 300 mm of penetration to 50 blows per 75 mm of penetration, indicating a compact to very dense relative density. The in-situ moisture contents of the sandy silt samples ranged from 7 to 20 percent by mass, indicating a moist to wet condition.

4.1.4 Sand

Sand deposit, with some amounts of silt and trace amounts of clay and gravel was encountered beneath the earth fill zone and sandy silt deposit in each borehole and extended to 16.8 m to 18.3 m depth below grade (Elev. 123.7 to 122.0 m).

N-values obtained from the sand deposit ranged from 15 per 300 mm of penetration to 50 blows per 300 mm of penetration, indicating a compact to very dense relative density (typically very dense). The in-situ moisture contents of the sand samples ranged from 2 to 25 percent by mass, indicating a moist to wet condition.

4.1.5 Inferred Bedrock

Weathered shale (inferred Bedrock of Georgian Bay Formation) was encountered in Borehole 8, 101, 102 and 103 at a depth of about 16.8 m to 18.3 m below grade and extended to the full depth of investigation (up to about 18.5 m depth below existing grade). The bedrock of the Georgian Bay Formation, typically found in the general area, is a deposit predominantly comprising thin to medium bedded blue-grey shale of Upper Ordovician age. The bedrock contains interbeds of grey calcareous shale, limestone/dolostone and calcareous sandstone which are discontinuous and nominally 50 to 300 mm thick.

The augered borehole method used at this site is conventionally accepted investigative practice. However, the augering and interval sampling method does not define the bedrock surface with precision, particularly where the surface of the rock is weathered, weaker and easily penetrated by the auger. The auger refusal is generally indicative of a presence of a relatively less weathered/sound shale and/or limestone/dolostone layers. It should be noted that confirmation and characterization of the bedrock through rock coring was not included in our scope of work. The bedrock surface elevation at the borehole locations, as noted on the Borehole Log, were inferred from the borehole auger grinding, spoon sampling/refusal and bouncing, therefore, actual bedrock surface elevations may vary from the elevations noted on the Borehole Log.

Based on the results of the field observations, the inferred bedrock depth and elevations are tabulated as follows:

Borehole No.	Ground Surface Elevation	Inferred Bedrock Depth below Grade	Top of Inferred Bedrock Elevation
8	Elev. 139.3 m	16.8 m	Elev. 122.5 m

Borehole No.	Ground Surface Elevation	Inferred Bedrock Depth below Grade	Top of Inferred Bedrock Elevation
101	Elev. 140.3 m	18.3 m	Elev. 122.0 m
102	Elev. 140.3 m	18.3 m	Elev. 122.0 m
103	Elev. 140.5 m	16.8 m	Elev. 123.7 m

4.2 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of natural moisture content determination for all samples, while Sieve and Hydrometer analysis were conducted on selected soil samples. The test results are plotted on the enclosed Borehole Logs at respective sampling depths.

The results (graphs) of the Sieve and Hydrometer (grain size) analysis are appended, and a summary of these results is presented as follow:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 9, Sample 4	2.5	15	55	23	7	SILTY SAND some gravel, trace clay
Borehole 9, Sample 9	6.2	0	87	10	3	SAND trace silt, trace clay
Borehole 10, Sample 10	9.4	0	96	3	1	SAND trace silt, trace clay
Borehole 101, Sample 4	2.5	3	30	48	19	SANDY SILT some clay, trace gravel
Borehole 103, Sample 10	9.4	4	83	11	2	SAND some silt, trace clay, trace gravel

4.3 Groundwater

Observations pertaining to the depth of water level and caving were made in the open boreholes immediately after completion of drilling during the 2018 investigation and are noted on the enclosed Borehole Logs. Monitoring wells were installed in Boreholes 10 to facilitate ground water level monitoring and for the purpose of the hydrogeological study. The ground water level measurements in the monitoring wells were taken on March 23, April 3, October 4, 2018 and September 19, September 30 and October 13, 2022 and are noted on the enclosed Borehole Logs. A summary of these observations is provided as follows:

Borehole No.	Depth of Boring below Grade (m)	Depth to Cave below Grade	Water Level Depth/Elevation at the Time of Drilling (m)	Water Level Depth/Elevation in Monitoring Wells (m)					
				Mar 23, 2018	Apr 3, 2018	Oct 4, 2018	Sep 19, 2022	Sep 30, 2022	Oct 13, 2022
BH 10	12.6	open	8.0	8.9/131.4	8.9/131.4	8.7/131.6	8.7/131.6	8.8/131.5	8.8/131.5

Ground water level and caving was measured in the Borehole 104 to 105 immediately after completion of drilling. Monitoring wells were installed in Boreholes 102, 103 and 105 to facilitate ground water level monitoring. The ground water level measurements in the monitoring wells were taken on September 19, September 30 and October 13, 2022 and are noted on the enclosed Borehole Logs. A summary of these observations is provided as follows:

Borehole No.	Depth of Boring below Grade (m)	Depth to Cave below Grade	Water Level Depth/Elevation at the Time of Drilling (m)	Water Level Depth/Elevation in Monitoring Wells (m)		
				Sep 19, 2022	Sep 30, 2022	Oct 13, 2022
BH 102	18.5	NA*	NA*	8.2/132.1	8.8/131.5	8.8/131.5
BH103	18.3	NA*	NA*	9.0/131.5	9.8/130.8	10.0/130.5
BH105	8.1	open	7.3/132.6	dry	dry	dry

* Water level and caving was not measured in the boreholes as the drilling mud/water was added during investigation.

For the practical purposes, the design ground water level may be taken as Elev. 132.1 m.

Construction dewatering at adjacent sites, existing building drains or dewatering systems, and seasonal fluctuations may cause significant changes to the depth of the groundwater table over time. Additional information pertaining to ground water at the site is discussed in the hydrogeological report by Terraprobe under a separate cover (File No. 1-22-0531-46).

5 DISCUSSIONS AND RECOMMENDATIONS

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use of the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

This report is provided on the basis of these terms of reference and on the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards and guidelines of practice. The Ontario Building Code may require additional considerations beyond the recommendations provided in this report, and must be followed. If there are any changes to the site development features or there is any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Terraprobe should be retained to review the implications of these changes with respect to the contents of this report.

5.1 Foundations

It is proposed to demolish the existing swimming pool to facilitate the infill development to include a 6-storey building in the western portion of the site. The proposed building will have a basement. The finished floor elevation (FFE) for the single level of basement would be set at Elev. 137.55 m. The established site grade would be set at Elev. 140.80 m. (refer to architectural drawing details)

The subsurface information encountered at the borehole locations are summarized as follows,

- Surficial layers, consisting of topsoil and pavement structure, extending up to 0.6 m depth below grade, overlying;
- Earth fill zone, extending to 2.3 to 8.4 m depth below grade, overlying;
- Typically compact to very dense sandy silt deposit, extending to Elev. 126.4 to 129.6 m, overlying;
- Compact to very dense sand deposit, extending to Elev. 123.7 to 122.0 m, overlying;
- Shale bedrock of Georgian Bay Formation, extending to the full depth of the investigation.
- The stabilized ground water level maybe taken as Elev. 132.1 m.

5.1.1 Caissons on Bedrock

The earth fill is not suitable to support the foundations, and the foundations must be extended to deeper depths to be founded on the partially weathered shale bedrock or sound/unweathered shale bedrock if the high bearing pressure if required. Considering that the top of the bedrock is about 16.8 m to 18.3 m depth below the existing grade, the building could be supported by caisson foundations bearing in the bedrock.

Based on the borehole information, the top of weathered shale was encountered at about 16.8 to 18.3 m below grade (Elev. 123.7 to 122.0 ±m). It appears that the top of the bedrock slopes down from the east to the west at the project site.

End-bearing caissons socketed a minimum of 1 m into the partially weathered bedrock (Zone II) may be used to support the proposed building. The caisson foundations made to bear on the weathered bedrock may be designed using a maximum factored geotechnical resistance at ULS of 8 MPa. The geotechnical reaction at Serviceability State Limits (SLS) is 5 MPa for up to 25 mm of settlement.

The capacity is applicable only if Terraprobe inspects the base of each caisson, and the caisson base is cleaned (see details in Section 5.1.1.1 of this report).

The settlement of foundations of different sizes and differential settlement between foundation units may be estimated using the following relationship.

$$\boldsymbol{\delta = 1000Q\,[2 \div (1 + 0.7/B)]^2 \div k}$$

Where,

δ = the estimated vertical displacement in the rock beneath the centre of the loaded footing (mm)

Q = the applied bearing pressure on the rock at the base of the footing (kPa)

B = the nominal footing width (metres)

k = the modulus of displacement (400,000kP/m for weathered shale)

In addition to the displacement of the rock, there will be compression of the concrete caisson shaft under loading which will increase the apparent settlement at the structure level. Top of weathered shale and the depth of the sound bedrock must be confirmed through Terraprobe's geotechnical engineering supervision during caisson installation.

Since the caissons are end bearing and founded on the bedrock, group effect generally has little influence on group resistance and the group efficiency may be assumed to be equal to 1.0. However, for practical purposes, the caisson piles may not be built much closer together than 2.5 diameter centre to centre. The pile layout and details must be reviewed by Terraprobe.

Caisson foundations at different elevations must be designed such that the higher caissons are set below a line drawn up at 10 horizontal to 7 vertical from the closest edge of the lower caisson.

If a pile cap or grade beam is to be incorporated into the design, the pile cap subgrade soil must be provided with a minimum of 1.2 m of soil cover or equivalent insulation for frost consideration.

5.1.1.1 Caisson Base Machine Cleaning and Inspection

Inspection and machine cleaning of the end bearing caissons base for above-recommended bearing pressures is critical and must be done prior to concrete placement. Otherwise, the bearing capacities provided in Section 5.1.1 are not valid. The following methodology may be utilized,

- Caissons will need to be installed with an adequate temporary steel liner to facilitate inspection and cleaning of the base. It should be noted that caisson liners are need to manage caving and groundwater seepage expected from the overburden.
- Any water accumulated in the caisson shall be removed prior to concrete placement using Tremie method (refer to Section 5.1.4 of this report).
- Once the top of bedrock elevation is established for a given caisson by Terraprobe, the caisson is then advanced into the unweathered/sound shale, to be sure the caisson tip is at least 1 m embedded in the unweathered/sound bedrock consistent with our geotechnical recommendations.
- Place about 0.6 m high concrete material into the caisson base; place the auger to the caisson base and spin the auger to collect the concrete and rock fragments/powder; and to allow any remaining rock fragments to “stick” together and to be removed.
- Rock fragment/powder and concrete mixture is then removed from the caisson hole.
- The caisson base is then visually inspected from the surface to ensure that the it is clean and concrete is placed in the clean hole.

5.1.1.2 Lateral Resistance

The solutions provided in the following sections can be used to estimate the lateral resistance of single pile.

Sound/Unweathered Shale

Caisson pile toes will be made in sound/unweathered bedrock of the Georgian Bay Formation. The maximum factored ultimate lateral geotechnical resistance of the sound rock at ULS is 1 MPa.

Overburden Soils

The lateral resistance design for the overburden, if required can be carried out in accordance with the following standards and papers:

- Canadian Geotechnical Society, Canadian Foundation Engineering Manual (4th Edition);

- Ontario Ministry of Transportation, Guidelines for the Design of High Mast Pole Foundations, May 2004 (Fourth Edition);
- Broms, B.B, Lateral Resistance of Piles in Cohesionless Soils, Journal of the Soil Mechanics and Foundations Division, Vol. 90, No. 3, May/June 1964; and
- Broms, B.B, Lateral Resistance of Piles in Cohesive Soils, Journal of the Soil Mechanics and Foundations Division, ASCE 90 (SM2): 27-63, 1964.

The coefficient of lateral subgrade reaction in sandy silt/ sand deposits is assumed to increase linearly with the depth below the grade, inversely with the diameter of the caisson pile and directly with the coefficient of horizontal subgrade reaction (a coefficient which varies with soil properties and not with soil-pile interaction). The coefficient of lateral subgrade reaction in cohesionless soils can be estimated as follows:

$$\mathbf{K_s = n_h\ z/D}$$

Where K_s = coefficient of lateral subgrade reaction (kN/m3)
n_h = coefficient of horizontal subgrade reaction (kN/m3)
z = depth (m)
D = pile diameter (m)

The recommended soil parameters for the design of caisson foundation units are given in table blow.

Soil Types	Coefficient of Horizontal Subgrade Reaction, nh (kN/m3)	Bulk Unit Weight, γ (kN/m3)	Angle of Internal Friction, Φ (°)
Sandy Silt	3×103 (above water) 2×103 (below water)	21	34
Sand	3×103 (below water)	20	38

As the caisson piles are generally below prevailing ground water level, the submerged soil unit weight (Bulk Unit weight - 9.8 kN/m3) should be used.

5.1.1.3 Uplift Resistance

A caisson pile embedded for a minimum of 1 m into the sound/unweathered bedrock may be designed using a working adhesion of 400 kPa. Note the pile weight also contributes the uplift resistance.

5.1.1.4 Construction Considerations

The borehole indicates that the overburden at this site consists of the earth fill, sandy silt and sand deposits. Water seepage can be expected from earth fill zone and sandy silt to silty sand/silt. It is therefore recommended that temporary liner(s) be made available on-site to support the caisson sidewalls and to provide seepage cut-off as and where required, and the caisson is well socketed into the bedrock for effective groundwater seepage cut-off.

The concrete should be poured expeditiously on completion of the caisson hole. It is recommended that the concrete be placed by the tremie method in accordance with OPSS.MUNI 904 as soon as the hole reaches its desired depth and the base is approved for concrete placement. The liner should be withdrawn as concrete is placed. During liner withdrawal, the level of concrete in the caisson hole must always be at least 0.6 m above the bottom of the temporary liner.

We recommend that the following notes be included in the contract documents:

- The strata may consist of fill material and wet sandy silt to sand native soil deposits. Ground water would be encountered above the base of the excavations.

- The contractor shall maintain the stability of the soil along the sides and at the base of the hole for the concrete placement at all times from the commencement of their construction to the placement of concrete.

- Positive ground water control and/or temporary liners may be required to maintain a sufficiently dry condition for proper caisson excavation, stability of the base and placement of concrete.

Caisson construction should be monitored by a geotechnical engineer to verify the soil conditions and to confirm that the caisson foundation subgrade conditions are consistent with the design assumptions made in this report. Excavations should be undertaken in accordance with OPSS 902, and caissons should be constructed in accordance with OPSS MUNI 903.

5.1.2 Ground Improvement

In lieu of the deep foundation system, the ground may be improved using the Geopier technique in order to support the structure on the conventional spread footing foundations. The detailed design information will be provided by the selected Design/Build contractor. The following section provides the brief design information.

Geopier elements are typically constructed to a level of 150 to 300 mm above the proposed footing bases. The foundations are then installed on top of the Geopier elements. The installation of Geopier foundations shall comply with applicable OPSS, ASTM and manufacturer's specifications. Vibration monitoring should be conducted during Geopier installation if this option is to be employed.

The Geopier installation results in strengthening and stiffening of subsurface soils which would allow foundations to be supported with comparatively higher bearing capacity to be provided by the selected Design/Build contractor. There are specific companies that specialize in the design and construction services for Geopier and can provide further information on the feasibility of this method, including detailed design, methodology, installation, bearing capacity and certification. Typically, a net geotechnical reaction of 200 to 400 kPa can be achieved by such ground improvement techniques. The main advantage of such system is that the foundations and basement slab can be constructed using conventional construction approach instead of incorporation if pile caps, grade beams etc.

5.1.3 Helical Piles

Alternatively, consideration may be given to support the building foundations on helical screw piles. Helical screw anchors (see enclosed information) could be drilled into the underlying dense to very dense undisturbed native soils to sufficient depth in order to obtain adequate resistance for the required support. Screw anchors require little to no excavation for installation, does not generate any soil spoils and can be installed with a portable equipment which could be advantageous in difficult access areas such as this site. The anchor is drilled deep into the competent soil providing sufficient resistance. The anchor is repeatedly extended deeper with extension rods. A pile cap/grade beam is constructed to transfer the structure's load into the underlying deeper and competent soils through helical piers. Helical piles can be supported on the underlying dense to very dense soil deposit.

There are specialized design/build companies who can review and provide detailed design for the helical pile foundation system. The average soil parameters are provided in Section 5.2 of this report.

5.1.4 Foundation Installation

The foundation installations must be reviewed in the field by Terraprobe. The on-site review of the condition of the foundation subgrade, as the foundations are constructed, is an integral part of the geotechnical engineering design function, and is not to be considered as third-party inspection services. If Terraprobe is not retained to carry out all of the foundation evaluations during construction, then Terraprobe accepts no responsibility for the performance of the foundations.

