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INNOVATIVE ENGINEERING DESIGN & CONSTRUCTION FOR VALUE ENGINEERED PROJECT DELIVERY

SITE SERVICING AND STORMWATER MANAGEMENT BRIEF
WAREHOUSE AT 6787 HIRAM DRIVE, OTTAWA, ON
(LIGHT INDUSTRIAL BUILDING)

PREPARED FOR:
Venom Motor Sport
6820 Mackeown Drive, Ottawa ON

DATE : (Revised) November 25th 2019

Distribution : City of Ottawa (3)

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APPENDICES

LIST OF DRAWINGS

1 INTRODUCTION

This report was prepared to address the serviceability of the proposed warehouse building development at 6787 Hiram drive , Ottawa. The portable and sanitary water demands as well as the required fire fighting water needs for the proposed development are covered in this report. The building is serviced by a septic system installed at rear of building to meet flood plain and minimum separation distance requirements. The required pre-consultation meeting was held December 12th 2017.

It will be noted that this lot posed peculiar design challenges in meeting setbacks, separation distances, easement and flood plain requirement because of its configurations; a narrow width compared to its extensive length.

The storm water management (SWM) design requirements that address the post-development conditions and the erosion and sediment control for the proposed development i is outlined in the report using the BMP approach.

The total area of the lot is 4003 square meters and is undeveloped. The proposed development is detailed in the project Site Plan & landscape Plan which together with is report.

The proposed development runs along east-west axis of the lot and at the rear side (west) is an existing flood control earth berm (which is to remain untouched during construction) and further behind is the Osgoode Gardens Cedar-Acres municipal drain. The shield creek water shed study of 2004 is consulted and referenced in executing this design.

The proposed development will have asphalt surface at the front and south side (loading dock access way), the rear side surface shall be a compacted granular A and it is designed for a truck turning radius to serve the two-unit loading dock. The parking lot and fire route are at the front.

STORMWATER DESIGN

The MOE "Stormwater Management Planning and Design Manual 2003" is referenced. The storm sewers system is designed based on the rational formula and the Manning's Equation under free flow conditions for the 5-year storm using a 10-minute inlet time.

The post-development runoff rate from the site should not exceed the runoff rate for the pre- development design storm based on existing site conditions

for all storm events up to the 100-year storm event, per the City of Ottawa and South Nation Conservation Authority design criteria.
The storm sewer system was designed referencing the City of Ottawa Sewer Design Guidelines (October 2012) and are sized using Manning's Equation, using a roughness coefficient N = 0.013 to account for uncontrolled runoff from 5-year storm event under open-channel conditions. The uncontrolled runoff was determined using the rational method and the City of Ottawa IDF curve Appendix 5.1A, for a 10-minute time of concentration. The storm sewer system comprises of 250mm diameter DR35 pipes at 0.35% slopes feeding into catch basins which connect to the Stormtech chambers. They also act as storage for storm water.

On site storm water storage is provided using Stormtech SC-740 storage chambers which are installed below grade beneath the parking lot and are calculated for up to the 100-year design storm. Calculations of the required on-site storage volumes is achieved using the manufacturer provided sizing chart . Please see Appendix A.

The MOE, Stormwater Management Planning and Design Manual, 2003, requires TSS removal of 80% . The City of Ottawa and South Nation Conservation require that this quality control standard be met. This is provided by a 2-tier treatment train comprised of a Stormceptor STC 300 and Stormtech isolator row placed in series.

Stormwater quantity control

Peak Flow for runoff quantities for the Pre-Development and Post-Development stages of the project were calculated using the rational method. The rational method the formula is:

$Q = 2.78C\,i\,A$
Q = Peak runoff measured in L/s
C = Runoff Coefficient
A = runoff area in hectares
i = storm intensity measure in mm/hr
2.78 = conversion factor to L/s

The intensity values are derived from IDF curves provided by the City of Ottawa for data collected at the Ottawa International airport. The return periods were considered, 2, 5 and 100-year events. The formulae for each are as follows:

2-Year event

$$i = \frac{732.951}{(t_C + 6.199)^{0.810}}$$

5-year event

$$i = \frac{998.071}{(t_C + 6.053)^{0.814}}$$

100 –year event

$$i = \frac{1735.688}{(t_C + 6.014)^{0.82}}$$

where t_C = time of concentration

Pre-development Site Conditions

The site is located on the west side of Hiram Drive in Greely, Ontario. The total lot area is 4003 square meters, of which 460 square meters is a rear 15m development setback limit. The total site area for the proposed development is 3543 square metres. The site has never been developed and the zoning is 'Rural General Industrial (RG3)'.

There is a municipal drain running along the rear (west) portion of the lot. The property on the opposite side, east, of the lot is an existing light industrial building. A road side ditch runs on both sides of Hiram drive. The property to the south and north of the lot are undeveloped. Hiram Drive borders the east side of the property. The existing storm water runoff consists of uncontrolled sheet flow from west to east towards the road side ditch. For storm water design calculations to determine the required storage volumes and allowable release rates, the pre-development conditions consist of grass surface on a low slope (averaging 2%) with a runoff coefficient of C=0.3 (based on the *City of Ottawa Sewer Design Guidelines Section 5.4.5.2.1)*.

The lot is relatively flat and is observed to flow to the Hiram drive roadside ditch as shown in the attached drawing titled "Pre-Development Catchment area". Runoff coefficient of 0.30 is used for the grass surface.

Making reference to the City of Ottawa Storm Sewer Design Guideline, Appendix 5-D (Oct 2012) the time of concentration for pre-development conditions was estimated to be 30 minutes for a particles travel distance approximately 115 metres through average grass with a slope of about 2%.

With respect to the referenced design guideline the post-development time of concentration is taken as 15 minutes approximately. To control of runoff from the site, post development design flow is limited to the 100-year storm.

The pre-development baseline runoff rate was established using the rational method. A 30-minute duration yields an intensity of 40.04 mm/hr for a 2-year storm event, 53.93 mm/hr for a 5-year storm event, and 91.87 mm/hr for a 100-year storm event. The pre- development runoff coefficient was set to C = 0.30 for the two and five year storms and C =0.375 for the 100 year storm to model the undeveloped grass and tree covered surfaces.

Pre-development peak flows calculations are used to ensure that the allowable post-development release rates do not exceed the predevelopment conditions. The total allowable runoff for the site based on the pre-development conditions are:

For the 2-year Storm event
= 2.78(0.30 x 40.04 x 0.3543)
= 11.83 L/S (i.e. 0.0118 m^3/s)

For the 5-year Storm event
= 2.78(0.30 x 53.93 x 0.3543)
= 15.94 L/S (i.e. 0.0159m^3/s)

For the 100-year Storm event
= 2.78(0.375x 91.87 x 0.3543)
= 33.93 L/S (i.e. 0.0339m^3/s)

Allowable Release Rate

To control post development runoffs from site it is required to limit allowable capture rate for all storm events up to the 100-year storm. The allowable release rate is estimated to be 11.8 L/s, 15.9 L/s and 33.9L/s for the 2-year, 5-year and 100-year predevelopment flows.
The uncontrolled catchment area is the landscape area, this area is insignificant compared to the development area and it is allowed to flow direct into the Hiram drive roadside ditch. The rear side grassed area slopes at about 1% to level with the top of the existing earth berm (which is to remain untouched)
A post-development time of concentration of 10 minutes obtained from Table 5.1 Ottawa IDF is an intensity of 76.81 mm/hr, 104.19 mm/hr and 178.56 mm/hr on the 2-year, 5-year and 100-year storm.

Qcontrolled = Qtotal allowable - Quncontrolled

For the 2-year Storm event
$Q_{controlled}$ = 11.8 L/s

For the 5-year Storm event
$Q_{controlled}$ = 15.9 L/s

For the 100-year Storm event
$Q_{controlled}$ = 33.9 L/s

Post Development Conditions

The controlled areas are shown as catchment CAI, CAII and CAIII in the attached drawing titled "Post Development Catchment Area" and the allowable release is tabulated in Appendix A.
The area CAI is compacted granular fill will discharge into catch basin CB1. The area CAII is the low-pitch roof which will discharge runoff equally to the north and south sides via downspouts. The north side discharges to catch basin CB5 via perforated pipes in the swale. The south side downspout discharges to area CAIII which incorporates the loading dock access driveway. Runoff coefficients of 0.90 is used for impervious surfaces, a coefficient of 0.80 is used for the compacted granular pavement at the rear and a coefficient of 0.30 is used for the grass surface. A 25% increase for the post development 100-year runoff coefficients was used (City of Ottawa guidelines).

The post development runoff rate should not exceed the allowable release rates of 11.8 L/s, 15.9 L/s and 33.9 L/s for the 2-year, 5-year and 100-year storm events. Runoffs in excess of the allowable release rate will be temporarily stored in the 250mm diameter DR 35 storm pipes and in a 64 unit Stormtech SC-740 chambers which is located below the parking lot and will be released to the dry pond. The runoff from the site will be discharged to the roadside ditch via the dry pond. Stormtech sizing sheet is shown in Appendix A.

Runoff from the loading dock access driveway, swale and the parking lot will be directed to the underground Stormtech storage by means of underground pipes and catch basins via an Oil Grit Separator - Stormceptor STC 300. This OGS provides the stormwater treatment and will discharge into the Stormtech storage chambers which also provides treatment for the runoffs.

Storage requirements

In reference to section 8.3.10.3 (Site level servicing analysis) of the Ottawa

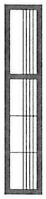
Sewer Design Guidelines 2012 the required 100-year storage volume shall be estimated using manual calculations using the modified Rational method as shown in the table below(the site is a lot less than 2ha). Our storage computation shall consider only the 5-year & 100-year storm events.
The catchment area is as follows:
CI = 876 sq.m
CII = 658 sq.m
CIII = 1477 sq.m
Total = 3011 Sq.m
The grassed area at the rear yard is 532 sq.m and flows to the rear (per section 8.3.9.7 of the guidelines).
The blended runoff coefficient (per section 8.3.10.3) is thus:
Roof & asphalt (CII & CIII) = 0.90
Compacted gravel (CI) = 0.80
C_{av} for 5-year storm = 0.85
C_{av} for 100-year storm = 125% of 0.85 = 1.25 x 0.85 = 1.06

Stormwater management summary
5-year event

Time (mins)	Intensity (mm/hr)	Peak flow (l/s)	Release rate(l/s)	Storage rate (l/s)	Storage Vol. (m^3)
10	104.19	74.13	15.9	58.4	35.04
20	70.25	49.99	15.9	34.09	40.10
30	53.93	38.37	15.9	22.47	40.45
40	44.18	31.43	15.9	15.53	37.27
50	37.65	26.79	15.9	10.89	32.67
60	32.94	23.44	15.9	7.54	27.14

100-year event

Time (mins)	Intensity (mm/hr)	Peak flow (l/s)	Release rate(l/s)	Storage rate (l/s)	Storage Vol. (m^3)
10	178.56	216.06	33.9	182.16	109.30
20	119.95	145.14	33.9	111.24	133.49
30	91.87	111.30	33.9	77.40	139.32
40	75.15	90.93	33.9	57.03	136.87
50	63.95	77.37	33.9	43.47	130.41
60	55.89	67.63	33.9	33.73	121.43



Storage is provided as follows:

1/ 250mmϕ DR35 pipes; total length = 112.5m; Area of pipe = $3.14x(0.125)^2$

Volume of pipes = 5.52 m^3

2/ Stormtech SC 740 Chambers = 139.32 - 5.52 = 133.8 m^3 (Provided = 134m^3)

64 Units of SC 740 storage chambers provided, total storage = 52m^3

See attached stormtech chambers sizing sheet

3/There is no parking lot ponding storage necessary.

