FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

16621 Hwy 12

Town of Midland

June 2023

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1. INTRODUCTION

1.1 Background

FRONTOP Engineering Ltd was retained by the owner of 2825951 Ontario Ltd. (the Client) to prepare a functional servicing, stormwater management, and water balance analysis report in support of the site plan approval for the proposed gas station construction at 16621 Hwy 12, Midland, Simcoe County, Ontario.

This functional servicing and stormwater management report will:

- Determine site specific stormwater management requirements in terms of quantity control and quality control;
- Calculate and design appropriate stormwater management measures to meet the requirements;
- Conduct a water balance analysis to identify impacts on groundwater recharge from the development and propose measures to mitigate negative impacts if there are any.
- Calculate sanitary peak flow from the development and evaluate the existing municipal sanitary system capacity;
- Calculate the water demand from the propose development and evaluate the existing municipal water supply system capacity.

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1.2 Site Location & Description

The site has a total area of 2,793 m^2, located at the south border area of the Town of Midland, bounded by Hwy 12 in the south, Brandon St in the west, an existing auto parts store to the east and natural land in the north as shown in Figure 1 below.

Under the existing condition, there are two small buildings with some paved driveway areas located at the south end of the site. The rest portion of site is undeveloped and covered by bushes.

Figure 1 Site Location (Source: Google Map)

1.3 Proposed Development

The existing buildings will be demolished. A new gas station including a building for a convenient store and restaurant and paved parking/driveways area will be constructed.

2. SITE GRADING DESIGN

The site grading design aims:

- Conform to Town Of Midland's Engineering design criteria.
- Minimize cut and fill operations and work towards a balanced site.
- Match existing boundary conditions
- Provide safe overland flow conveyance for major storm conditions
- Provide suitable cover on proposed servicing
- Achieve stormwater management and environmental objectives required for the site.
- Elevations along the north and south property lines will be increased to contain and control the runoff within the developed site without any negative impacts to the adjacent properties and municipal system.
- Proposed grading plan will direct runoff (minor system) towards municipal system along Hwy 12 via catch basins and stormwater sewers and direct major system to the public roads.

3. GEOTECHNICAL & HYDROGEOLOGICAL INVESTIGATIONS

A geotechnical and hydrogeological investigation was completed to determine the subsurface conditions and provide geotechnical and hydrogeological recommendations for the proposed development. Based on these investigations, the native soil underlying the site is clayey silt to gravely sand between the depths of 0.7 m to 8.4m which typically exhibits a favorable permeability characteristics. Tested infiltration rate of 14.3 cm/min for the gravelly sand and 2.3 cm/min for clayey silt. These infiltration rates are used for the design of site LID facilities depending on the location and depth of the facilities. Groundwater levels varies between 3.29 m and 9.27 m below surface at three testing bore holes. Detailed information is shown in the Hydrogeological Assessment report.

4. STORMWATER MANAGEMENT

4.1 Stormwater Management Criteria

Based on the Town's Engineering Development Design Standards (Revised December 2012), the site stormwater management should meet the following targets:

- Quantity Control: poste development flows from the 5yr, 25yr and 100 yr frequency storm shall not exceed the pre-development runoff from the same frequency storm.
- Quality Control: Enhanced Level 1 runoff quantity control to removal 80% TSS.
- Water Balance: comments from the Severn Sound Source Protection Authority indicated that the property is located within the Wellhead Protection Area Q2 (WHPA-A2) and policy LUP-12 in the Approved South Georgian Bay Lake Simcoe Source Protection Plan would apply. Policy LUP-12 requires a hydrogeological study be provided to ensure that the pre and post infiltration rate will remain neutral.

4.1 Stormwater Quantity Control

4.1.1 Existing Drainage Pattern

As shown in Figure 2, the existing site has high points in the middle and was divided into two drainage catchments with the north portion draining towards the adjacent property in the north through overland flow and the south portion draining to the Hwy 12 road side ditch.

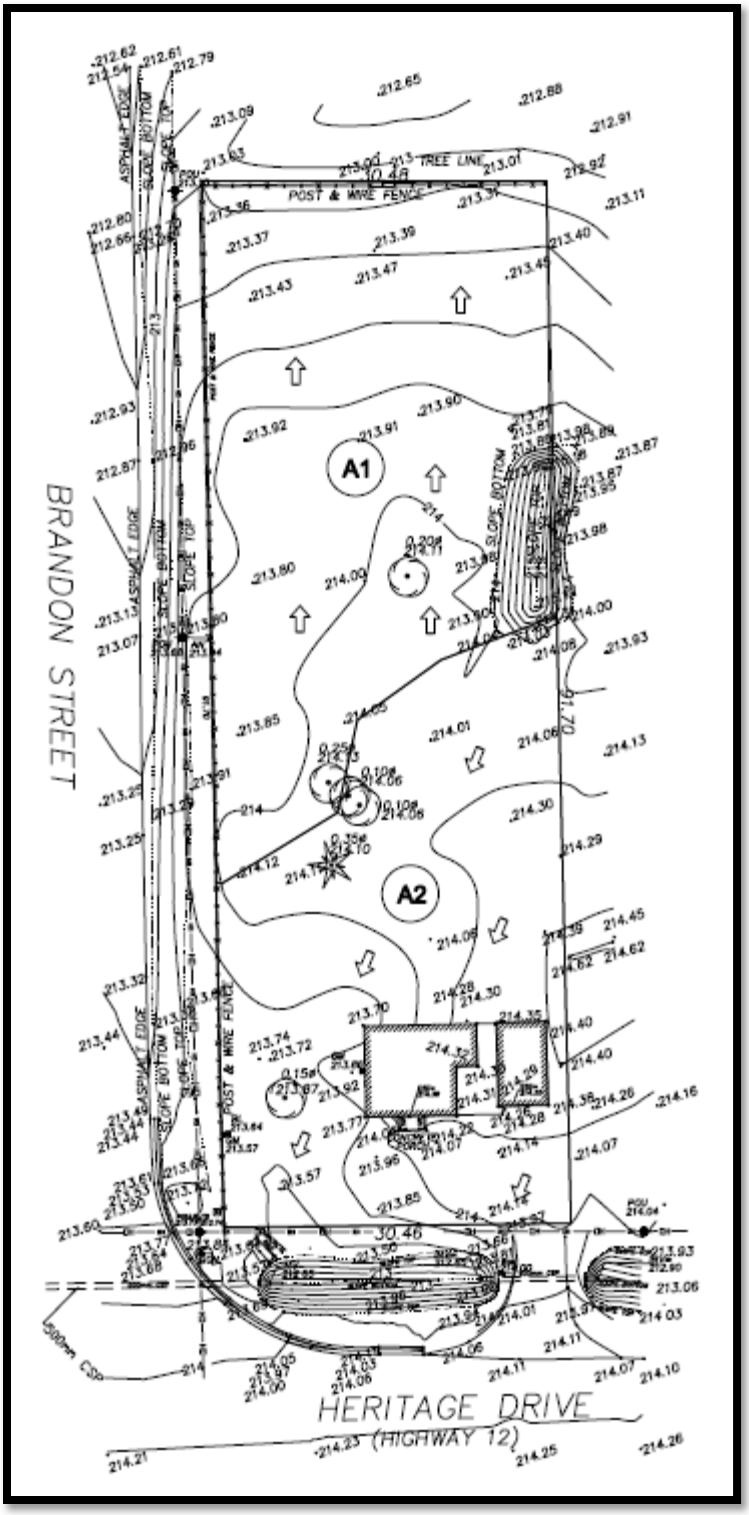


Figure 2 Existing Site Drainage Pattern

4.2.2 Post Drainage Pattern

As shown on the site design, the proposed development is almost fully covered with hard surfaces including a new store building, gas canopy, parking and driveways. In order to not have any negative

impact to the neighbouring properties and Hwy 12 drainage system, post-development runoff from the site will be collected and controlled onsite and discharged into the Hwy 12 roadside ditch within allowable rate. Table 1 summarizes the land use changes under existing and post development conditions.

Table 1 Land Uses under Existing and Post-development Conditions

Existing Condition			
	land use	**Area (m^2)**	**Runoff Coefficient**
Area A1	Open Space (pervious)	1465	0.25
Area A2	Building Roof	101.3	0.9
	driveway	167	0.9
	Open space (Pervious)	1059.7	0.25
	Total	1328	0.38
Total		**2793**	**0.31**
Post Development Condition			
A1 +A2	Building roof	333	0.9
	gas canopy	200	0.9
	driveway	717.7	0.9
	parking lot	500.8	0.9
	Total Imperious Areas	2527.9	0.9
	landscape area (Pervious)	265.1	0.25
Total		**2793**	**0.838**

4.2.3 Stormwater Quantity Control Analysis

Rational method is used to calculate the peak runoff rates under the existing and post-development conditions based on the equation below:

Q = 0.0028 C I A where:

Q = Flow in cubic metres per second
A = Area in Hectares
C = Run-off coefficient
I = Intensity in mm/hr

IDF curves used for the Town of Midland were derived from rainfall data recorded from the Orillia Atmospheric Environment services weather station. The equation for these cures are as follows as provided in the Town's Engineering Design Standards:

2 Year Storm	1=	$\frac{807.44}{(T.C. + 6.75)^{0.828}}$
5 Year Storm	1=	$\frac{1135.4}{(T.C. + 7.5)^{0.841}}$
10 Year Storm	1=	$\frac{1387}{(T.C. + 7.97)^{0.852}}$
25 Year Storm	1=	$\frac{1676.2}{(T.C. + 8.3)^{0.858}}$
50 Year Storm	1=	$\frac{1973.1}{(T.C. + 9.0)^{0.868}}$
100 Year Storm	1=	$\frac{2193.1}{(T.C. + 9.04)^{0.871}}$

Table 2 summarizes the peak runoff rates under existing and post-development conditions for the 5yr, 25yr and 100 yr design events. Calculation results show that the peak runoff rates under post development condition would be dramatically increased if no control. It is noted that in order to meet the quantity control target, i.e., poste development flows from the 5yr, 25yr and 100 yr frequency storm shall not exceed the pre-development runoff from the same frequency storm, the post condition peak runoff from the entire site has to be controlled and matched the pre-condition peak runoff from Area A2 only.

Table 2 Pre- and Post-condition Site Runoff Peak Rates

Qp - Peak Flow Calculations (Rational Method)						
Pre-Development						
Rainfall Intensity (I = A/(T+B)^C)						
	2 yr	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**
A	807.44	1135.40	1387.00	1676.20	1973.10	2193.10
B	6.750	7.500	7.790	8.300	9.000	9.040
C	0.828	0.841	0.852	0.858	0.868	0.871
Time of Concentration = T (min)	10.0	10.0	10.0	10.0	10.0	10.0
Intensity = I (mm/hr)	78.276	102.3	119.4	138.4	153.2	168.449
Peak Flow using Rational Method (Q = 0.00278*C*I*A)						
Area = A (ha) (A1 only)	**0.1328**					
Runoff Coefficient = C	0.380	0.380	0.380	0.380	0.380	0.380
Peak Flow = Q (m^3/s)	**0.0110**	**0.0143**	**0.0167**	**0.0194**	**0.0215**	**0.0236**
Post-Development						
Rainfall Intensity (I = A/(T+B)^C)						
	2 yr	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**
A	807.44	1135.40	1387.00	1676.20	1973.10	2193.10
B	6.750	7.500	7.790	8.300	9.000	9.040
C	0.828	0.841	0.852	0.858	0.868	0.871
Time of Concentration = T (min)	10.0	10.0	10.0	10.0	10.0	10.0
Intensity = I (mm/hr)	78.3	102.3	119.4	138.4	153.2	168.4
Peak Flow using Rational Method (Q = 0.00278*C*I*A)						
Area = A (ha) (Entire site)	**0.2793**					
Runoff Coefficient = C	0.838	0.838	0.838	0.838	0.838	0.838
Peak Flow = Q (m^3/s)	**0.0509**	**0.0666**	**0.0777**	**0.0901**	**0.0997**	**0.1096**
% Change	**364%**	**364%**	**364%**	**364%**	**364%**	**364%**

To mitigate the increased peak runoff from the site development condition, surface ponding through a controlled orifice is proposed. Modified rational method is used to calculate required detention volumes. Detailed calculation results are included in Appendix B. A total detention storage of 63.0 m^3 is required to ensure post-condition 5yr, 25yr and100 yr runoff rate match pre-condition for the same frequency storms. The actual storage provided on site is 69 m^3

Surface ponding on top of the paved parking/driveway areas with 75 mm orifice inserted in the storm pipe is used to control the peak runoff. Table 3 shows the orifice storage level - discharge rates indicating the stormwater quantity control targets are achieved.

Table 3 Orifice Level – Discharge Rates

Design Storm	Storage Required (m^3)	Water Ponding Depth over parking lot (m)	Orifice Diameter (mm)	Orifice Discharge Coefficient Cd	Water Head over Orifice Centerline (m)	Orifice Discharge Rate (L/s)	Targeted Peak Runoff Rate (L/s)
5yr	37.4	0.16	75	0.82	0.88	15.0	14.3
25yr	51.0	0.18	75	0.82	0.9	15.2	19.4
100yr	63.0	0.25	75	0.82	0.97	15.8	23.6

4.2 Water Balance

According to the comments from Severn Sound Source Protection Authority, the property is located within the Wellhead Protection Area Q2 (WHPA-A2) and policy LUP-12 in the Approved South Georgian Bay Lake Simcoe Source Protection Plan would apply. Policy LUP-12 requires a hydrogeological study be conducted and ensure that the pre and post infiltration rate will remain neutral.

Water balance assessment methodology established in the Hydrogeological Assessment Submissions Conservation Authority Guidelines for Development Applications June 2013 (the Hydrogeological Assessment Guidelines) was used to assess the site development impact to groundwater recharge and to identify any infiltration requirements.

Canadian Climate Normals 1981-2010 from the local station, Midland Water Pollution Control Plant are used as inputs to the Thornthwait method to calculate the annual evapotranspiration and moisture surplus. Climate water balance data are summarized in Table 4 below.

Table 4 Summary of Climate Water Balance

Month	Monthly	Avg Monthly	PET	Daylight	PET	Land Use: Grass (AWC=70mm)[4]	
	Precip[1]., P	Temp[1]., T	Unadjusted	Correction	Adjusted	AET	Moisture Surplus
	(mm)	(°C)	(mm)	Factor	(mm)	(mm)	(mm)
Jan.	109.8	-8.5	0.0	0.766	0.0	0.0	109.8
Feb.	69.9	-6.4	0.0	0.871	0.0	0.0	69.9
Mar.	65.7	-1.9	0.0	0.986	0.0	0.0	65.7
Apr.	65.1	5.8	28.1	1.115	31.3	28.7	36.4
May	92.8	12.2	59.7	1.230	73.4	117.5	-24.7
Jun.	89.5	18.1	87.9	1.291	113.5	119.4	-29.9
Jul.	72.7	20.8	102.2	1.268	129.5	110.0	-37.3
Aug.	77.9	19.9	97.5	1.173	114.3	89.6	-11.7
Sep.	99.1	15.9	74.3	1.048	77.9	103.7	-4.6
Oct.	90.1	9.3	42.5	0.919	39.1	39.4	50.7
Nov.	103.6	3.2	12.7	0.804	10.2	10.7	92.9
Dec.	104.4	-3.1	0.0	0.742	0.0	0.0	104.4
Sum	**1040.6**					**618.9**	**421.7**

Notes.
1. Monthly precipitation and average daily temperature data are from Midland Water Pollution Control Plant by Environ c
2. Site is located at 44°45'28.056" N, 79°52'31.014" W, at elevation of 180.0 m ASL.
3. Values based on long-term averages between 1981 and 2010 (30 years of data).
4. Available water holding capacity (AWC) of 70mm for grassy field based on soil type of loamy sand or silty clay soil.

The site infiltration factors are determined according to the suggested values in MOE 2003 Stormwater Management and Design Manual based on the existing and proposed site surface and subsurface conditions.

Table 5 – 8 below summarize the water budget assessment results, indicating that 537 m^3/year on site infiltration volume is required to mitigate the negative impact of the site development on the groundwater recharge process.

Table 5 Water Budget - Pre-Development

Catchment Designation	Pervious Area (Pasture and shrubs)	Impervious (building roof and driveways)	Total
Area (m2)	2524.7	268.3	2793
Infiltration Factors			
Topography Infiltration Factor	0.2	0	
Soil Infiltration Factor	0.2	0	
Cover Infiltration Factor	0.2	0	
MOE Infiltration Factor	0.6	0	
Actual Infiltration Factor			
Runoff Coefficient	0.4	1	
Runoff from Impervious Surface	-	0.9	
Inputs			
Precipitation (mm/yr)	1040.6	1040.6	1040.6
Total Inputs (mm/yr)	1040.6	1040.6	1040.6
Outputs			
Precipitation Surplus (mm/yr)	421.7	936.54	471
Net Surplus (mm/hr)	421.7	936.54	471
Evapotranspiration (mm/yr)	618.9	104.06	
Infiltration (mm/yr)	253	0	228.7
Onsite Infiltration	0	0	0.0
Total Infiltration (mm/yr)	253.02	0	229
Runoff Pervious Area	168.68		639
Runoff Impervious Area		936.54	251
Total Runoff (mm/yr)	168.68	936.54	319
Total Outputs (mm/yr)	1040.6	1040.6	1041
Inputs (Volume)			
Precipitation (m^3/yr)	2627	279	2906
Outputs (Volume)			
Net Surplus (m3/yr)	1065	251	1316
Evapotranspiration (m3/yr)	1563	28	1590
Infiltration (m3/yr)	639	0	639
Onsite Infiltration (m3/yr)	0	0	0
Total Infiltration(m3/yr)	639	0	639
Runoff Pervious Area(m3/yr)	426		426
Runoff Impervious Area (m3/yr)		251	251
Total Runoff (m3/yr)	426	251	677
Total Outputs (m3/yr)	2627	279	2906

Table 6 Water Budget - Post-Development

Catchment Designation	Pervious Area (Grass/Landscape Area)	Impervious (building roof/ driveways/ Parking)	Total
Area (m2)	483	2310	2793
Infiltration Factors			
Topography Infiltration Factor	0.2	0	
Soil Infiltration Factor	0.2	0	
Cover Infiltration Factor	0.1	0	
MOE Infiltration Factor	0.5	0	
Actual Infiltration Factor			
Runoff Coefficient	0.5	1	
Runoff from Impervious Surface	-	0.9	
Inputs			
Precipitation (mm/yr)	1040.6	1040.6	1040.6
Total Inputs (mm/yr)	1040.6	1040.6	1040.6
Outputs			
Precipitation Surplus (mm/yr)	421.7	936.5	848
Net Surplus (mm/hr)	421.7	936.5	848
Evapotranspiration (mm/yr)	618.9	104.1	
Infiltration (mm/yr)	210.9	0	36.5
Onsite Infiltration	0	0	0.0
Total Infiltration (mm/yr)	210.85	0	36
Runoff Pervious Area	210.85		102
Runoff Impervious Area		936.5	2163
Total Runoff (mm/yr)	210.85	936.5	811
Total Outputs (mm/yr)	1040.6	1040.6	1041
Inputs (Volume)			
Precipitation (m^3/yr)	503	2404	2906
Outputs (Volume)			
Net Surplus (m3/yr)	204	2163	2367
Evapotranspiration (m3/yr)	299	240	539
Infiltration (m3/yr)	102	0	102
Onsite Infiltration (m3/yr)	0	0	0
Total Infiltration(m3/yr)	102	0	102
Runoff Pervious Area(m3/yr)	102		102
Runoff Impervious Area (m3/yr)		2163	2163
Total Runoff (m3/yr)	102	2163	2265
Total Outputs (m3/yr)	503	2404	2906