The underside of footing/pile cap elevations must be designed to provide a minimum of 1.2 m of soil cover or equivalent insulation to the foundation subgrade for frost protection considerations in unheated areas.

Prior to pouring foundation concrete, the foundation subgrade should be cleaned of all deleterious materials such as topsoil, fill, softened, disturbed or caved materials, as well as any standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the foundation subgrade and concrete must be provided.

5.2 Earth Pressure Design Parameters

Walls or bracings subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

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

Where:
- P = the horizontal pressure at depth h (kPa)
- K = the earth pressure coefficient
- h_w = the depth below the ground water level (m)
- γ = the bulk unit weight of soil (kN/m^3)
- γ_w = the bulk unit weight of water (9.8 kN/m^3)
- γ' = the submerged unit weight of the exterior soil, ($\gamma_{sat} - \gamma_w$)
- q = the complete surcharge loading (kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, this equation can be simplified to:

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

This equation assumes that free-draining granular backfill is used and positive drainage is provided to ensure that there is no hydrostatic pressure acting in conjunction with the earth pressure.

Resistance to sliding of retaining structures is developed by friction between the base of the footing and the soil. This friction **(R)** depends on the normal load on the soil contact (**N**) and the frictional resistance of the soil (**tan ϕ**) expressed as **$R = N \tan \phi$**. The factored geotechnical resistance at ULS is **0.8 R**.

Passive earth pressure resistance is generally not considered as a resisting force against sliding for conventional retaining structure design because a structure must deflect significantly to develop the full passive resistance.

The average values for use in the design of structures subject to unbalanced earth pressures within the excavation/shoring zone for this project site are tabulated as follow:

Parameter	Definition	Units
ϕ	angle of internal friction	degrees
γ	bulk unit weight of soil	kN/m^3
K_a	active earth pressure coefficient (Rankine)	dimensionless
K_o	at-rest earth pressure coefficient (Rankine)	dimensionless
K_p	passive earth pressure coefficient (Rankine)	dimensionless

Stratum/Parameter	γ	Φ	K_a	K_o	K_p
Earth Fill	18.0	28	0.36	0.53	2.77

Stratum/Parameter	γ	Φ	K_a	K_o	K_p
Sandy Silt	21.0	34	0.28	0.44	3.54
Sand	20.0	38	0.24	0.38	4.20

The values of the earth pressure coefficients are for the horizontal backfill grade behind the wall. The earth pressure coefficients for inclined grade will vary based on the inclination of the retained ground surface.

5.3 Earthquake Design Parameters

Under Ontario Regulation 88/19, the ministry amended Ontario's Building Code (O. Reg 332/12) to further harmonize Ontario's Building Code with the 2015 National Codes. These changes will help reduce red tape for businesses and remove barriers to interprovincial trade throughout the country. The amendments are based on code change proposals the ministry consulted in 2016 and 2017. The majority of the amendments came into effect on January 1, 2020, which includes structural sufficiency of buildings to withstand external forces and improve resilience.

Seismic hazard is defined in the 2012 Ontario Building Code (OBC 2012) by uniform hazard spectra (UHS) at spectral coordinates of 0.2 s, 0.5 s, 1.0 s and 2.0 s and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g. shear wave velocity (v_s), Standard Penetration Test (SPT) resistance, and undrained shear strength (s_u)) in the top 30 meters of the site stratigraphy below the foundation level, as set out in Table 4.1.8.4A of the Ontario Building Code (2012). There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g. sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain peak ground acceleration (PGA), peak ground velocity (PGV) site coefficients Fa and Fv, respectively, used to modify the UHS to account for the effects of site-specific soil conditions.

Based on the above noted information, it is recommended that the site designation for seismic analysis be **Site Class C**, as per Table 4.1.8.4.A of the Ontario Building Code (2012). Consideration may be given to conducting a site-specific Multichannel Analysis of Surface Waves (MASW) at this site to determine the average shear wave velocity in the top 30 metres of the site stratigraphy.

The values of the site coefficient for design spectral acceleration at period T, F(T), and of similar coefficients F(PGA) and F(PGV) shall conform to Tables 4.1.8.4.B. to 4.1.8.4.I. using linear interpolation for intermediate values of PGA.

5.4 Basement Floor Slab

The slab will be made on a subgrade of existing earth fill, engineered fill or native sand. The existing earth fill, when compacted in place, is considered suitable for the support of a lightly loaded slab on grade. The modulus of subgrade reaction appropriate for slab on grade design is 18,000 kPa/m for compacted earth fill.

Prior to the construction of the slab on grade, it is recommended that the existing earth fill or native sand be proof-rolled and inspected under the supervision of Terraprobe for obvious loose or disturbed areas as exposed, or for areas containing excessively deleterious materials or moisture. These areas shall be recompacted in place and retested, or else replaced with Granular B placed as engineered fill (in lifts 150 mm thick or less and compacted to a minimum of 98 percent SPMDD).

The basement floor slab should be provided with a capillary moisture barrier and drainage layer. This can be made by placing the slab on a minimum of 200 mm thick 19 mm clear stone layer (OPSS.MUNI 1004) compacted by vibration to a dense state. This material also serves as the drainage media for the subfloor drainage system. Provision of subfloor drainage is required in conjunction with the perimeter drainage of the structure. Suitable geotextile (for instance OPSS.MUNI 1860 Class II non-woven geotextile) needs to be placed to separate granular base course from the subgrade to prevent migration of soil fines where the silt/sand subgrade soils are encountered.

The subfloor drainage system is an important building element, as such the storm sumps which ensure the performance of this system must have a duplexed pump arrangement for 100 percent pumping redundancy provided with emergency power. Basement and subfloor drainage provisions are further discussed in Section 5.5 of this report.

5.5 Basement Drainage

To assist in maintaining dry basements and preventing seepage, it is recommended that exterior grades around the building be sloped away at a 2 percent gradient or more, for a distance of at least 1.2 m. Provision of subfloor drainage is required in conjunction with the perimeter drainage of the structure, to collect and remove the water that infiltrates at the building perimeter and under the floor. Perimeter and subfloor drainage are required throughout below grade areas for a drained structure.

It is recommended that the subfloor drainage system consists of minimum 100 mm diameter perforated pipes spaced at a maximum of 6 metres on centre. The pipes must be surrounded by a minimum of 100 mm of 19 mm clear stone, and the pipe inverts should be a minimum 300 mm below the base of the slab. A subdrain detail is provided in Figure 4.

Foundation walls must be damp proofed in conformance to Section 5.8.2 of the Ontario Building Code (2012). Prefabricated drainage composites, such as Miradrain 2000 (Mirafi) or Terradrain 200 (Terrafix), should be incorporated between the shoring wall or backfill and the cast-in-place concrete foundation wall to make a drained cavity. Drainage from the cavity must be collected at the base of the wall in non-perforated pipes and conveyed directly to the sumps. The flow to the building sump from the subsurface drainage system will be governed largely by the building perimeter drainage collection during rainfall and runoff events. Typical excavation drainage details are provided in Figure 3A & 3B.

The drainage system is a critical structural element since it keeps water pressure from acting on the basement floor slab or on the foundation walls. As such, the sump that ensures the performance of this system must have a duplexed pump arrangement for 100% pumping redundancy and these pumps must be on emergency power. The size of the pump should be adequate to accommodate the anticipated storm event flows. It is expected that the seepage can be controlled with typical widely available, commercial sump pumps. A hydrogeological report has been prepared by Terraprobe under a separate cover (File No. 1-22-0531-46) to address anticipated water flow into the building.

5.6 Pavement

Design recommendations for the entrance driveway are provided in this section. For the pavement structure supported on concrete deck, recommendations will be provided during the detailed design stage in consultation with the design team.

5.6.1 Pavement Design

The asphalt pavement design for the entrance driveways and internal private road supported on soil subgrade is provided in the following table. Note the proposed pavement structure meets the minimum requirements for the internal private roadways provided in *Section 6 – Design Requirements* of *Development Requirement Manual.*

Pavement Structural Layers	Driveway/Fire Route	Minimum Requirements
HMA Surface Course, OPSS.MUNI 150 HL 3	40 mm	40 mm
HMA Binder Course, OPSS.MUNI 1150 HL 8	85 mm	65 mm
Granular Base Course, OPSS.MUNI 1010 Granular A	200 mm	200 mm
Granular Subbase Course, OPSS.MUNI 1010 Granular B Type I	300 mm	250 mm
Total Thickness	625 mm	555 mm

HL 3 and HL 8 hot mix asphalt mixes should be designed, produced and placed in conformance with OPSS 1150 and OPSS.MUNI 310 requirements and the relevant City's requirements.

Both the Granular A and Granular B Type I materials should meet the requirements of OPSS.MUNI 1010 requirements and the relevant City's standards. Granular materials should be compacted to 100 percent of SPMDD.

HL3 HS hot mix asphalt is recommended as padding. Padding should be placed in lifts not exceeding 50 mm.

Performance graded asphalt cement, PG 58-28, conforming to OPSS.MUNI 1101 requirements, should be used in both HMA binder and surface courses.

A tack coat (SS1) should be applied to all construction joints prior to placing hot mix asphalt to create an adhesive bond. SS1 tack coat should also be applied between hot mix asphalt binder and surface courses.

5.7 Excavations

The boreholes data indicate that the earth fill materials and undisturbed native soils would be encountered in the excavations. Excavations must be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety.

TYPE 1 SOIL

a. is hard, very dense and only able to be penetrated with difficulty by a small sharp object;
b. has a low natural moisture content and a high degree of internal strength;
c. has no signs of water seepage; and
d. can be excavated only by mechanical equipment.

TYPE 2 SOIL

a. is very stiff, dense and can be penetrated with moderate difficulty by a small sharp object;
b. has a low to medium natural moisture content and a medium degree of internal strength; and
c. has a damp appearance after it is excavated.

TYPE 3 SOIL

a. is stiff to firm and compact to loose in consistency or is previously-excavated soil;
b. exhibits signs of surface cracking;
c. exhibits signs of water seepage;
d. if it is dry, may run easily into a well-defined conical pile; and
e. has a low degree of internal strength

TYPE 4 SOIL

a. is soft to very soft and very loose in consistency, very sensitive and upon disturbance is significantly reduced in natural strength;
b. runs easily or flows, unless it is completely supported before excavating procedures;
c. has almost no internal strength;
d. is wet or muddy; and
e. exerts substantial fluid pressure on its supporting system.

The earth fill materials encountered in the boreholes are classified as Type 3 Soil, while the undisturbed native soils would be classified as Type 2 Soil above and Type 3 Soil below prevailing ground water level under these regulations.

Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates the steepest slopes of excavation by soil type as follows:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in the Occupational Health and Safety Act and Regulations for Construction Projects, and include provisions for timbering, shoring and moveable trench boxes.

It must be noted that larger size particles that are not specifically identified in the boreholes may be present in the earth fill (e.g. construction debris or other obstructions) or in the sand (e.g. cobbles and boulders). The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples of particles of this size. Provision must be made in the excavation contracts to allocate risks associated with the time spent and equipment utilized to remove or penetrate such obstructions when encountered.

5.8 Groundwater Control

Terraprobe has completed Hydrogeological Report (File No. 1-22-0531-46) for this site to provide ground water control measures and estimate ground water discharge volume (Refer to this report for detailed information about ground water volumes, quality and control provisions).

The ground water levels measured in the monitoring wells installed in Boreholes 10, 102, 103 and 105 on March 23, April 3, 2018; October 4, 2019, and September 19, 30 and October 13, 2022 generally ranged from about Elev. 130.5 m to Elev. 132.1 m. For the practical purposes, the design ground water level may be taken as Elev. 132.1 m. The finished floor elevation (FFE) for the single level of basement would be set at Elev. 137.55 m. The earth fill and the sandy silt and sand at the site are generally cohesionless and allow for the free flow of water. In general, the volume of water anticipated to flow into open excavations is such that temporary pumping from the excavations is expected to suffice for the control of the seepage using a conventional sump pump system.

For excavations extending below the prevailing ground water level, it will be necessary to lower the ground water level and maintain it below the excavation base (at least 1.0 m) prior to and during the subsurface construction. A professional dewatering expert should review the subsurface information to assess the potential requirement of dewatering and establish appropriate dewatering methodology which will be responsibility of the dewatering contractor. Consideration should be given to install a skim coat of lean concrete (mud-slab) to preserve the subgrade integrity, and to provide a working platform as required based on site conditions.

5.8.1 Regulatory Requirements

The volume of water entering the excavation will be based on both ground water infiltration and precipitation events. Based on recent regulation changes within O.Reg. 63/16, the following dewatering limits and requirements are as follows:

- Construction Dewatering less than 50,000 L/day: The taking of both ground water and storm water does not require a Construction Dewatering Assessment Report (CDAR) and does not require a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).
- Construction Dewatering greater than 50,000 L/day and less than 400,000 L/day: The taking of ground water and/or storm water requires a Construction Dewatering Assessment Report (CDAR) and does not require a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).
- Construction Dewatering greater than 400,000 L/day: The taking of ground water and/or storm water requires a Construction Dewatering Assessment Report (CDAR) and requires a Permit to Take Water (PTTW) from the Ministry of the Environment and Climate Change (MOECC).

If it is expected that greater than 50,000 L/day of water will be pumped, a CDAR and/or a PTTW should be obtained as soon as possible in advance of construction to avoid possible delays. Depending on the construction methodology for the site servicing (trench boxes or open cut, and length of trench) and the time of year (high versus low ground water levels), there is the possibility that water taking of greater than 50,000 L/day may occur at this site.

A CDAR takes up to 1 month to complete if monitoring wells are already installed on site. Once the CDAR is completed, it is uploaded to the Environmental Activity and Sector Registry (EASR), which registers the construction dewatering with the MOECC without the need for a permit. If the results of the CDAR indicate that greater than 400,000 L/day will be pumped, a PTTW application must be submitted to the MOECC. A PTTW application can take up to an additional 3 months for the MOECC to process upon completion of the CDAR. Note that Environmental Compliance Assessments, Impact Study Reports and applicable municipal, provincial and conservation authority approvals (completed by others) will be required as part of the CDAR.

5.9 Backfill

The native soils are considered suitable for backfill provided the moisture content of these soils is within 3 percent of the Optimum Moisture Content (OMC). It should be noted that there may be wet zones within the subsurface soils which could be too wet to compact. Any soil material with 3 percent or higher in-situ moisture content than its OMC, could be put aside to dry or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content could be wasted and replaced with imported material which can be readily compacted.

In settlement sensitive areas, the backfill should consist of clean earth and should be placed in lifts of 150 mm thickness or less, and heavily compacted to a minimum of 95 percent Standard Proctor Maximum Dry Density (SPMDD) at a water content close to OMC (within 3 percent). The upper 1.2 m of the pavement subgrade must be compacted to a minimum of 98 percent SPMDD.

It should be noted that the soils encountered on the site are generally not free draining, and will be difficult to handle and compact should they become wetter as a result of inclement weather or seepage. Hence, it can be expected that the earthworks will be difficult and may incur additional costs if carried out during wet periods (i.e. spring and fall) of the year.

5.10 Shoring Design Consideration

Decisions regarding shoring methods and sequencing are the responsibility of the Contractor. Temporary shoring system design should be carried out by a licensed Professional Engineer experienced in shoring design.

A special attention should be made along the proposed excavation shoring sections adjacent to the limits of the existing building. No excavation shall extend below a line cast as one vertical to one horizontal from foundations of the existing structure without adequate alternate support being provided. Underpinning guidelines are provided in Figure 5.

The shoring requirements for the site will have to be examined in detail with respect to the proximity of existing structures and site boundary constraints. Depending upon the site conditions, the shoring system may need to consist of a rigid (interlocking drilled caissons) and a steel soldier piles and timber lagging shoring system. The site conditions must be carefully assessed by the shoring designer to select appropriate type of shoring system in light of the close proximity of the existing high-rise buildings. It is imperative that the shoring system provides adequate support to the existing building foundations.

5.10.1 Earth Pressure Distribution

Applicable soil parameters are included in the Earth Pressure Design Parameters Section (Section 5.2).

If a single level of support will be required for shoring system, a triangular earth pressure distribution similar to that used for the basement wall design, is appropriate for this case,

$$\mathbf{P = K(\gamma h + q)}$$

Where:

P = the horizontal pressure (kPa)
K = the earth pressure coefficient
h = the total depth of excavation (m)
γ = the bulk unit weight of soil (kN/m^3)
q = the complete surcharge loading (kPa)

Where multiple supports are used to support the excavation, research has shown that a distributed pressure diagram more realistically approximates the earth pressure on a shoring system of this type, when restrained by pre-tensioned anchors.