Stormwater Quality Control requirements

The required suspended solids removal treatment is the MOECC Enhanced Protection Level (level 1) which is long term 80% TSS removal.

The storm water 80% TSS removal will be accomplished by the use of Oil-Grit Interceptor, The Stormceptor STC 300, and the header row and isolator row of the underground Stormtech storage chambers installed in series as shown in the Servicing, Grading & Erosion Control plans. This multi-component approach will exceed the required TSS removal threshold. See attached Stormceptor information and calculations sheets in Appendix B.

Dry pond design

The dry pond has been incorporated in this storm water management as a downstream component to enhance on-site post treatment storage n the event of record storm event.

It is estimated that the maximum retention period will be 24 hours.

Operation and Maintenance

Sediments buried in site snow storage during winter is discharged into the storm water storage system during spring melt.

The isolation row and header row should be inspected and maintained in accordance with manufacturers recommendations periodically. Sediments should be vacuumed-out if accumulated in significant thickness. The Stormtech manufacturers maintenance procedure should be strictly followed.

The storm water storage system should be inspected after every significant rainfall events. If it appears that it takes longer than expected for the water to completely drain and the manufacturer recommended maintenance procedure should be initiated

WATER SERVICE – FIRE FIGHTING SUPPLY

Since municipal water services are not available, the water demand for fire fighting for the proposed development has to be determined because the buildings GFA exceeds 600 square meter. The fire water protection requirements is calculated in accordance with the Fire Underwriter's Survey (FUS) as follows:

Step 1:
F (fire water flow) = 220C $\sqrt{A}$
C = Coef. Variant of Non-combustible construction = 0.8
A = total floor area = 21m x 48.77m = 1024 sq.m

F = 220 x 0.8 x $\sqrt{1024}$ = 5,632 L/min

Step 2:
Reduction for increase due to occupancy (F3 light industrial occupancy) = -25%
F = 5632 – 0.25 x 5632= 4224 L/min

Step 3:
Reduction for automatic sprinkler (no sprinkler system) = 0%

Step 4:
Addition for building exposure within 45m:
East = Hiram drive, separation charge = 0%
West = 39m to property line, separation charge = 5%
North = 3.1m to prop. line, no unprotected opening, separation charge = 20%
South = 7.3m to prop. line, no unprotected opening, separation charge = 20%
F (west) = 0.05 x 5632 + 5632 = 5914 L/min
F (north & south) = 0.2 x 5632 + 5632 = 6758 L/min
F (fire water flow to nearest 1000L/min) = 7,000 L/min

The North & South walls are 2-hr FRR with no unprotected opening and there is a Fire Service station within a kilometer to this project, the City of Ottawa fire protection engineer therefore accepted the proposed concrete underground fire water storage tank of 80,000 liter capacity.

WATER SERVICE - DOMESTIC

The facility is to be serviced by a cased drilled well. A Hydro geological and terrain analysis report has been obtained and forward to MOECC.

The water system shall be pressurized with a submersible well pump with a flow rate of 30 l/m. The well casing shall be a minimum of 0.40m above grade and shall be a minimum of 0.30m above the 100-year flood plain elevation.
A seamless 1.25" polyethylene pipe rated at 160psi and at a minimum depth of 2.4m shall be installed between the well and into the building as shown in the project plans.

SANITARY SERVICE

There is no City of Ottawa sanitary sewer main to service the site therefore an on-site septic system shall be provided per OBC2012 table 8.2.1.3.B. The daily design sanitary sewage flow for the proposed occupancy is calculated in reference to information obtained from the above mentioned table thus :

For Warehouse per water closet = 950 l/day x2
per loading bay = 150 l/day x2
office space = 75L per 9.3 sq.m; 192 sq.m = 75 x21 = 1575 l/day
Design daily flow = 3,775 L/day

Section 8.2.2.3(b) requires the minimum working capacity of a septic tank in non-residential occupancies to be three times the daily design sanitary sewage flow. An on-site Class 4 septic system is adopted. Due to space constraint resulting from the peculiar configuration of the lot and in order to meet the flood plain design considerations of the SNCA a tertiary treatment septic system, which incorporates sustainability features, is designed.

The on-site system consists of EcoFlo pump Station, 12,000L precast concrete septic tank and two EcoFlo ST-750 Biofilter treatment units. A septic system permit application is to be filled at the Ottawa Septic System Office and the SNCA. A copy of the approved permit will be forwarded to the relevant City of Ottawa departments when available.

EROSION AND SEDIMENT CONTROL

Erosion and sediment control plans reflect the minimum BMP standards and the City of Ottawa by-laws,. It is the responsibility property owner to ensure that the erosion control measures are implemented.

The property owner shall understand that an Erosion and sediment control plan is a living document that shall be modified as situation may dictate.

During construction, and as per OPSD 219.110, silt fence is installed along the property as shown in the Servicing, Grading and Erosion Control Plan. The silt fence could be polypropylene, nylon, and polyester and it should be backed by a wire fence supported on posts at maximum of 2.0 m apart. High strength filter fabric can also be installed without a wire fence backing if posts are not over 1.0 m apart and should be lapped 0.15m and stapled. The bottom edge of the filter fabric should be anchored in a 0.30m deep trench, to prevent flow under the fence.

Catch basin covers should be protected right after installation with filter cloths until end of construction activities.
Silt fences should only be removed at end of construction.

EARTH RETAINING SHEET PILE WALL

The placement of the Stormtech stormwater storage system below the parking lot necessitated the introduction of a sheet pile retaining wall on the south side property line. The design maximum height of this wall is 0.85m which is less than 1.0m therefore minimal engineering is needed and slope stability report is not required in accordance section 5.8 of the City of Ottawa slope stability report guidelines. The sheet pile retaining system is adopted for its efficiency and it is cost effective for the wall height. The design approach is the Coulomb's theory.
The design information for this wall is as follows:
Sheet pile type : hot-rolled Z-section
Maximum wall height (free standing) : 0.85m
Maximum (passive) pressure = 16kN/m^2
Dept of embedment = 2.0m (max)

CONCLUSIONS

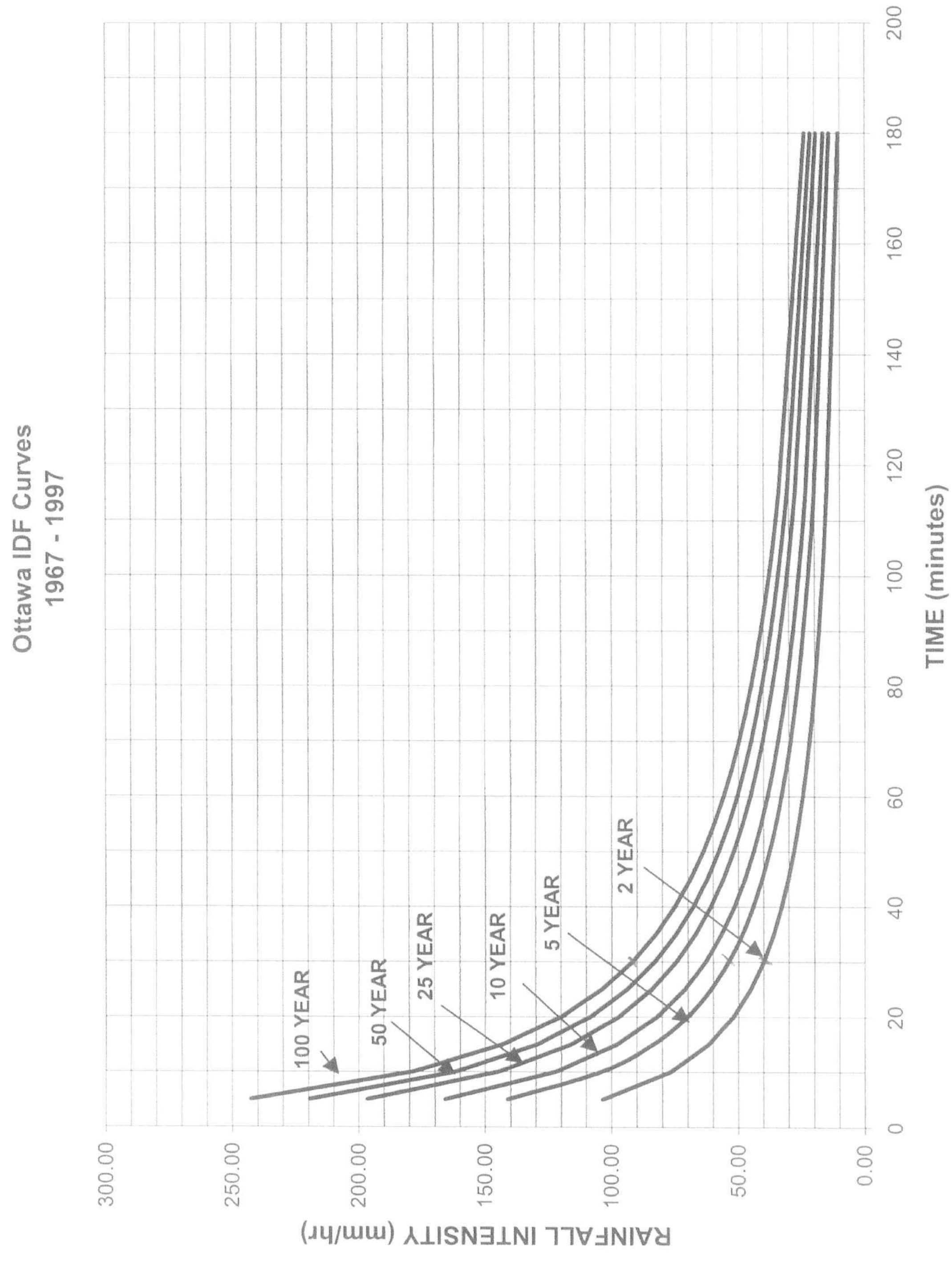
SWM for the proposed development will be achieved by matching post development runoff rates to pre-development runoff rates for all storm events to and including the 100 year storm event and implementing prevailing industry BMP.