Table 7 Water Budget - Post-Development with Mitigation

Catchment Designation	Pervious Area (Grass/Landscape Area)	Impervious (building roof/ driveways/ Parking)	Total
Area (m2)	483	2310	2793
Infiltration Factors			
Topography Infiltration Factor	0.2	0	
Soil Infiltration Factor	0.2	0	
Cover Infiltration Factor	0.1	0	
MOE Infiltration Factor	0.5	0	
Actual Infiltration Factor			
Runoff Coefficient	0.5	1	
Runoff from Impervious Surface	-	0.9	
Inputs			
Precipitation (mm/yr)	1040	1040	140
Total Inputs (mm/yr)	1040	1040	1040
Outputs			
Precipitation Surplus (mm/yr)	421.7	936	
Net Surplus (mm/hr)	421.7	936	
Evapotranspiration (mm/yr)	618.9	104	
Infiltration (mm/yr)	210.85	0	36.5
Onsite Infiltration	0	0	
Total Infiltration (mm/yr)	210.85	0	36
Runoff Pervious Area	210.85		102
Runoff Impervious Area		936	2162
Total Runoff (mm/yr)	210.85	936	811
Total Outputs (mm/yr)	1040.6	1040	1040
Inputs (Volume)			
Precipitation (m^3/yr)	502	2402	2905
Outputs (Volume)			
Net Surplus (m3/yr)	204	2162	2366
Evapotranspiration (m3/yr)	299	240	539
Infiltration (m3/yr)	102	0	102
Onsite Infiltration (m3/yr)	0	0	537
Total Infiltration(m3/yr)	102	0	639
Runoff Pervious Area(m3/yr)	102		102
Runoff Impervious Area (m3/yr)		2162	2162
Total Runoff (m3/yr)	102	2162	2264
Total Outputs (m3/yr)	503	2402	2905

Table 8 Water Budget Summary

Characteristic	Pre-Development	Post-Development	Change (Pre- to Post-)	Post-Development with Mitigation	Change (pre- to post-with Mitigation)
Outputs (Volume)					
Net Surplus (m3/yr)	1316	2367	80%	2366	80%
Evapotranspiration (m3/yr)	1590	539	-66%	539	-66%
Infiltration (m3/yr)	639	102	-84%	102	-84%
Onsite Infiltration (m3/yr)	0	0	0%	537	0%
Total Infiltration(m3/yr)	639	102	-84%	639	0%
Runoff Pervious Area(m3/yr)	426	102	-76%	102	-76%
Runoff Impervious Area (m3/yr)	251	2163	761%	2162	760%
Total Runoff (m3/yr)	677	2265	235%	2264	234%
Total Outputs (m3/yr)	2906	2906	0%	2905	0%

Since the proposed site is a gas station with high volume of vehicle traffic and limited pervious areas, surface runoff is prone to contamination and not suitable for groundwater recharge. The proposed building has a roof area of 333 m^2 and the gas canopy has a roof area of 200 m^2. Clean runoff from these two roofs will be collected and fed into the proposed underground infiltration storage.

Based on the % of total annual rainfall depth vs. daily rainfall amount curve derived from 1991 Toronto Rainfall data from16 rain gauge stations, statistically 100% of average rainfall event depths are 40 mm and less, which means that if the proposed infiltration facility can capture 40 mm rainfall event, it will capture 100% of total annual rainfall volume.

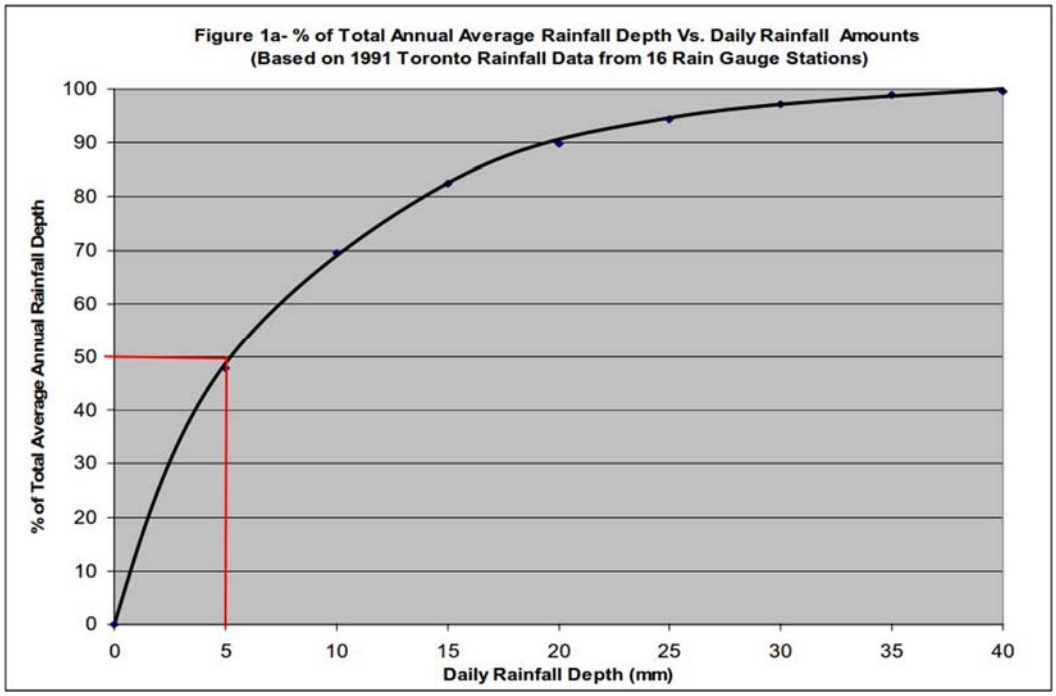


Table 8 summarizes that a site infiltration facility with a minimum storage volume of 21.3 m^3 would capture 100 % of annual runoff from the total 533 m^2 roof area and will infiltrate a total volume of 555 m^3 every year, achieving the annual infiltration target.

Table 8 Infiltration storage

Total roof area	533	m^2
Annual precipitation	1040.6	mm
Target infiltration volume	40	mm
Annual precipitation to be captured	100%	
Infiltration facility storage	21.3	m^3
Annual infiltration volume	555	m^3

The modular underground stormwater storage product with open bottom will be used to collect and infiltrate roof runoff into the ground. Detailed product information is provided in Appendix C.

The infiltration storage demission is 5.6 m(L) x 3.2 m (W) x 1.32 m (H), providing active storage volume of 22.71 m^3.

Equation 4.3 in the MOE 2003 Stormwater Management Planning and Design Manual is used to calculate the drawdown time:

$$A = \frac{1{,}000\,V}{Pn\Delta t}$$

Equation 4.3: Infiltration Trench Bottom Area

where A = bottom area of the trench (m^2)
V = runoff volume to be infiltrated (Table 3.2)
P = percolation rate of surrounding native soil (mm/h)
n = porosity of the storage media (0.4 for clear stone)
Δt = retention time (24 to 48 hours)

Based on the tested infiltration rate of 13.3 cm/min for silty fine sand, the facility drawdown time is 17.6 hr which meets the requirements.

4.3 Stormwater Quality Control

The site stormwater quality control will be provided by a Stormceptor unit EF4 which would provide 83% annual TSS removal efficiency.

5. SANITARY SERVICING

After the consultation with the Town staff, the most feasible sanitary serving plan for the site is to bring the existing 200 mm sanitary sewer ending in front of the auto parts store to the site. There is a dead end manhole about 200 m east to the site. As surveyed, the pipe invert is 208.61 m at the existing manhole. With 1% slope, the extended sewer invert is at the elevation of 210.6 m in front of the site, which is feasible to serve the site sanitary system.

Sanitary flow from the proposed site is determined in accordance with the Town of Midland Engineering development Design standards December 2012.

The proposed development contains a convenient store and restaurant with a total building area of 333 m^2 and estimated occupancy load of 27 people.

As indicated in the Town design standard, the average daily flow rate from commercial property is 2.5 L/day/m2 of floor area. Maximum design flows are to be determined using average daily flow and the Harmon Peaking Factor.

Harmon's Peaking Factor is calculated based on the formula:

$$M = 1 + \frac{14}{4 + P^{0.50}}$$

Where M = ratio of peak flow to average flow
P = tributary population in thousands

Inflow/Infiltration allowance is 0.23 L/ha/s.

The peak sanitary design flow from the propose development is:

Average Daily Wastewater Flow = 333 m^2 x 2.5 L/day/ m^2 = 832.5 L/day = 0.00964 L/s
Total Peak Sanitary Flow = 0.0096L/s * 4 (peaking factor) + 0.2793ha * 0.23L/ha/s = 0.103 L/s

The pre-constructed 200 mm service lateral at slope of 1% has pipe full capacity of 46.4 L/s.

The proposed development can be serviced by the extended 200 mm sanitary sewer along Hwy 12.

6. WATER SERVICING

A new site water service connection will be constructed and connected to the existing 300 mm watermain on Hwy 12.

Water demand from the proposed site is determined in accordance with the Town's design standard.

Average Daily Demand = 27 ppl x 450 L/cap/day =0.14 L/s
Max. Daily demand peak factor = 2.0
Max. Hourly Peak Factor = 4.5
Max. Hourly Demand = 0.63 L/s

The anticipated water demand for this development is 0.734 L/s for domestic use.

A 50 mm watermain service connection will be provided for the building for domestic water supply.

7. EROSION AND SEDIMENT CONTROL PLAN

To ensure stormwater quality control during the construction, erosion and sediment control measures will be carried out prior to any on-site activities. The following works will be included:

- A temporary sediment control fence will be placed along the boundaries prior to site grading.
- A construction plan will be implemented to limit the size of disturbed areas minimizing the nonessential clearing and grading areas.
- Sediment traps will be provided as required.
- An erosion control, or "mud mat" will be installed at the construction entrance, and regular clean up of mud tracking from the site on to existing roads will be undertaken during the construction period.
- All temporary erosion and sediment control measures will be routinely inspected and repaired during construction. Temporary controls will not be removed until the areas are restored and stable.

7. CONCLUSIONS AND RECOMMENDATIONS

The recommendations and conclusions of this report regarding the site grading, sanitary, storm sewer and watermain servicing and stormwater management for the proposed development are:

1. Grading will be carried out in accordance with the Town of Midland Engineering Design Standard.

2. Municipal sanitary services will be extended from the existing manhole about 200 m east of the property. A new section of 200 mm sanitary sewer will be constructed along Hwy 12 to bring the sanitary serving to the site.

3. An existing 300mm water main is available on Brandon Road. A 100 mm service connections will be constructed to service the domestic and fire flow requirements for the site. Hydrant fire flow test will be performed in the future to confirm the municipal system capacity.

4. 5 year minor storm system is designed to convey the site runoff to the road side ditch in front of the property along Hwy 12.

5. Stormwater quantity control is achieved by surface ponding with an orifice to control the post development condition peak flow to pre-condition 5 year peak flow rate.

6. Stormwater quality control target of 80% TSS removal is achieved through underground infiltration facility and an OGS unit.

7. Erosion and sediment control measures are proposed to ensure silt and sediment from the site construction will be remain on site.

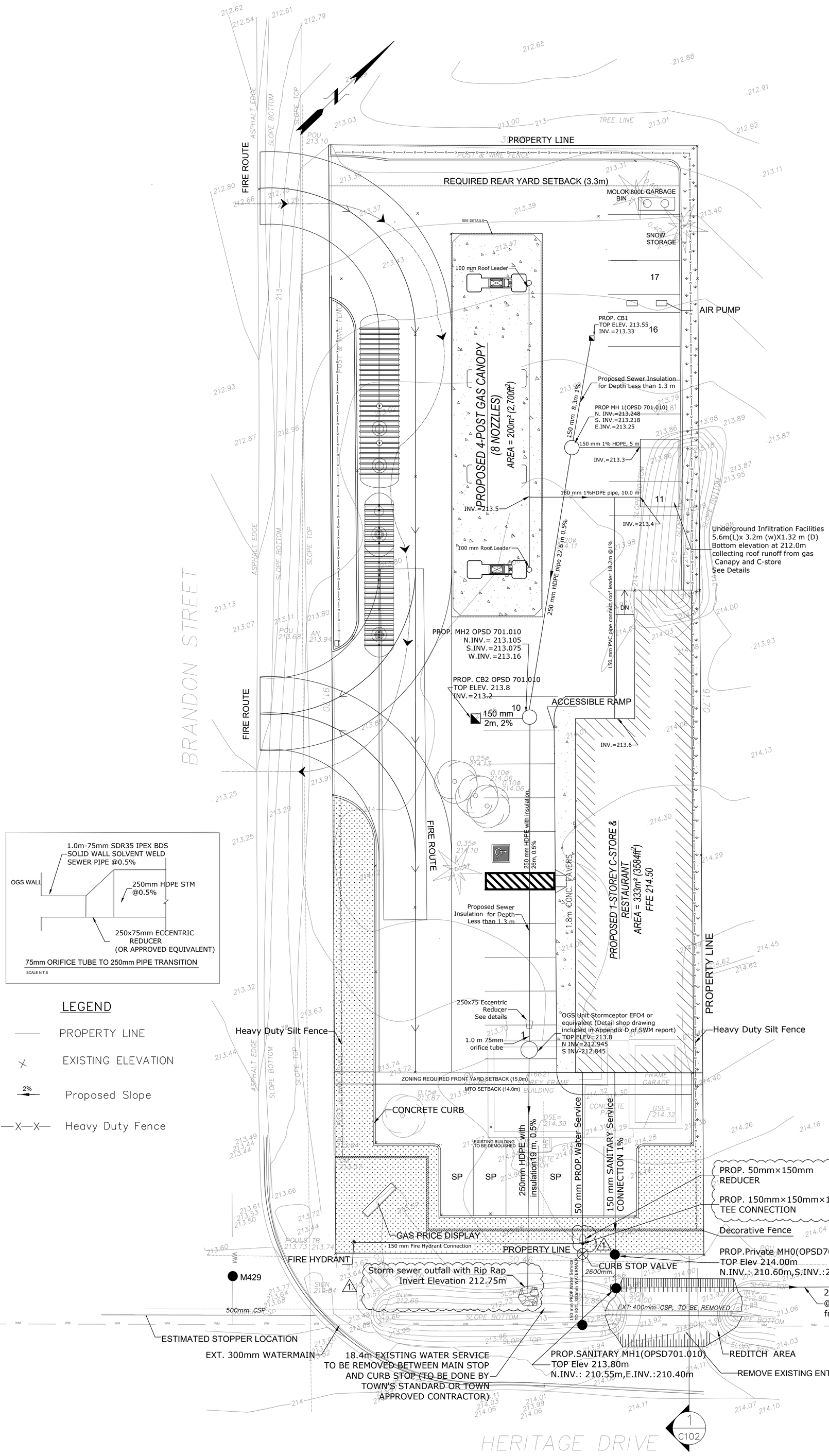
8. Functional servicing and stormwater management concept presented in this report shall be adopted as a basis for the detailed engineering design.

Prepared By:

FRONTOP Engineering Ltd.

Frank Feng, P.Eng, M.Eng. M.Sc.
Senior Project Manager

APPENDIX A



LEGEND

- PROPERTY LINE
- EXISTING ELEVATION
- 2% Proposed Slope
- —X—X— Heavy Duty Fence

GENERAL NOTES

1.LOCATION AND SIZE OF EXISTING UTILITIES WAS DERIVED FROM VARIOUS DRAWINGS FROM OTHERS. THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN AND, WHERE SHOWN THE ACCURACY OF THE LOCATION SHOWN OF SUCH UTILITIES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL CONTACT ALL SUCH UTILITIES INVOLVED AND INFORM HIMSELF AS TO THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME LIABILITY FOR DAMAGE TO THEM. CONTRACTOR TO REPORT ANY CONFLICTS OR DISCREPANCIES WITH THIS DRAWING TO THE ENGINEER IMMEDIATELY.

2. ALL MEASUREMENTS ARE IN METRES UNLESS OTHERWISE NOTED.

3. ALL_WORK SHALL BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF THE ONTARIO PROVINCIAL STANDARD SPECIFICATIONS AND DRAWINGS, AND THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT (NPSCD) UNLESS OTHERWISE NOTED ON THE DRAWINGS OR IN THE SPECIFICATIONS.

4. COMPUTER DRAWING FILE CO-ORDINATES FOR THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION LAYOUT UNLESS SPECIFICALLY DIRECTED BY THE ENGINEER.

5. ALL GRANULAR MATERIAL SHALL BE COMPACTED TO 100% STANDARD PROCTOR DENSITY AND ALL NATIVE BACKFILL SHALL BE COMPACTED TO 95% STANDARD PROCTOR DENSITY UNLESS OTHERWISE NOTED.

6. ALL CONSTRUCTION SHALL BE CARRIED OUT IN SUCH A WAY THAT SILTATION OR OTHER DAMAGE TO WATER COURSES DOES NOT OCCUR. THE REQUIREMENTS OF THE MINISTRY OF NATURAL RESOURCES ARE TO BE ADHERED TO IN THIS RESPECT.

7. ALL EXCAVATION IN EXISTING ROADWAYS OR OTHER PAVED SURFACES SHALL BE BACKFILLED WITH GRANULAR "A" COMPACTED TO 100% SPD. MIN.

8. CONTRACTOR TO OBTAIN EXACT LOCATION AND ELEVATION OF EXISTING UTILITIES PRIOR TO COMMENCEMENT OF WORK AND REPORT ANY CONFLICTS OR DISCREPANCIES WITH THESE DRAWINGS TO THE ENGINEER IMMEDIATELY.

ROADS AND EARTHWORKS

9. FILL FOR ROADWAY AND PARKING AREAS TO BE CONSTRUCTED IN ACCORDANCE WITH OPSS 501 IN 200mm THICK LIFTS, USING SUITABLE NATIVE EXCAVATED OR IMPORTED MATERIAL APPROVED BY CONTRACT ADMINISTRATOR AND GEOTECHNICAL ENGINEER. THE SUBSOIL BELOW ANY ROADWAY OR PARKING AREA SHALL BE PROOF ROLLED AND INSPECTED BY THE GEOTECHNICAL ENGINEER OR HIS DESIGNATE PRIOR TO THE PLACEMENT OF ANY GRANULAR MATERIAL. THE UPPER 0.6m BELOW ANY RIGID OR PAVED SURFACE SHALL BE COMPACTED TO 98% SPD MIN.