The borehole data indicate that sandy silt/silty sand/sand depoists would be encountered in the excavations. For the cohesionless soils (sandy silt/silty sand/sand) a multi-level supported shoring system can be designed based on an earth pressure distribution consisting of a rectangular pressure distribution with a pressure defined by:

$$\mathbf{P = 0.65\ K(\gamma H + q)}$$

Where:

P = the horizontal pressure (kPa)
K = the earth pressure coefficient
γ = the bulk unit weight of soil (kN/m^3)
H = the total depth of excavation (m)
q = the complete surcharge loading (kPa)

5.10.2 Soldier Pile Toe Design

It is envisaged that the soldier pile will be generally socketed in the sandy silt/ sand deposits. The horizontal resistance of the soldier pile toes will be developed by the embedment below the excavation base where resistance is developed from passive earth pressure. It is noted that where soils exist beneath the ground water level, the unit weight of the soil is diminished by buoyancy, and therefore, the resistance from these soils will be different depending on whether the soils are dewatered, or remain below the nominal ground water level. Therefore, the design of the shoring should consider the construction plan and sequence with respect to the depth of ground water control. There may be zones of material within the subsurface soils which may be wet and permeable such that augered borings for soldier piles made into these soils may be unstable. In these cases, it will be necessary to advance temporarily cased holes to prevent excess caving during the soldier pile installations.

5.10.3 Shoring Support

It will be necessary to secure encroachment agreements from the City and the adjacent landowners, in order to use soil anchors on the adjacent properties. Pre-construction condition surveys should be carried out for the adjacent structures to establish existing conditions prior to excavation and mitigate the possibility of spurious claims for excavation induced damages. Access to the properties for such surveys must be part of any encroachment agreements.

Due to the highly variable nature of the subsurface soils expected to be present within bond zone, a careful evaluation of the subsurface soil conditions is required by the shoring designer to establish appropriate levels/elevations and design of the soil anchors. The anchor design will be governed by the weakest material in the profile. It is imperative that a detailed design is carried out at every different anchor level and location, and the anchors must be tested at each level.

Consideration should be given a post-grouted anchor system which may be a more feasible option for this site. The design adhesion for post-grouted earth anchors is controlled as much by the installation technique as the soil and therefore a proto-type anchor must be made and performance tested at each anchor level executed to demonstrate the anchor capacity and validate the design assumptions. This test must be completed before production anchors are made. Depending upon the location and elevation of the soil anchors, the post-grouted anchors at this site may carry an **ultimate** transfer load of about 70 to 90 kN/m made in sandy silt/sand deposit of post-grouted anchor length (of nominal 150 mm diameter) depending upon the material type as confirmed by a performance/load test. It should be noted that these values are provided as preliminary guidance only and the bond strength values to be used for design and the actual anchor performance must be verified by a performance/load test.

Regardless, the subsurface soil information should be reviewed by the shoring designer to decide on the suitable type of earth anchors and design capacity values to be employed at this site.

If adjacent landowners are not agreeable to anchored support, then internal bracing or rakers would be necessary. The footings for the rakers would be made in sandy silt/sand deposits where they could be designed for a bearing pressure of 300 kPa when inclined at 45 degrees.

A careful review of the new excavation for the basement and the existing foundations in the proximity should be carried out. If the new excavation encroaches in to the soil bearing zone of the existing foundations, then it is imperative that the integrity of the existing foundation subgrade is maintained through adequately designed and constructed shoring system or by underpinning (refer to Figure 4), as required.

5.11 Quality Control

Excavations on this site must be shored to preserve the integrity of the surrounding properties and structures. The Ontario Building Code 2012 stipulates that engineering review of the subsurface conditions is required on a continuous basis during the installation of earth retaining structures. Terraprobe should be retained to provide this review, which is an integral part of the geotechnical design function as it relates to the shoring design considerations. Terraprobe can provide detailed shoring design services for the project, if requested.

All foundations must be monitored by the geotechnical engineer on a continuous basis as they are constructed. The on-site review of the condition of the foundation soil as the foundations are constructed is an integral part of the geotechnical design function and is required by Section 4.2.2.2 of the Ontario Building Code 2012. If Terraprobe is not retained to carry out foundation evaluations during construction, then Terraprobe accepts no responsibility for the performance or non-performance of the foundations, even if they are ostensibly constructed in accordance with the conceptual design advice provided in this report.

Concrete for this structure will be specified in accordance with the requirements of CAN3 - CSA A23.1. Terraprobe maintains a CSA certified concrete laboratory and can provide concrete sampling and testing services for the project as necessary.

The requirements for fill placement on this project should be stipulated relative to Standard Proctor Maximum Dry Density (SPMDD), as determined by ASTM D698. In-situ determinations of density during fill placement by Procedure Method B of ASTM D2922 are recommended to demonstrate that the contractor is achieving the specified soil density. Terraprobe is a CNSC licensed operator of appropriate nuclear density gauges for this work and can provide sampling and testing services for the project as necessary.

Terraprobe can provide thorough in house resources, quality control services for Building Envelope, Roofing, as well as Structural Steel in accordance with CSA W178, as necessary, for the Structural and Architectural quality control requirements of the project. Terraprobe is certified by the Canadian Welding Bureau under W178.1-1996.

6 LIMITATIONS AND RISK

6.1 Procedures

This subsurface investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained by Terraprobe.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

6.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Ground water levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from this investigation made at the site by Terraprobe and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

This report was prepared for the express use of Straight Investments. and their retained design consultants and is not for use by others. This report is copyright of Terraprobe Inc. and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe and Hanseatic Holdings Ltd. who are the authorized users.

It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

We trust the foregoing information is sufficient for your present requirements. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Yours truly,
Terraprobe Inc.

B. Singh, M. Sc.., P.Eng.
Principal

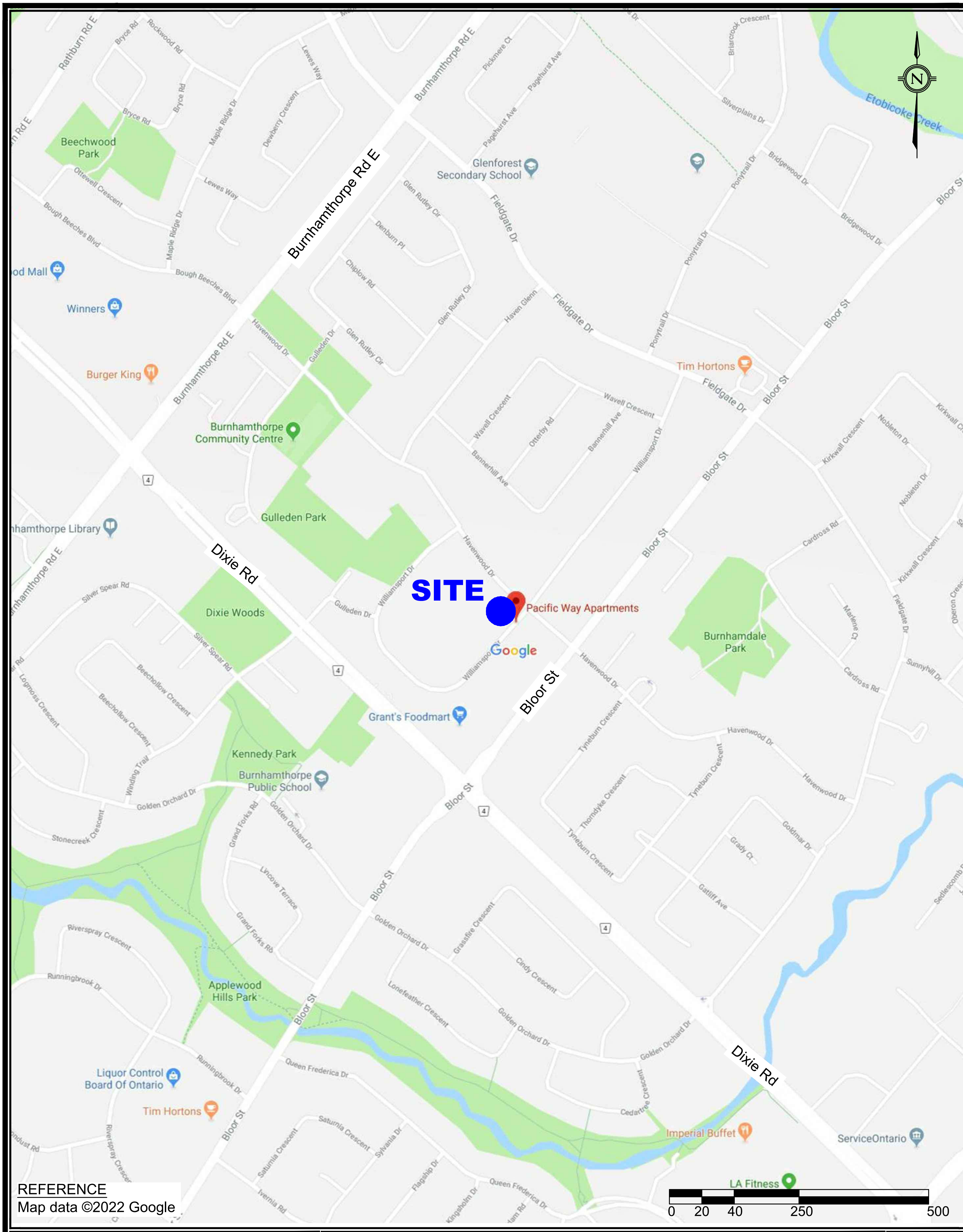
Seth Zhang, M. Eng, M.Sc., P.Eng
Associate

ENCLOSURES

TERRAPROBE INC.

FIGURES

TERRAPROBE INC.



REFERENCE
Map data ©2022 Google

Terraprobe

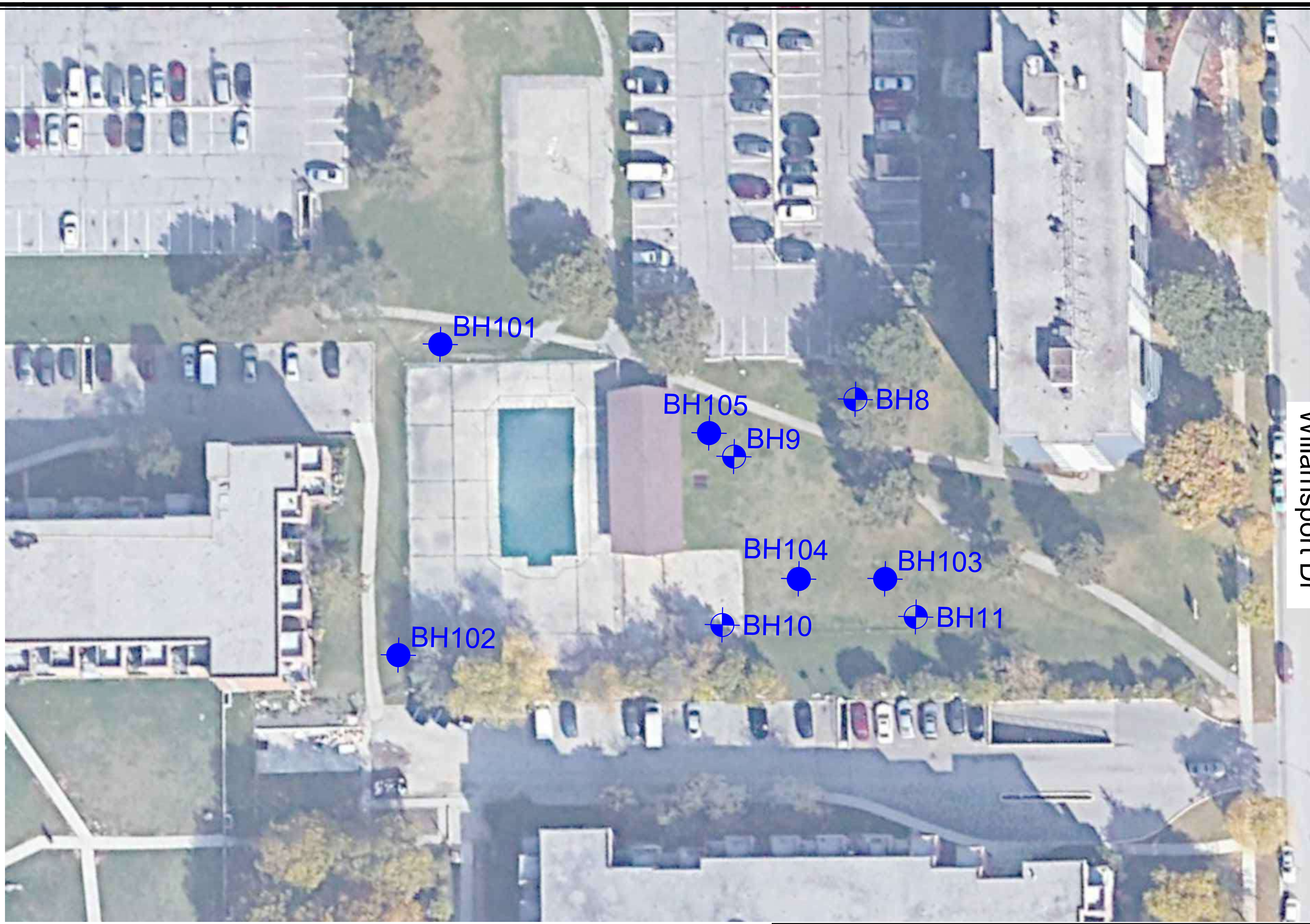
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: **SITE LOCATION PLAN**

FIGURE : 1

File. No.: 1-22-0531-01

Y:\Shared\CA\Terraprobe\Brampton\1-Project Files\2022\1-22-0531 - 1485 Williamsport Drive, Mississauga\01-Geotechnical Investigation\A. Dwgs, Logs\AutoCAD\1-22-0531-01 Figs.dwg, DWG To PDF.pc3, Kamal, Kamal



REFERENCE
Image © 2022 Google

LEGEND
Borehole Location (2022)
Borehole Location (2018)

0 5 10 15 20
SCALE 1:500

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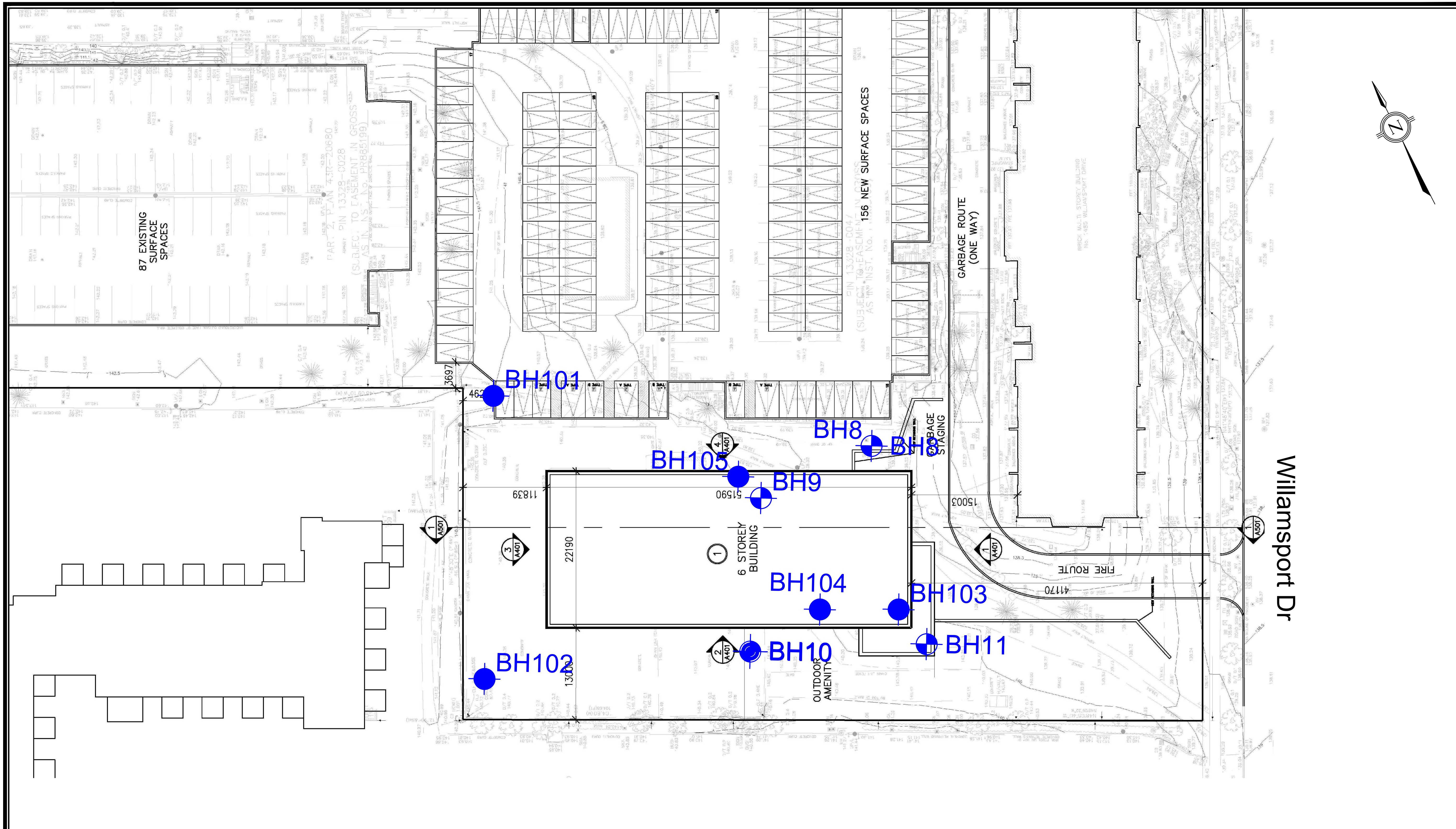
Title:
BOREHOLE LOCATION PLAN
Existing Condition