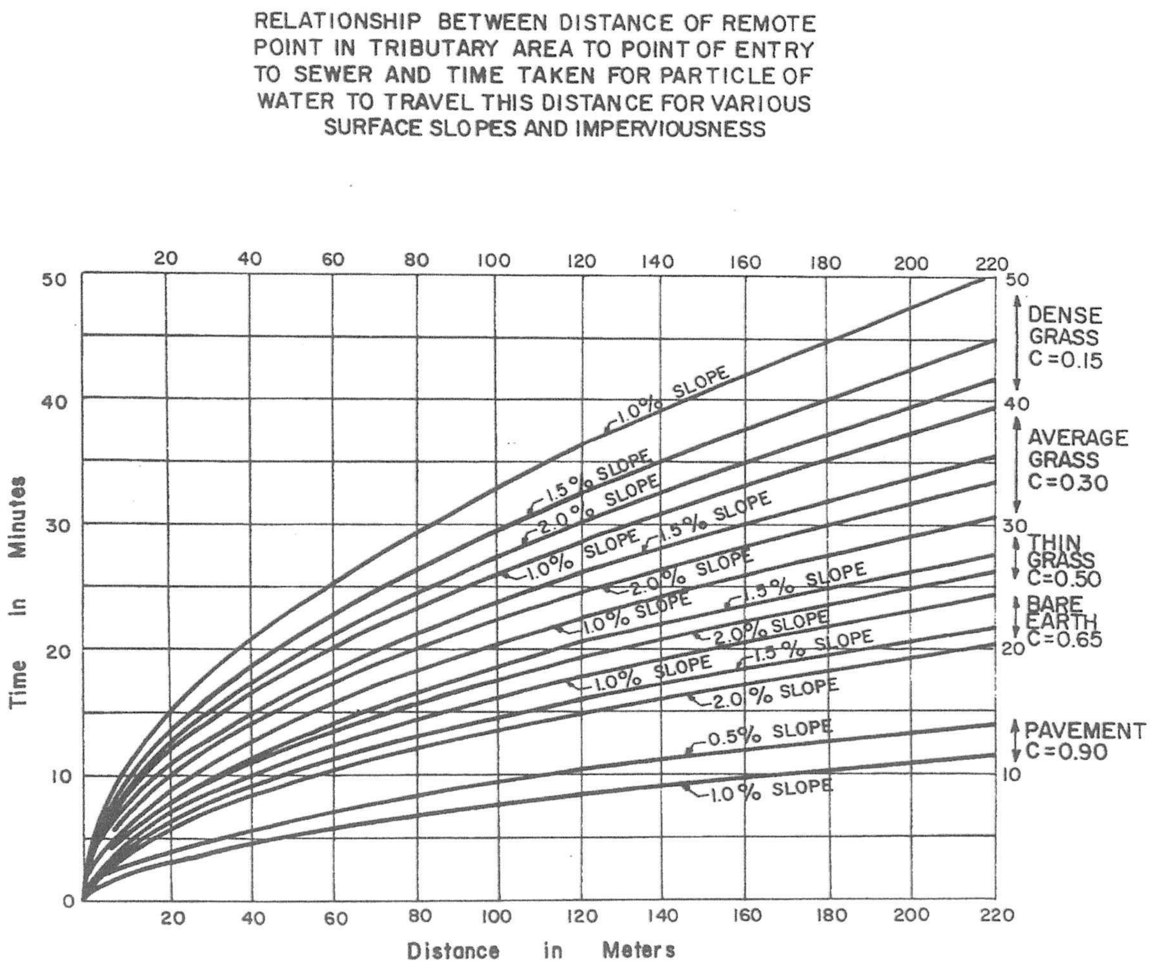
The design has been executed to be in conformity with flood protection measures outlined by the South Nation Conservation and also conform to development agreement for subdivision signed between the City of Ottawa and the first owners of the lots.

Chinedu J. Enendu, P.Eng

APPENDIX A

APPENDIX 5-A OTTAWA INTENSITY DURATION FREQUENCY (IDF) CURVE





INLET TIMES FOR VARIOUS SLOPES AND IMPERVIOUSNESS

StormTech® Detention • Retention • Recharge
Subsurface Stormwater Management™

Project:	6787 HIRAM DRIVE OTTAWA ON
By:	ROCKVILLE ENG INC
Point of Contact	CHINEDUENENDU
Date:	25/11/2019

Units: **Metric**

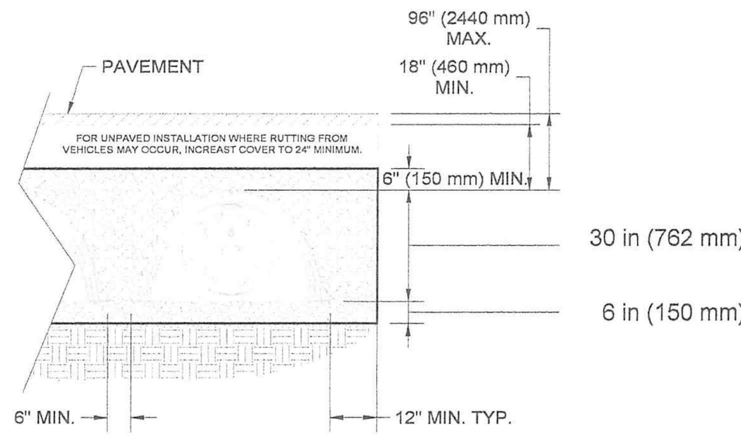
System Requirements

Required Storage Volume	**134**	cubic meters
Select Stormtech Chamber System	SC-740	
Stone Porosity (Industry Standard = 40%)	**40%**	
Stone Foundation Depth	150	mm
Storage Volume Per Chamber	2.12	cubic meters
Avg Cover over Chambers (460mm min. & 2440mm max.)	18	mm

Check to ensure the correct value and units are used for the cover

Number of Chambers Required - 64

Approximate Bed Size Required	224	square meters
Tons of Stone Required	257	Tonnes
Volume of Excavation	208	cubic meters
Area of Filter Fabric	591	square meters
# of End Caps Required	**20**	Each
Length of ISOLATOR ROW	**15.19**	m
ISOLATOR FABRIC	**23**	square meters



Is the limiting dimension for the bed the width or length? **width**

Controlled by Width (Rows)

Width 15 m

You have switched between Imperial and Metric Units please check to ensure correct width is entered for the units shown above. Also check input data for cover over chambers and foundation depth.

# of Chambers Long	7	EA
# of Rows	10	EA
Actual Length	16.29	m
Actual Width	14.91	m

6 of the chambers rows will contain only 6 chambers

Controlled by Length

Length 10 m

# of Chambers long	-	EA
# of Rows	-	EA
Actual Length	-	m
Actual Width	-	m

Material Estimate

To use this sheet: Please enter data into the **blue** and **green** cells. If switching between Imperial and Metric units please check the correct units and data is input in the **green** cells.

Please call StormTech @ 888-892-2694 for conceptual cost estimates.

Φ

Stormceptor®

Stormceptor Sizing Detailed Report

PCSWMM for Stormceptor

Project Information

Date	25/11/2019
Project Name	6787 Hiram Drive
Project Number	192072778
Location	Ottawa, ON

Stormwater Quality Objective

This report outlines how Stormceptor System can achieve a defined water quality objective through the removal of total suspended solids (TSS). Attached to this report is the Stormceptor Sizing Summary.

Stormceptor System Recommendation

The Stormceptor System model STC 300 achieves the water quality objective removing 88% TSS for a Fine (organics, silts and sand) particle size distribution.

The Stormceptor System

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for all rainfall events, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.

Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Stormceptor is the only oil and sediment separator on the market sized to remove TSS for a wide range of particle sizes, including fine sediments (clays and silts), that are often overlooked in the design of other stormwater treatment devices.

Small storms dominate hydrologic activity, US EPA reports

"Early efforts in stormwater management focused on flood events ranging from the 2-yr to the 100-yr storm. Increasingly stormwater professionals have come to realize that small storms (i.e. < 1 in. rainfall) dominate watershed hydrologic parameters typically associated with water quality management issues and BMP design. These small storms are responsible for most annual urban runoff and groundwater recharge. Likewise, with the exception of eroded sediment, they are responsible for most pollutant washoff from urban surfaces. Therefore, the small storms are of most concern for the stormwater management objectives of ground water recharge, water quality resource protection and thermal impacts control."

"Most rainfall events are much smaller than design storms used for urban drainage models. In any given area, most frequently recurrent rainfall events are small (less than 1 in. of daily rainfall)."

"Continuous simulation offers possibilities for designing and managing BMPs on an individual site-by-site basis that are not provided by other widely used simpler analysis methods. Therefore its application and use should be encouraged."

– US EPA Stormwater Best Management Practice Design Guide, Volume 1 – General Considerations, 2004

Design Methodology

Each Stormceptor system is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology from up-to-date local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective.

The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing (summary of analysis presented in Appendix 2):

- Site parameters
- Continuous historical rainfall, including duration, distribution, peaks (Figure 1)
- Interevent periods
- Particle size distribution
- Particle settling velocities (Stokes Law, corrected for drag)
- TSS load (Figure 2)
- Detention time of the system

The Stormceptor System maintains continuous positive TSS removal for all influent flow rates. Figure 3 illustrates the continuous treatment by Stormceptor throughout the full range of storm events analyzed. It is clear that large events do not significantly impact the average annual TSS removal. There is no decline in cumulative TSS removal, indicating scour does not occur as the flow rate increases.

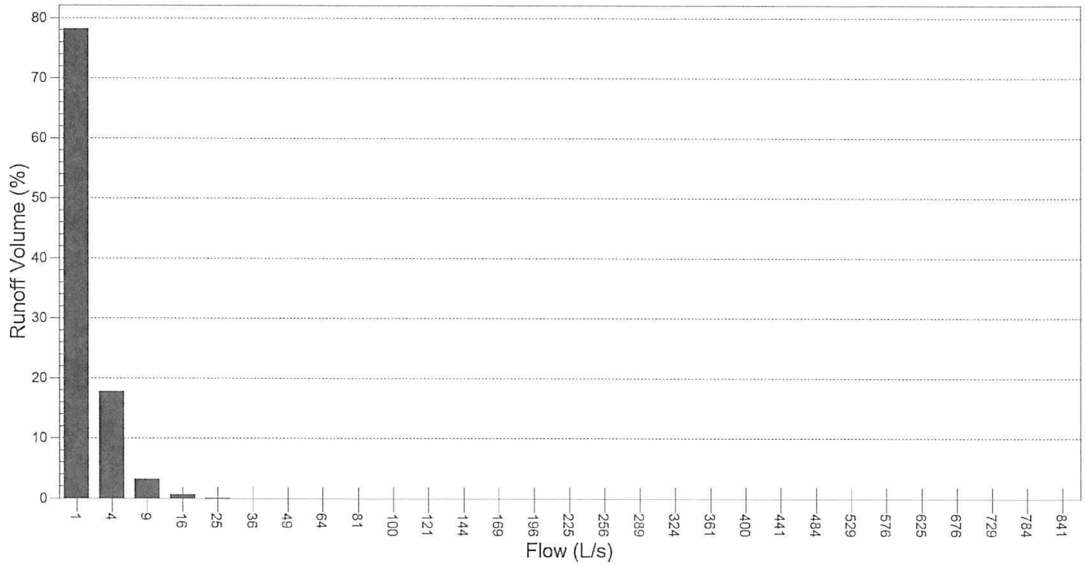


Figure 1. Runoff Volume by Flow Rate for OTTAWA MACDONALD-CARTIER INT'L A – ON 6000, 1967 to 2003 for 0.16 ha, 53% impervious. Small frequent storm events represent the majority of annual rainfall volume. Large infrequent events have little impact on the average annual TSS removal, as they represent a small percentage of the total annual volume of runoff.