10. MINIMUM ASPHALT AND GRANULAR THICKNESS FOR DRIVEWAY AND PARKING AREA PER OPSS 310 & 314 AS FOLLOWS:

	HEAVY DUTY	LIGHT DUTY
SURFACE COURSE	40mm HL3	40mm HL3
BINDER COURSE	65mm HL8	50mm HL8
GRANULAR BASE	500mm GRAN."A"	350mm GRAN."A"
TOTAL THICKNESS	605mm	440mm

11. WHERE DISTURBED OR DAMAGED, EXISTING ROADS TO a REINSTATED TO MATCH EXISTING, WHICHEVER IS GREATER. PAVEMEN REINSTATEMENT SHALL COMPLY WITH OPSD 509.010 & OPSS 310, INCLUDING STEP JOINT 300mm WIDE FOR SURFACE COURSE (WHERE APPLICABLE). ALL TO THE SATISFACTION OF THE ROAD AUTHORITY.

12.ALL CURB SHALL BE CONSTRUCTED WITH A LEDGE AT THE BACK OF THE CURB TO FACILITATE FUTURE SIDEWALK CONSTRUCTION.

HYDRANT

13. FIRE HYDRANT ASSEMBLY SHALL BE DRY TYPE AND SHALL BE INSTALLED TO THE SATISFACTION OF TOWN OF MIDLAND FIRE DEPARTMENT.

SEWERS

14. SUBDRAIN TO BE 100mm HIGH-DENSITY POLYETHYLENE PER OPSS 405; FILTER-WRAPPED WITH GRANULAR "A" SURROUND PER OPSD 216.021.

15. SEE DRAWING C107 (SERVICE C) FOR ADDITIONAL SEWER NOTES. 1

WATERMAIN

16.WATERMAINS MUST FOLLOW THE ONTARIO MINISTRY OF THE ENVIRONMENT PROCEDURE F-6-1 THAT GOVERN THE SEPARATION OF SEWERS AND WATERMAINS. A MINIMUM VERTICAL CLEARANCE OF 0.50 m 1 WHEN CROSSING OVER AND 0.5 m WHEN CROSSING UNDER SEWERS AND ALL OTHER UTILITIES ARE REQUIRED.

17. SEE DRAWING C107 (SERVICE C) FOR ADDITIONAL WATERMAIN NOTES. 1

FRONTOP ENGINEERING LIMITED

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LICENSED PROFESSIONAL ENGINEER
J. FENG
MAR 16, 2023
PROVINCE OF ONTARIO

NO.	ISSUED/REVISED	DATE
5	REVISED FOR PERMIT 1	MAR 16, 2023
4	REVISED FOR PERMIT	SEP 26, 2022
3	REVISED FOR PERMIT	MAR 06, 2022
2	REVISED FOR PERMIT	FEB 24, 2022
1	REVISED FOR PERMIT	JULY 15, 2021

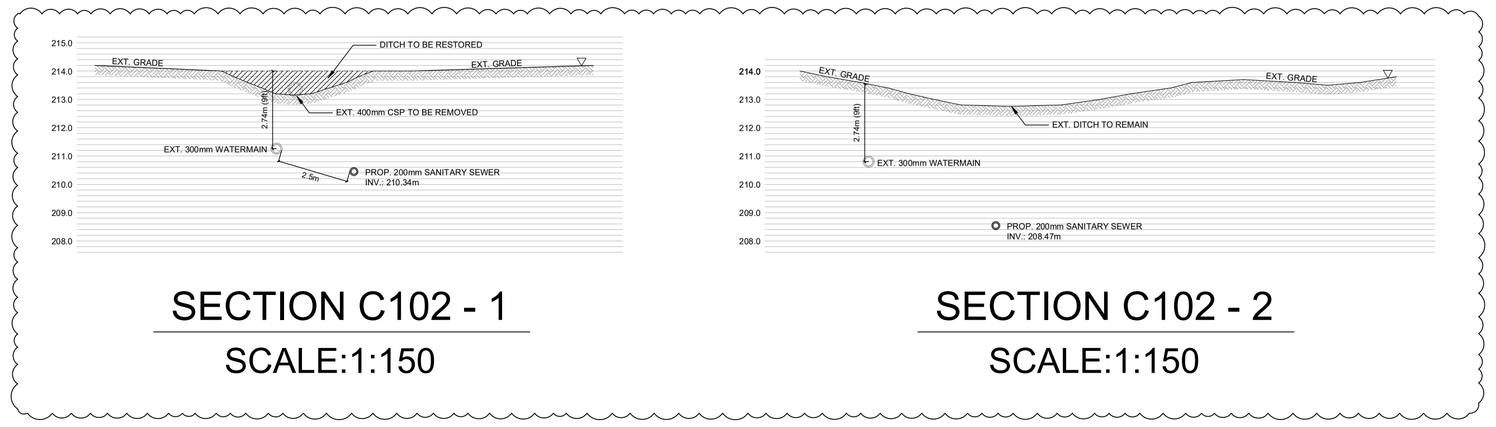
Owner & Address

16621 HWY 12
MIDLAND, ONTARIO

Drawing Title

SERVICE PLAN

Project No. DES21-03-13A
Drawn by R.F.
Checked by L.X.
Date MAR 16, 2023
Drawing No. C102
Scale 1:180

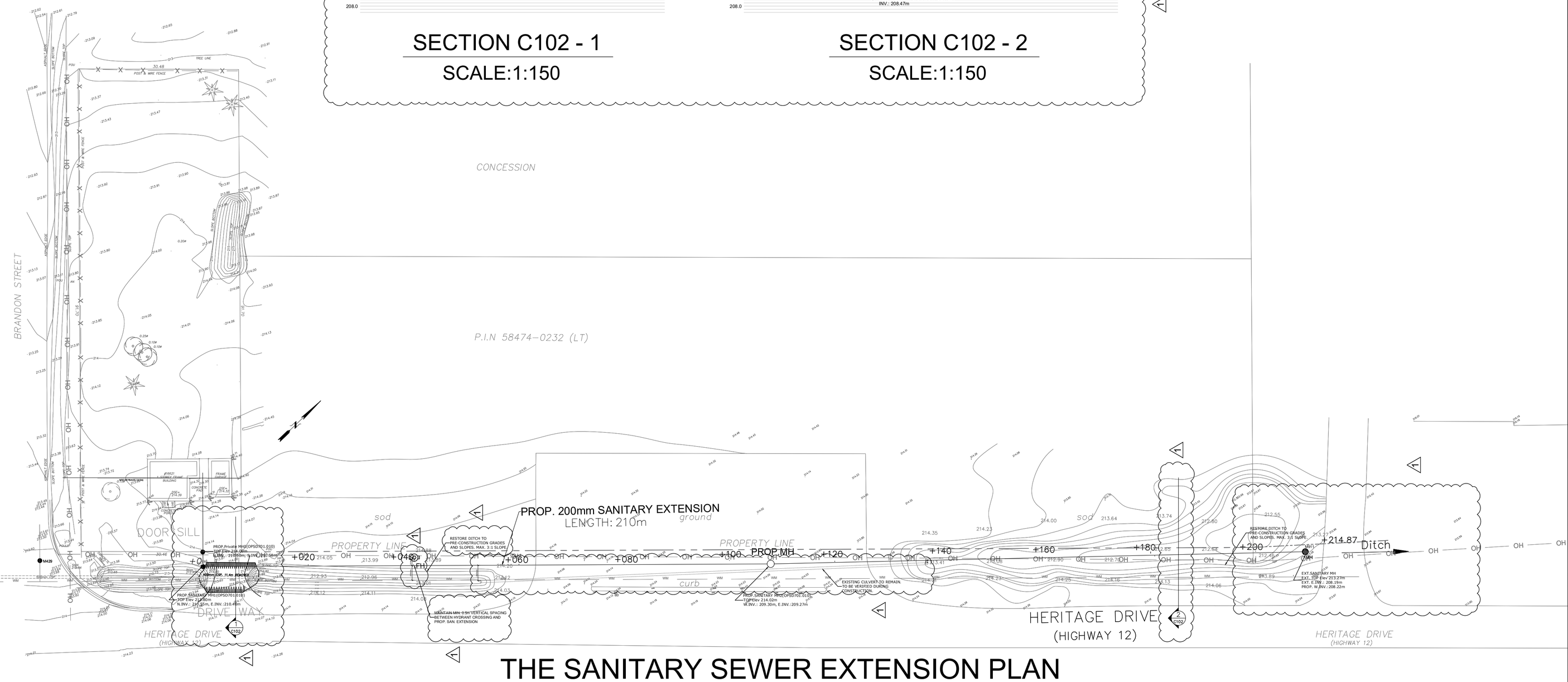


SECTION C102 - 1

SCALE:1:150

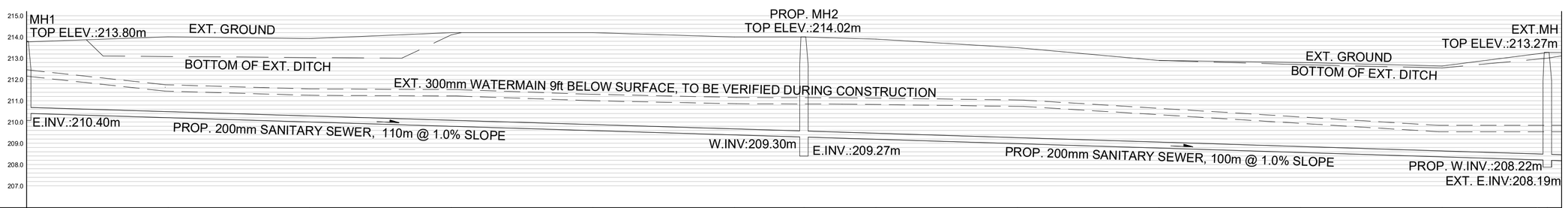
SECTION C102 - 2

SCALE:1:150



THE SANITARY SEWER EXTENSION PLAN

SCALE:1:450



STATION	+0.00	+020	+040	+060	+080	+100	+110	+120	+140	+160	+180	+200	+214.87
EXT.G.E	213.76	214.03	213.93	214.20	214.20	214.02	214.00	213.90	213.50	212.90	212.80	212.65	213.26
DITCH BOT. G.E	212.90	213.10	213.01	214.10	N/A	N/A	N/A	N/A	213.40	212.80	212.60	212.41	213.00

THE SANITARY SEWER EXTENSION PROFILE

HORZ:1:450
VERT: 1:150

Project No.	DES21-03-13A
Drawn by	R.F.
Checked by	L.X.
Date	MAR 16, 2023
Drawing No.	C106
Scale	1:180

Owner & Address

16621 HWY 12
MIDLAND, ONTARIO

Drawing Title

SERVICE PLAN

NO.	DATE
5	REVISED FOR PERMIT — MAR 16, 2023
4	REVISED FOR PERMIT — SEP 28, 2022
3	REVISED FOR PERMIT — MAR 06, 2022
2	REVISED FOR PERMIT — FEB 24, 2022
1	REVISED FOR PERMIT — JULY 15, 2021
	ISSUED/REVISED — DATE

LICENCED PROFESSIONAL ENGINEER
J. FENG
MAR 16, 2023
PROVINCE OF ONTARIO

FRONTOP ENGINEERING LIMITED
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7.All work and conditions on site to commence and shall be site specified by the General Contractor.

STORM SEWERS

1. STORM SEWER PIPES 300mm & 375mm IN DIA. SHALL BE PVC SDR 35 CONFORMING TO C.S.A. SPECIFICATION B182.2-M1990 AND B182.4-M1992 OR LATEST REVISION THEREOF. STORM SEWER PIPES 450mm DIA. OR LARGER SHALL BE REINFORCED CONCRETE CONFORMING TO C.S.A. SPECIFICATION A257.2-M1982 OR LATEST REVISION THEREOF. PIPE JOINTS SHALL BE BY MEANS OF APPROVED RUBBER GASKETS CONFORMING TO C.S.A. SPECIFICATION A257.3-M1982 OR LATEST REVISION THEREOF.

2. SEWER BEDDING AND BACKFILL FOR STORM SEWERS SHALL BE AS PER O.P.S.D. 802.030 CLASS 'B' WITH GRANULAR 'A' BEDDING FOR CONCRETE PIPE AND 802.010 FOR PVC PIPE.

3. STORM MANHOLES AS PER O.P.S.D. 701.010, 701.011, 701.012 AND WITH SIZE AS NOTED ON DRAWINGS, FRAME AND COVER AS PER O.P.S.D. 401.010 TYPE 'B', SAFETY PLATFORMS AS PER O.P.S.D. 404.020 AND SHALL BE INSTALLED IN MANHOLES WHERE DEPTH EXCEEDS 5.0m, STORM MANHOLE BENCHING TO BE TO OBVERT OF PIPE AND AS PER O.P.S.D. 701.021, MINIMUM 230mm IN WIDTH AND TO CROWN OR AS SPECIFIED ON DRAWINGS.

4. STREET CATCHBASINS SHALL BE AS PER O.P.S.D. 705.020 (DOUBLE) AND 705.010 (SINGLE) WITH FRAME AND GRATES AS PER O.P.S.D. 400.110. CATCHBASIN CONNECTIONS SHALL BE AS PER O.P.S.D. 708.030, SINGLE CB LEAD - 200mm DIA.; DOUBLE CB LEAD - 250mm DIA. CATCHBASIN LEADS SHALL BE PVC SDR-35, CONFORMING TO C.S.A. SPECIFICATION B182.2 AND B182.4 OR LATEST REVISION THEREOF.

5. STORM SEWER SERVICE CONNECTIONS SHALL BE SINGLE OR DOUBLE 150mm DIA. WHITE PVC CONFORMING TO SDR-28 AS PER O.P.S.D. 1006.020. SERVICE CONNECTIONS TO TERMINATE AT STREETLINE. 50mm × 100mm MARKER STAKES TO BE INSTALLED AT THE END OF ALL SERVICE CONNECTIONS. MARKER STAKES ARE TO EXTEND TO MIN. 1.2m ABOVE PRE-GRADE ELEVATIONS AND TO BE SUITABLY MARKED STM OR BE COLOUR PAINTED AS DIRECTED BY THE ENGINEER.

6. A MINIMUM VERTICAL CLEARANCE OF 300mm SHALL BE PROVIDED BETWEEN THE OUTSIDE OF ALL PIPE BARRELS AT ALL POINTS OF PIPE CROSSINGS. WHERE THE MINIMUM CLEARANCE CANNOT BE OBTAINED, THE CROSSING SHALL BE ENCASED IN 15MPa CONCRETE.

7. ALL STRUCTURES ARE TO BE COMPLETE WITH WATERPROOFING WRAP AT JOINTS AND RUBBER BOOTS AT CONNECTIONS.

8. CONSTRUCTION METHODS AND MATERIALS SHOULD BE IN COMPLIANCE WITH THE TOWN OF MIDLAND'S ENGINEERING DEVELOPMENT DESIGN STANDARDS, MECP'S 2022 DESIGN CRITERIA FOR SANITARY SEWERS, STORM SEWERS AND FORCEMAINS FOR ALTERATIONS AUTHORIZED UNDER ENVIRONMENTAL COMPLIANCE APPROVAL, AND INDUSTRY BEST PRACTICES.

SANITARY SEWERS

1. SANITARY MANHOLES AS PER O.P.S.D. 701.010 WITH FRAMES AND COVERS AS PER O.P.S.D. 401.010 TYPE 'A'. SANITARY MANHOLE TOPS TO BE STAMPED "SANITARY".

2. SANITARY SEWER PIPES SHALL BE PVC OR CONCRETE AND AS SHOWN ON DRAWINGS PVC PIPE SHALL BE SDR-35 CONFORMING TO C.S.A. SPECIFCATION B182.2-M1990 AND B182.4-M1992 OR LATEST REVISION THEREOF. 300mm DIA. AND SMALLER CONCRETE PIPES TO BE NON-REINFORCED EXTRA STRENGTH CONFORMING TO C.S.A. SPECIFICATION A257.1-M1982 OR LATEST REVISION THEREOF.

3. BEDDING FOR PVC SANITARY SEWERS TO BE AS PER O.P.S.D. 802.010 WITH GRANULAR 'A' BEDDING.

4. BENCHING TO BE AS PER O.P.S.D. 701.021 WITH MINIMUM WIDTH OF 230mm OR AS SPECIFIED ON DRAWINGS.

5. SAFETY PLATFORMS TO BE AS PER O.P.S.D. 404.020 AND TO BE INSTALLED IN MANHOLES WHERE DEPTH EXCEEDS 5.0m.

6. DROP STRUCTURES SHALL BE AS PER O.P.S.D. 1003.010.

7. SANITARY SERVICE CONNECTIONS SHALL BE SINGLE 125mm GREEN PVC SDR-28 PIPE AS PER O.P.S.D. 1006.02. SERVICE CONNECTIONS TO TERMINATE AT STREETLINE, 50mm × 100mm MARKER STAKES TO BE INSTALLED AT THE END OF ALL SERVICE CONNECTIONS. MARKER STAKES ARE TO EXTEND TO MIN. 1.2m ABOVE PRE-GRADE ELEVATIONS AND TO BE SUITABLY MARKED "SAN" OR BE COLOUR PAINTED AS DIRECTED BY THE ENGINEER.

8. RISERS ARE REQUIRED ON ALL SANITARY CONNECTIONS WHERE COVER ON MAIN SEWER EXCEEDS 4.5m AS PER O.P.S.D. 1006.020 MODIFIED TO PROVIDE HL8 GRADED LIMESTONE BEDDING MATERIAL MAXIMUM 3.0m IN DEPTH OR AS APPROVED BY THE TOWN.

9. A MINIMUM VERTICAL CLEARANCE OF 300mm SHALL BE PROVIDED BETWEEN THE OUTSIDE OF ALL PIPE BARRELS AT ALL POINTS OF PIPE CROSSINGS. WHERE THE MINIMUM CLEARANCE CANNOT BE OBTAINED, THE CROSSING SHALL BE ENCASED IN 15MPa CONCRETE.

10. ALL STRUCTURES ARE TO BE COMPLETE WITH WATERPROOFING WRAP AT JOINTS AND RUBBER BOOTS AT CONNECTIONS.

11. CONSTRUCTION METHODS AND MATERIALS SHOULD BE IN COMPLIANCE WITH THE TOWN OF MIDLAND'S ENGINEERING DEVELOPMENT DESIGN STANDARDS, MECP'S 2022 DESIGN CRITERIA FOR SANITARY SEWERS, STORM SEWERS AND FORCEMAINS FOR ALTERATIONS AUTHORIZED UNDER ENVIRONMENTAL COMPLIANCE APPROVAL, AND INDUSTRY BEST PRACTICES.

WATERMAINS

1. WATERMAINS 150mm DIA. TO 300mm DIA. SHALL BE PVC CL. 150 (DR-18) CONFORMING TO A.W.W.A. C900-89 AND C.S.A. CAN3 B137.3-M1986 OR LATEST REVISION THEREOF WITH GASKETED JOINTS AND BE PROVIDED WITH 12 GAUGE SOLID COPPER TRACER WIRE.