File No.
1-22-0531-01

FIGURE :
2



REFERENCE
Project: Pacific Way
Title: Site Plan, Proj. No.: 21-15
Date: Sep 12, 2022, Dwg. No.: A101
By: Architectureunfolded

LEGEND
Borehole Location (2022)
Borehole Location (2018)

SCALE 1:500

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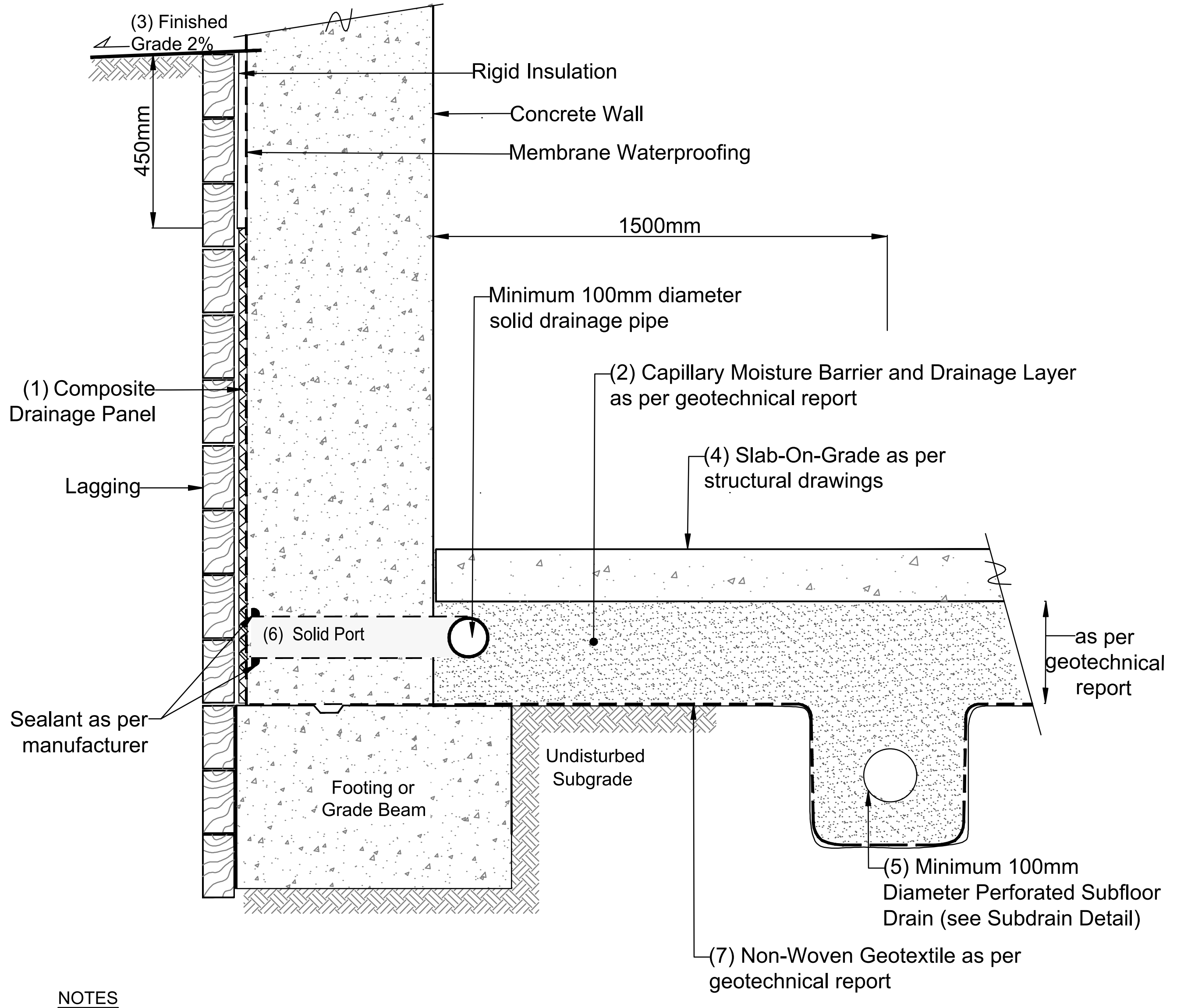
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: **BOREHOLE LOCATION PLAN**
Proposed Condition

File No. 1-22-0531-01

FIGURE : 2B



NOTES

1) Prefabricated composite drainage panels to consist of Miradrain 6000, or approved equivalent. Panels should provide continuous cover as per manufacturer's requirements.

2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS. MUNI 1004), or as indicated in geotechnical report, compacted to a dense state. Upper 50mm can be replaced with Granular “A” (OPSS. MUNI 1010) compacted to 98% SPMDD where vehicular traffic is required. A vapour barrier may be required depending on floor type.

3) Exterior finished grade away from wall at a minimum grade of 2% for min. 1.2m.

4) Building floor slab-on-grade shall not be structurally connected to foundation wall or footing.

5) Subfloor drain invert to be a minimum of 300mm below underside of floor slab, to be set in parallel rows, one way, and at the spacing specified in the geotechnical report. Don't connect subfloor drains to perimeter drains.

6) Embedded ports to be set a distance of maximum 3m on-centre. Each port to have a minimum cross-sectional area of 1500mm². Perimeter drainage must be collected and conveyed directly to the building sumps in solidpipe.

7) When the subgrade consists of a cohesionless soil, the subgrade must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).

8) Geotechnical report contains specific details. Final detail must be reviewed before system is considered acceptable to use.

N.T.S.

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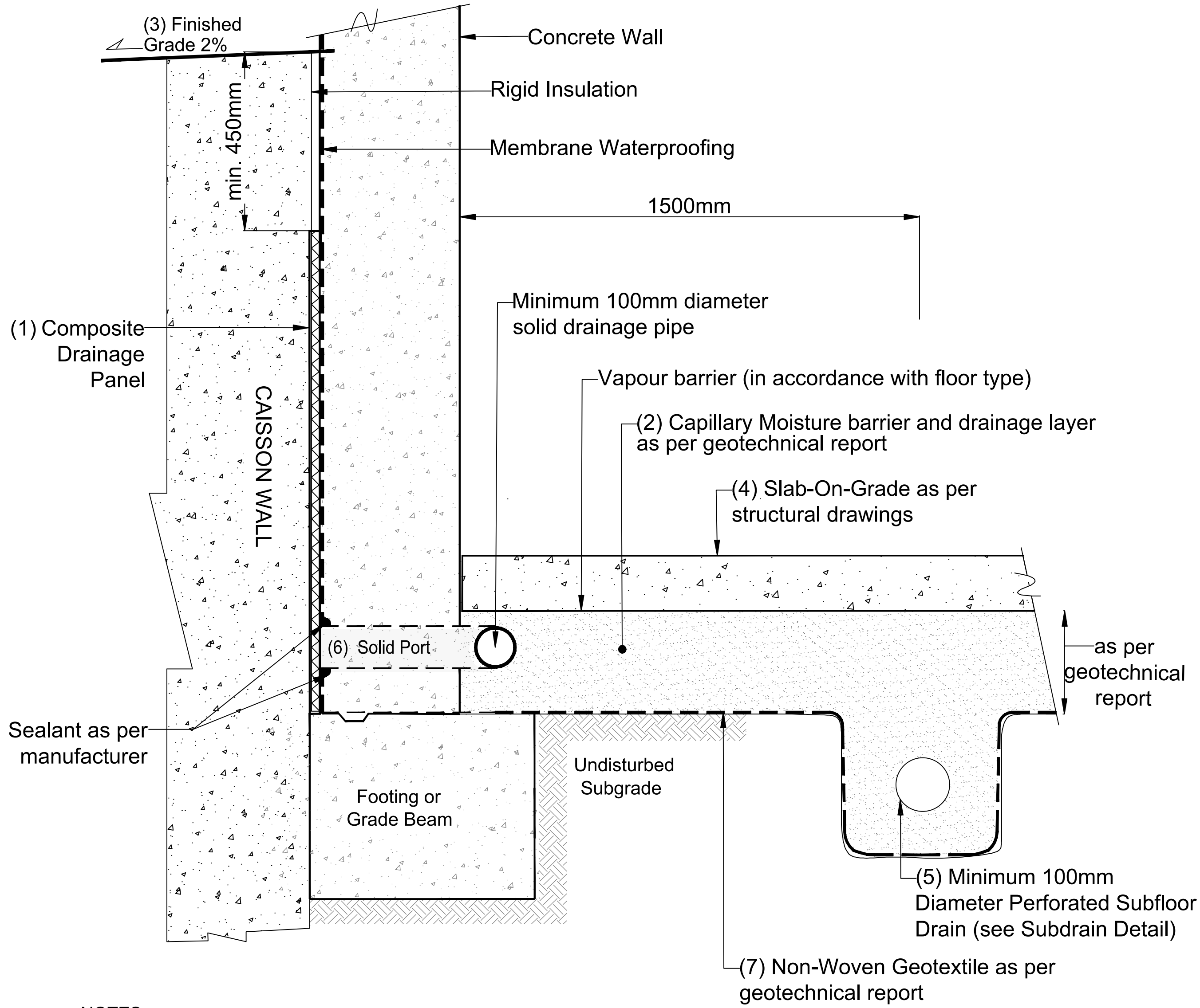
Title:

SCHEMATIC DRAINAGE DETAIL
SOLDIER PILE □ LAGGING SHORING SYSTEM



NOTES

1) Prefabricated composite drainage panels to consist of Miradrain 6000, or approved equivalent. Panels should provide continuous cover as per manufacturer's requirements.
2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS. MUNI 1004), or as indicated in geotechnical report, compacted to a dense state. Upper 50mm can be replaced with Granular “A” (OPSS. MUNI 1010) compacted to 98% SPMDD where vehicular traffic is required. A vapour barrier may be required depending on floor type.
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8) Geotechnical report contains specific details. Final detail must be reviewed before system is considered acceptable to use.

N.T.S

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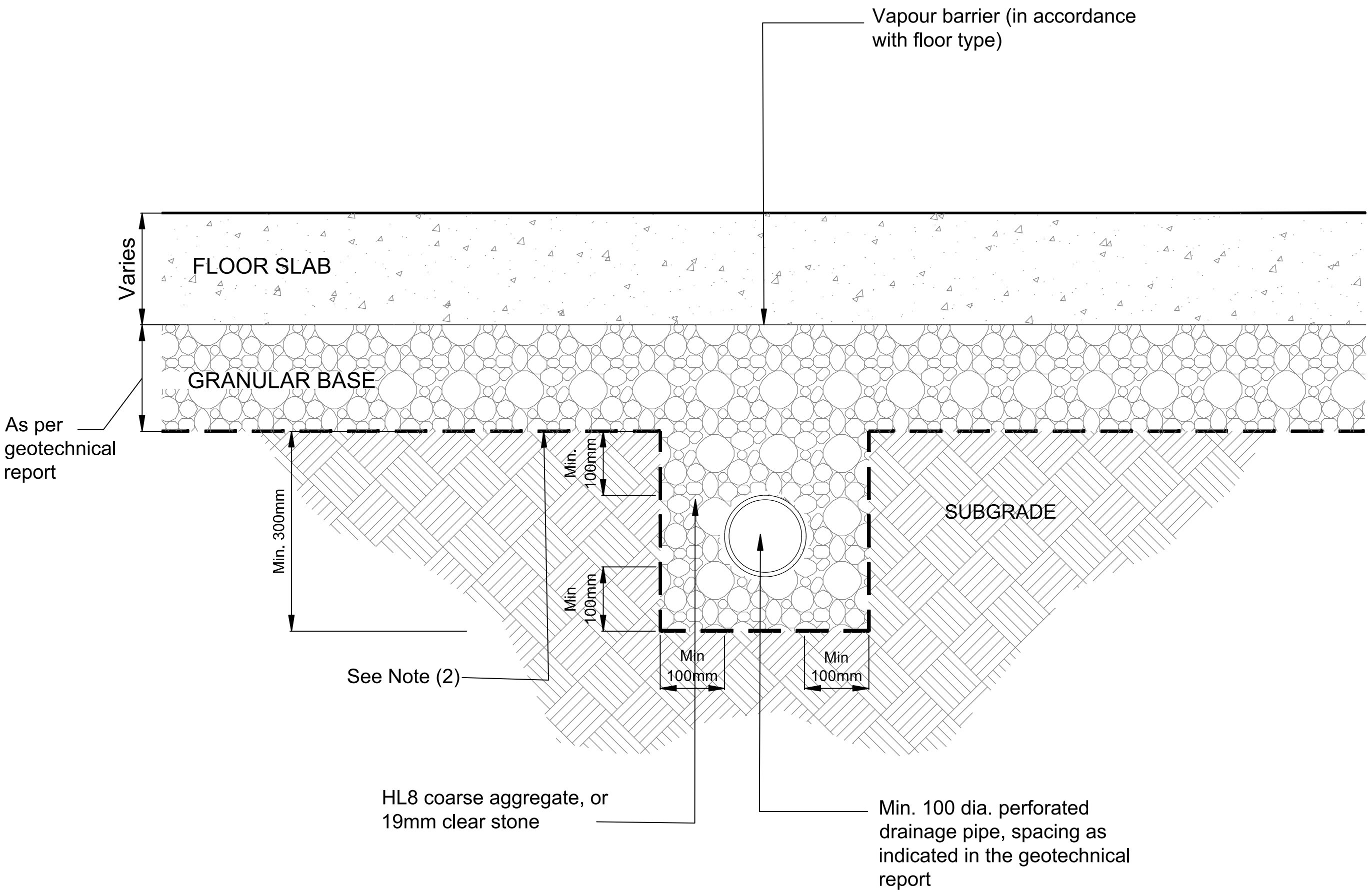
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

SCHEMATIC BASEMENT DRAINAGE DETAIL
CAISSON WALL SHORING SYSTEM



NOTES:

1. Typical schematic only. Must be read in conjunction with Geotechnical Report.
2. When the subgrade consists of cohesionless soil, it must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).
3. Not to Scale

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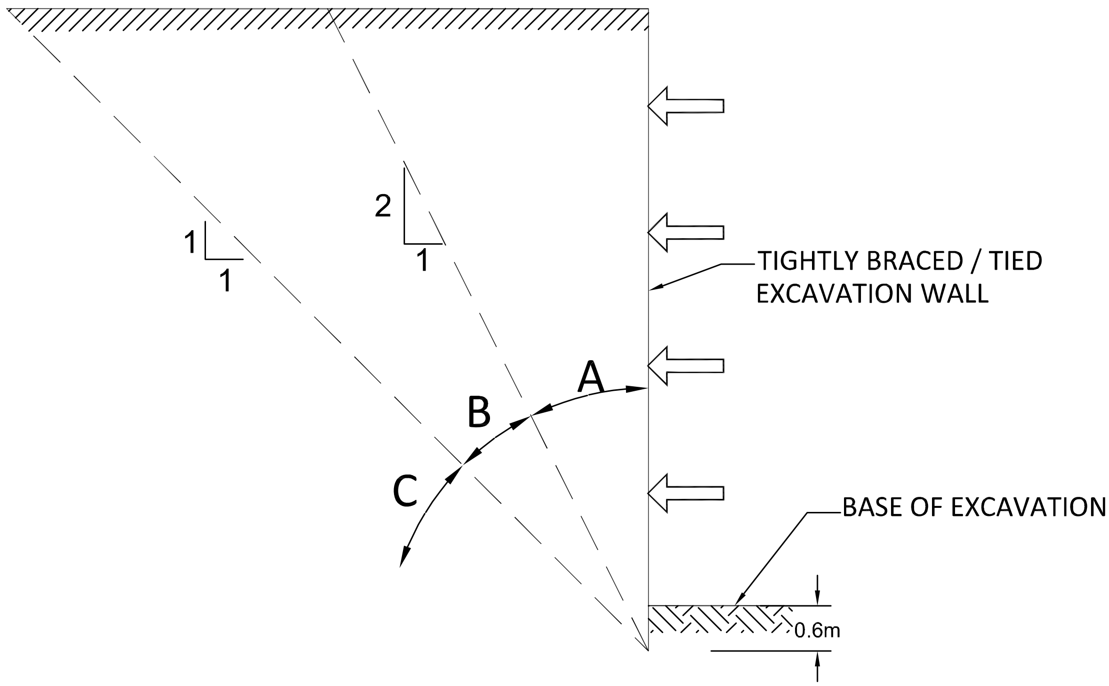
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

TYPICAL BASEMENT SUBDRAIN DETAIL



Zone A: Foundations within this zone often require underpinning. Horizontal and vertical pressures on excavation wall of non-underpinned foundations must be considered.