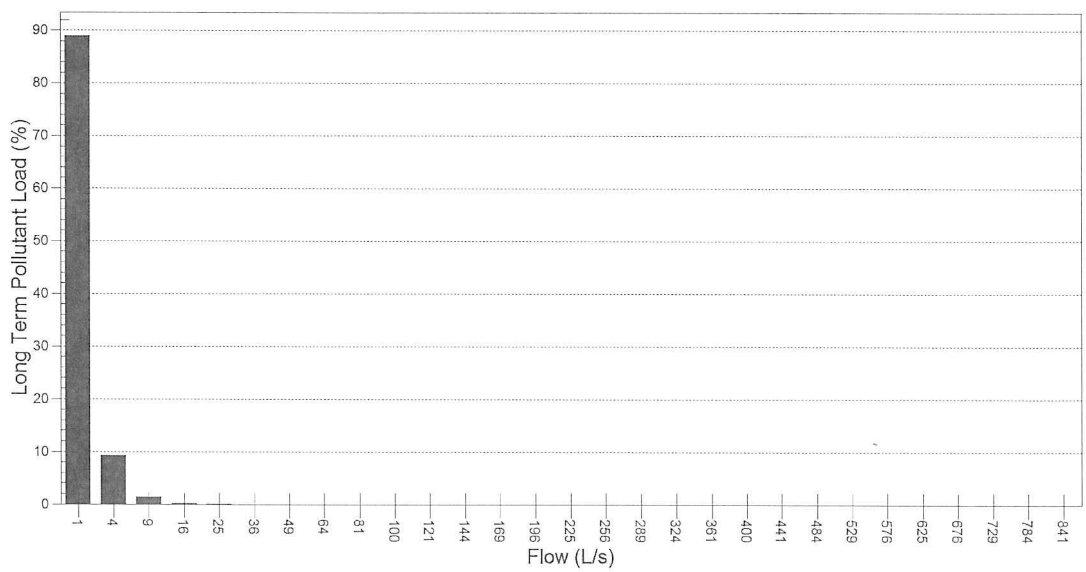
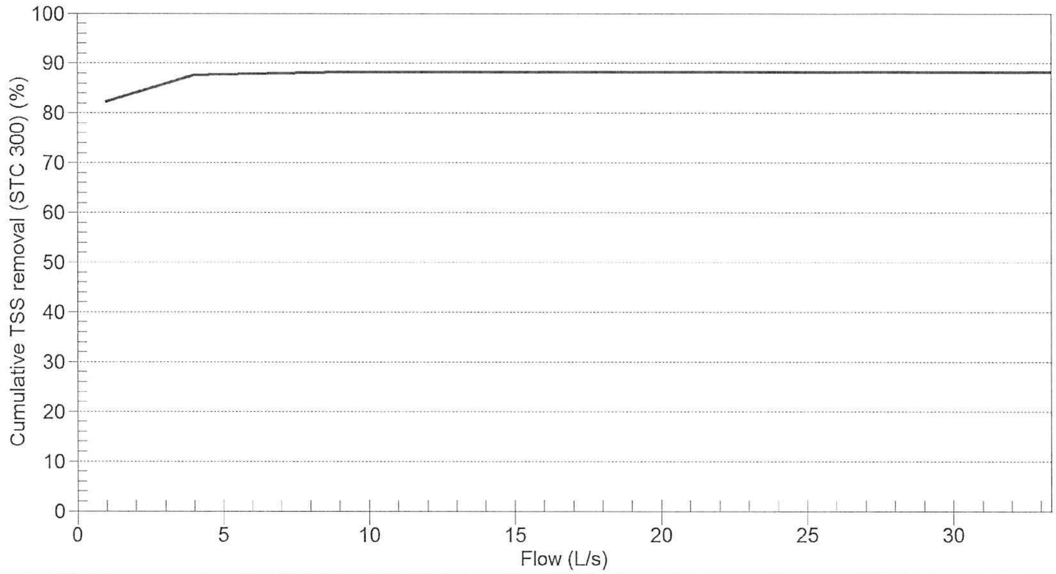


Figure 2. Long Term Pollutant Load by Flow Rate for OTTAWA MACDONALD-CARTIER INT'L A – 6000, 1967 to 2003 for 0.16 ha, 53% impervious. The majority of the annual pollutant load is transported by small frequent storm events. Conversely, large infrequent events carry an insignificant percentage of the total annual pollutant load.



Stormceptor Model	STC 300	Drainage Area (ha)	0.16
TSS Removal (%)	88	Impervious (%)	53

Figure 3. Cumulative TSS Removal by Flow Rate for OTTAWA MACDONALD-CARTIER INT'L A – 6000, 1967 to 2003. Stormceptor continuously removes TSS throughout the full range of storm events analyzed. Note that large events do not significantly impact the average annual TSS removal. Therefore no decline in cumulative TSS removal indicates scour does not occur as the flow rate increases.

Stormceptor®

Appendix 1
Stormceptor Design Summary

Project Information

Date	25/11/2019
Project Name	6787 Hiram Drive
Project Number	192072778
Location	Ottawa, ON

Designer Information

Company	Rockville Eng Inc
Contact	Chinedu Enendu

Notes

N/A

Drainage Area

Total Area (ha)	0.3011
Imperviousness (%)	85

The Stormceptor System model STC 300 achieves the water quality objective removing 88% TSS for a Fine (organics, silts and sand) particle size distribution.

Rainfall

Name	OTTAWA MACDONALD-CARTIER INT'L A
State	ON
ID	6000
Years of Records	1967 to 2003
Latitude	45°19'N
Longitude	75°40'W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 300	**88**
STC 750	92
STC 1000	93
STC 1500	93
STC 2000	95
STC 3000	96
STC 4000	97
STC 5000	97
STC 6000	98
STC 9000	98
STC 10000	98
STC 14000	99

Stormceptor®

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

Fine (organics, silts and sand)

Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
20	20	1.3	0.0004					
60	20	1.8	0.0016					
150	20	2.2	0.0108					
400	20	2.65	0.0647					
2000	20	2.65	0.2870					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

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Appendix 2
Summary of Design Assumptions

SITE DETAILS

Site Drainage Area

Total Area (ha)	0.3011	Imperviousness (%)	85

Surface Characteristics

Width (m)	30
Slope (%)	2
Impervious Depression Storage (mm)	0
Pervious Depression Storage (mm)	
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (mm/h)	61.98
Min. Infiltration Rate (mm/h)	10.16
Decay Rate (s^{-1})	0.00055
Regeneration Rate (s^{-1})	0.01

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Maintenance Frequency

Sediment build-up reduces the storage volume for sedimentation. Frequency of maintenance is assumed for TSS removal calculations.

Maintenance Frequency (months)	12

Dry Weather Flow

Dry Weather Flow (L/s)	No

Upstream Attenuation

Stage-storage and stage-discharge relationship used to model attenuation upstream of the Stormceptor System is identified in the table below.

Storage ha-m	Discharge L/s
0	0

PARTICLE SIZE DISTRIBUTION

Particle Size Distribution

Removing fine particles from runoff ensures the majority of pollutants, such as heavy metals, hydrocarbons, free oils and nutrients are not discharged into natural water resources. The table below identifies the particle size distribution selected to define TSS removal for the design of the Stormceptor System.

Fine (organics, silts and sand)							
Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s	Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
20	20	1.3	0.0004				
60	20	1.8	0.0016				
150	20	2.2	0.0108				
400	20	2.65	0.0647				
2000	20	2.65	0.2870				

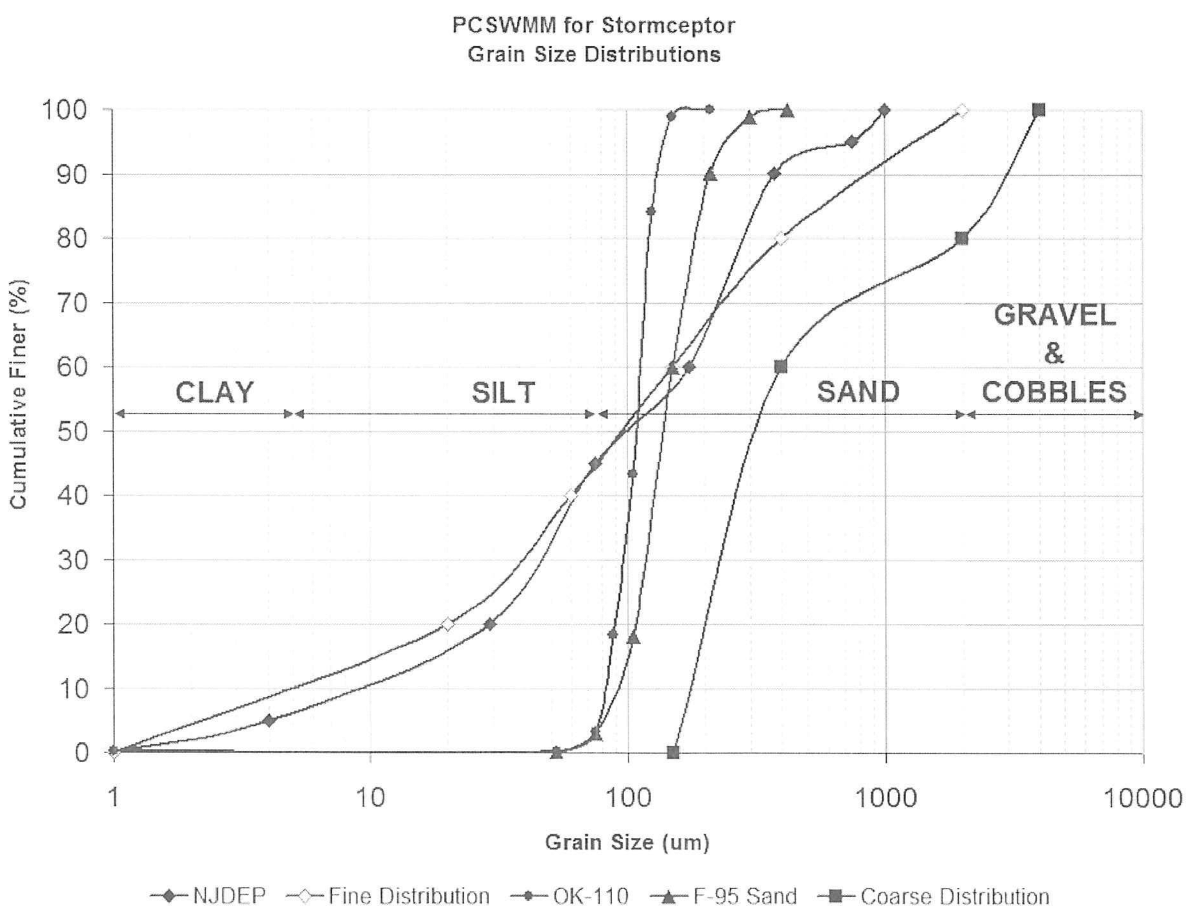

Figure 1. PCSWMM for Stormceptor standard design grain size distributions.

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TSS LOADING

TSS Loading Parameters

TSS Loading Function	Buildup / Washoff

Parameters

Target Event Mean Concentration (EMC) (mg/L)	125
Exponential Buildup Power	0.4
Exponential Washoff Exponential	0.2

HYDROLOGY ANALYSIS

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of the Stormceptor System are based on the average annual removal of TSS for the selected site parameters. The Stormceptor System is engineered to capture fine particles (silts and sands) by focusing on average annual runoff volume ensuring positive removal efficiency is maintained during all rainfall events, while preventing the opportunity for negative removal efficiency (scour).

Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A		
Rainfall File Name	ON6000.NDC	Total Number of Events	4537
Latitude	45°19'N	Total Rainfall (mm)	20978.1
Longitude	75°40'W	Average Annual Rainfall (mm)	567.0
Elevation (m)	371	Total Evaporation (mm)	951.7
Rainfall Period of Record (y)	37	Total Infiltration (mm)	9831.7
Total Rainfall Period (y)	37	Percentage of Rainfall that is Runoff (%)	49.1

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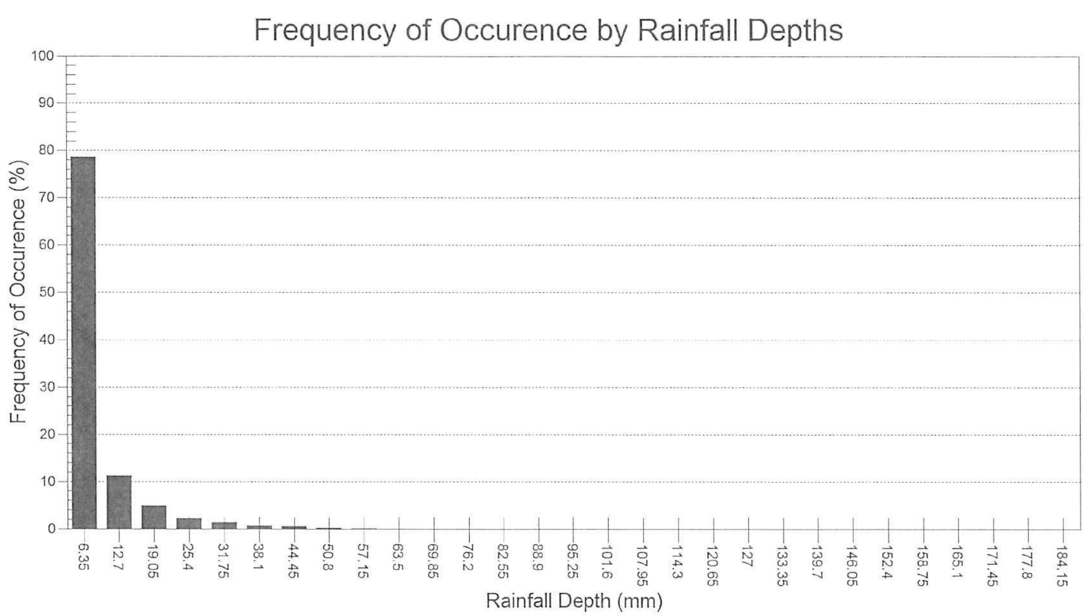
Rainfall Event Analysis

