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February 13, 2023

GEL Project Number 873-009-22

## Stormwater Management Report 2<sup>nd</sup> Submission

### Regarding:

Proposed Warehouse Addition  
31 Patterson Road  
City of Barrie, County of Simcoe

### Prepared on behalf of:

Canplas Industries Ltd.

### By:

GERRITS ENGINEERING LIMITED  
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## 1. Introduction

Gerrits Engineering Ltd. (GEL) has been retained by Canplas Industries Ltd. (Client) to prepare a Stormwater Management Report for the proposed warehouse addition development of the existing warehouse plant building, in the geographic Municipality of City of Barrie, County of Simcoe, Ontario. The subject lands are approximately 4.46 ha in area and it is proposed to construct a 2,100 m<sup>2</sup> addition to the already existing 14,473 m<sup>2</sup> facility. As a result of these works, additional parking spaces are also proposed. This report will address the detailed design and stormwater management controls required for the proposed building addition construction.

### 1.1. Supporting & Reference Documents

The following documents have been referenced in the preparation of this report:

- Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- Ministry of Transportation, Drainage Management Manual (MTO, 1997)
- City of Barrie, Storm Drainage & Stormwater Management Policies & Design Guidelines, November 2009
- Water Transmission and Distribution Policies and Design Standard, January 2021
- Sanitary Sewage Collection System Policies and Design Guideline, October 2017
- Lake Simcoe Region Conservation Authority (LSRCA), Technical Guidelines for Stormwater Management, September, 2016
- Ontario Building Code 2012 (O.B.C.)

### 1.2. Subject Property

The subject site as shown below in Figure 1 (in red) is approximately 4.46 ha in area and is designated for industrial use. It is legally described as Part of Lots 1, 2, 3, 4 and 5 Registered Plan No. 20, in the geographic Township of Innisfil, City of Barrie, County of Simcoe. In general, the site very gently slopes from the west to the east towards the Highway 400 corridor. From here, the water flows slightly east before crossing under Highway 400. Currently the site is occupied by the existing Canplas industrial facility and is approximately 14,473 m<sup>2</sup> in footprint with the areas to the east and south being largely undeveloped. Topographical information is based on a survey that was completed by Rudy Mak Surveying, dated May 2015, as well as an aerial map from Google Imagery.



**Figure 1 - Subject Property (shown in Red)**

## 2. Storm Drainage and Stormwater Management

A key component of the Development is the need to address environmental and related Stormwater Management (SWM) issues. These are examined in a framework aimed at meeting the City of Barrie, Lake Simcoe Region Conservation Authority (LSRCA), and Ministry of the Environment, Conservation and Parks (MECP) requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems.

It is understood that the objectives of the SWM plan are to:

- Protect life and property from flooding and erosion.
- Maintain water quality for ecological integrity, recreational opportunities etc.
- Protect and maintain groundwater flow regime(s).
- Protect aquatic and fishery communities and habitats.
- Maintain and protect significant natural features.
- Protect and provide diverse recreational opportunities that are in harmony with the environment.



## 2.1. Existing Drainage Conditions

The subject lands are evaluated as a single catchment. The watershed drains into Whiskey Creek which crosses under the Highway 400 corridor to the east of the subject property. The elevations range from approximately 236.0 to 234.7m at a typical slope of about 0.6%. According to the Soil Survey of Simcoe County, Report No. 29 of the Ontario Soil Survey, Ministry of Agriculture and Food, surface soils on the subject property consist of Tioga Sandy Loams (SCS Type A). This soil type is routinely characterized as having good drainage characteristics. Referencing Design Chart 1.07 "Runoff Coefficients" of the Ministry of Transportation, Drainage Management Manual, 1997, we determine the runoff coefficient for the existing drainage conditions as follows:

$$\text{Site Area} = 44,560.0 \text{ m}^2 \quad \text{AR} = 31,192.0 \text{ m}^2 \quad \text{Weighted R} = 0.70$$

Given the size of the site, the Modified Rational Method will be used to determine the existing release rates:

Catchment Area	= 4.46 ha
Runoff Coefficient	= 0.70
Time of Concentration ( $t_c$ )	= 10 minutes
Rainfall Intensity	= City of Barrie Curve Parameters
Peaking Factor ( $C_i$ )	= 1.00 (2-10 year design periods)
	= 1.10 (25 year design period)
	= 1.20 (50 year design period)
	= 1.25 (100 year design period)
Peak Runoff Rate ( $Q_r$ )	= $C \times I \times A \times 360^{-1}$

Applying the above results in the following release rates:

**Table 1: Subject Site Allowable Release Rate**

	2 year ( $\text{m}^3/\text{s}$ )	5 year ( $\text{m}^3/\text{s}$ )	10 year ( $\text{m}^3/\text{s}$ )	25 year ( $\text{m}^3/\text{s}$ )	50 year ( $\text{m}^3/\text{s}$ )	100 year ( $\text{m}^3/\text{s}$ )
Pre-Development	0.72	0.94	1.09	1.41	1.70	1.95

## 2.2. Proposed Drainage Conditions

The proposed Development will increase the imperviousness of the site and it is important to quantify this increase in stormwater runoff rates for proper sizing of on-site controls with downstream facilities. As per the proposed site's statistics, the post development weighted runoff is as follows:

Landscape	11,653 $\text{m}^2$	R = 0.10	AR = 1,165.3
Asphalt	15,704 $\text{m}^2$	R = 0.95	AR = 14,918.8
Building	16,573 $\text{m}^2$	R = 0.95	AR = 15,744.4
Concrete	630 $\text{m}^2$	R = 0.95	AR = <u>598.5</u>
		Total	AR = 32,427.0

$$\text{Site Area} = 44,560.0 \text{ m}^2 \quad \text{AR} = 32,427.0 \text{ m}^2 \quad \text{Weighted R} = 0.73$$



The anticipated post-development runoff coefficient of 0.73 is reasonable for a development of this type. The Modified Rational Method will be used to determine the proposed release rates.

Catchment Area	= 4.46 ha
Runoff Coefficient	= 0.73
Time of Concentration ( $t_c$ )	= 10 minutes
Rainfall Intensity	= City of Barrie Curve Parameters
Peaking Factor ( $C_i$ )	= 1.00 (2-10 year design periods)
	= 1.10 (25 year design period)
	= 1.20 (50 year design period)
	= 1.25 (100 year design period)
Peak Runoff Rate ( $Q_r$ )	= $C \times I \times A \times 360^{-1}$

Applying the above results in the following release rates:

**Table 2: Post Development Release Rate**

	2 year ( $m^3/s$ )	5 year ( $m^3/s$ )	10 year ( $m^3/s$ )	25 year ( $m^3/s$ )	50 year ( $m^3/s$ )	100 year ( $m^3/s$ )
Post-Development w/o Attenuation	0.75	0.98	1.14	1.47	1.78	2.04

When reviewing the post development conditions, we find that the anticipated release rates are greater than the pre-development conditions and therefore additional quantity control measures will be required.

### 2.3. Quantity Control

The development of this Site increases the existing stormwater runoff rate above that of the allowable release rate. Therefore, site quantity controls have been designed to closely approximate the allowable release rates. For quantity control, the site has been graded such that the stormwater will be captured by catch basins and catch basin manholes. Referencing drawing STM-2, subcatchment areas P-1, P-3, and P-5 – P-7 will have the stormwater runoff captured and overcontrolled by subsurface storage in the form of a Greenstorm system within the landscaped area to offset the other areas releasing uncontrolled to result in the overall release from the site meeting the pre-development peak flow release rates. Release from the subject site will be controlled by an outlet pipe sized using the following equation:

$$Q = cA\sqrt{2gh}$$

$Q$  = allowable release rate

$A$  = orifice area =  $0.0314 \text{ m}^2$  (200mm dia)

$c$  = orifice coefficient = 0.63

$g$  = gravitational constant =  $9.81 \text{ m/s}^2$

$h$  = high water level over center of orifice

Applying the above equation, we find that a 200mm orifice plate installed between the outlet manhole and the Oil Grit Separator will restrict the flows such that the controlled stormwater flows from the site are at a rate of less than the allowable release rates for all storm events. The Pre and Post Development calculated release rates for the proposed development are detailed in Table 3 below. Calculations have been included within Appendix A.

**Table 3: Site Release Rates**

	Design Storm Event Release Rate (m <sup>3</sup> /s)					
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
Allowable Release Rate	0.65	0.86	0.99	1.28	1.55	1.77
Post Development with Attenuations	0.59	0.77	0.89	1.14	1.37	1.57
Storage Volume Required (m <sup>3</sup> )	115	153	179	235	287	331

Quantity storage requirements within the subject site are calculated to be approximately 331 m<sup>3</sup>. The total available quantity control volume on site is approximately 340 m<sup>3</sup>, which exceeds storage requirements. This includes a proposed stormwater management facility (Greenstorm System) that has been sized to have a total available quantity control volume of about 309 m<sup>3</sup>, accompanied by subsurface structures/pipes, which will generate approximately 31 m<sup>3</sup>. Detailed calculations have been provided in Appendix A.