Zone B: Foundation within this zone often do not require underpinning. Horizontal and vertical pressures on excavation wall of non-underpinned foundations must be considered.

Zone C: Foundations within this zone usually do not require underpinning.

REFERENCE:

User's Guide - NBC 2005 Structural Commentaries
(Part 4 of Division B) - Commentary K

Terraprobe
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Title:

GUIDELINES FOR UNDERPINNING SOILS

APPENDIX A

TERRAPROBE INC.

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silty	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
▼	1st water level measurement
▼	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at or close to plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

Terraprobe

LOG OF BOREHOLE 101

Project No. : 1-22-0531-01 | Client : Starlight Investments | Originated by : ZJ

Date started : September 15, 2022 | Project : 1485 Williamsport Drive | Compiled by : FM

Sheet No. : 1 of 2 | Location : Mississauga, Ontario | Checked by : HR

Position : E: 613375, N: 4830612 (UTM 17T) | Elevation Datum : Geodetic

Rig type : Track-mounted | Drilling Method : Solid stem augers/mud rotary

SOIL PROFILE

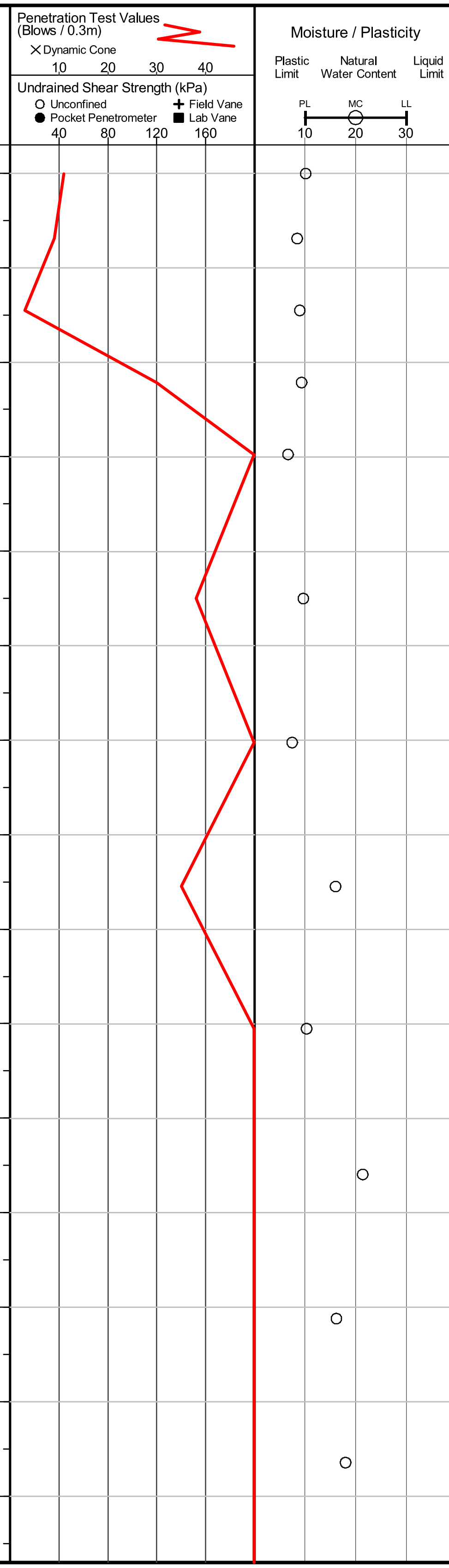
Elev / Depth (m)	Description
140.3	**GROUND SURFACE**
140.0	130mm **ASPHALTIC CONCRETE**
0.3	150mm **AGGREGATE**
	FILL, sandy silt to sand and silt, trace gravel, very loose to compact, brown, moist
138.0 / 2.3	**SANDY SILT**, some clay, trace gravel, compact to very dense, brown, moist
	...sand and gravel, wet
	...sand and gravel, wet
	...wet
	...grey
129.6 / 10.7	**SAND**, some silt, trace gravel, trace clay, very dense, brown, wet

SAMPLES

Number	Type	SPT 'N' Value	Lab Data and Comments (Grain Size Distribution (%) (MIT): GR SA SI CL)
1	SS	11	
2	SS	9	
3	SS	3	
4	SS	30	3 30 48 19
5	SS	57	
6	SS	38	
7	SS	85	
8	SS	35	
9	SS	80 / 265mm	
10	SS	53	
11	SS	52	
12	SS	70	

Depth Scale (m): 0 – 14

Elevation Scale (m): 140 – 126



Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level

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file: 1-22-0531-01 bh logs.gpj

LOG OF BOREHOLE 101

Terraprobe

Project No.	: 1-22-0531-01	Client	: Starlight Investments	Originated by	: ZJ
Date started	: September 15, 2022	Project	: 1485 Williamsport Drive	Compiled by	: FM
Sheet No.	: 2 of 2	Location	: Mississauga, Ontario	Checked by	: HR

Position : E: 613375, N: 4830612 (UTM 17T) — Elevation Datum : Geodetic

Rig type : Track-mounted — Drilling Method : Solid stem augers/mud rotary

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description *(continued)*	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)	Moisture (Natural Water Content, %)
15		**SAND**, some silt, trace gravel, trace clay, very dense, brown, wet *(continued)*		13	SS	64	125	O
16							124	
17		...grey below		14	SS	90 / 290mm	123	O
18	122.0						122	
	121.8 18.5	**INFERRED BEDROCK**, shale fragments (GEORGIAN BAY FORMATION)		15	SS	50/ 50mm		O

Penetration Test Values (Blows / 0.3m): X Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): O Unconfined, + Field Vane, ● Pocket Penetrometer, ■ Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL); 10 20 30

Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level | Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

file: 1-22-0531-01 bh logs.gpj

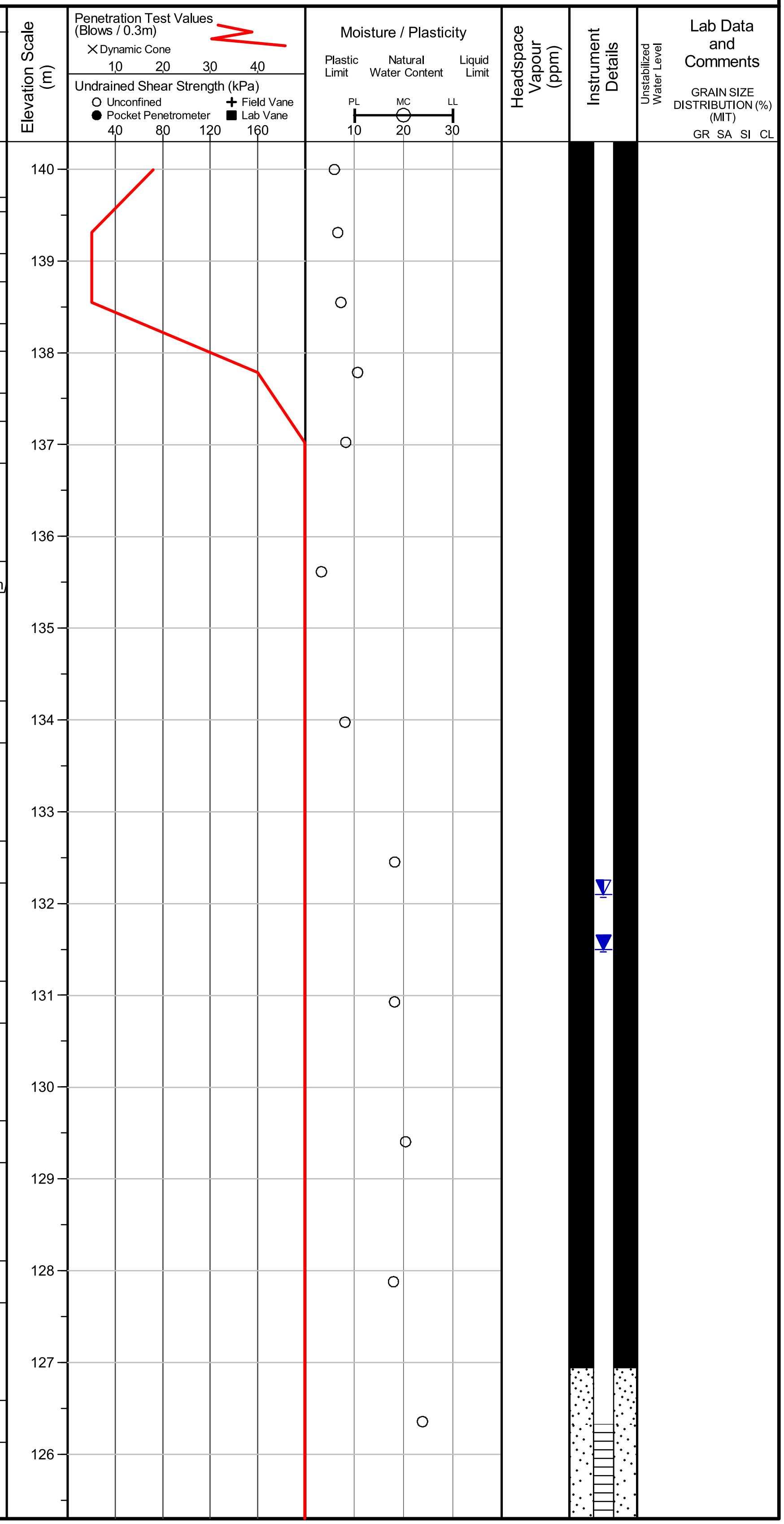
LOG OF BOREHOLE 102

Terraprobe

Project No. : 1-22-0531-01	Client : Starlight Investments		Originated by : ZJ
Date started : September 14, 2022	Project : 1485 Williamsport Drive		Compiled by : FM
Sheet No. : 1 of 2	Location : Mississauga, Ontario		Checked by : HR

Position : E: 613355, N: 4830590 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Track-mounted
Drilling Method : Solid stem augers/mud rotary

Elev (m)	Depth (m)	Description	Sample Number	Type	SPT 'N' Value
140.3	0	GROUND SURFACE			
140.0	0.3	130mm **ASPHALTIC CONCRETE**; 150mm **AGGREGATE**			
		FILL, sandy silt to sand and silt, trace gravel, very loose to compact, brown, moist	1	SS	18
			2	SS	5
			3	SS	5
138.0	2.3	**SANDY SILT**, some clay, trace gravel, compact to very dense, brown, moist	4	SS	40
			5	SS	66
			6	SS	50 / 75mm
			7	SS	53
			8	SS	64
			9	SS	61
			10	SS	65
			11	SS	54
126.4	13.9	**SAND**, some silt, trace gravel, trace clay, very dense, brown, wet	12	SS	57



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LOG OF BOREHOLE 102

Terraprobe

Project No.	: 1-22-0531-01	Client	: Starlight Investments	Originated by	: ZJ
Date started	: September 14, 2022	Project	: 1485 Williamsport Drive	Compiled by	: FM
Sheet No.	: 2 of 2	Location	: Mississauga, Ontario	Checked by	: HR

Position : E: 613355, N: 4830590 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Track-mounted
Drilling Method : Solid stem augers/mud rotary

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description (continued)	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
15		**SAND**, some silt, trace gravel, trace clay, very dense, brown, wet *(continued)*	13	SS	68	125
16						124
17		...shale fragments	14	SS	90 / 250mm	123
18	122.0					122
	122.0 18.3	**INFERRED BEDROCK**, shale fragments (GEORGIAN BAY FORMATION)	15	SS	50 / 50mm	

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40
Undrained Shear Strength (kPa): Unconfined, Field Vane, Pocket Penetrometer, Lab Vane 40 80 120 160
Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL 10 20 30
Headspace Vapour (ppm)
Instrument Details
Unstabilized Water Level
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL

END OF BOREHOLE

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 19, 2022	8.2	132.1
Sep 30, 2022	8.8	131.5
Oct 13, 2022	8.8	131.5

file: 1-22-0531-01 bh logs.gpj

LOG OF BOREHOLE 103

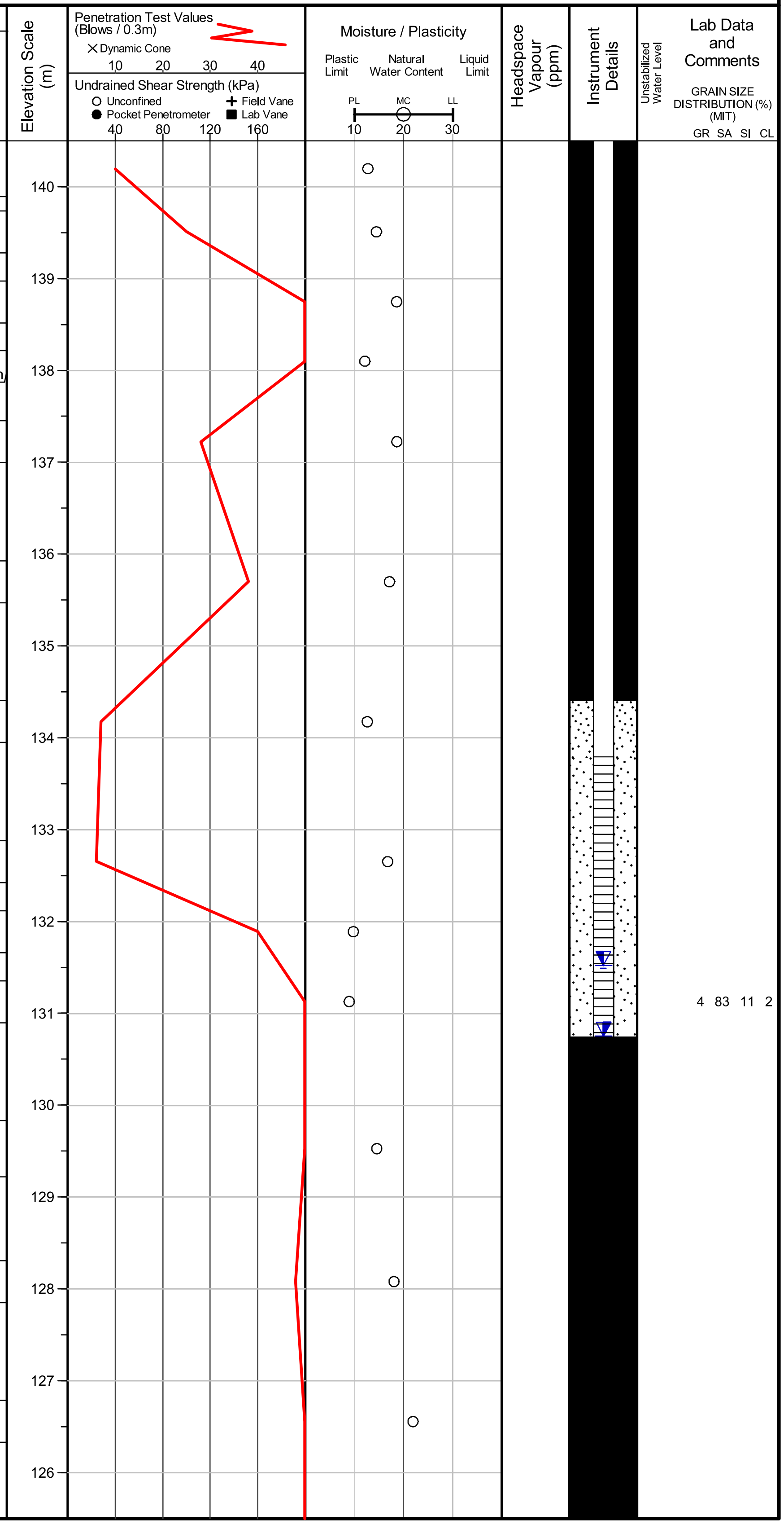
Terraprobe

Project No. : 1-22-0531-01	Client : Starlight Investments		Originated by : ZJ
Date started : September 12, 2022	Project : 1485 Williamsport Drive		Compiled by : FM
Sheet No. : 1 of 2	Location : Mississauga, Ontario		Checked by : HR