Rainfall Depth mm	No. of Events	Percentage of Total Events %	Total Volume mm	Percentage of Annual Volume %
6.35	3564	78.6	5671	27.0
12.70	508	11.2	4533	21.6
19.05	223	4.9	3434	16.4
25.40	102	2.2	2244	10.7
31.75	60	1.3	1704	8.1
38.10	33	0.7	1145	5.5
44.45	28	0.6	1165	5.6
50.80	9	0.2	416	2.0
57.15	5	0.1	272	1.3
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0
133.35	0	0.0	0	0.0
139.70	0	0.0	0	0.0
146.05	0	0.0	0	0.0
152.40	0	0.0	0	0.0
158.75	0	0.0	0	0.0
165.10	0	0.0	0	0.0
171.45	0	0.0	0	0.0
177.80	0	0.0	0	0.0
184.15	0	0.0	0	0.0
190.50	0	0.0	0	0.0
196.85	0	0.0	0	0.0
203.20	0	0.0	0	0.0
209.55	0	0.0	0	0.0
>209.55	0	0.0	0	0.0



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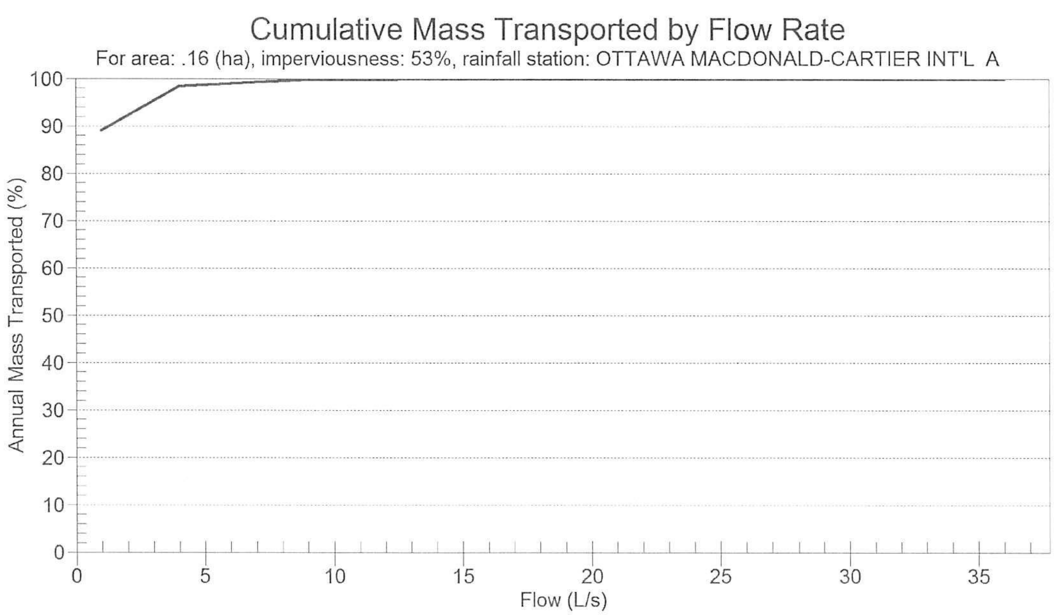
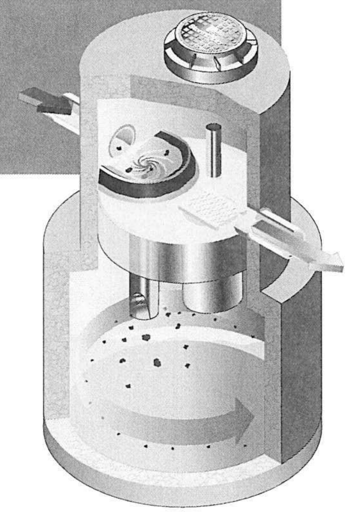
Pollutograph

Flow Rate L/s	Cumulative Mass %
1	89.1
4	98.4
9	99.8
16	100.0
25	100.0
36	100.0
49	100.0
64	100.0
81	100.0
100	100.0
121	100.0
144	100.0
169	100.0
196	100.0
225	100.0
256	100.0
289	100.0
324	100.0
361	100.0
400	100.0
441	100.0
484	100.0
529	100.0
576	100.0
625	100.0
676	100.0
729	100.0
784	100.0
841	100.0
900	100.0



APPENDIX B

Stormceptor® STC



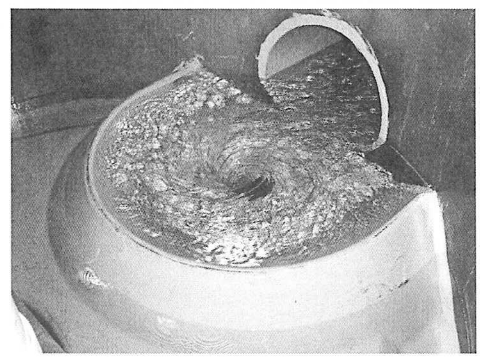
The calm *during* the storm

When it rains, oils, sediment and other contaminants are washed from paved surfaces directly into our storm drains and waterways. Non-point source pollution such as stormwater now accounts for 80% of water pollution in North America and governments are responding with demanding regulations to protect our water resources.

Removing more pollutants

Stormceptor removes more pollutants from stormwater than any other separator.

- Maintains continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate
- Designed to remove a wide range of particle sizes, as well as free oils, heavy metals and nutrients that attach to fine sediment
- Can be designed to remove a specific particle size distribution (PSD)



A calm treatment environment

- Stormceptor slows incoming stormwater to create a non-turbulent treatment environment, allowing free oils and debris to rise, and sediment to settle
- Scour prevention technology ensures pollutants are captured and contained during all rainfall events, even extreme storms

Proven performance

With more than 20 years of industry experience, Stormceptor has been performance tested and verified by some of the most stringent technology evaluation programs in North America. Stormceptor has been performance verified through numerous verification programs, including;

- NJCAT
- Washington ECOLOGY
- EN858 Class 2

PCSWMM for Stormceptor – *Advanced online sizing & design software*

The most accurate, easy to use design tool available.

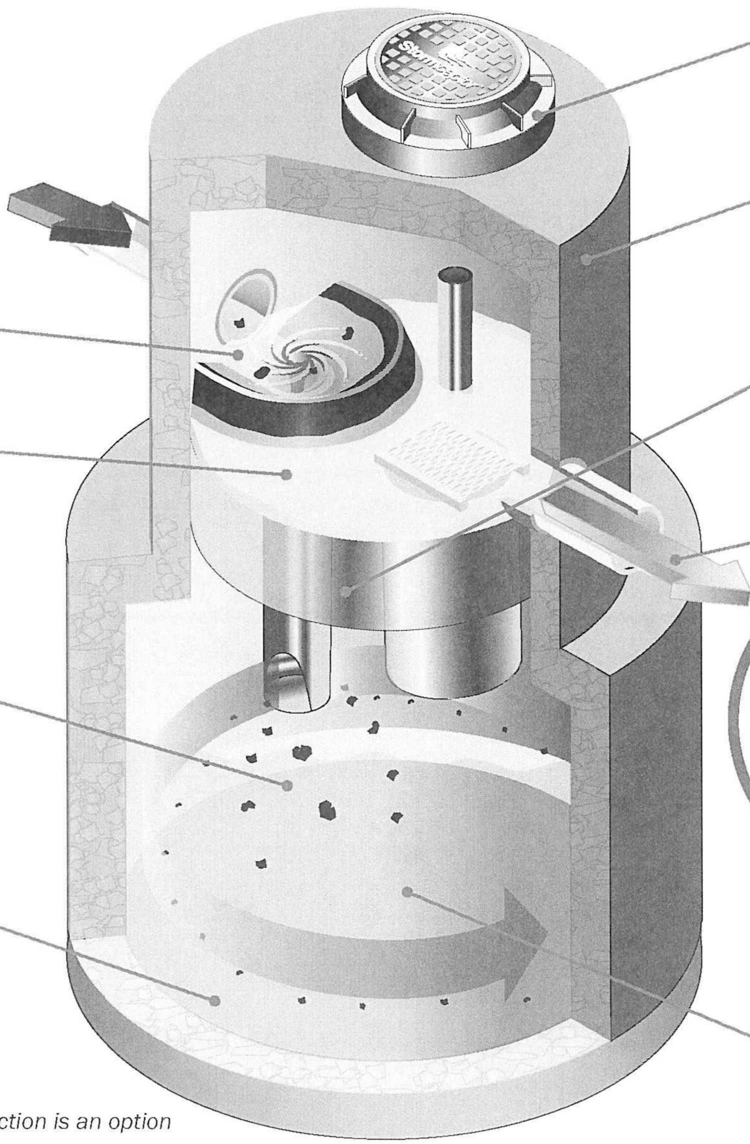
- This continuous simulation modeling software combines localized rainfall data from over 1,900 weather stations across North America allowing for region-specific design with a selection of particle sizes to design the best Stormceptor for your site
- Within a single project, multiple Stormceptor units can be sized and the information revisited as project parameters change
- Provides a summary report that includes projected performance calculations

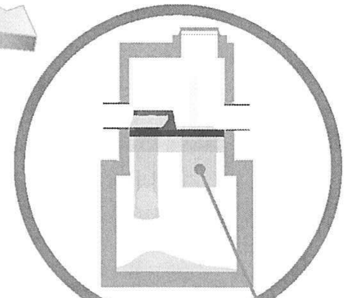
www.imbriumsystems.com/PCSWMMforStormceptor

With over 40,000 units operating worldwide, Stormceptor performs and protects every day, in every storm.

Stormceptor® STC

The calm *during* the storm

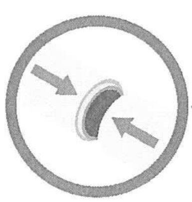




* *Fiberglass construction is an option*

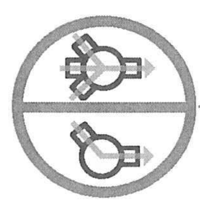
Easy to install

Small footprint saves time and money with limited disruption to your site.



Seamless

Minimal drop between inlet and outlet pipes makes Stormceptor ideal for retrofits and new development projects.



Flexible

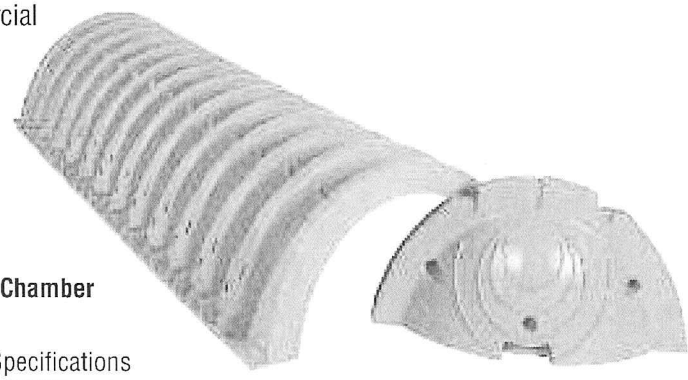
Multiple inlets can connect to a single unit.