2. UNLESS OTHERWISE INDICATED, WATER SERVICE CONNECTIONS SHALL BE 25mm TYPE 'K' COPPER INSTALLED AS PER O.P.S.D. 1104.010. ROBAR INDUSTRIES LTD. SADDLE NO. 266 OR APPROVED EQUAL SHALL BE USED ON ALL PVC WATERMAINS 250mm DIA. OR LESS. WATERBOXES SHALL BE INSTALLED 0.15m FROM STREETLINE WITHIN THE MUNICIPAL ROAD ALLOWANCE. WATERBOXES TO BE OF THE BALL TYPE. WATERBOXES NOT TO BE LOCATED IN DRIVEWAYS.

3. A MIN. HORIZONTAL SEPARATION OF 2.5m AND A MIN. VERTICAL SEPARATION OF 0.50m BETWEEN WATERMAINS AND SEWERS MUST MAINTAINED IF WATERMAIN IS ABOVE OR BELOW SEWER, MEASURED OUTSIDE TO OUTSIDE OF PIPES.

4. WATERMAIN BEDDING AND EMBEDMENT MATERIAL SHALL BE GRANULAR AS PER O.P.S.D. 802.010 GRANULAR 'A' TO CONFORM TO O.P.S.S. 1010. (VALVES IN V.C. SHOULD BE FLANGED VALUES).

5. ALL HYDRANTS SHALL BE AS PER O.P.S.D. 1105.010, SHALL HAVE PUMPER CONNECTIONS, ANCHOR TEES AND BE NON-DRAINING, PROVIDE STORZ FITTING AT PUMPER CONNECTION NOZZLE.

6. ALL PLUGS, CAPS, TEES AND BENDS SHALL HAVE THRUST BLOCKS OR BE MECHANICALLY RESTRAINED. THRUST BLOCKS TO CONFORM TO O.P.S.D. 1103.010 (HORIZONTAL) AND O.P.S.D. 1103.020 (VERTICAL).

7. MINIMUM DEPTH OF COVER OVER WATERMAIN SHALL BE 1.70m MEASURED FROM THE OBVERT TO THE FINISHED GRADE OVER THE WATERMAIN.

8. GATE VALVES SHALL BE RESILIENT SEAT VALVES WITH NON-RISING STEM, 50mm METRO TYPE OPERATING NUT OPENING COUNTER-CLOCKWISE AND BE PLACED IN VALVE CHAMBERS.

9. DRAIN AND AIR RELEASE CHAMBERS, FRAMES AND COVERS TO CONFORM TO O.P.S.D. 401.010 TYPE 'A'. COVERS TO BE STAMPED "WATER". BACKFILL SHALL BE GRANULAR 'B' CONFORMING TO O.P.S.S. 1010.

10. DUCTILE IRON FITTING SHALL BE CATHODICALLY PROTECTED. EXACT WEIGHT OF THE ANODES TO BE DETERMINED AT THE TIME OF CONSTRUCTION BY GEOTECHNICAL ENGINEER. IF DETERMINED WEIGHTS ARE LESS THAN THE TOWN'S MINIMUM REQUIREMENTS, THEN THE TOWN'S MINIMUM REQUIREMENTS SHOULD BE USED.

11. CONSTRUCTION METHODS AND MATERIALS SHOULD BE IN COMPLIANCE WITH THE TOWN OF MIDLAND'S ENGINEERING DEVELOPMENT DESIGN STANDARDS, MECP'S 2022 DESIGN CRITERIA FOR SANITARY SEWERS, STORM SEWERS AND FORCEMAINS FOR ALTERATIONS AUTHORIZED UNDER ENVIRONMENTAL COMPLIANCE APPROVAL, AND INDUSTRY BEST PRACTICES.

12. EXISTING MUNICIPAL WATERMAIN LOCATION AND ELEVATION HAVE TO BE VERIFIED DURING CONSTRUCTION.

FRONTOP ENGINEERING LIMITED

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LICENSED PROFESSIONAL ENGINEER
J. FENG
MAR 16, 2023
PROVINCE OF ONTARIO

NO.	ISSUED/REVISED	DATE
1	REVISED FOR PERMIT	MAR 16, 2023

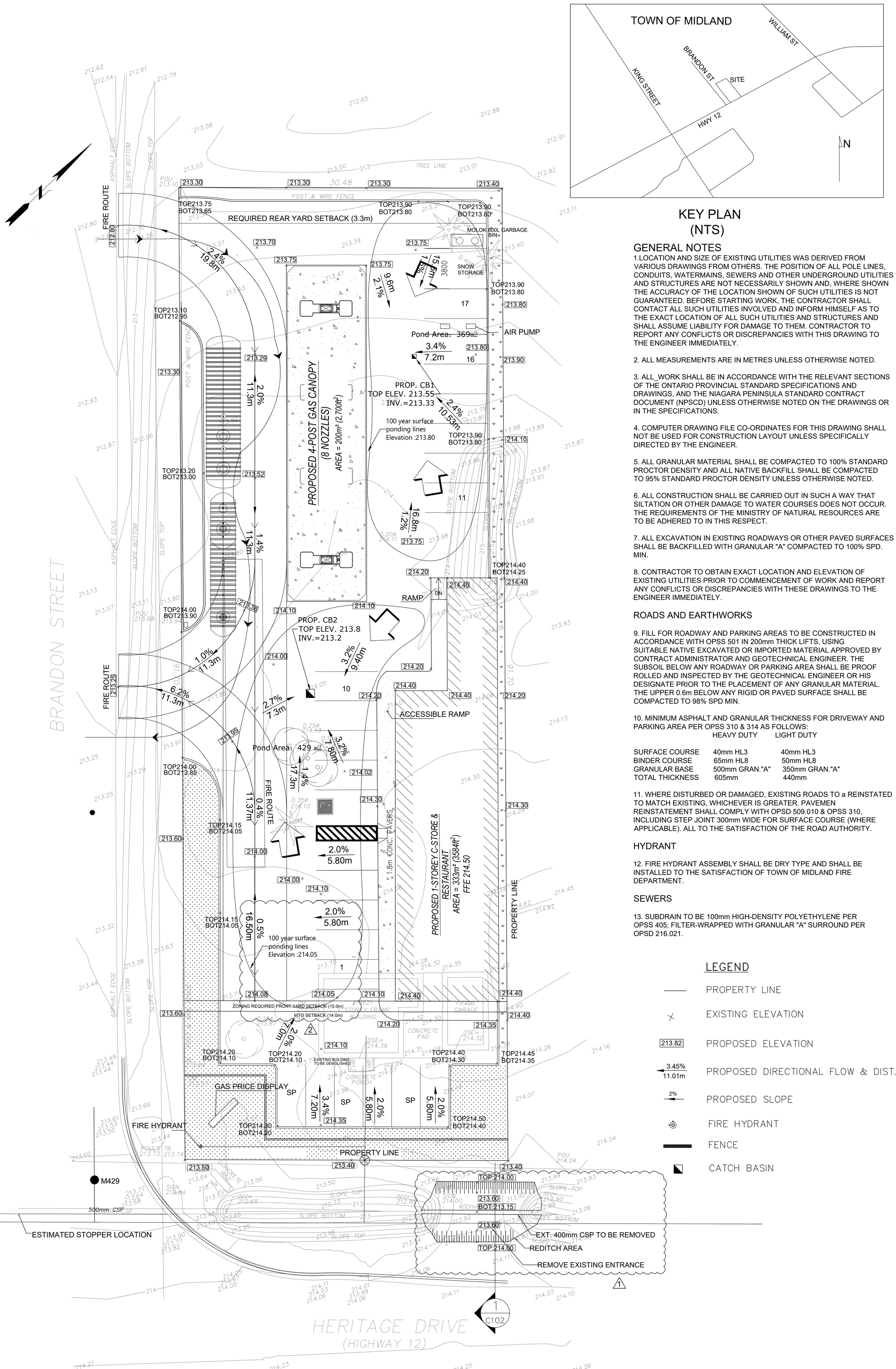
Owner & Address

16621 HWY 12
MIDLAND, ONTARIO

Drawing Title

GENERAL NOTES

Project No. DES21-03-13A
Drawn by R.F.
Checked by L.X.
Date MAR 16, 2023
Drawing No. C107
Scale



KEY PLAN
(NTS)

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ROADS AND EARTHWORKS

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10. MINIMUM ASPHALT AND GRANULAR THICKNESS FOR DRIVEWAY AND PARKING AREA PER OPSS 310 & 314 AS FOLLOWS:

	HEAVY DUTY	LIGHT DUTY
SURFACE COURSE	40mm HL3	40mm HL3
BINDER COURSE	65mm HL8	50mm HL8
GRANULAR BASE	500mm GRAN."A"	350mm GRAN."A"
TOTAL THICKNESS	605mm	440mm

11. WHERE DISTURBED OR DAMAGED, EXISTING ROADS TO a REINSTATED TO MATCH EXISTING, WHICHEVER IS GREATER. PAVEMEN REINSTATEMENT SHALL COMPLY WITH OPSD 509.010 & OPSS 310, INCLUDING STEP JOINT 300mm WIDE FOR SURFACE COURSE (WHERE APPLICABLE). ALL TO THE SATISFACTION OF THE ROAD AUTHORITY.

HYDRANT

12. FIRE HYDRANT ASSEMBLY SHALL BE DRY TYPE AND SHALL BE INSTALLED TO THE SATISFACTION OF TOWN OF MIDLAND FIRE DEPARTMENT.

SEWERS

13. SUBDRAIN TO BE 100mm HIGH-DENSITY POLYETHYLENE PER OPSS 405; FILTER-WRAPPED WITH GRANULAR "A" SURROUND PER OPSD 216.021.

LEGEND

- PROPERTY LINE
- EXISTING ELEVATION
- 213.82 — PROPOSED ELEVATION
- 3.45% / 11.01m — PROPOSED DIRECTIONAL FLOW & DIST.
- 2% — PROPOSED SLOPE
- FIRE HYDRANT
- FENCE
- CATCH BASIN

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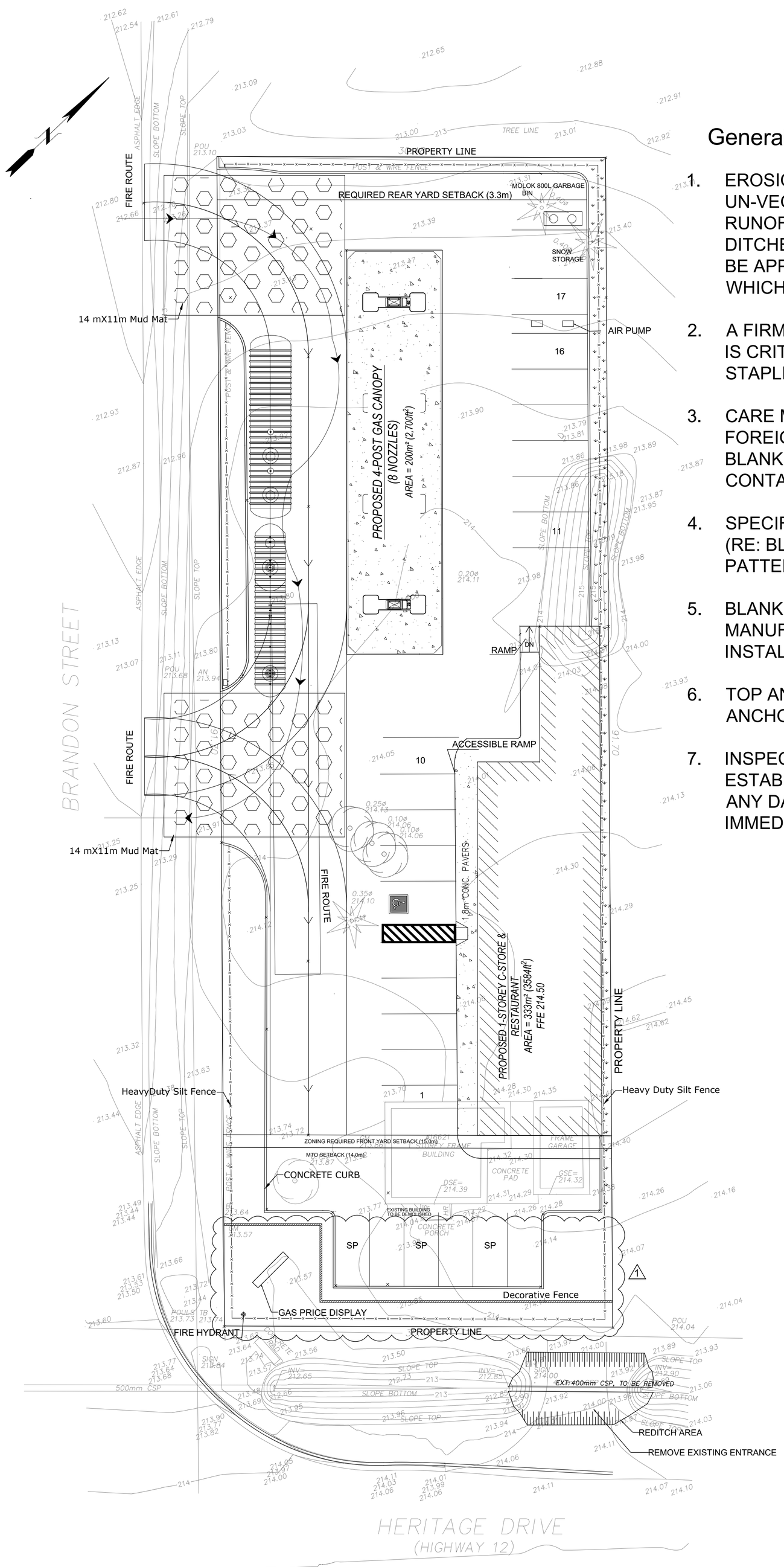
LICENSED PROFESSIONAL ENGINEER
J. FENG
JUNE 14, 2023
PROVINCE OF ONTARIO

NO.	ISSUED/REVISED	DATE
6	REVISED FOR PERMIT 2	JUNE 14, 2023
5	REVISED FOR PERMIT 1	MAR 16, 2023
4	REVISED FOR PERMIT	AUG 17, 2022
3	REVISED FOR PERMIT	MAR 06, 2022
2	REVISED FOR PERMIT	FEB 24, 2022
1	REVISED FOR PERMIT	JULY 15, 2021

Owner & Address
16621 HWY 12
MIDLAND, ONTARIO

Drawing Title
GRADING PLAN

Project No. DES21-03-13A
Drawn by R.F.
Checked by A.Z.
Date JUNE 14, 2023
Drawing No. C101
Scale 1:180

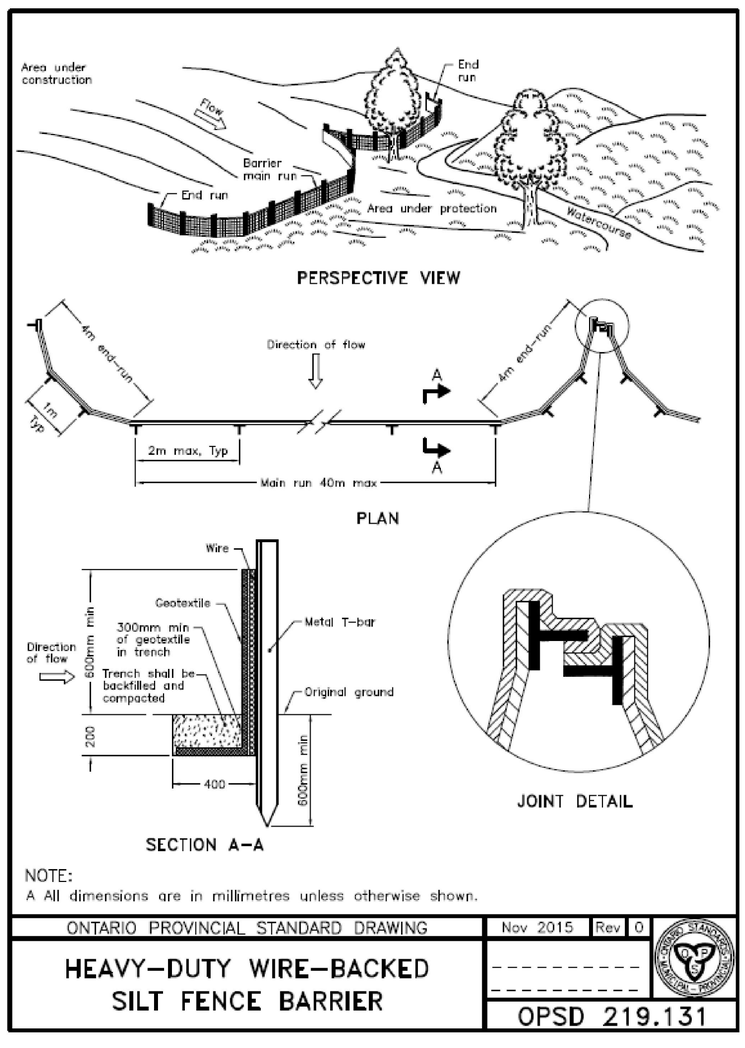


General Notes:

1. EROSION CONTROL BLANKET SHALL BE USED FOR UN-VEGETATED DISTURBED AREAS SUBJECT TO RAINFALL AND RUNOFF AND CONVEYANCE SYSTEMS INCLUDING SWALES AND DITCHES RECEIVING CONCENTRATED FLOWS. THEY SHALL ALSO BE APPLIED TO ALL EXPOSED SLOPES GREATER THAN 2H:1V WHICH ARE SUBJECT TO RAINFALL AND RUNOFF.
2. A FIRM, CONTINUOUS CONTACT BETWEEN THE BLANKET AND SOIL IS CRITICAL. CAREFUL ROLLING AFTER INSTALLATION AND STAPLING MAY BE REQUIRED TO OBTAIN FIRM CONTACT.
3. CARE MUST BE TAKEN DURING INSTALLATION TO REMOVE ALL FOREIGN DEBRIS (I.E. ROCKS, BRANCHES, PLASTICS) TO PREVENT BLANKET, MATS OR NETS FROM TENTING DUE TO LACK OF FIRM CONTACT WITH THE SOIL SURFACE.
4. SPECIFIC MANUFACTURER'S INSTRUCTIONS MUST BE FOLLOWED (RE: BLANKET TYPE/APPLICATION, ANCHORING, AND STAPLE PATTERN.
5. BLANKETS SHOULD OVERLAP AT EDGES AND AT END - REFER TO MANUFACTURER'S INSTRUCTIONS FOR THE EXACT DETAILS OF INSTALLATION.
6. TOP AND BOTTOM ENDS MAY NEED TO BE SECURED IN AN ANCHOR TRENCH.
7. INSPECT PERIODICALLY UNTIL VEGETATIVE COVER IS ESTABLISHED, PARTICULARLY AFTER EACH RAINFALL EVENT FOR ANY DAMAGE TO THE BLANKET. REPAIR ALL DAMAGED AREAS IMMEDIATELY.