Position : E: 613400, N: 4830553 (UTM 17T) — Elevation Datum : Geodetic

Rig type : Track-mounted — Drilling Method : Solid stem augers/mud rotary

Elev / Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Moisture / Plasticity (Natural Water Content)	Lab Data and Comments (GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL)
140.5	GROUND SURFACE							
140.3 / 0.2	150mm **TOPSOIL**							
	FILL, sandy silt to sand and silt, trace gravel, very loose to compact, brown, moist		1	SS	10			
			2	SS	25			
			3	SS	76			
			4	SS	50 / 75mm			
			5	SS	28			
			6	SS	38			
			7	SS	7			
			8	SS	6			
132.1 / 8.4	**SAND**, some silt, trace gravel, trace clay, dense to very dense, brown, moist to wet		9	SS	40			
			10	SS	55			4 83 11 2
			11	SS	53			
			12	SS	48			
			13	SS	60			



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file: 1-22-0531-01 bh logs.gpj

LOG OF BOREHOLE 103

Terraprobe

Project No.	: 1-22-0531-01	Client	: Starlight Investments	Originated by	: ZJ
Date started	: September 12, 2022	Project	: 1485 Williamsport Drive	Compiled by	: FM
Sheet No.	: 2 of 2	Location	: Mississauga, Ontario	Checked by	: HR

Position : E: 613400, N: 4830553 (UTM 17T) — Elevation Datum : Geodetic

Rig type : Track-mounted — Drilling Method : Solid stem augers/mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Elevation Scale (m)
15		*(continued)* **SAND**, some silt, trace gravel, trace clay, dense to very dense, brown, moist to wet *(continued)* ...shale fragments	14	SS	84 / 225mm	125
16						124
17	123.7 / 16.8	**INFERRED BEDROCK**, shale fragments (GEORGIAN BAY FORMATION)	15	SS	50 / 50mm	123
18	122.2 / 18.3	**END OF BOREHOLE**	16	SS	50 / 25mm	

Penetration Test Values (Blows / 0.3m) — X Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — O Unconfined, + Field Vane, ● Pocket Penetrometer, ■ Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30

Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level | Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 19, 2022	9.0	131.5
Sep 30, 2022	9.8	130.8
Oct 13, 2022	10.0	130.5

Terraprobe

LOG OF BOREHOLE 104

Project No. : 1-22-0531-01
Client : Starlight Investments
Originated by : ZJ

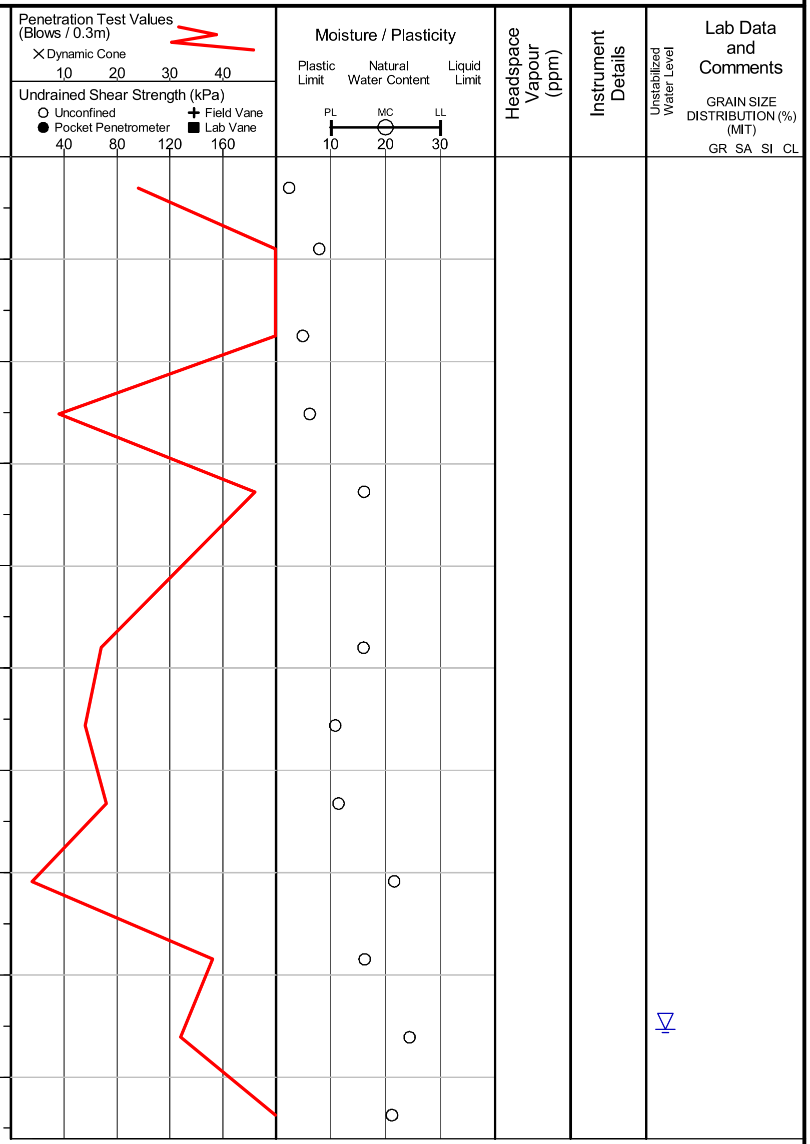
Date started : September 13, 2022
Project : 1485 Williamsport Drive
Compiled by : FM

Sheet No. : 1 of 1
Location : Mississauga, Ontario
Checked by : HR

Position : E: 613393, N: 4830564 (UTM 17T)
Elevation Datum : Geodetic

Rig type : Track-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description (SOIL PROFILE)	Sample Number	Type	SPT 'N' Value	Elevation Scale (m)
0	140.0	**GROUND SURFACE**				140
	139.8 / 0.2	230mm **TOPSOIL**				
		FILL, sandy silt to sand and silt, trace gravel, loose to very dense, brown, moist	1	SS	24	
1			2	SS	50 / 125mm	139
			3	SS	51	
2						138
			4	SS	9	
3			5	SS	46	137
4						136
			6	SS	17	
5			7	SS	14	135
6		...trace wood pieces	8	SS	18	134
7			9	SS	4	133
	132.2 / 7.8	**SAND**, some silt, trace gravel, trace clay, dense to very dense, brown, wet	10	SS	38	
8						132
			11	SS	32	
9						131
	130.4 / 9.6		12	SS	54	



END OF BOREHOLE

Unstabilized water level measured at 8.5 m below ground surface; borehole caved to 8.5 m below ground surface upon completion of drilling.

file: 1-22-0531-01 bh logs.gpj

Terraprobe

LOG OF BOREHOLE 105

Project No. : 1-22-0531-01	Client : Starlight Investments	Originated by : ZJ
Date started : September 13, 2022	Project : 1485 Williamsport Drive	Compiled by : FM
Sheet No. : 1 of 1	Location : Mississauga, Ontario	Checked by : HR

Position : E: 613397, N: 4830583 (UTM 17T) | Elevation Datum : Geodetic

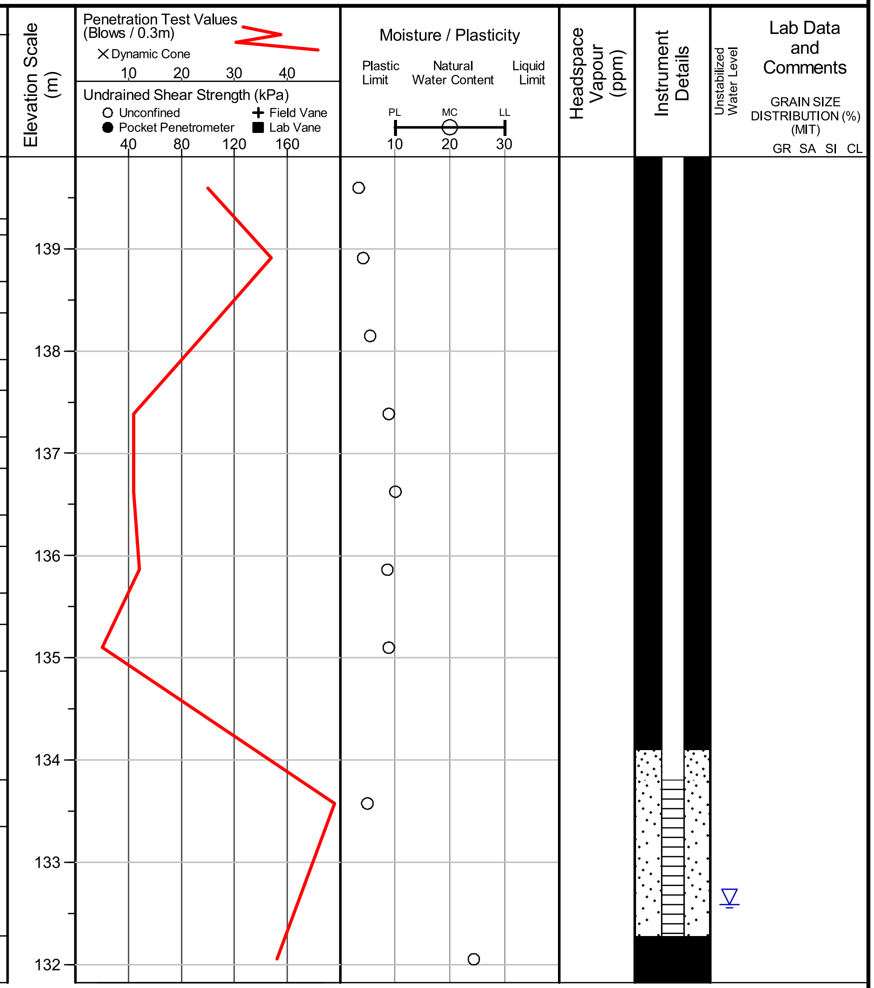
Rig type : Track-mounted | Drilling Method : Solid stem augers

SOIL PROFILE

Elev / Depth (m)	Description
139.9	**GROUND SURFACE**
139.6 / 0.3	130mm **ASPHALTIC CONCRETE**
	150mm **AGGREGATE**
	FILL, sandy silt to sand and silt, trace gravel, loose to dense, brown, moist
133.8 / 6.1	**SAND**, some silt, trace gravel, trace clay, dense, brown, moist
	...wet
131.8 / 8.1	**END OF BOREHOLE**

SAMPLES

Number	Type	SPT 'N' Value
1	SS	25
2	SS	37
3	SS	24
4	SS	11
5	SS	11
6	SS	12
7	SS	5
8	SS	49
9	SS	38



Unstabilized water level measured at 7.3 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 19, 2022	dry	n/a
Sep 30, 2022	dry	n/a
Oct 13, 2022	dry	n/a

APPENDIX B

TERRAPROBE INC.

Terraprobe

LOG OF BOREHOLE 8

Project No.	: 1-22-0531-01	Client	: Starlight Investments	Originated by	: SM
Date started	: March 7, 2017	Project	: 1485 Williamsport Drive	Compiled by	: JH
Sheet No.	: 1 of 2	Location	: Mississauga, Ontario	Checked by	: MD

Position : E: 613414, N: 4830578 (UTM 17T) — Elevation Datum : Geodetic

Rig type : Truck-mounted — Drilling Method : Solid stem augers

SOIL PROFILE

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log
0	139.3	**GROUND SURFACE**	
		125mm **TOPSOIL**	Topsoil
		FILL, sand and silt, trace gravel, trace clay, compact to dense, brown, moist	Fill
3		...at 3.0 m, trace rock fragments possible cobble, very dense	
		...at 3.7 m, compact	
		...at 4.6 m, very dense	
6	133.2 / 6.1	**SAND**, trace silt, trace gravel, trace clay, very dense, light brown, moist	Sand
9		...at 9.1 m, wet	
13		...at 13.7 m, grey	

SAMPLES

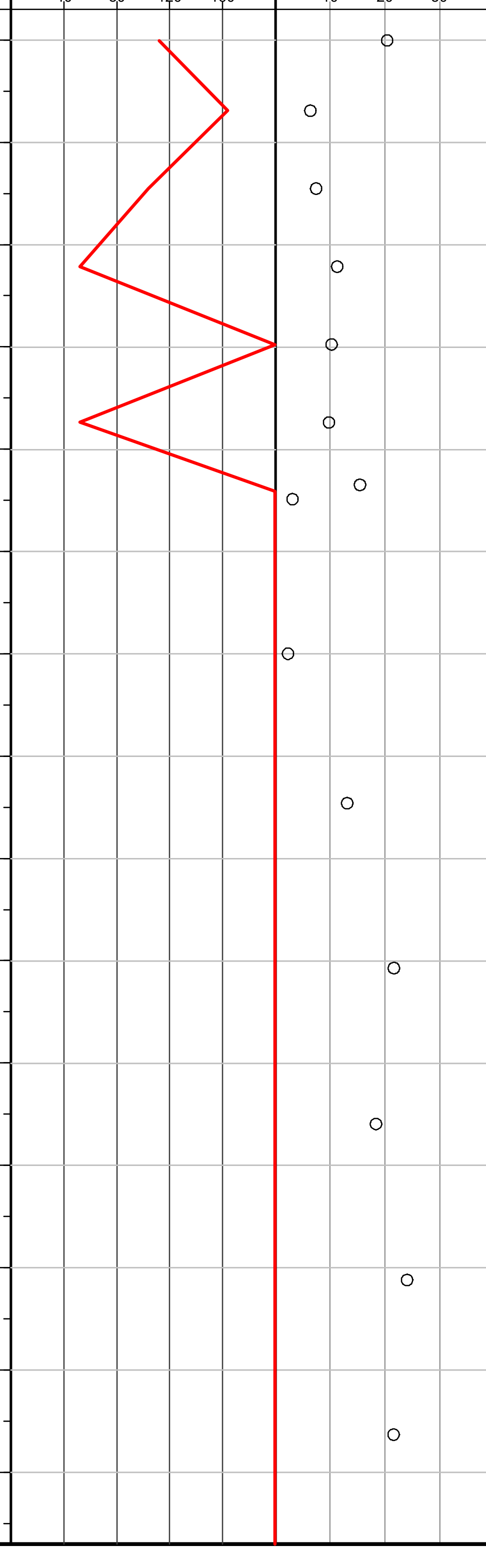
Number	Type	SPT 'N' Value
1	SS	28
2	SS	41
3	SS	26
4	SS	13
5	SS	56
6	SS	13
7A / 7B	SS	50 / 125mm
8	SS	90 / 250mm
9	SS	50 / 125mm
10	SS	63
11	SS	73
12	SS	76
13	SS	91 / 275mm

Elevation Scale (m): 139, 138, 137, 136, 135, 134, 133, 132, 131, 130, 129, 128, 127, 126, 125

Penetration Test Values (Blows / 0.3m) — × Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — O Unconfined, + Field Vane, ● Pocket Penetrometer, ■ Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30



Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

- ...at 3.0m, spoon wet
- ...at 3.7m, light auger grinding to 4.3m
- ...at 9.1m, spoon wet, cave
- ...at 14.9m, very hard

(continued next page)

LOG OF BOREHOLE 8

Terraprobe

Project No. : 1-22-0531-01	Client : Starlight Investments		Originated by : SM
Date started : March 7, 2017	Project : 1485 Williamsport Drive		Compiled by : JH
Sheet No. : 2 of 2	Location : Mississauga, Ontario		Checked by : MD

Position : E: 613414, N: 4830578 (UTM 17T)
Elevation Datum : Geodetic
Rig type : Truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	SOIL PROFILE – Description	Number	Type	SPT 'N' Value	Elevation Scale (m)	Moisture / Plasticity	Lab Data and Comments
15		(continued) **SAND**, trace silt, trace gravel, trace clay, very dense, light brown, moist *(continued)* ...at 15.2 m, trace shale fragments	14	SS	50 / 150mm	124		auger grinding to 15.2m ...at 15.2m, very hard auger grinding to 16.8m ...at 15.8m, bedrock to 16.2m
16						123		
	122.5 / 16.8	...at 16.8 m, inferred weathered bedrock	15	AS				

Column headings also printed: Graphic Log; Penetration Test Values (Blows / 0.3m) × Dynamic Cone 10 20 30 40; Undrained Shear Strength (kPa) O Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160; Plastic Limit, Natural Water Content, Liquid Limit, PL MC LL 10 20 30; Headspace Vapour (ppm); Instrument Details; Unstabilized Water Level; GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 4.3 m below ground surface; borehole caved to 7.9 m below ground surface upon completion of drilling.