Can be used as a bend structure.

StormTech SC-310 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.

StormTech®
Detention • Retention • Recharge
Subsurface Stormwater Management℠



StormTech SC-310 Chamber
(not to scale)

Nominal Chamber Specifications

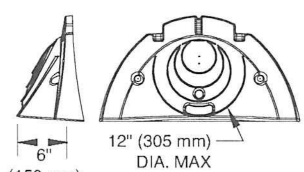
Size (L x W x H)
85.4" x 34.0" x 16.0"
(2170 x 864 x 406 mm)

Chamber Storage
14.7 ft³ (0.42 m³)

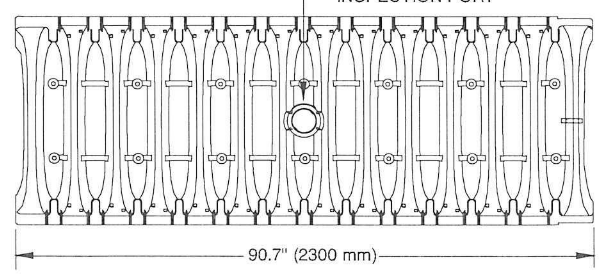
Minimum Installed Storage*
31.0 ft³ (0.88 m³)

Weight
37.0 lbs (16.8 kg)

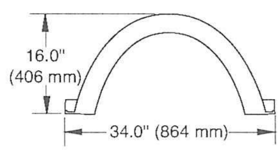
Shipping
41 chambers/pallet
108 end caps/pallet
18 pallets/truck

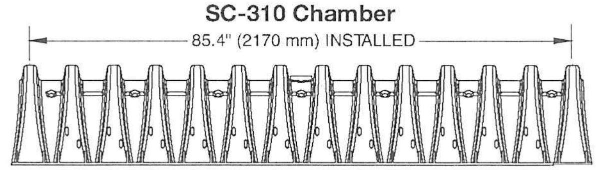


SC-310 End Cap

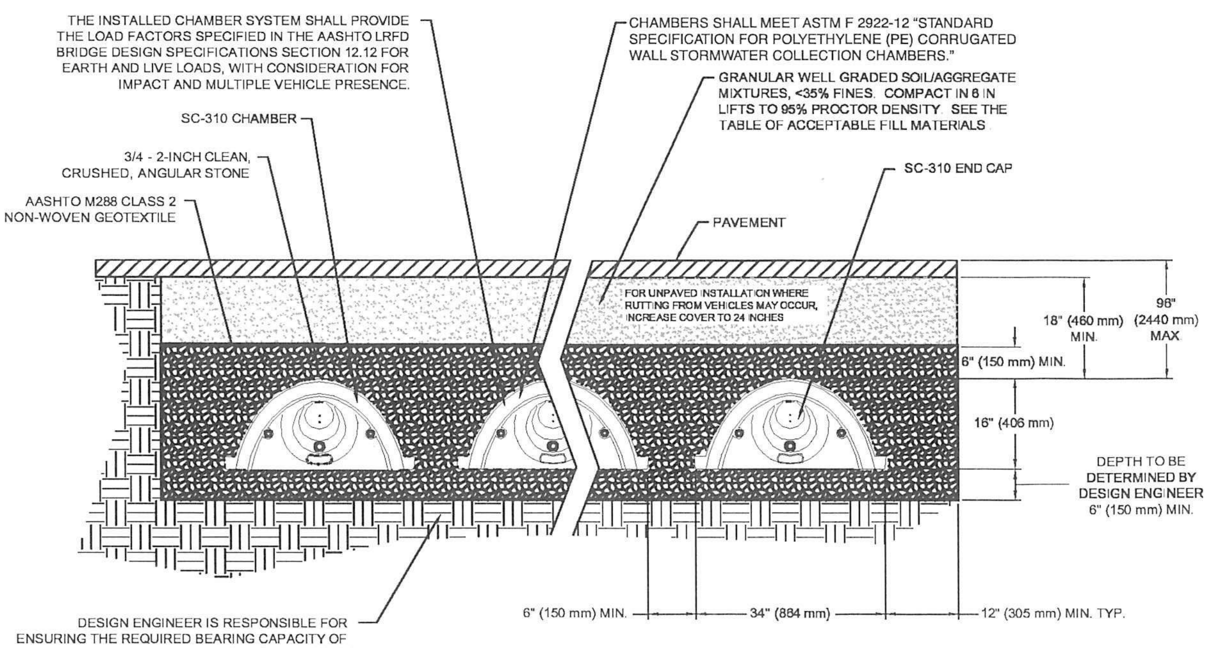


SC-310 Chamber





Typical Cross Section Detail
(not to scale)



MADE IN THE U.S.A.

THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

SC-310 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
28 (711)	14.70 (0.416)	31.00 (0.878)
27 (686)	14.70 (0.416)	30.21 (0.855)
26 (680)	Stone 14.70 (0.416)	29.42 (0.833)
25 (610)	Cover 14.70 (0.416)	28.63 (0.811)
24 (609)	14.70 (0.416)	27.84 (0.788)
23 (584)	14.70 (0.416)	27.05 (0.766)
22 (559)	14.70 (0.416)	26.26 (0.748)
21 (533)	14.64 (0.415)	25.43 (0.720)
20 (508)	14.49 (0.410)	24.54 (0.695)
19 (483)	14.22 (0.403)	23.58 (0.668)
18 (457)	13.68 (0.387)	22.47 (0.636)
17 (432)	12.99 (0.368)	21.25 (0.602)
16 (406)	12.17 (0.345)	19.97 (0.566)
15 (381)	11.25 (0.319)	18.62 (0.528)
14 (356)	10.23 (0.290)	17.22 (0.488)
13 (330)	9.15 (0.260)	15.78 (0.447)
12 (305)	7.99 (0.227)	14.29 (0.425)
11 (279)	6.78 (0.192)	12.77 (0.362)
10 (254)	5.51 (0.156)	11.22 (0.318)
9 (229)	4.19 (0.119)	9.64 (0.278)
8 (203)	2.83 (0.081)	8.03 (0.227)
7 (178)	1.43 (0.041)	6.40 (0.181)
6 (152)	0	4.74 (0.134)
5 (127)	0	3.95 (0.112)
4 (102)	Stone Foundation 0	3.16 (0.090)
3 (76)	0	2.37 (0.067)
2 (51)	0	1.58 (0.046)
1 (25)	0	0.79 (0.022)

Note: Add 0.79 cu. ft. (0.022 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Stone Foundation Depth in. (mm) 6 (150)	12 (305)	18 (460)
StormTech SC-310	14.7 (0.4)	31.0 (0.9)	35.7 (1.0)	40.4 (1.1)

Note: Storage volumes are in cubic feet per chamber. Assumes 40% porosity for the stone plus the chamber volume.

Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH TONS (CUBIC YARDS)	**6"**	**12"**	**18"**
StormTech SC-310	2.1 (1.5 yd³)	2.7 (1.9 yd³)	3.4 (2.4 yd³)
METRIC KILOGRAMS (METER³)	**150 mm**	**305 mm**	**460 mm**
StormTech SC-310	1830 (1.1 m³)	2490 (1.5 m³)	2990 (1.8 m³)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber

	Stone Foundation Depth 6" (150 mm)	12" (305 mm)	18" (460 mm)
StormTech SC-310	2.9 (2.2)	3.4 (2.6)	3.8 (2.9)

Note: Volumes are in cubic yards (cubic meters) per chamber. Assumes 6" (150 mm) of separation between chamber rows and 18" (460 mm) of cover. The volume of excavation will vary as the depth of the cover increases.

STANDARD LIMITED WARRANTY OF STORMTECH LLC ("STORMTECH"): PRODUCTS

(A) This Limited Warranty applies solely to the StormTech chambers and endplates manufactured by StormTech and sold to the original purchaser (the "Purchaser"). The chambers and endplates are collectively referred to as the "Products."

(B) The structural integrity of the Products, when installed strictly in accordance with StormTech's written installation instructions at the time of installation, are warranted to the Purchaser against defective materials and workmanship for one (1) year from the date of purchase. Should a defect appear in the Limited Warranty period, the Purchaser shall provide StormTech with written notice of the alleged defect at StormTech's corporate headquarters within ten (10) days of the discovery of the defect. The notice shall describe the alleged defect in reasonable detail. StormTech agrees to supply replacements for those Products determined by StormTech to be defective and covered by this Limited Warranty. The supply of replacement products is the sole remedy of the Purchaser for breaches of this Limited Warranty. StormTech's liability specifically excludes the cost of removal and/or installation of the Products.

(C) **THIS LIMITED WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANT-ABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**

(D) This Limited Warranty only applies to the Products when the Products are installed in a single layer. **UNDER NO CIRCUMSTANCES, SHALL THE PRODUCTS BE INSTALLED IN A MULTI-LAYER CONFIGURATION.**

(E) No representative of StormTech has the authority to change this Limited Warranty in any manner or to extend this Limited Warranty. This Limited Warranty does not apply to any person other than to the Purchaser.

(F) Under no circumstances shall StormTech be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Products, or the cost of other goods or services related to the purchase and installation of the Products. For this Limited Warranty to apply, the Products must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and StormTech's written installation instructions.

(G) **THE LIMITED WARRANTY DOES NOT EXTEND TO INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES. STORMTECH SHALL NOT BE LIABLE FOR PENALTIES OR LIQUIDATED DAMAGES, INCLUDING LOSS OF PRODUCTION AND PROFITS; LABOR AND MATERIALS; OVERHEAD COSTS; OR OTHER LOSS OR EXPENSE INCURRED BY THE PURCHASER OR ANY THIRD PARTY. SPECIFICALLY EXCLUDED FROM LIMITED WARRANTY COVERAGE ARE DAMAGE TO THE PRODUCTS ARISING FROM ORDINARY WEAR AND TEAR; ALTERATION, ACCIDENT, MISUSE, ABUSE OR NEGLECT; THE PRODUCTS BEING SUBJECTED TO VEHICLE TRAFFIC OR OTHER CONDITIONS WHICH ARE NOT PERMITTED BY STORMTECH'S WRITTEN SPECIFICATIONS OR INSTALLATION INSTRUCTIONS; FAILURE TO MAINTAIN THE MINIMUM GROUND COVERS SET FORTH IN THE INSTALLATION INSTRUCTIONS; THE PLACEMENT OF IMPROPER MATERIALS INTO THE PRODUCTS; FAILURE OF THE PRODUCTS DUE TO IMPROPER SITING OR IMPROPER SIZING; OR ANY OTHER EVENT NOT CAUSED BY STORMTECH. THIS LIMITED WARRANTY REPRESENTS STORMTECH'S SOLE LIABILITY TO THE PURCHASER FOR CLAIMS RELATED TO THE PRODUCTS, WHETHER THE CLAIM IS BASED UPON CONTRACT, TORT, OR OTHER LEGAL THEORY.**

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7.0 Inletting the Chambers

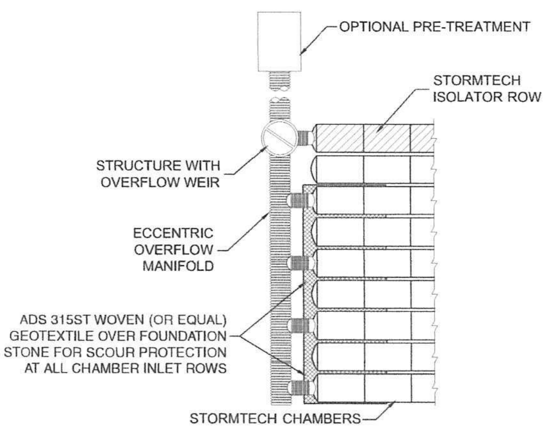
The design flexibility of a StormTech chamber system includes many inletting possibilities. Contact StormTech's Technical Service Department for guidance on designing an inlet system to meet specific site goals.