LEGEND

- PROPERTY LINE
- EXISTING ELEVATION
- Mud Tracking Mat
- —X—X— Heavy Duty Fence



FRONTOP ENGINEERING LIMITED
101 AMBER STREET, UNIT 1&2, MARKHAM ON L3R 3B2
TELEPHONE: (905)947-0900 FAX: (905)305-9370
Website: www.frontop.ca Email: info@frontop.ca

NOTES:

1. All drawings are to be read in conjunction with the latest version of the Ontario Building Code.
2. Verify all dimensions prior to construction.
3. Do not scale drawings.
4. Report all discoveries of errors, omissions or discrepancies to the Architect or Design Engineer as applicable.
5. The drawings are the property of the Architect and/or Engineer and must be returned on completion of the project. Any unauthorized use is prohibited.
6. Use only the latest revised drawings or those that are marked issued for construction.
7. All area calculations are approximate and shall be site specified by the General Contractor.

LICENSED PROFESSIONAL ENGINEER
J. FENG
MAR 16, 2023
PROVINCE OF ONTARIO

NO.	ISSUED/REVISED	DATE
5	REVISED FOR PERMIT 1	MAR 16, 2023
4	REVISED FOR PERMIT	SEP 29, 2022
3	REVISED FOR PERMIT	MAR 06, 2022
2	REVISED FOR PERMIT	FEB 24, 2022
1	REVISED FOR PERMIT	JULY 15, 2021

Owner & Address
16621 HWY 12
MIDLAND, ONTARIO

Drawing Title
EROSION SEDIMENT CONTROL

Project No. DES21-03-13A
Drawn by R.F.
Checked by A.Z.
Date MAR 16, 2023
Drawing No. C105
Scale 1:200

APPENDIX B

Project Name	**tion at 16621 Hwy 12, Midland On,**					
Scenario:	**25yr Post to pre-condition 25yr**					
a =	1676.200					
b =	8.300					
c =	0.858					
Required storage estimation based on Modified Rational Method						
Target Release Rate =	19.42	L/s				
A =	0.2793	ha				
C =	0.838		**post developmetn runoff coefficient**			
Starting t_c =	10	minutes				
Time increment =	10	minutes				
Max storage requirement =	**51.0**	**m^3**				
Duration of Storm (min)	**Intensity (mm/hr)**	**Peak flow (m^3/s)**	**Peak flow Vol. (m^3)**	**Release Rate Vol. (m^3)**	**Req'd Storage Vol. (m^3)**	
10	138.40	0.090	54.0	11.6	42.4	
20	95.21	0.062	74.3	23.3	51.0	
30	73.44	0.048	86.0	34.9	51.0	<<< Max Storage
40	60.19	0.039	93.9	46.6	47.3	
50	51.21	0.033	99.9	58.2	41.7	
60	44.71	0.029	104.7	69.9	34.8	
70	39.76	0.026	108.6	81.5	27.1	
80	35.87	0.023	112.0	93.2	18.8	
90	32.71	0.021	114.9	104.8	10.0	
100	30.10	0.020	117.5	116.5	1.0	
110	27.91	0.018	119.8	128.1	-8.4	
120	26.03	0.017	121.9	139.8	-17.9	
130	24.41	0.016	123.8	151.4	-27.6	
140	22.99	0.015	125.6	163.1	-37.5	
150	21.74	0.014	127.2	174.7	-47.5	
160	20.62	0.013	128.8	186.4	-57.6	
170	19.63	0.013	130.2	198.0	-67.8	
180	18.73	0.012	131.6	209.7	-78.1	
190	17.92	0.012	132.8	221.3	-88.5	
200	17.17	0.011	134.0	233.0	-99.0	
210	16.50	0.011	135.2	244.6	-109.5	
220	15.88	0.010	136.3	256.3	-120.0	
230	15.30	0.010	137.3	267.9	-130.6	
240	14.77	0.010	138.3	279.6	-141.2	
250	14.28	0.009	139.3	291.2	-151.9	

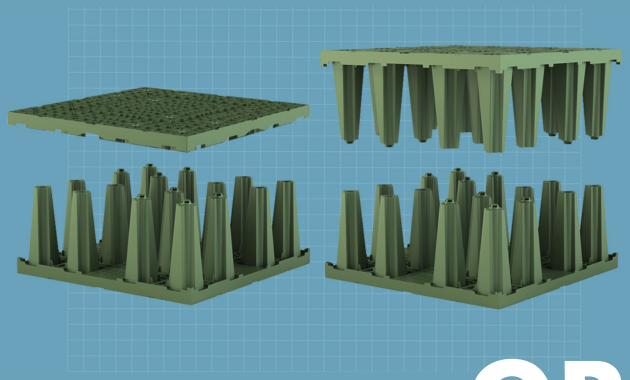
Project Name	**Proposed Gas Station at 16621 Hwy 12, Midland On,**					
Scenario:	**100yr Post to pre-condition 100yr**					
a =	2193.100					
b =	9.040					
c =	0.871					
Required storage estimation based on Modified Rational Method						
Target Release Rate =	23.63	L/s				
A =	0.2793	ha				
C =	0.838		**post developmetn runoff coefficient**			
Starting t_c =	10	minutes				
Time increment =	10	minutes				
Max storage requirement =	**63.0**	**m^3**				
Duration of Storm (min)	**Intensity (mm/hr)**	**Peak flow (m^3/s)**	**Peak flow Vol. (m^3)**	**Release Rate Vol. (m^3)**	**Req'd Storage Vol. (m^3)**	
10	168.45	0.110	65.7	14.2	51.6	
20	116.62	0.076	91.0	28.4	62.7	
30	90.13	0.059	105.5	42.5	63.0	<<< Max Storage
40	73.89	0.048	115.3	56.7	58.6	
50	62.86	0.041	122.7	70.9	51.8	
60	54.85	0.036	128.4	85.1	43.4	
70	48.76	0.032	133.2	99.3	33.9	
80	43.95	0.029	137.2	113.4	23.8	
90	40.06	0.026	140.7	127.6	13.1	
100	36.84	0.024	143.8	141.8	2.0	
110	34.13	0.022	146.5	156.0	-9.5	
120	31.81	0.021	149.0	170.1	-21.2	
130	29.81	0.019	151.2	184.3	-33.1	
140	28.06	0.018	153.3	198.5	-45.2	
150	26.52	0.017	155.2	212.7	-57.5	
160	25.15	0.016	157.0	226.9	-69.9	
170	23.92	0.016	158.7	241.0	-82.4	
180	22.81	0.015	160.2	255.2	-95.0	
190	21.81	0.014	161.7	269.4	-107.7	
200	20.90	0.014	163.1	283.6	-120.5	
210	20.07	0.013	164.4	297.8	-133.3	
220	19.30	0.013	165.7	311.9	-146.2	
230	18.60	0.012	166.9	326.1	-159.2	
240	17.94	0.012	168.1	340.3	-172.2	
250	17.34	0.011	169.2	354.5	-185.3	

Project Name	**tion at 16621 Hwy 12, Midland On,**					
Scenario:	**5yr Post to pre-condition**					
a =	1135.400					
b =	7.500					
c =	0.841					
Required storage estimation based on Modified Rational Method						
Target Release Rate =	14.35	L/s				
A =	0.2793	ha				
C =	0.838		**post developmetn runoff coefficient**			
Starting t_c =	10	minutes				
Time increment =	10	minutes				
Max storage requirement =	**37.4**	**m^3**				
Duration of Storm (min)	**Intensity (mm/hr)**	**Peak flow (m^3/s)**	**Peak flow Vol. (m^3)**	**Release Rate Vol. (m^3)**	**Req'd Storage Vol. (m^3)**	
10	102.27	0.067	39.9	8.6	31.3	
20	69.93	0.045	54.6	17.2	37.4	<<< Max Storage
30	53.88	0.035	63.1	25.8	37.2	
40	44.16	0.029	68.9	34.4	34.5	
50	37.61	0.024	73.4	43.0	30.3	
60	32.86	0.021	76.9	51.7	25.3	
70	29.26	0.019	79.9	60.3	19.7	
80	26.42	0.017	82.5	68.9	13.6	
90	24.12	0.016	84.7	77.5	7.2	
100	22.22	0.014	86.7	86.1	0.6	
110	20.62	0.013	88.5	94.7	-6.2	
120	19.25	0.013	90.1	103.3	-13.2	
130	18.06	0.012	91.6	111.9	-20.3	
140	17.03	0.011	93.0	120.5	-27.5	
150	16.12	0.010	94.3	129.1	-34.8	
160	15.30	0.010	95.5	137.7	-42.2	
170	14.57	0.009	96.7	146.3	-49.7	
180	13.92	0.009	97.8	155.0	-57.2	
190	13.32	0.009	98.8	163.6	-64.8	
200	12.78	0.008	99.7	172.2	-72.4	
210	12.28	0.008	100.7	180.8	-80.1	
220	11.83	0.008	101.5	189.4	-87.8	
230	11.41	0.007	102.4	198.0	-95.6	
240	11.02	0.007	103.2	206.6	-103.4	
250	10.66	0.007	104.0	215.2	-111.2	

APPENDIX C

STORMCON

STORMWATER MANAGEMENT
STORMWATER STORAGE



GREENSTORM ST
GREENSTORM ST-B
INSTALLATION MANUAL

www.stormcon.ca

ATTENTION

Staff responsible for installation, assembly, operation, maintenance and repair must have appropriate qualifications required for this kind of work.The builder is responsible for organising in detail authority, responsibility and supervision of staff.

The operational safety of the system components supplied is only guaran- teed in case of proper installation and correct use. Technical threshold values must not be exceeded.

Observe the accident prevention regula- tions and relevant standards and direc- tives for installation, fitting, operation, maintenance and repair!

This includes (in extracts):

Accident prevention regulations
- Construction work BGV C22
- Technical wastewater systems GUV-V C5

Safety regulations for working in enclosed spaces of technical wastewater systems GUV-R 126

Handling biological working materials in technical wastewater systems GUV-R 145

Directives for working in tanks and narrow spaces BGR 117

Standards
- Excavations and trenches - slopes, planking and strutting, breadths of working spaces DIN 4124

- Construction and testing of drains and sewers DIN EN 1610

Tool for safety and health protection in technical wastewater systems.

WARNING

- Hazards from gases and vapours such as risk of suffocation, risk of poisoning and risk of explosion
- Risk of falling
- Risk of drowning
- Germ pollution and wastewater with sewage
- High physical and psychic strain during work in deep, narrow and dark spaces
- and others

DANGER

Non-compliance with the operating manual may result in considerable property damage, injury or death.

CAUTION

The system is part of an entire network. During installation, maintenance, ser- vice and repair work on one component, always consider the entire system.

Avoid work during rain.

Changes or modifications to the system may only be carried out with the agree- ment of the manufacturer. For safety reasons, use original spare parts and accessories approved by the manufac- turer. The use of other parts voids the liability for any consequences arising therefrom.

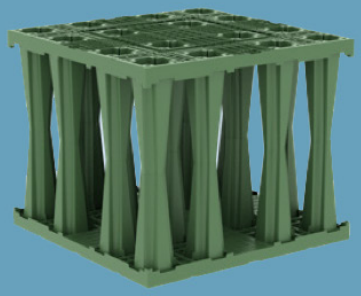
STORMCON

CONTACT / SALES

PARTH PUSHKARNA parthp@stormcon.ca

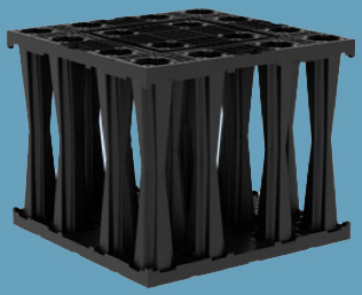
GREG DZIEWIECKI gregd@stormcon.ca

GREENSTORM ST*

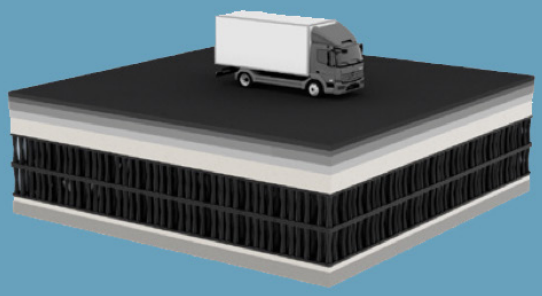


SLW 60/ HGV 60

GREENSTORM STB



SLW 30/ HGV 30



Certifcation CSTB

NB

In what follows, an illustrative explanation of the GreenStorm system will be given by means of the green module. All properties and advantages also apply to the GreenStorm ST-B system. The systems have been optimised for different installation situations.

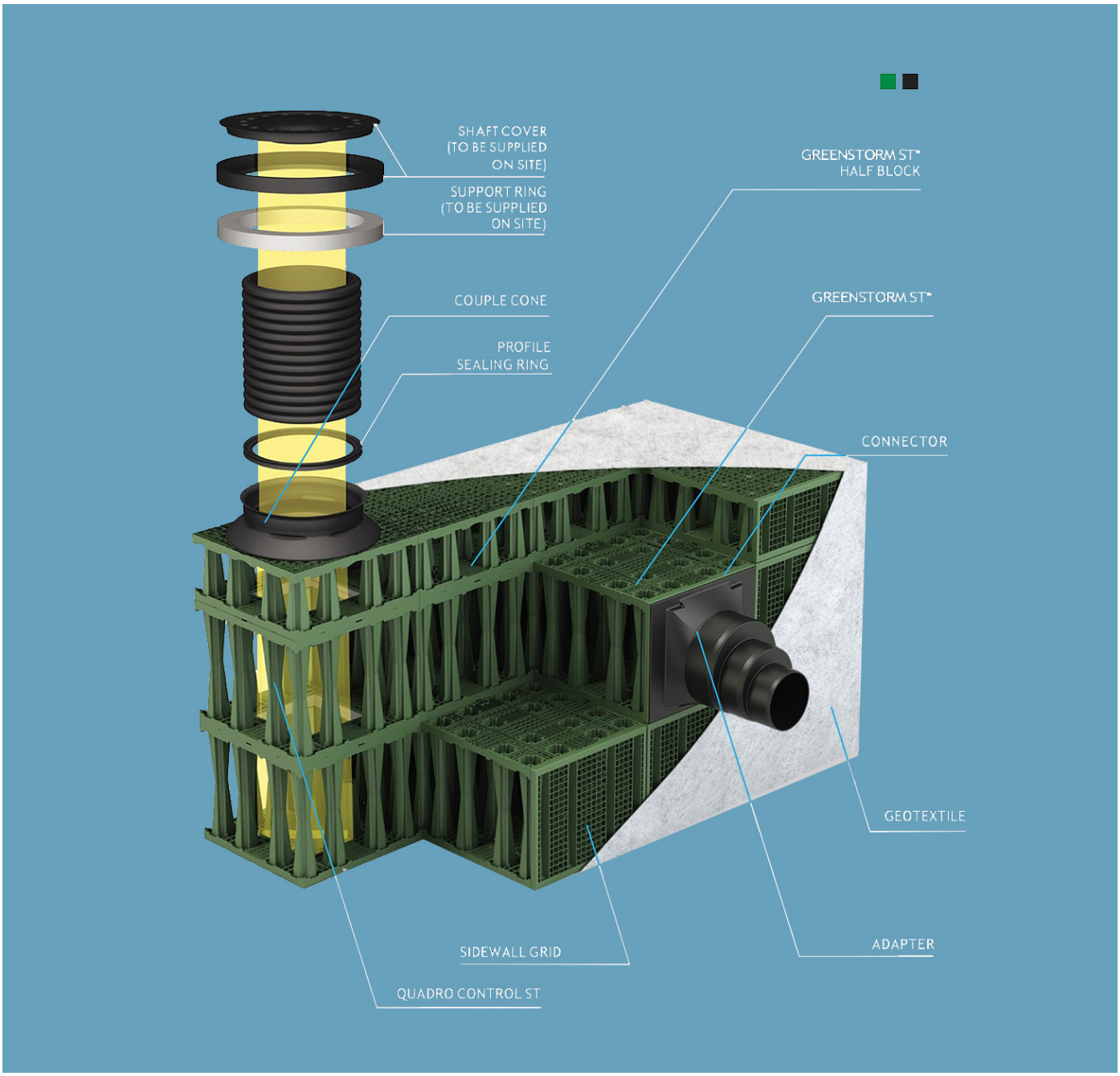
In the following, please be sure to pay attention to these signs:
Statements marked with this sign apply to both GreenStorm ST and GreenStorm ST-B.

STORMCON

TABLE OF CONTENTS

STORMCON

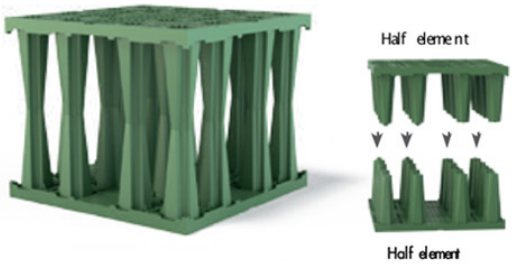
Quadro® Control ST – system shaft



*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

GREENSTORM® ST STORAGE/ INFILTRATION MODULE

GreenStorm® ST

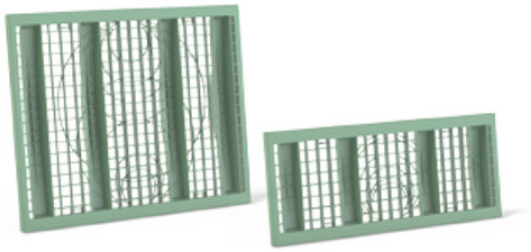


consisting of:
GreenStorm ST half

GreenStorm® ST half block

consisting of:
one GreenStorm ST half element and one roof slab

Sidewall grid

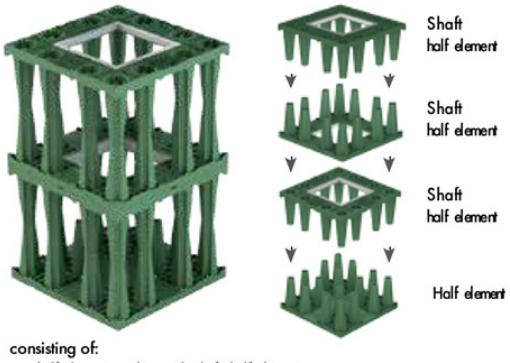


Sidewall grid for GreenStorm ST full

Sidewall grid for GreenStorm ST half

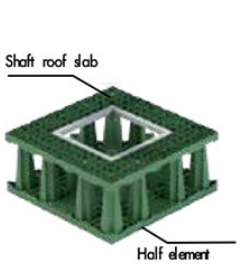
Adapter

Quadro®Control ST

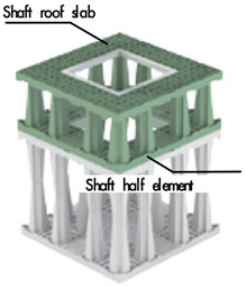


consisting of:
one half element and several shaft half elements

Quadro®Control ST – half shaft



consisting of:
one half element
and one shaft roof slab



consisting of:
one shaft half element and one shaft roof slab

TRANSPORT AND STORAGE

GreenStorm ST modules are delivered stacked on pallets (63.00 in. x 31.5 in).
A pallet contains 34 half elements for 17 modules. When leaving the factory, two pallets are typically stacked on top of each other. Sidewall grids and roof slabs (required for half blocks only) are packed on separate pallets.