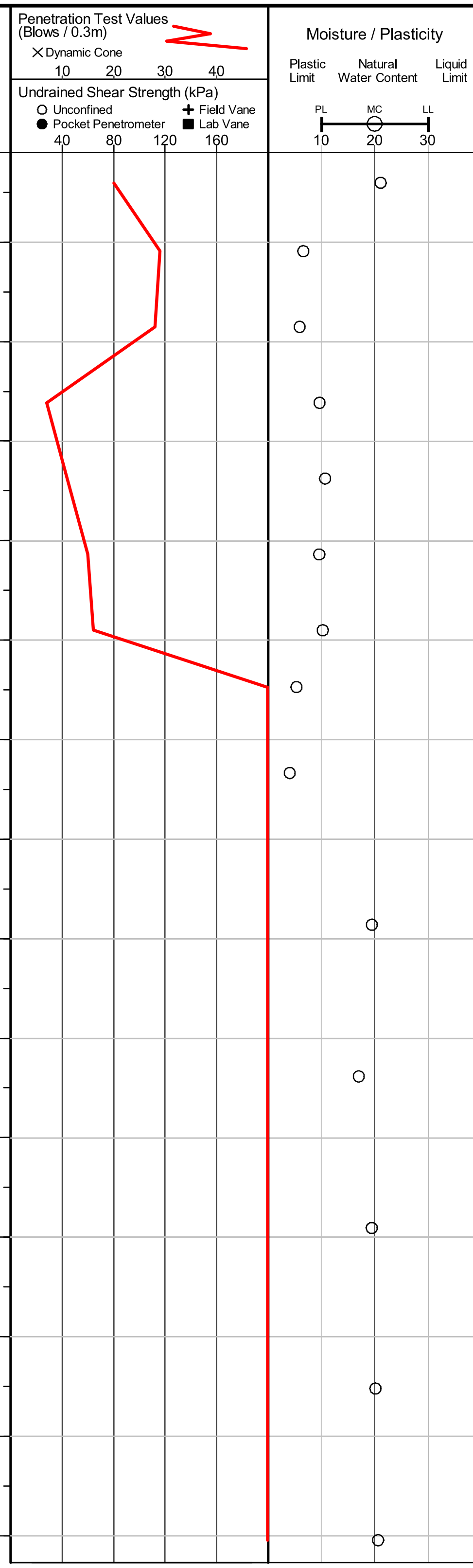
Terraprobe

LOG OF BOREHOLE 9

Project No. : 1-22-0531-01 | Client : Starlight Investments | Originated by : MC
Date started : March 14, 2017 | Project : 1485 Williamsport Drive | Compiled by : JH
Sheet No. : 1 of 1 | Location : Mississauga, Ontario | Checked by : MD

Position : E: 613398, N: 4830582 (UTM 17T) | Elevation Datum : Geodetic
Rig type : Truck-mounted | Drilling Method :

Elev / Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments: Grain Size Distribution (%) (MIT) GR SA SI CL
139.9	GROUND SURFACE					
	600mm TOPSOIL	1	SS	20	PID: 0	
139.3 / 0.6	FILL, silty sand, some gravel, trace clay, loose to compact, brown, moist	2	SS	29	PID: 0	
		3	SS	28	PID: 10	
		4	SS	7	PID: 5	15 55 23 7
	...at 3.0 m, silty	5	SS	11	PID: 5	
		6	SS	15	PID: 5	
		7	SS	16	PID: 0	
134.6 / 5.3	SAND, trace silt, trace gravel, trace clay, very dense, brown, moist	8	SS	50 / 75mm	PID: 0	
		9	SS	50 / 125mm	PID: 0	0 87 10 3
		10	SS	50 / 125mm	PID: 0	
		11	SS	50 / 125mm	PID: 0	
	...at 10.7 m, wet	12	SS	50 / 125mm	PID: 5	
		13	SS	80	PID: 0	
	...at 13.7 m, grey	14	SS	64	PID: 5	
125.7 / 14.2	END OF BOREHOLE					



Depth Scale (m): 0 – 14; Elevation Scale (m): 139 – 126

Unstabilized Water Level: ▽ at approx. 8.2 m

Wet cave at 8.2 m below ground surface upon completion of drilling.

file: 1-22-0531-01 bh logs.gpj

Terraprobe

LOG OF BOREHOLE 10

Project No. : 1-22-0531-01 | Client : Starlight Investments | Originated by : JH

Date started : March 15, 2017 | Project : 1485 Williamsport Drive | Compiled by : JH

Sheet No. : 1 of 1 | Location : Mississauga, Ontario | Checked by : MD

Position : E: 613383, N: 4830567 (UTM 17T) | Elevation Datum : Geodetic

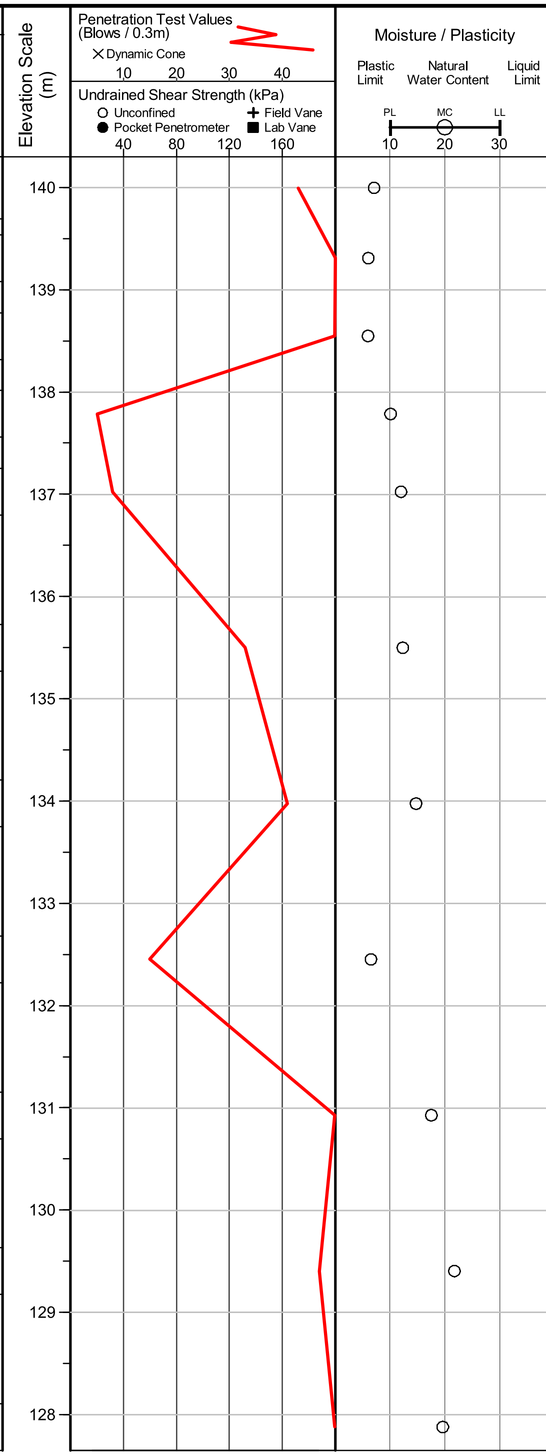
Rig type : Truck-mounted | Drilling Method : Solid stem / hollow stem augers

SOIL PROFILE

Elev / Depth (m)	Description
140.3	**GROUND SURFACE**
140.1 / 0.2	145mm **PC CONCRETE**
	FILL, sand, some silt, some gravel, trace clay, dense to very dense, brown, moist
	...at 3.0 m, with pockets of light sand
	...at 4.6 m, with dark brown layers
134.2 / 6.1	**SAND**, some silt, trace gravel, trace clay, compact to dense, brown, moist
	...at 9.1 m, very dense
	...at 10.7 m, wet
127.7 / 12.6	**END OF BOREHOLE**

SAMPLES

Number	Type	SPT 'N' Value
1	SS	43
2	SS	50
3	SS	60
4	SS	5
5	SS	8
6	SS	33
7	SS	41
8	SS	15
9	SS	82
10	SS	47
11	SS	81



Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

...at 2.3m, switched to hollow stem auger

March 15, 2018
March 16, 2018

Sample 10: 0 96 3 1

...at 12.2m, water added

Unstabilized water level measured at 8.0 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Mar 23, 2018	8.9	131.4
Apr 3, 2018	8.9	131.4
Oct 4, 2018	8.7	131.6
Sep 19, 2022	8.7	131.6
Sep 30, 2022	8.8	131.5
Oct 13, 2022	8.8	131.5

LOG OF BOREHOLE 11

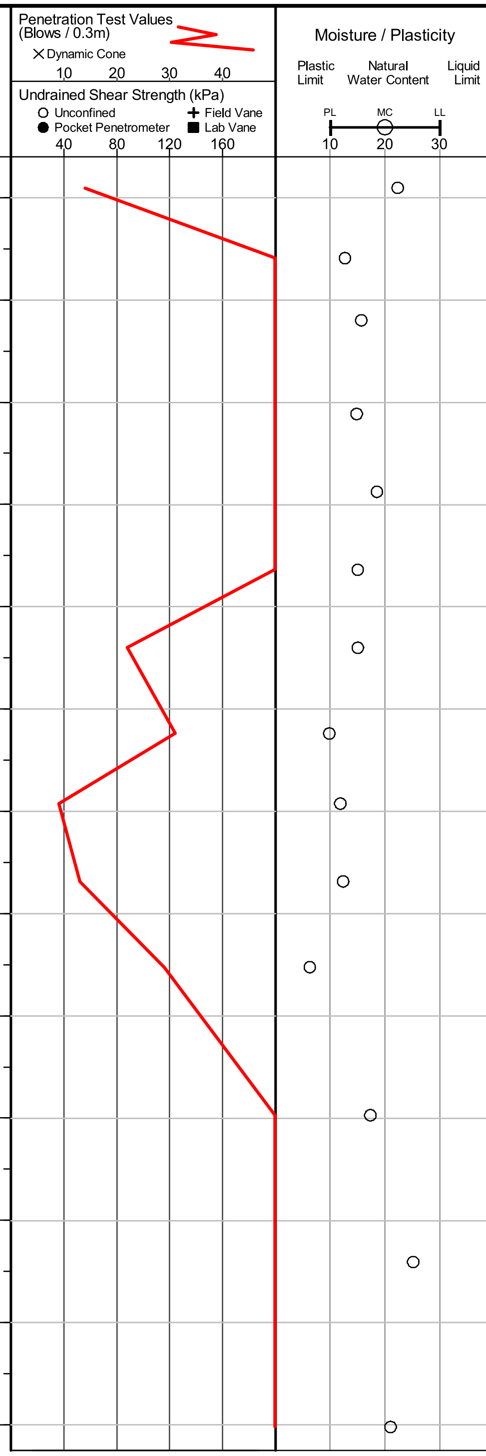
Terraprobe

Project No. : 1-22-0531-01	Client : Starlight Investments		Originated by : SM
Date started : March 8, 2017	Project : 1485 Williamsport Drive		Compiled by : JH
Sheet No. : 1 of 1	Location : Mississauga, Ontario		Checked by : MD

Position : E: 613402, N: 4830551 (UTM 17T) — Elevation Datum : Geodetic

Rig type : Truck-mounted — Drilling Method : Hollow stem augers

Elev / Depth (m)	Description	Sample Number	Type	SPT 'N' Value	Headspace Vapour (ppm)	Lab Data and Comments
140.4	GROUND SURFACE					
	150mm **TOPSOIL**	1	SS	14	PID: 0	SS1 Analysis: OC Pest
139.8 / 0.6	**FILL**, sand, trace gravel, trace silt, very dense, light brown, damp	2	SS	80	PID: 0	...at 0.8m, light auger grinding to 1.5m
		3	SS	50 / 150mm	PID: 0	SS2 Analysis: M&I, PCB
		4	SS	76	PID: 0	
		5	SS	75	PID: 20	SS5 Analysis: PHC
		6	SS	70	PID: 0	
	...at 4.6 m, moist, compact to dense	7	SS	22	PID: 0	
	...at 5.2 m, trace brick, trace glass, trace asphalt, dark brown	8	SS	31	PID: 0	
	...at 6.1 m, trace cinders	9	SS	9	PID: 0	
		10	SS	13	PID: 0	
132.8 / 7.6	**SAND**, trace silt, trace gravel, trace clay, compact, light brown, moist	11	SS	29	PID: 0	SS11 Analysis: M&I, PHC
	...at 9.1 m, wet, very dense	12	SS	85	PID: 0	
		11	SS	50 / 125mm	PID: 0	...at 10.7m, spoon wet ...at 10.7m, water added
127.8 / 12.6		12	SS	65	PID: 0	



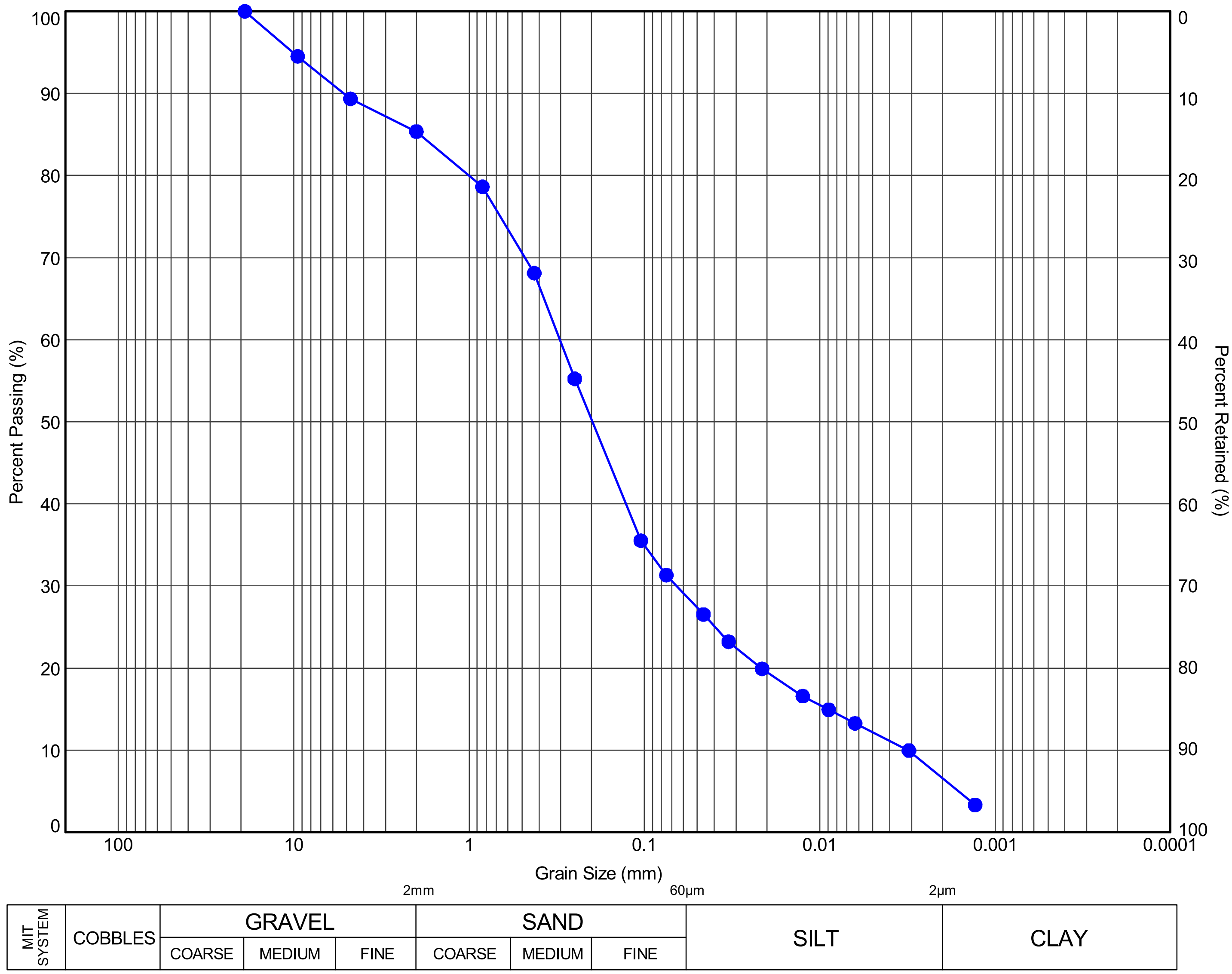
END OF BOREHOLE

Borehole was dry and caved to 7.9 m below ground surface upon completion of drilling.

file: 1-22-0531-01 bh logs.gpj

APPENDIX C

TERRAPROBE INC.