7.1 TREATMENT TRAIN

A properly designed inlet system can ensure good water quality, easy inspection and maintenance, and a long system service life. StormTech recommends a treatment train approach for inletting an underground stormwater management system under a typical commercial parking area. *Treatment train* is an industry term for a multi-tiered water quality network. As shown in **Figure 7**, a StormTech recommended inlet system can inexpensively have tiers of treatment upstream of the StormTech chambers:

Tier 1 – Pre-treatment (BMP)
Tier 2 - StormTech Isolator® Row
Tier 3 - Enhanced Treatment (BMP)

Figure 7 – Typical StormTech Treatment Train Inlet System



7.2 PRE-TREATMENT (BMP) – TREATMENT TIER 1

In some areas pre-treatment of the stormwater is required prior to entry into a stormwater system. By treating the stormwater prior to entry into the system, the service life of the system can be extended, pollutants such as hydrocarbons may be captured, and local regulations met. Pre-treatment options are often described as a Best Management Practice or simply a BMP.

Pre-treatment devices differ greatly in complexity, design and effectiveness. Depending on a site's characteristics and treatment goals, the simple, least expensive pre-treatment solutions can sometimes be just as effective as the complex systems. Options include a simple deep sumped manhole with a 90° bend on its outlet, baffle boxes, swirl concentrators, and devices that combine these processes. Some of the most effective pre-treatment options combine engineered site grading with vegetation such as bio-swales or grassy strips.

The type of pretreatment device specified as the first level of treatment up-stream of a StormTech chamber system can vary greatly throughout the country and from site-to-site. It is the responsibility of the design engineer to understand the water quality requirements and design a stormwater treatment system that will satisfy local regulators and follow applicable laws. A design engineer should apply their understanding of local weather conditions, site topography, local maintenance requirements, expected service life, etc…to select an appropriate stormwater pre-treatment system.

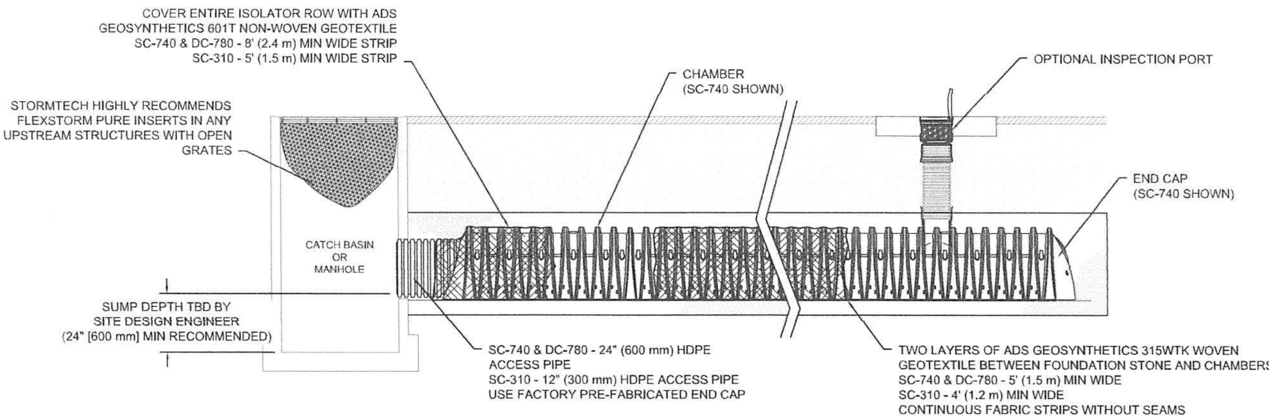
7.3 STORMTECH ISOLATOR ROW – TREATMENT TIER 2

StormTech has a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance. The StormTech Isolator Row is a row of standard StormTech chambers surrounded with appropriate filter fabrics and connected to a manhole for easy access. This application basically creates a filter/detention basin that allows water to egress through the surrounding filter fabric while sediment is trapped within. It may be best to think of the Isolator Row as a first-flush treatment device. *First-Flush* is a term typically used to describe the first ½" to 1" (13-25 mm) of rainfall or runoff on a site. The majority of stormwater pollutants are carried in the sediments of the first-flush, therefore the Isolator Row is an effective component of a treatment train.

The StormTech Isolator Row should be designed with a manhole with an overflow weir at its upstream end. The diversion manhole is multi-purposed. It can provide access to the Isolator Row for both inspection and maintenance and acts as a diversion structure. The manhole is connected to the Isolator Row with a short length of 12" (300 mm) pipe for the SC-310 chamber and 24" (600 mm) pipe for the SC-740 and DC-780 chambers. These pipes are connected to the Isolator Row with a 12" (300 mm) fabricated end cap for the SC-310 chamber and a 24" (600 mm) fabricated end cap for the SC-740 and DC-780 chambers. The overflow weir typically has its crest set between the top of the chamber and its midpoint. This allows stormwater in excess of the Isolator Row's storage/conveyance capacity to bypass into the chamber system through the downstream manifold system.

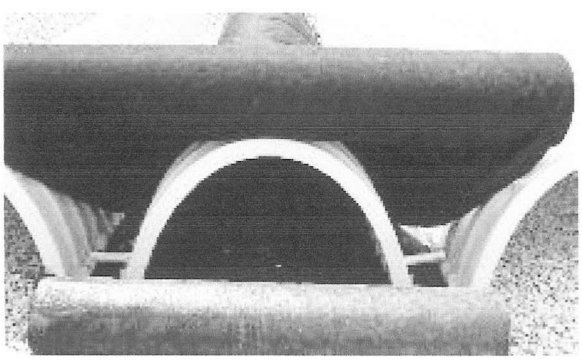
Specifying and installing proper geotextiles is essential for efficient operation and to prevent damage to the system during the JetVac maintenance process. In a typical configuration, two strips of woven geotextile that meet AASHTO M288 Class 1 requirements are required between the chambers and the stone foundation. This strong filter fabric traps sediments and protects the stone base during maintenance. A strip of non-woven

Figure 8 – StormTech Isolator Row Detail



Note: Non-woven geotextile over DC-780 Isolator Row chambers is not required.

AASHTO M288 Class 2 geotextile is draped over the Isolator chamber row. This 6-8 oz. (217-278 g/m²) non-woven filter fabric prevents sediments from migrating out of the chamber perforations while allowing modest amounts of water to flow out of the Isolator Row. **Figure 8** is a detail of the Isolator Row that shows proper application of the geotextiles. Contact StormTech for a table of acceptable geotextiles.



Inspection is easily accomplished through the upstream manhole or optional inspection ports. Maintenance of an Isolator Row is fast and easy using the JetVac process through the upstream manhole. Section 12.0 explains the inspection and maintenance process in more detail.

Isolator Rows can be sized to accommodate either a water quality volume or a water quality flow rate requirement. The use of filter fabric around the Isolator Row chambers allows stormwater to egress out of the row during and between storm events. The rate of egression for design is dependent upon the chamber model and sediment accumulation on the geotextile. Contact StormTech's Technical Services Department for more information on Isolator Row sizing.

7.4 ENHANCED TREATMENT (BMP) – TREATMENT TIER 3

As regulations have become more stringent, requiring higher levels of containment removal, water quality systems may be required to treat higher flow rates, greater volumes or to provide a higher level of filtration or other more sophisticated treatment process. StormTech systems can easily be configured with enhanced treatment techniques located either upstream or down stream of the retention or detention chamber system. Located upstream of an infiltration bed, between the pretreatment device and the Isolator Row, enhanced treatment provides a high level of contaminant removal which protects groundwater or better preserves the infiltration surface. Located downstream of detention, enhanced treatment provides a higher level of contaminant removal prior to discharge to a receiving body.

Enhanced treatment BMPs are normally applied where specific regulations and specific water quality product approvals are in place. StormTech works closely with providers of enhanced treatment technologies to meet local requirements.

7.5 TREATMENT TRAIN CONCLUSION

The treatment train is a highly effective water-quality approach that may not add significant cost to a StormTech system being installed under commercial parking areas. The StormTech Isolator Row adds a significant level of treatment, easy inspection and maintenance, while maintaining storage volume credit for the cost of a modest amount of geotextile. Finally where higher levels of treatment are required, StormTech can integrate other technologies into the treatment train to provide the most cost effective treatment approach. This treatment train concept provides three levels of treatment, inspection and maintenance upstream and downsstream of the StormTech detention/retention bed.

For quick calculations, refer to the Site Calculator on StormTech's website at ***www.stormtech.com****.*

10.1 SYSTEM SIZING

The following steps provide the calculations necessary to size a system. If you need assistance determining the number of chambers per row or customizing the bed configuration to fit a specific site, call StormTech's Technical Services Department at **1-888-892-2694.**

1) Determine the amount of storage volume (V_S) required.

It is the design engineer's sole responsibility to determine the storage volume required by local codes.

TABLE 8 – Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (150)	12 (300)	18 (450)
StormTech SC-740	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)
StormTech SC-310	14.7 (0.4)	31.0 (0.9)	35.7 (1.0)	40.4 (1.1)
	ft³ (m³)	**9 (230)**	**12 (300)**	**18 (450)**
StormTech DC-780	46.2 (1.3)	78.4 (2.2)	81.8 (2.3)	88.6 (2.5)

Note: Assumes 40% porosity for the stone plus the chamber volume.

2) Determine the number of chambers (C) required.

To calculate the number of chambers needed for adequate storage, divide the storage volume (Vs) by the volume of the selected chamber, as follows:
C = Vs / Volume per Chamber

3) Determine the required bed size (S).

To find the size of the bed, multiply the number of chambers needed (C) by either:

StormTech SC-740 / DC-780
bed area per chamber = 33.8 ft² (3.1 m³)

StormTech SC-310
bed area per chamber = 23.7 ft² (2.2 m³)

S = (C x bed area per chamber) +
[1 foot (0.3 m) x bed perimeter in feet (meters)]

NOTE: It is necessary to add one foot (0.3 m) around the perimeter of the bed for end caps and working space.

4) Determine the amount of clean, crushed, angular stone (Vst) required.

TABLE 9 – Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH tons (yd³)	**6"**	**12"**	**18"**
StormTech SC-740	3.8 (2.8)	4.6 (3.3)	5.5 (3.9)
StormTech SC-310	2.1 (1.5)	2.7 (1.9)	3.4 (2.4)
METRIC kg (m³)	**150 mm**	**300 mm**	**450 mm**
StormTech SC-740	3450 (2.1)	4170 (2.5)	4490 (3.0)
StormTech SC-310	1830 (1.1)	2490 (1.5)	2990 (1.8)
ENGLISH tons (yd³)	**9"**	**12"**	**18"**
StormTech DC-780	4.2 (3.0)	4.7 (3.3)	5.6 (3.9)
METRIC kg (m³)	**230 mm**	**300 mm**	**450 mm**
StormTech DC-780	3810 (2.3)	4264 (2.5)	5080 (3.0)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

To calculate the total amount of clean, crushed, angular stone required, multiply the number of chambers (C) by the selected weight of stone from **Table 9.**
NOTE: Clean, crushed, angular stone is also required around the perimeter of the system.

5) Determine the volume of excavation (Ex) required.
6) Determine the area of filter fabric (F) required.

TABLE 10 – Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (150 mm)	**12" (300 mm)**	**18" (450 mm)**
StormTech SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)
StormTech SC-310	2.9 (2.2)	3.4 (2.6)	3.8 (2.9)
	9" (230 mm)	**12" (300 mm)**	**18" (457 mm)**
StormTech DC-780	5.9 (4.5)	6.3 (4.8)	6.9 (5.3)

Note: Assumes 6" (150 mm) of separation between chamber rows and 18" (450 mm) of cover. The volume of excavation will vary as the depth of the cover increases.