The components of the QuadroControl ST shaft are delivered pre-assembled on separate pallets. These pallets are marked accordingly. Preferably unload the pallets using forklifts or other lifting tools. The lifting tools must have the technical equipment required for lifting gear operation.

GreenStorm ST can be stored outdoors. Stor- age time should, however, not exceed one year . Protect the material from direct sunlight (e.g. store in the shade or cover with bright-coloured, light-tight foil).

Check the components for defects before installation.

The impact stability of the material decreases in sub-zero temperatures. *Damaged modules must NOT be installed!*

The relevant safety provisions of the building industry apply.

SEPARATING PALLETS

CAUTION

Solid and level ground is required for storage at the construction site.

Avoid dropping, dumping as well as hitting the GreenStormST modules against each other.

We recommend using hoisting slings to separate both stacked pallets. Separate the pallets before removing the half elements.

EXCAVATING PIT AND CREATING BEARING

The excavation pit must be made according to planning specifications. During excavation work, the walls of the pit must be sloped or constructed such that they pose no danger to the workers due to downsliding masses. In addition, national regulations must be observed. Take measures to ensure that the exca- vation pit is free from water during the entire execution time. In order to install GreenStorm ST modules, a horizontal, level and stable bearing is essential.

To this end, create a levelling layer of approx. 3.93 in, preferably made of crushed stones or gravel (without fine fractions), above the bottom of the exca- vation pit. The layer must be compacted carefully and smoothed to achieve a level surface.

The compression level Dpr should be ≥ 97 % (Evd ≥ 522135.85 lbf/ft2 or CBR ≥ 8 % top edge of the bearing). If the soil has been included in the infiltration calculation, the permeability of the compacted layer must at least correspond to the permeability (kf value) of the backfill soil (soil groups GE, GW, SE, SW, SI). The quality of the bedding area is decisive for further installation and strongly affects both bearing and setting proper- ties of the storage/infiltration modules, particularly in case of multi-layer designs

LAYING GEOTEXTILE

Wrap the entire storage/infiltration system in geotextile. Before starting to lay the modules, spread out the geotextile on the planum. The geotex- tile must have sufficient lateral excess length in order to eventually wrap up the entire system. It must overlap at least 11.81 in. at all edges.

ATTENTION

Ensure that the geotextile surface is completely closed and no openings occur even during backfilling!

IMPORTANT CHARACTERISTICS OF GEOTEXTILE (E.G. RIGOFLOR):

Thickness: ≥ 0.07in

Puncture resistance: 449.6lbf

Geotextile class: 3

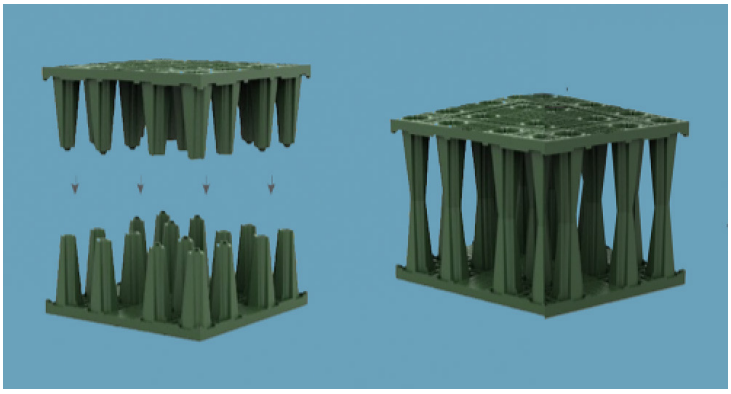
Characteristic opening width: 0.003 in

kf value (at 20 kPa): 0.134mph

Water permeability acc. to EN ISO 11058: 90 l/sm2

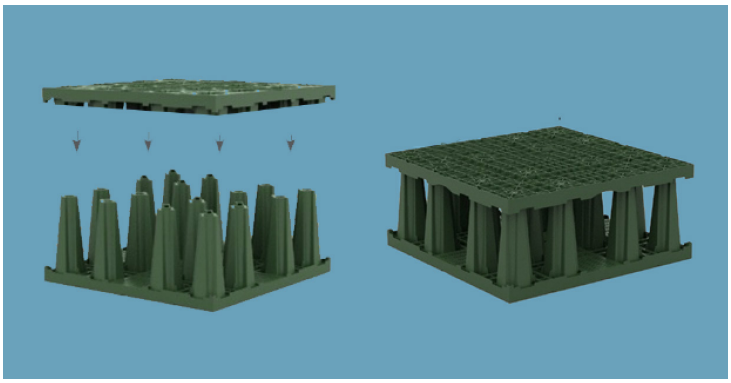
Mass per unit area: 4.74 lb/ft2

INSTALLATION



Each GreenStorm ST module consists of two half elements. Slight hand pres- sure is enough to create a connection of high tensile strength. The modules can be pre-assembled both inside and outside the excavation pit.

The pre-assembled modules must be arranged according to planning specifications.



Each GreenStorm ST half block consists of one half element and one roof slab. Slight hand pressure is enough to create a connection of high tensile strength. The modules can be pre-as- sembled both inside and outside the excavation pit.
For a 0.5-layer system, the pre-as- sembled modules must be arranged on the planum according to plan- ning specifications. For multi-layer systems, the half blocks must be arranged in the top layer.

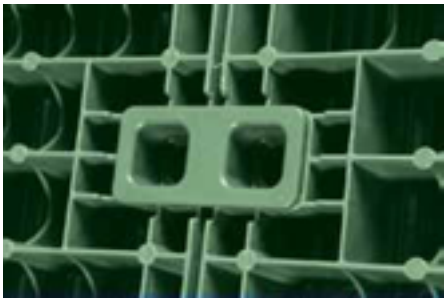
ATTENTION

Half blocks must be installed with the roof slab located on top.

PRE-ASSEMBLY OUTSIDE THE EXCAVATION PIT

PRE-ASSEMBLY INSIDE THE EXCAVATION PIT

INSTALLATION



Single-layer connector using the example of GreenStorm ST

Multiple-layer connector using the example of GreenStorm ST-B

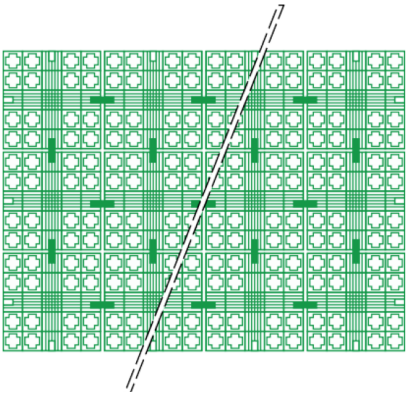
CONNECTOR, FULL BLOCK/HALF BLOCK:

Connectors help secure the modules in place.

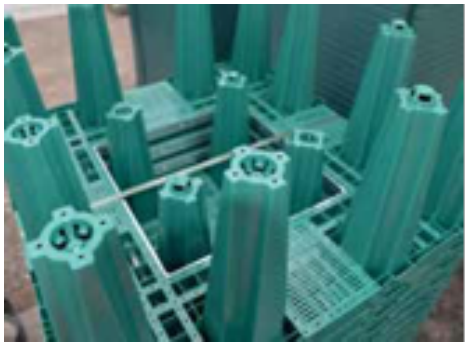
Secure modules using connectors on the top surface of the module in the centre of each edge that neighbours another module.

Determination of requirements:

Connector		Application	Requirement	
single-layer		for single-layer installation	requirement for single-layer installation	1 pc. per module
			requirement formultiple layer installation	2 pcs. per module
multiple layer		for multiple layer installation	requirement for 2-layer installation	1 pc. per module
			requirement for 3-layer installation	1.3 pcs. per module

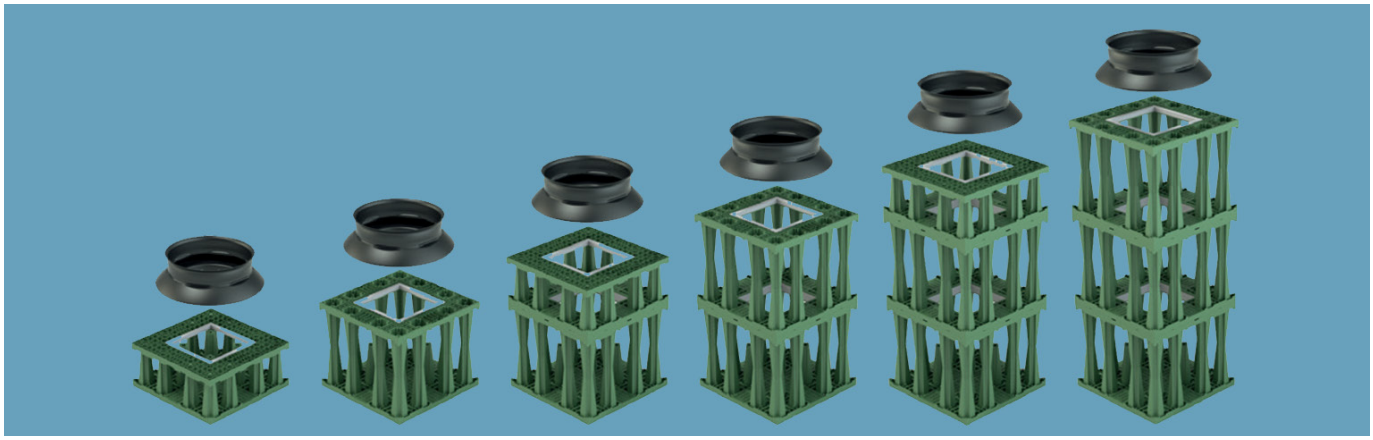


DELIVERY



The components of the QuadroControl ST shaft are delivered to the site pre-assembled and packed on a pallet.

SHAFT VARIANTS



1/2-layer 1-layer 11/2-layer 2-layer 21/2-layer 3-layer

Product	Cat. no.	Cone	Profile sealing ring for extension pipe	Shaft half element	Shaft roof slab with frame	Half element
						
		pc(s).	pc(s).	pc(s).	pc(s).	pc(s).
Quadro Control ST 0.5	515.04.005	1	1		1	1
Quadro Control ST 1	515.04.010	1	1	1		1
Quadro Control ST 1.5	515.04.015	1	1	2	1	1
Quadro Control ST 2	515.04.020	1	1	3		1
Quadro Control ST 2.5	515.04.025	1	1	4	1	1
Quadro Control ST 3	515.04.030	1	1	5		1
QuadroControl ST-B 0.5	515.04.205	1	1		1	1
QuadroControl ST-B 1	515.04.210	1	1	1		1
QuadroControl ST-B 1.5	515.04.215	1	1	2	1	1
QuadroControl ST-B 2	515.04.220	1	1	3		1
QuadroControl ST-B 2.5	515.04.225	1	1	4	1	1
QuadroControl ST-B 3	515.04.230	1	1	5		1

INSTALLATION OF SHAFT ELEMENTS

The shaft is constructed layer by layer and it grows as construction of the system progresses.

The installation of the bottom layer of the QuadroControl ST shaft always starts with connecting the half element and the shaft half element.

Install the shaft bottom in the intended position in the layout.

Please ensure that the opening with the metal frame faces upwards. Use block connectors to connect to the adjacent GreenStorm ST modules.

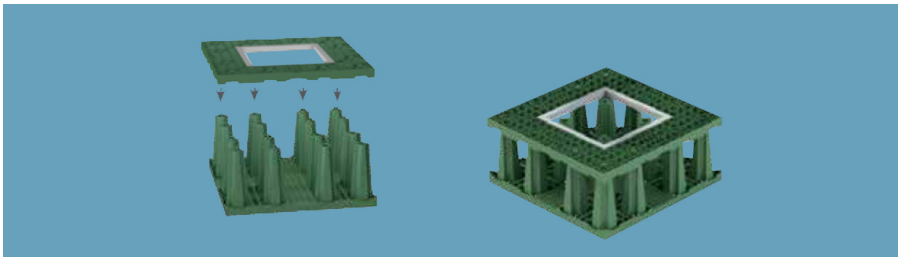
Additional complete layers:

Each of these layers is made of two shaft half elements. Place the shaft components onto the already existing shaft bottom using multi-layer connectors

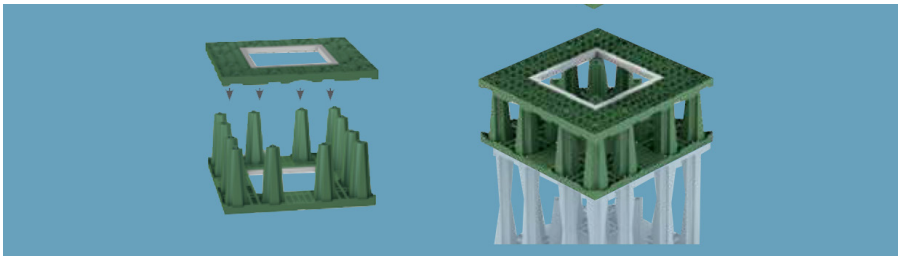
INSTALLATION OF SHAFT ELEMENTS

Half-layer shaft:
Always start by putting the half element and the shaft roof slab together.

Install the shaft in the intended position in the layout. Please ensure that the opening with the metal frame faces upwards. Use block connectors to connect to the adjacent GreenStorm ST modules.



Upper half layer:
This layer consists of a shaft half element and a shaft roof slab. Place the half layer onto the subjacent shaft part using multi-layer connectors; the roof slab must face upwards.



How to place cones:
Regardless of the number of layers, the couple cones provide the transition to the extension pipes. Preferably put the couple cones on the shaft openings only after the upper system layer has been completed.

Before installing the couple cones, wrap the entire storage/infiltration system including shafts in geotextile. At the square openings, cut out the geotextile.

Installation of extension pipes:
Insert the extension pipes into the cone coupling using the sealing rings included in the delivery (please use lubricant). Before, mount profile sealing rings onto the first corrugation trough of the extension pipes.

Make sure that the extension pipes are installed upright and do not shift during compaction.

TEMPORARY CONSTRUCTION SITE COVERS

Extension pipes are delivered with temporary construction site covers.

They are used to prevent backfill or other dirt from entering the shafts during installa- tion. The temporary construction site cover is not accessible and may not be trafficked!

Do NOT remove temporary construction site covers before installing permanent shaft covers.

Purpose of temporary construction site covers when backfilling

Temporary construction site cover for extension pipes

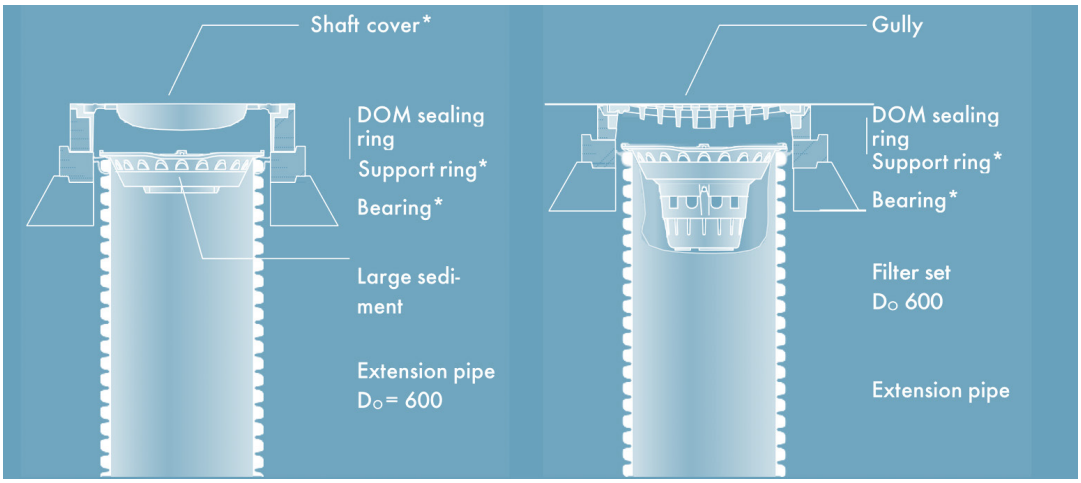
SHAFT COVERS

After installing the covering (see next chapter), mount shaft covers. Cut the extension pipe DO 600 such that it reaches the support ring. Seal the gap between the support ring and the shaft cover using a DOM sealing ring.

Mount the sealing ring onto the last corrugation of the extension pipe. Place a sediment trap DO 600 on the extension pipe. If according to planning specifications, the shaft must feature a gully gutter, place the filter set DO 600 on the extension pipe.

Shaft covers or gully gutters and con- crete support rings are not included in the scope of delivery and must be supplied on site. Carry out and install shaft covers according to planning specifications.

The inside diameter must be at least 24.0 in. Shaft covers must be suitable for the expected traffic loads. If national guidelines, such as EN 124, are applicable, they must be observed.
Put a support ring h = 3.93 in. on an appropriate bearing under the shaft cov- er/gully gutter. Create the bearing from compacted bearing layer material or in-situ concrete C 16/20. Avoid interlocking of the bearing with the corrugations of the extension pipe (use casing aid!). Vertical loads may only be transferred to the load-bearing underground.



Shaft cover on the shaft (e.g. inspection shaft)*to be supplied on site

Gully gutter on the shaft (e.g. swale emergency overflow)
*to be supplied on site

CAUTION

Installation in sub-zero temperatures requires greater care (impact stability, please refer to the section on transport and storage).
Modules are slippery when wet or frosty!

DOM sealing ring

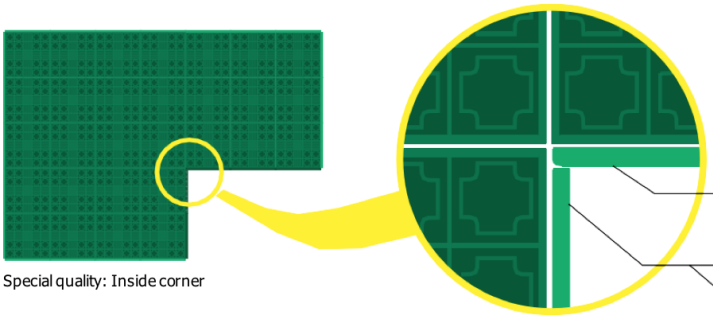
INSTALLING SIDEWALL GRIDS

Use sidewall grids to cover tunnel ends of the storage/infiltration system. Place the sidewall grid in the centre. Pressing the sidewall grid is enough to connect the module tight using four locking pins.

ATTENTION

Depending on on-site requirements, the installation of the sidewall grids can already take place outside the excavation pit.