MIT SYSTEM

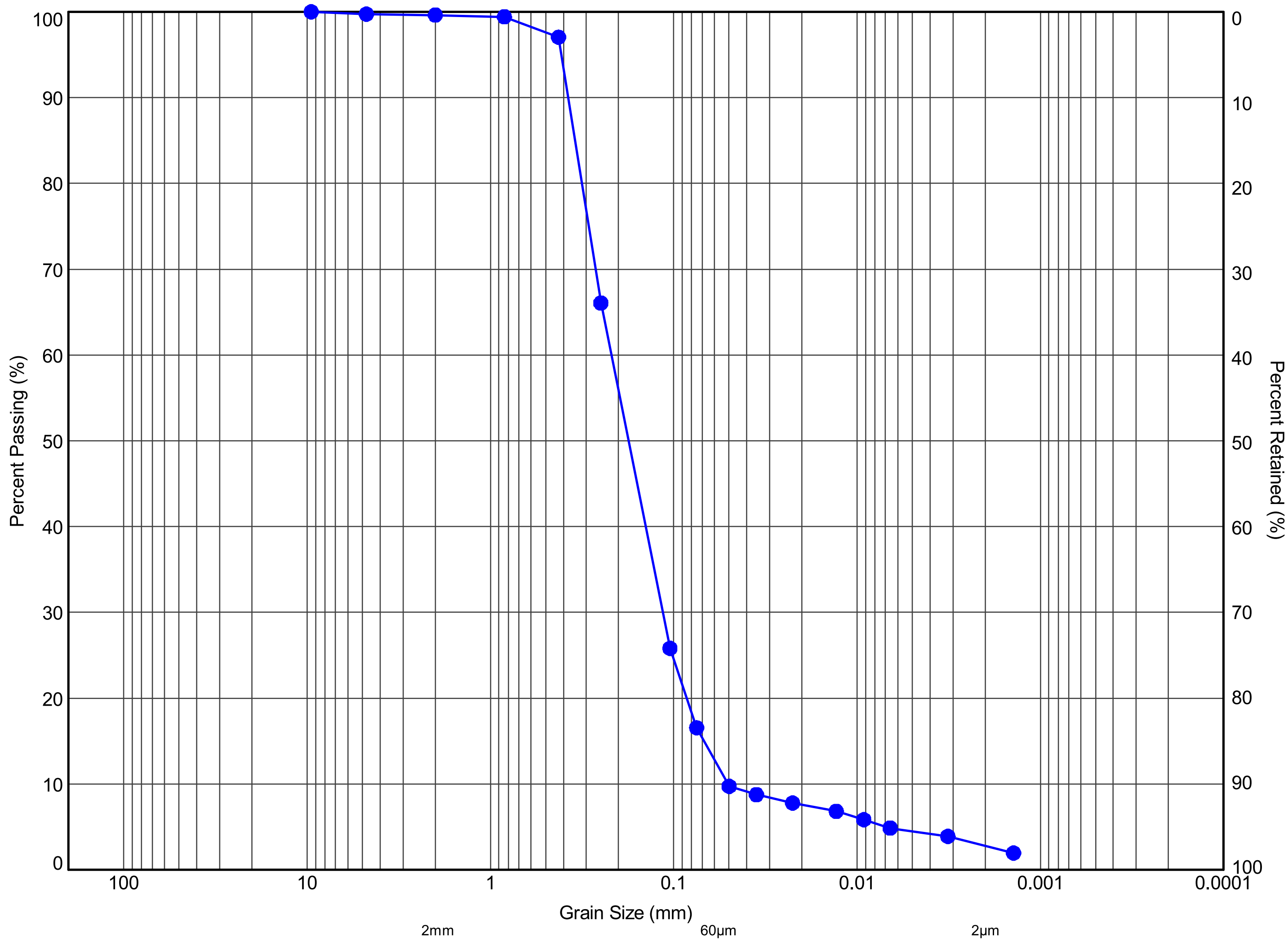
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**9**	SS4	2.5	137.4	15	55	23	7	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILTY SAND, SOME GRAVEL, TRACE CLAY

File No.: **1-22-0531-01**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

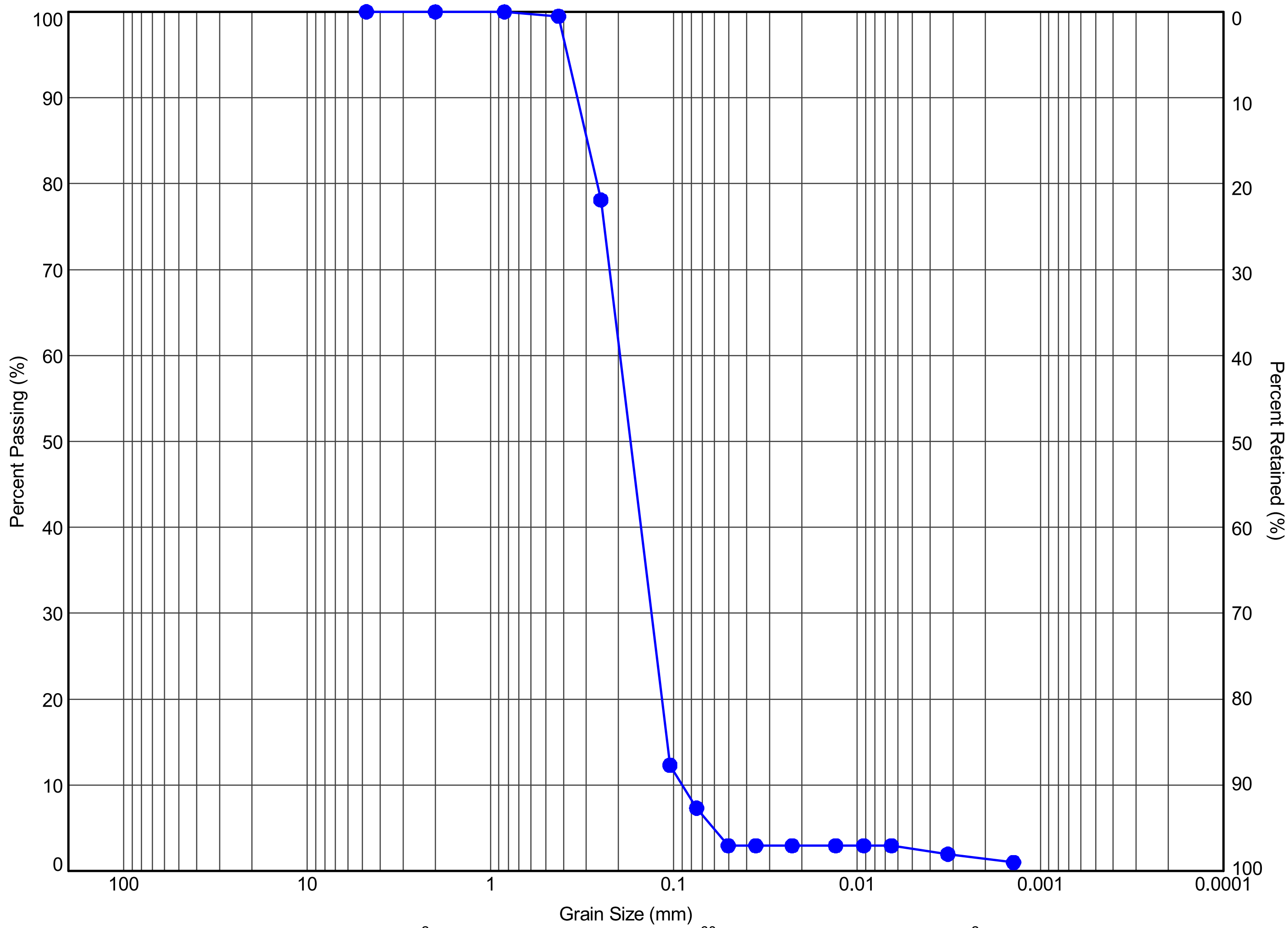
MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**9**	SS9	6.2	133.7	0	87	10	3	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title: **GRAIN SIZE DISTRIBUTION**
SAND, TRACE SILT, TRACE CLAY

File No.: **1-22-0531-01**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**10**	SS10	10.9	129.4	0	96	3	1	

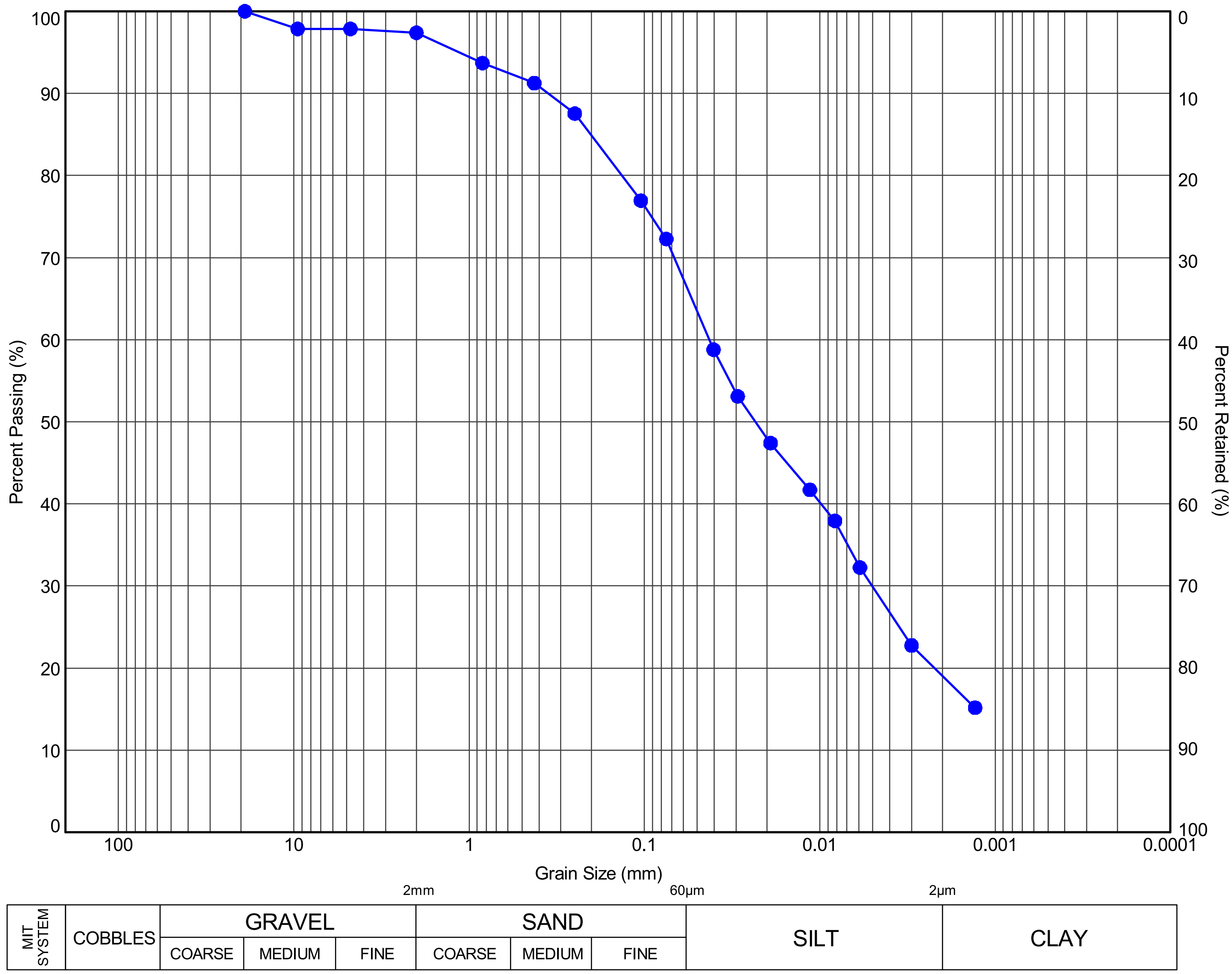
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SAND, TRACE SILT, TRACE CLAY

File No.: **1-22-0531-01**



MIT SYSTEM

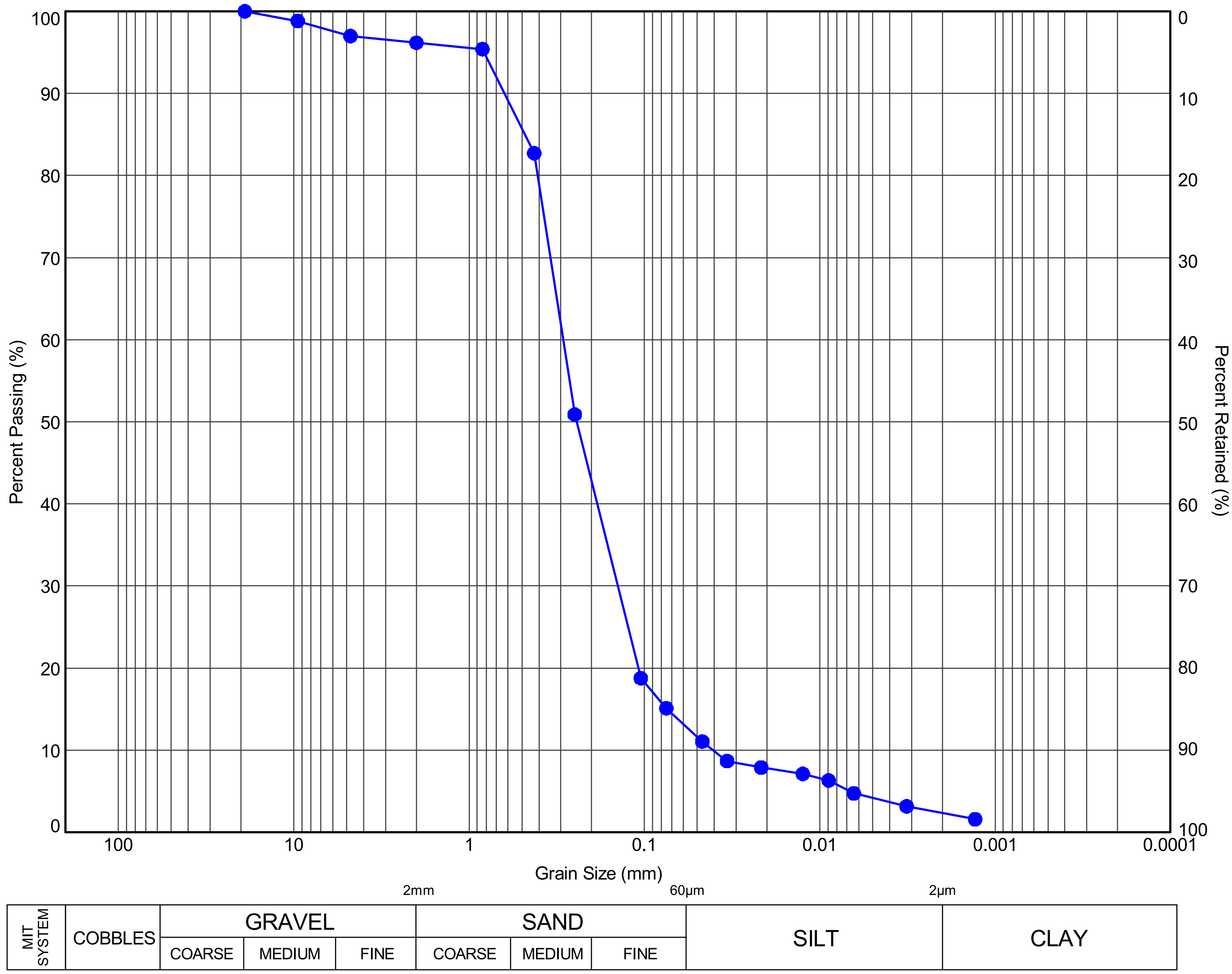
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**101**	SS4	2.5	137.8	3	30	48	19	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SANDY SILT, SOME CLAY, TRACE GRAVEL

File No.: **1-22-0531-01**



MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**103**	SS10	9.4	131.1	4	83	11	2	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title: **GRAIN SIZE DISTRIBUTION**
SAND, SOME SILT, TRACE GRAVEL, TRACE CLAY

File No.: **1-22-0531-01**