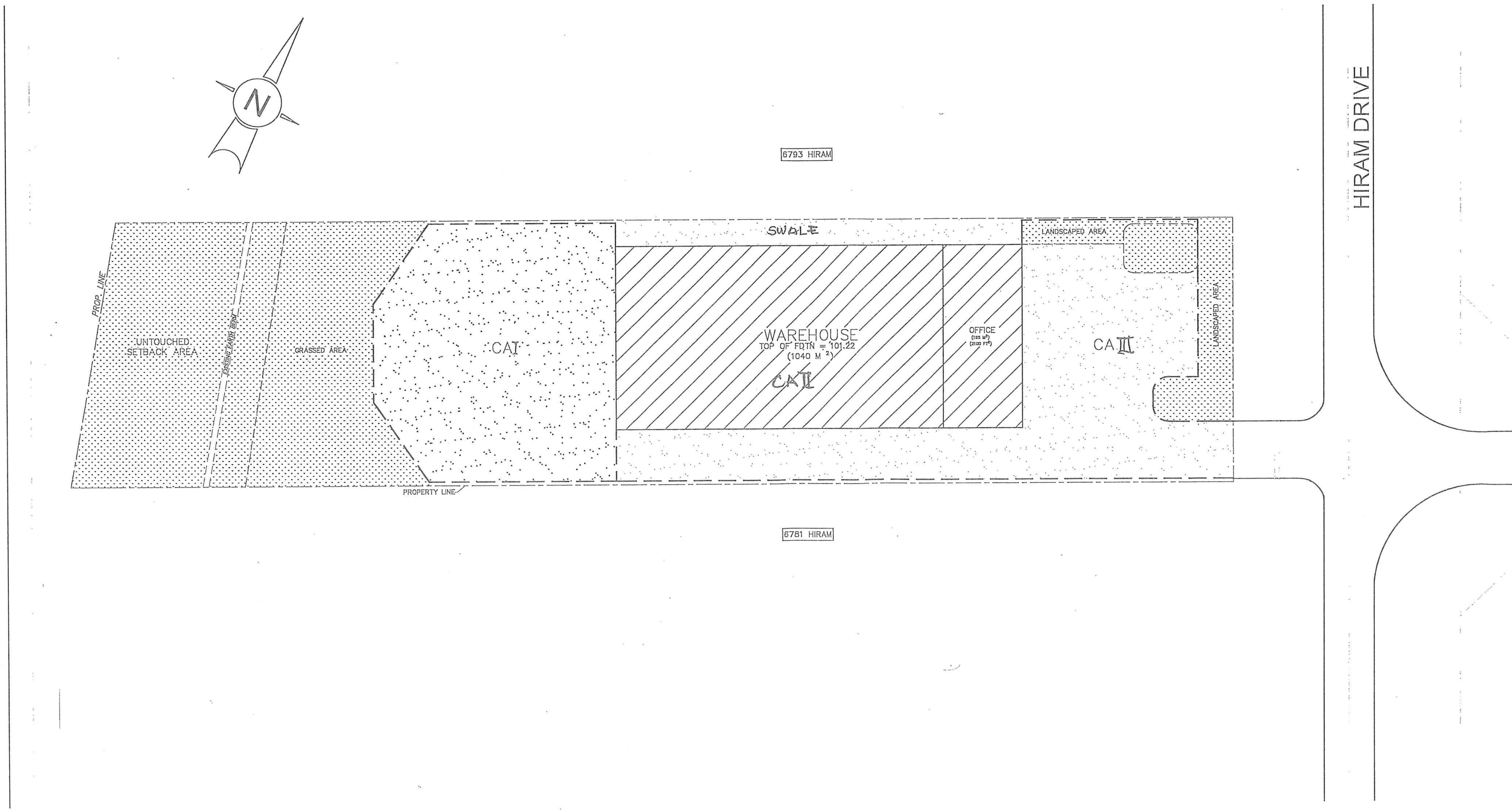
Each additional foot of cover will add a volume of excavation of 1.3 yds³ (1.0 m³) per SC-740 / DC-780 and 0.9 yds³ (0.7 m³) per SC-310 chamber.

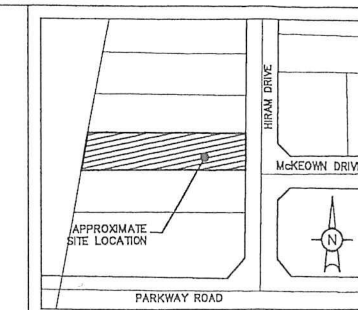
The bottom and sides of the bed and the top of the embedment stone must be covered with ADS 601 (or equal) a non-woven geotextile (filter fabric). The area of the sidewalls must be calculated and a 2 foot (0.6 m) overlap must be included where two pieces of filter fabric are placed side-by-side or end-to-end. Geotextiles typically come in 15 foot (4.6 m) wide rolls.

7) Determine the number of end caps (E_C) required.

Each row of chambers requires two end caps.

E_C = number of rows x 2





KEY PLAN
N.T.S

GENERAL NOTES:

1. All dimensions are in meters; all elevations are in meters and are geodetic.
2. TBM = Nail on existing hydro pole. Elevation = 99.91
3. This is not a legal survey.
4. Property boundary was derived from PLAN 4M–351 (H.A. KEN SHIPMAN SURVEYING LTD.)
5. Contractor is responsible for location and protection of utilities.
6. Contractor to verify that appropriate permits have been acquired prior to any construction.
7. All dimensions to be verified on site by contractor prior to construction.
8. Inspection of rough grade by Rockville Engineering Inc. and City of Ottawa must be conducted prior to placement of topsoil or sod.
9. All materials and construction to be in accordance with City of Ottawa standards and Ontario Provincial Standards and Specifications, sewer and watermain material types; disinfection,provide minimum 2.4 meters of cover for water services, cathodic protection, City of Ottawa insulation specifications for watermain, pipe bedding, reinstatement of disturbed areas and leakage testing.
10. Any changes made to this plan must be verified and approved by Rockville Engineering Inc.
11. Part of property is located in flood plain boundary per "Conservation Authorities Act"
12. Rear–yard Set–back area to remain undisturbed
13. Flood plain EL: West = 99.78
    East = 99.59
14. CSRS Summary Monument: Spike in utilities pole 0.3 above grade (elevation = 99.6m, see attached survey plan).

REVISION	DESCRIPTION	DATE
2	REVISION	12/07/2019
1	LOT CONFIGURATION ADDED	18/06/2018

CONSULTANT:

ROCKVILLE ENG INC
323 COVENTRY RD
UNIT 7, OTTAWA K1K 3X6
TEL 613-710-7727
INFO@ROCKVILLEENGINC.COM
WWW.ROCKVILLEENGINC.COM

CLIENT: VENOM MOTOR SPORT LTD.
6820 MCKEOWN DR.
GREELY, ON

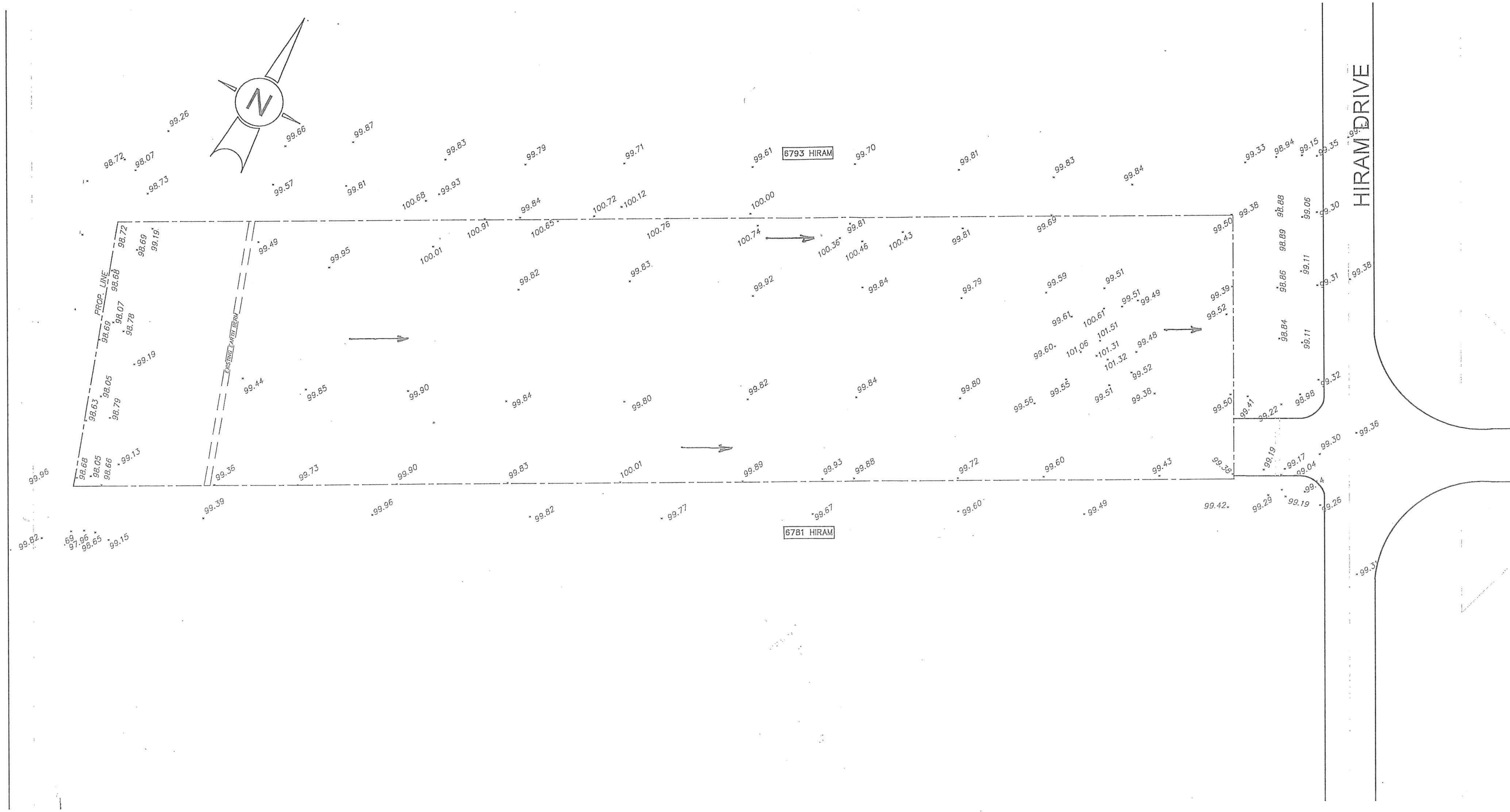
PROJECT: LIGHT INDUSTRIAL BUILDING (WAREHOUSE)

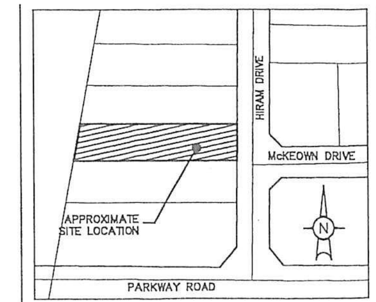
SITE: 6787 HIRAM DR. GREELY, ON

DRAWING: POST–DEVELOPMENT CATCHMENT AREA

PROJECT NO.	DESIGN:	DRAWN:	APPROVED:
6787HIRAM	C.ENENDU	N.ECKERT	C.ENENDU
SCALE AT A1: 1:500	DATE: 7/12/2019	DRAWING NO: A1	SHEET: 2 of 2

D07-12-18-0090





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SCALE AT A1: 1:500	DATE: 7/12/2019	DRAWING NO: A0	SHEET: 1 of 2