If there is enough space, the installation of all sidewall grids can alternatively be carried out after the installation of modules has been completed.Similar application with sidewall grid/ half block.



Special quality: Inside corner

NB

Use sidewall grids shortened at one side for storage/infiltration designs with inside corners.

GreenStorm ST sidewall grid
Cat. no. 519.94.000

GreenStorm ST sidewall grid, short
Cat. no. 519.94.010

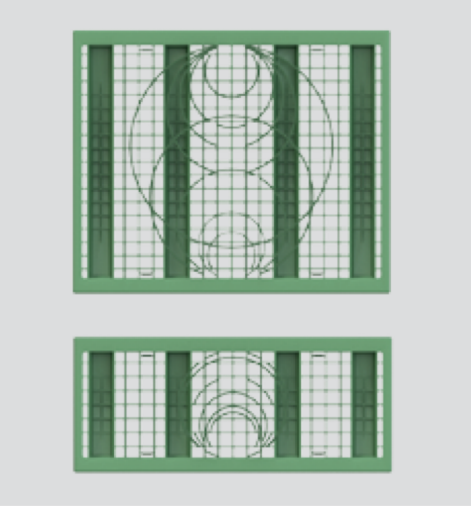
GreenStorm ST half block sidewall grid, short
Cat. no. 519.94.011

GreenStorm ST-B sidewall grid
Cat. no. 519.94.200

GreenStorm ST-B sidewall grid, short
Cat. no. 519.94.210

GreenStorm ST-B sidewall grid, short
Cat. no. 519.94.211

CUTTING OPENINGS IN SIDEWALL GRIDS



To directly connect supply pipe and drain pipe, the sidewall grids have pre- marked circles for solid wall pipes with nominal diameters of DN 110 to 500 (DN 110 to DN 250 for sidewall grid/half block).

Module layers	Connection height
1/2-layer	1.57 in.
1-layer	1.57 in.
1 1/2-layer	27.55 in.
2-layer	27.55 in.
2 1/2-layer	53.54 in.
3-layer	53.54 in.

Connection heights (independent of nominal diameter)from the trench soil

NB

We recommend using a jigsaw.

INSERTING ADAPTERS (DN 315/DN 400/DN500)

The adapter must be cut to the nominal diameter according to planning specifi- cations.

The pipe DN 315 can be connected directly. The adapter can be installed at soil level or turned by 180° at crown level.

Securing with an adapter fastener

NB

An angular grinder is best suited for cutting. Please cut approx. 0.40 in. from the edge to maintain the inser- tion chamfer. Mount the prepared adapter to the module just like a sidewall grid and secure it using an adapter fastener.

CREATING GEOTEXTILE WRAPPING

GreenStorm systems must be wrapped completely in geotextile (e.g. RigoFlor). At the edges, provide sufficient overlap- ping (at least 11.81 in.) to make sure no backfill material enters the system. Produce sand-tight pipe inlets by cross- shaped cutting of the geotextile.

ATTENTION

Ensure that the geotextile sur- face is completely closed and no openings occur even during backfilling!

LATERAL BACKFILLING

Connectors secure the individual GreenStorm ST modules and prevent the storage/ infiltration system from shifting during backfilling.

Use non-cohesive, non-frozen earth- work material with a maximum grain size of 12.60 in. for backfilling.

Distribute the backfill material evenly and compact it in layers of max. 11.81 in. using a light or machine (area vibrator or vibratory ram- mer). In doing so, a compac- tion level Dpr of > 97 % should be achieved.

The modules must NOT be damaged. National guidelines for earthworks (such as ZTV E-StB) must be adhered to.

Make sure that the geotextile overlap- ping is not pulled apart during backfill- ing and compact- ing and that the GreenStorm ST modules are not damaged!

The permeability of the backfill must at least correspond to the permeability of the backfill soil.

CREATING COVER

The storage/infiltration module must be covered according to planning specifications. Non-cohesive, compacta- ble graded earthwork material with a maximum grain size of 12.60 in. should be used for cover, which is a mandatory requirement under trafficked areas!
Frozen soil is not permissible! Additionally, nation-al guidelines for earthworks (such as ZTV E-StB) apply.

Stability analysis

Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against perma- nently impacting soil and traffic loads. The stability must be proven according to Eurocode, taking into account partial safety factors and/or limiting factors.

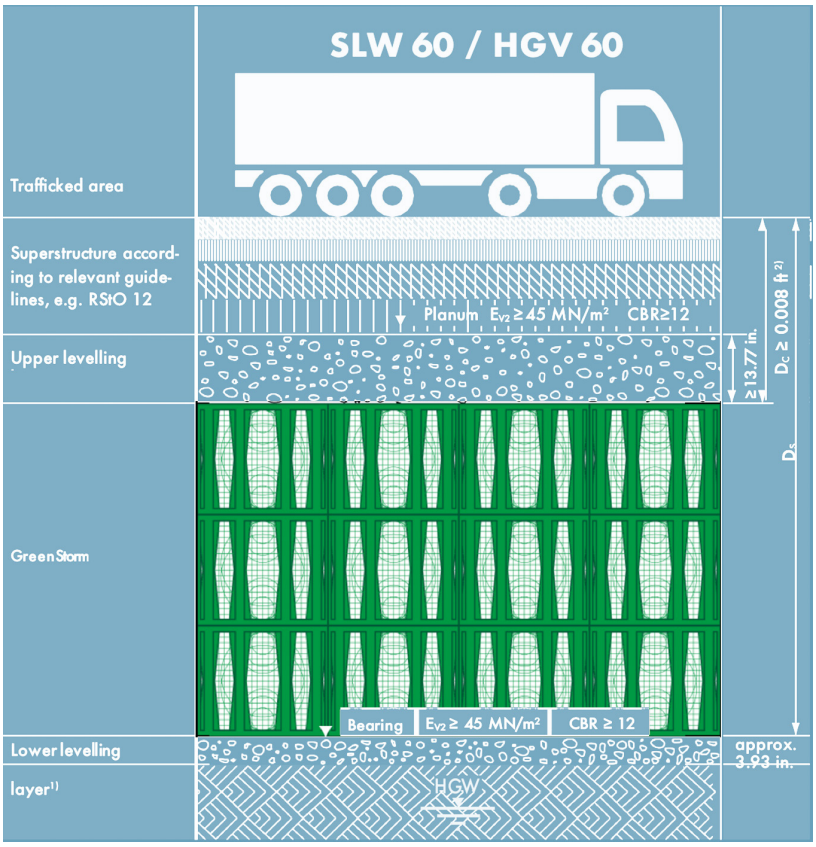
With conventional installation parameters*, depths of cover of D_C 157.48 in. and soil depths of D_S 236.22 in are possible for infiltration systems. A project-specific stability analysis can be prepared by. Under trafficked areas, a minimum cover D_C of 31.5 in. must be observed.

* HGV 60, specific weight of soil 115.61 lb/ft3; Mean soil temperature max. 73.4 °F;
Soil depth 236.22 in; k =0,3; 4-layer

ATTENTION

Note for HGW over structure soil: GreenStorm ST systems, which are used as watertight storage systems with impermeable membranes, have been designed for application above the highest groundwater level (HGW).
Use in groundwater is possible under corresponding technical conditions after consultation. Please contact us!

STANDARD INSTALLATION UNDER A TRAFFICKED AREA



National guidelines, e.g. RStO 12, must always be observed for installation under trafficked areas. To build the pla- num for the subsequent road construc-tion, a cover must be provided, preferably a gravel sub-base with a thickness of at least 13.77 in. Other construction mate- rials normally lead to greater depths of cover.

Generally, at the surface of the cover (= planum), a uniform modulus of deformation EV2 ≥ 939844.54 lbf/ft² or CBR ≥ 12% must be achieved.

Soil layers must always be provided and compacted in layers of max. 311.81 in. The compaction level Dpr should be ≥ 97%.

Carry out compacting using light or medium area vibrators only!

1) At least the same permeability (kf) as the subsoil for infiltration systems
2) Lower cover upon request!

CAUTION Compacting using vibratory rollers and explosion rammers is not permissible!
Carry out compacting using light or medium area vibrators only!

CREATING COVER

The storage/infiltration module must be covered according to planning specifications. Non-cohesive, compacta- ble graded earthwork material with a maximum grain size of 1.26 in. should be used for cover, which is a mandatory requirement under trafficked areas!

Frozen soil is not permissible! Additionally, national guidelines for earthworks (such as ZTV E-StB) apply.

Stability analysis
Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against perma- nently impacting soil and traffic loads. The stability must be proven according to Eurocode, taking into account partial safety factors and/or limiting factors.

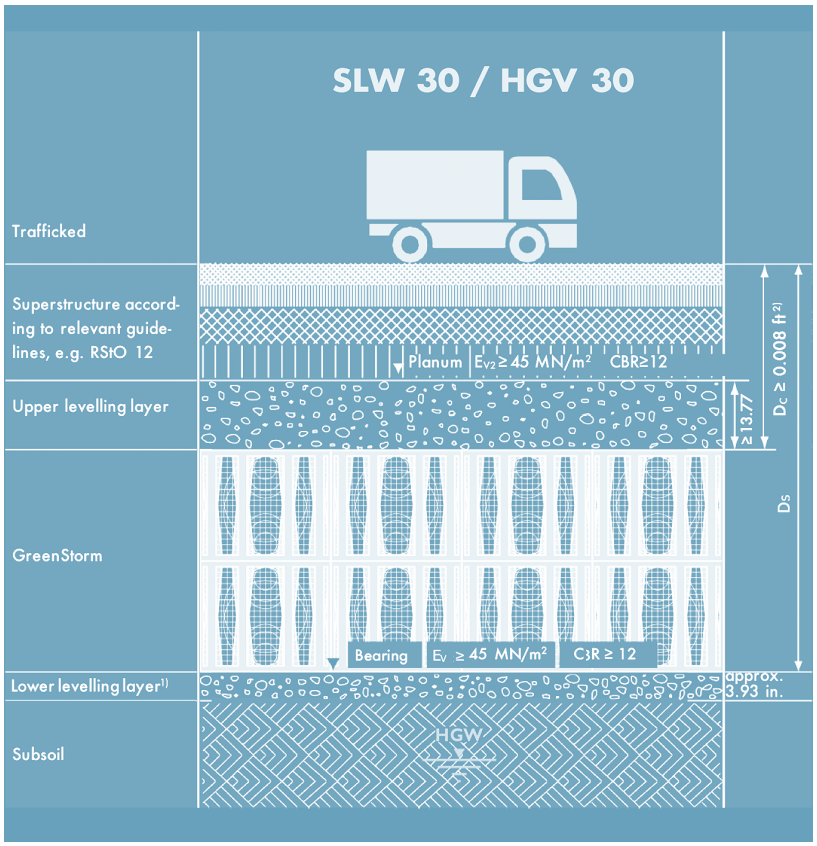
With conventional installation parame- ters*, depths of cover of DC 98.42 in. and soil depths of DS 157.48 in. are possible for infiltration systems. A project-specific stability analysis can be prepared by. Under trafficked areas, a minimum cover DC of 80 cm must be observed.

* HGV 30, specific weight of soil 115.61 lb/ft3 Mean soil temperature max. 73.4 °F, K=0.3

ATTENTION

Note for HGW over structure soil: GreenStorm ST-B systems, which are used as watertight storage systems with impermeable membranes, have been designed for application above the highest groundwater level (HGW).
Use in groundwater is possible under corresponding technical conditions after consultation. Please contact us!

STANDARD INSTALLATION UNDER A TRAFFICKED AREA



National guidelines, e.g. RStO 12, must always be observed for installation under trafficked areas. To build the pla- num for the subsequent road construction, a cover must be provided, preferably a gravel sub-base with a thickness of at least 13.77 in. Other construction mate- rials normally lead to greater depths of cover.

Generally, at the surface of the cover (= planum), a uniform modulus ofdefor- mation Ev2 ≥ 939844.54 lbf/ft² or CBR ≥ 12% must be achieved.

Soil layers must always be provided and compacted in layers of max. 11.81in. The compaction level Dpr should be ≥ 97%.

Carry out compacting using light or medium area vibrators only!

1) At least the same permeability (kf) as the subsoil for infiltration systems
2) Lower cover upon request!

CAUTION Compacting using vibratory rollers and explosion rammers is not permissible!

USE OF CONSTRUCTION VEHICLES DURING INSTALLATION

Use of vehicles when applying the first cover layer:

The first cover layer can be applied for example using a wheel loader or a front- type mobile excavator. For a wheel loader or mobile excavator with a maximum total weight of 30000 lbs (chain, 4 wheels, twin-tyres), a compacted cover of at least 11.81 in. must be placed over the storage/ infiltration system. Possible formation of ruts must be taken into account!

Avoid steering manoeuvres at this construction stage.

Use of construction vehicles:

Driving over the cover with heavy construction vehicles with a wheel load of up to 11240.45 lbf (e.g. HGV 30) is possible if the thickness of the compacted cover is not less than 23.62 in. Possible formation of ruts must be taken into account!

When dumping the earthwork material, the wheel load of 11240.45 lbf must not be exceeded; if necessary, load distribution plates must be used.

CAUTION

It is not permissible to drive construc- tion vehicles directly on the modules!

MODULAR RESERVOIR CONSTRUCTION FOR MANY APPLICATIONS

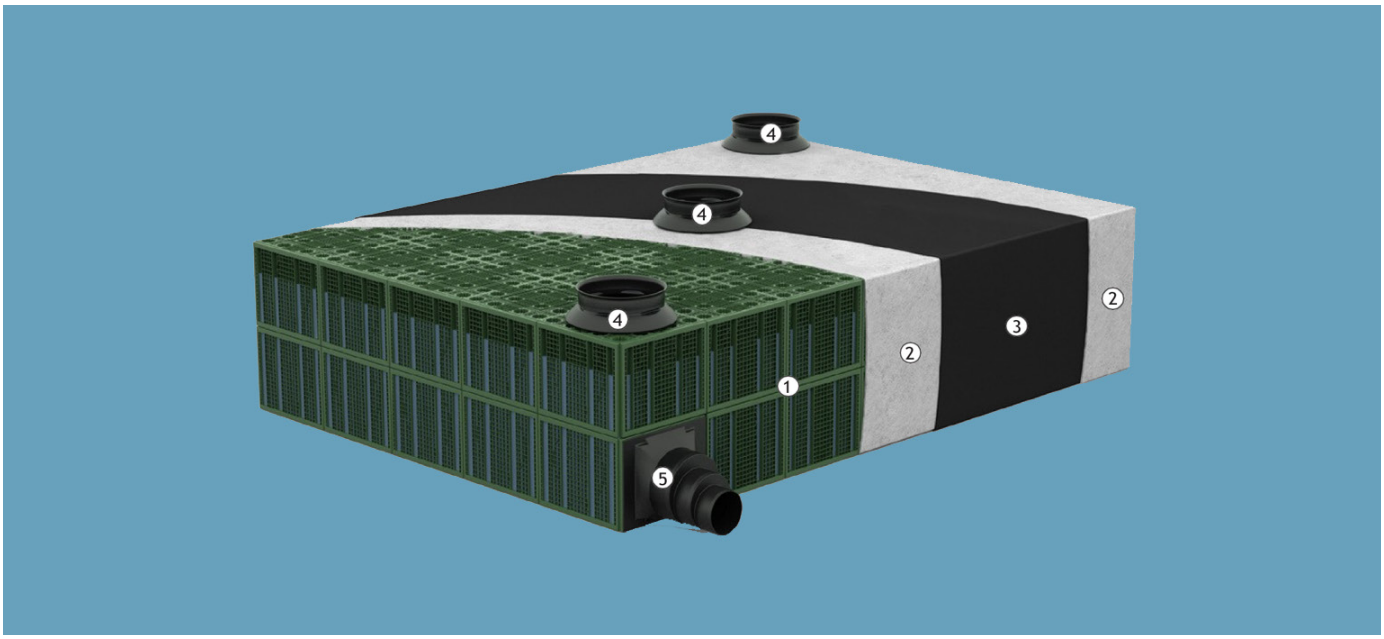
Use of vehicles when applying the first cover layer:

When using GreenStorm ST for stormwater storage, the system can be wrapped in impermeable plastic foil (KDB).

Please observe the manufacturer's specifications when installing the KDB impermeable membrane.

Applications:

- Stormwater retention
- Stormwater harvesting
- Fire water storage
- Combined applications



1 GreenStorm ST* storage/infiltration module 2 Geotextile 3 Impermeable membrane
4 QuadroControl ST system shaft 5 Adapter

INSTALLATION OF GREENSTORM STORAGE/INFILTRATION MODULES UNDER THE EFFECTS OF FROST I IN FROST ZONES

When using GreenStorm modules for the realization of underground infiltration or storage tanks, the general climatic conditions at the location must be taken into account. In zones exposed to frost, the effects of temperature on the product properties and the entire underground building during installation and operation have to be considered.

The construction work must always be carried out professionally in accordance with the relevant national guidelines and additionally in accordance with our installation guideline.

PRODUCT CHARACTERISTICS OF GREENSTORM:

GreenStorm modules are made of the thermoplastic Polypropylene (PP). The term "thermoplastic" already says that this plastic has temperature-dependent properties. At lower ambient temperatures, the material generally becomes stiffer and the strength of the modules also increases. This leads to improved static properties.

However, the impact sensitivity increases at lower temperatures.
In particular during installing the modules, backfilling and closing the construction pit, punctual impact stresses can occur and should therefore be minimized by appropriate care. This is particularly important when selecting and using compaction equipment and compaction processes.

Due to the robustness of GreenStorm, the installation does not lead to a problem, even if it is exposed to frost. This has been practiced for many years in Central and Northern Europe.

PROPERTIES OF THE ENTIRE UNDERGROUND BUILDING

According to the state of the art, the corresponding regulations and our installation guideline, the following requirements have to be considered:

1. Soil investigation to evaluate the soil situation on site and as a basis for the realization of the building project; the soil quality and the load-bearing capacity of the subsoil are decisive for the planned use and the installation of the underground building
2. Manufacturing of a suitable lower bedding zone
3. Manufacturing of the lateral bedding zone and backfill
4. Manufacturing of the cover and remaining backfilling

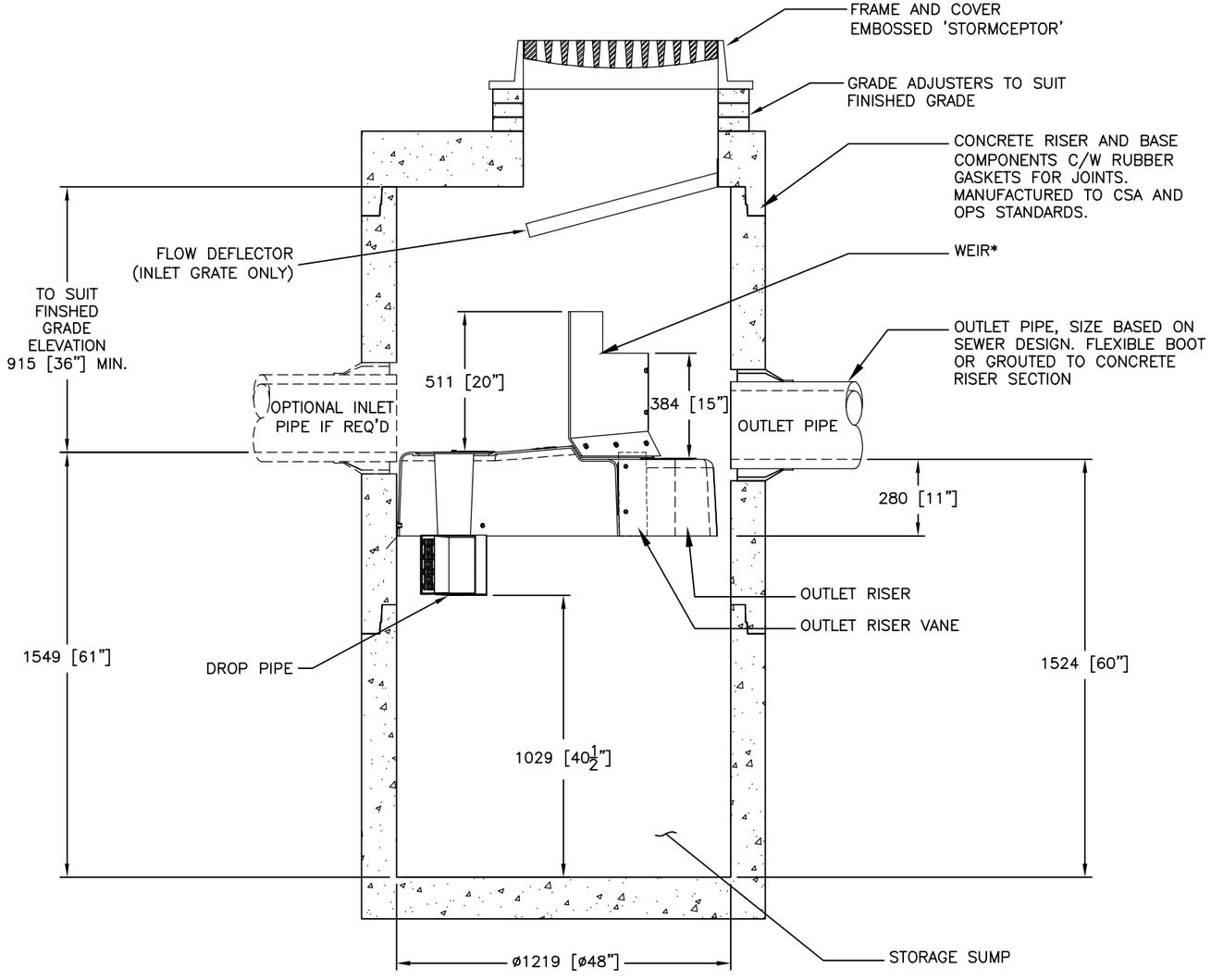
For points 2 - 4, suitable soil material has to be used in the required composition to achieve the desired load capacities. This is usually non-cohesive, compressible material. Frozen Materials are not allowed!

A stable subsoil is important for the buried structure in order to ensure the permanent function and lifetime. Usually it can be assumed that frozen ground does not guarantee sufficient load bearing capacity; especially if a frost-thaw change can take place. This can lead to softening and destabilization of the subsoil and, under certain circumstances, to a complete loss of the loadbearing capacity. In order to prevent this, the installation on frozen ground must be avoided or constructive protective measures must be taken.

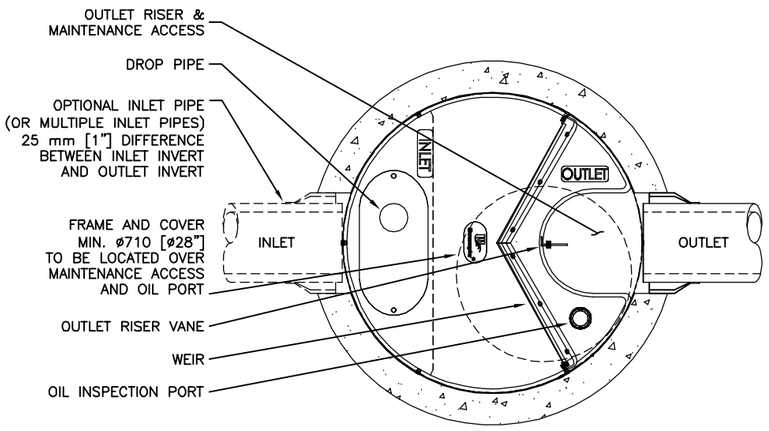
STORMCON

NOTES

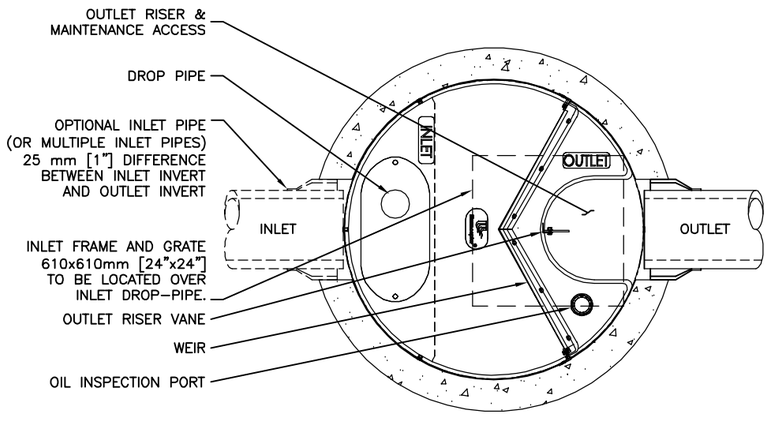
APPENDIX D



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF4 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO4 (OIL CAPTURE CONFIGURATION). WEIR HEIGHT IS 150 mm (6 INCH) FOR EF04.

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EF4
STRUCTURE ID	*
WATER QUALITY FLOW RATE (L/s)	*
PEAK FLOW RATE (L/s)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
DRAINAGE AREA (HA)	*
DRAINAGE AREA IMPERVIOUSNESS (%)	*

PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
1	6/8/18	UPDATES	JSK
0	5/26/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium®
7007 RIDGE ROAD, SUITE 350, HANOVER, MD 21076
USA 888-279-9828 CA 800-388-4601 INTL +1-416-960-9900

DATE: 5/26/2017

DESIGNED:	DRAWN:
JSK	JSK
CHECKED:	APPROVED:
BSF	SP
PROJECT No.:	SEQUENCE No.:
EF4	*

SHEET: 1 OF 1

Stormceptor®

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

07/29/2021

Province:	Ontario
City:	Midland
Nearest Rainfall Station:	ORILLIA TS
NCDC Rainfall Station Id:	5820
Years of Rainfall Data:	28

Site Name:	16621 hwy 12

Drainage Area (ha):	0.28
Runoff Coefficient 'c':	0.84

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	8.25
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	16221 Hwy12 Gas Station
Project Number:	45977
Designer Name:	Lijing 910 Xu
Designer Company:	Frontop engineering
Designer Email:	lijingxu2016@gmail.com
Designer Phone:	905-947-0900
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	83
EFO6	88
EFO8	91
EFO10	92
EFO12	92

Recommended Stormceptor EFO Model: EFO4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 83

Water Quality Runoff Volume Capture (%): > 90

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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 waterwavs.

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

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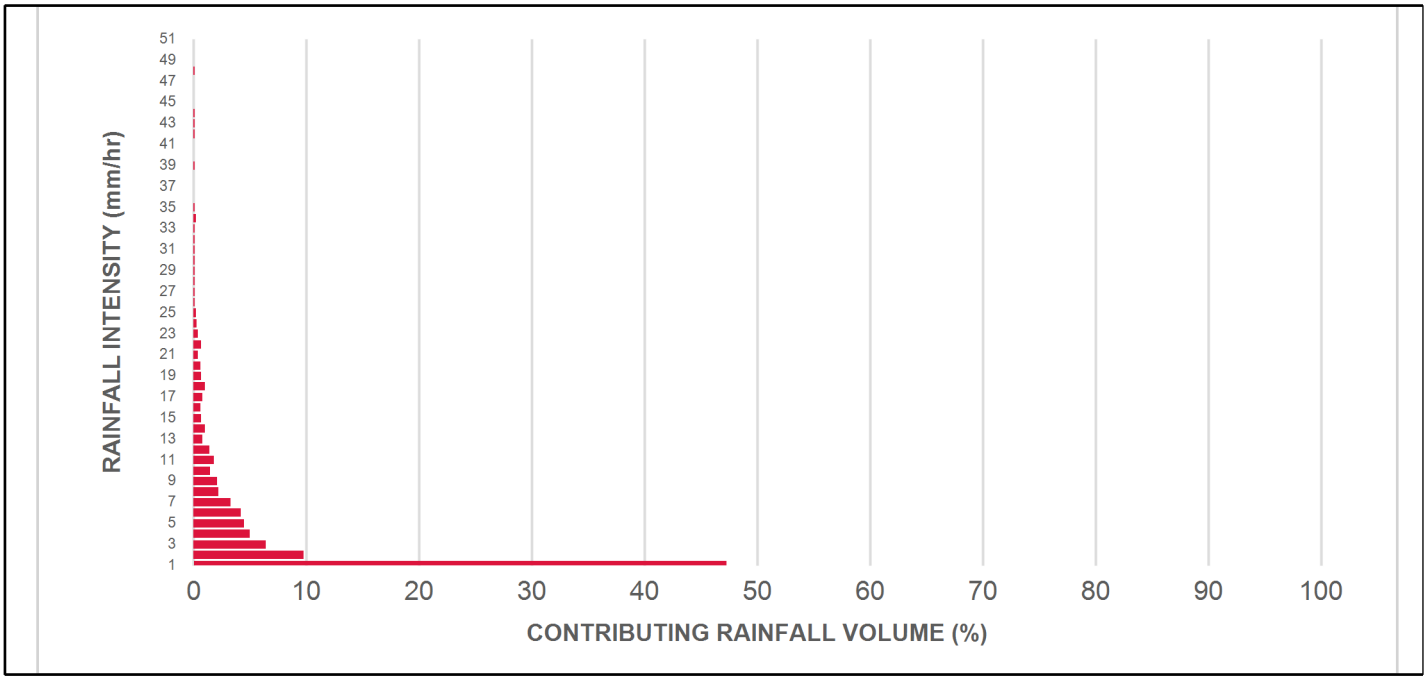
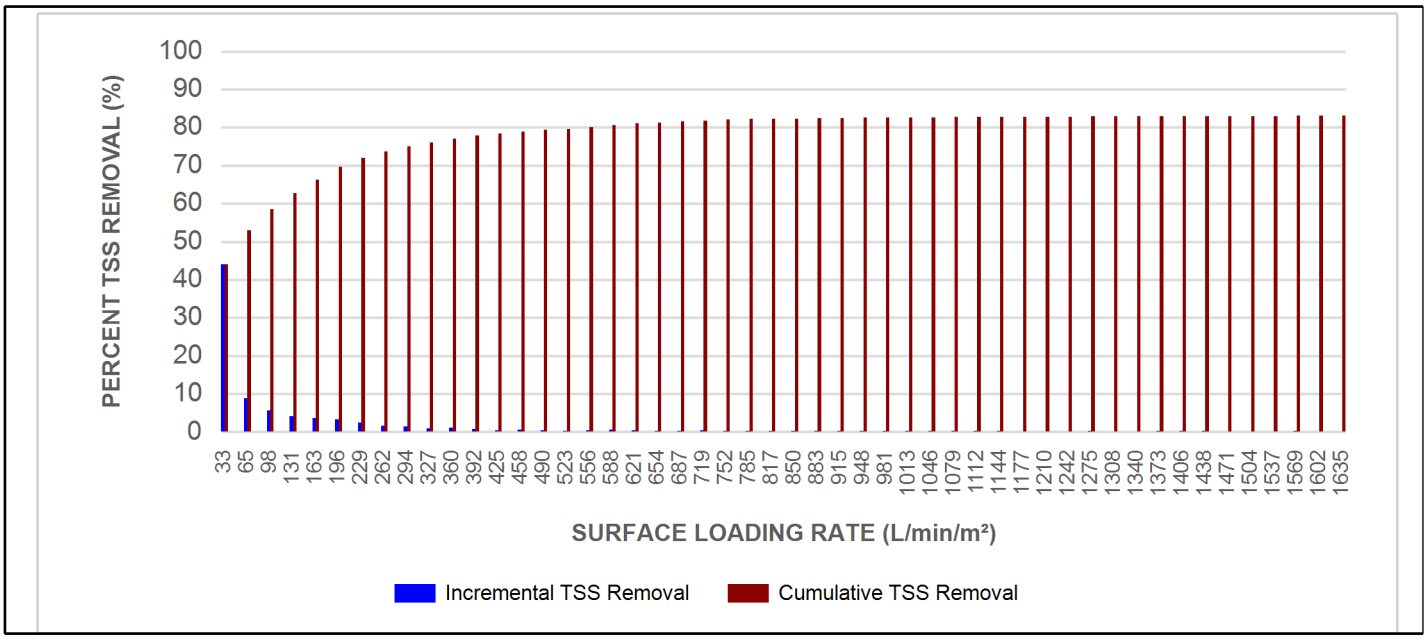
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	47.3	47.3	0.65	39.0	33.0	93	44.0	44.0
2	9.8	57.1	1.31	78.0	65.0	91	8.9	52.9
3	6.4	63.5	1.96	118.0	98.0	88	5.6	58.5
4	5.0	68.5	2.62	157.0	131.0	84	4.2	62.7
5	4.5	73.0	3.27	196.0	163.0	80	3.6	66.3
6	4.2	77.2	3.92	235.0	196.0	77	3.2	69.6
7	3.3	80.5	4.58	275.0	229.0	74	2.4	72.0
8	2.2	82.7	5.23	314.0	262.0	71	1.6	73.6
9	2.1	84.8	5.88	353.0	294.0	68	1.4	75.0
10	1.5	86.3	6.54	392.0	327.0	65	1.0	76.0
11	1.8	88.1	7.19	432.0	360.0	62	1.1	77.1
12	1.4	89.5	7.85	471.0	392.0	59	0.8	77.9
13	0.8	90.3	8.50	510.0	425.0	57	0.5	78.4
14	1.0	91.3	9.15	549.0	458.0	57	0.6	78.9
15	0.7	92.0	9.81	588.0	490.0	55	0.4	79.3
16	0.6	92.6	10.46	628.0	523.0	54	0.3	79.6
17	0.8	93.4	11.12	667.0	556.0	54	0.4	80.1
18	1.0	94.4	11.77	706.0	588.0	53	0.5	80.6
19	0.7	95.1	12.42	745.0	621.0	52	0.4	81.0
20	0.6	95.7	13.08	785.0	654.0	52	0.3	81.3
21	0.4	96.1	13.73	824.0	687.0	52	0.2	81.5
22	0.7	96.8	14.38	863.0	719.0	51	0.4	81.8
23	0.4	97.2	15.04	902.0	752.0	51	0.2	82.0
24	0.3	97.5	15.69	942.0	785.0	51	0.2	82.2
25	0.2	97.7	16.35	981.0	817.0	51	0.1	82.3

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 (%)
26	0.1	97.8	17.00	1020.0	850.0	51	0.1	82.3
27	0.1	97.9	17.65	1059.0	883.0	51	0.1	82.4
28	0.1	98.0	18.31	1098.0	915.0	50	0.1	82.4
29	0.1	98.1	18.96	1138.0	948.0	50	0.1	82.5
30	0.1	98.2	19.62	1177.0	981.0	50	0.1	82.5
31	0.1	98.3	20.27	1216.0	1013.0	50	0.1	82.6
32	0.1	98.4	20.92	1255.0	1046.0	50	0.1	82.6
33	0.1	98.5	21.58	1295.0	1079.0	49	0.0	82.7
34	0.2	98.7	22.23	1334.0	1112.0	49	0.1	82.8
35	0.1	98.8	22.88	1373.0	1144.0	49	0.0	82.8
36	0.0	98.8	23.54	1412.0	1177.0	48	0.0	82.8
37	0.0	98.8	24.19	1452.0	1210.0	48	0.0	82.8
38	0.0	98.8	24.85	1491.0	1242.0	48	0.0	82.8
39	0.1	98.9	25.50	1530.0	1275.0	47	0.0	82.9
40	0.0	98.9	26.15	1569.0	1308.0	47	0.0	82.9
41	0.0	98.9	26.81	1608.0	1340.0	47	0.0	82.9
42	0.1	99.0	27.46	1648.0	1373.0	46	0.0	82.9
43	0.1	99.1	28.12	1687.0	1406.0	46	0.0	83.0
44	0.1	99.2	28.77	1726.0	1438.0	45	0.0	83.0
45	0.0	99.2	29.42	1765.0	1471.0	44	0.0	83.0
46	0.0	99.2	30.08	1805.0	1504.0	43	0.0	83.0
47	0.0	99.2	30.73	1844.0	1537.0	42	0.0	83.0
48	0.1	99.3	31.39	1883.0	1569.0	41	0.0	83.1
49	0.0	99.3	32.04	1922.0	1602.0	40	0.0	83.1
50	0.0	99.3	32.69	1962.0	1635.0	40	0.0	83.1
Estimated Net Annual Sediment (TSS) Load Reduction =								**83 %**

RAINFALL DATA FROM ORILLIA TS 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

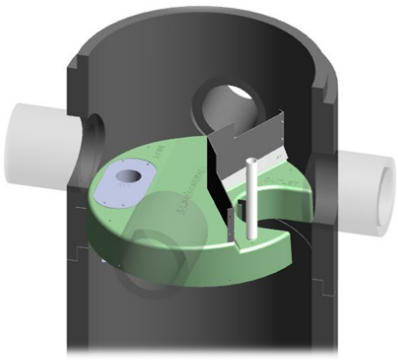
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test 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.

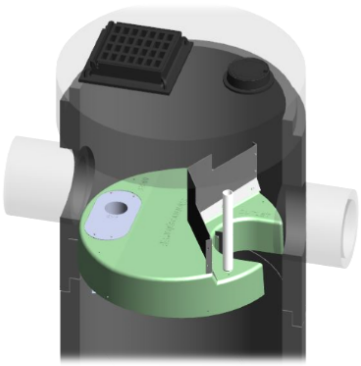
DESIGN FLEXIBILITY

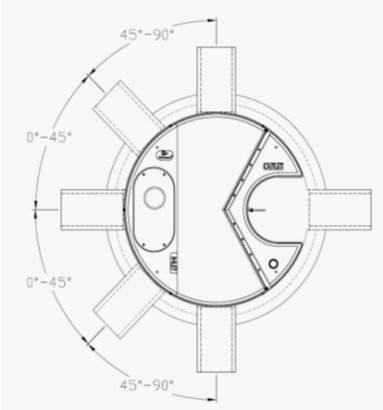
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend 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)	(ft^3)	(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 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 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/m2 to 2600 L/min/m2) 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.