It is proposed to discharge the controlled storm water runoff from the subject site to a swale located at the southeast corner of the subject site. This swale drains into Whiskey Creek which crosses under the Highway 400 corridor to the east of the subject property.

## 2.4. Quality Control

The MOE issued a “Stormwater Management Planning and Design Manual” in March 2003. This manual has been adopted by a variety of agencies including the Town. The objective of our SWM quality control will be to ensure MOE’s Enhanced Protection. To achieve Enhanced Protection, permanent and temporary control of erosion and sediment transport are proposed and are discussed in the following sections.

### 2.4.1. Stormwater Quality Control During Construction

To ensure stormwater quality control during construction, it is imperative that effective environmental and sedimentation controls be in place throughout the entire area subject to construction activities. With the requirement of earth grading, there will be a potential of soil erosion. It is therefore recommended that the following be implemented to assist in achieving acceptable stormwater runoff quality:

- Restoration of exposed surfaces with vegetation and non-vegetative material as soon as construction schedules permit;
- Installation of filter strips, silt fences and rock check dams or other similar facilities throughout the site, and specifically during all construction activities;
- Reduce stormwater drainage velocities where possible;
- Ensure that disturbed areas that are left inactive for more than 30 days shall be vegetated and stabilized as instructed by the Engineer;
- Minimize the amount of existing vegetation removed.



### 2.4.2. Permanent Quality Control

The objective of the permanent SWM quality controls will be to ensure MOE's Enhanced Protection. The proposed development will increase the imperviousness of the site. It is important to quantify this increase to evaluate the potential downstream impacts. As per the site's statistics, the post development's Total Imperviousness (TIMP) is:

Area of Building	=	16,573 m <sup>2</sup>
Area of Asphalt	=	15,704 m <sup>2</sup>
Area of Concrete	=	630 m <sup>2</sup>
Total Area	=	44,560 m <sup>2</sup>

$$\begin{aligned}\text{TIMP} &= (A_{\text{BLD}} + A_{\text{ASP}} + A_{\text{CONC}}) / A_{\text{TOTAL}} \\ &= (32,907) / 44,560 \\ &= 0.74 \text{ (or 74\%)}\end{aligned}$$

Given the nature of the site, and the favorable on-site soil conditions, it is proposed to utilize Low Impact Development (LID) methods to provide quality control. On-site controls in the form of a Green Storm Infiltration Gallery system be used as the means of addressing quality controls for runoff from the building area. As for the parking lot, it is proposed to install an oil/grit separator. See below for additional information.

### 2.4.3. LID Facilities

$$A_D = 44,560 \text{ m}^2$$

$$\text{TIMP} = 74\%$$

From Table 3.2 (extrapolating for TIMP = 74%)

$$\begin{aligned}V_{\text{Req'd}} &= 36.3 \text{ m}^3/\text{ha} \\ &= 36.3 \text{ m}^3/\text{ha} \times 4.46 \text{ ha} \\ &= 161.7 \text{ m}^3\end{aligned}$$

Therefore, the volume of the LID facility must provide about 161.9 m<sup>3</sup> of volume for infiltration to meet MOE Enhanced removal requirements.

### 2.4.4 Oil/Grit Separator

The development's parking facilities pose a risk to stormwater quality through the collection of grit, salt, sand and oils on the paved and gravel surface. A Stormfilter treatment unit is proposed to treat the stormwater released from this site to the MECP's Enhanced or Level 1 Protection standard. This MECP standard stipulates a Total Suspended Solids (TSS) removal of at least 80%. The SFPD0814 model will treat the post development flows to the required MECP quality standard, with a TSS removal rate of approximately 80%. The design criteria and background information on how the Stormfilter unit is sized is provided within Appendix B.



### 2.4.5 Infiltration Gallery

As indicated previously, it is proposed to utilize subsurface infiltration galleries to provide infiltration from the proposed building roof to provide quality control. The proposed facilities are calculated to have approximately **166.0 m<sup>3</sup>** of combined infiltration volume being provided, which exceeds the MECP requirements of 161.7 m<sup>3</sup>. The Green Storm infiltration gallery systems are proposed to be located to the east of the building, partially in the landscaped area. Details pertaining to the infiltration facility sizing can be found in Appendix A.

### 2.4.4. Volume Control

In accordance with the LSRCA Technical Guidelines for Stormwater Management Submissions – September 2016, section 2.2.2.1 Stormwater Volume Control must be provided for nonlinear redevelopment projects creating 0.5 or more hectares of impervious surfaces. The runoff from a 25mm event from the net increase in impervious area is to be captured and retained/treated on-site. The proposed subject site only creates an additional 0.15 ha of impervious surfaces and as such is technically exempt from this requirement. However, a review of what this volume would need to be is as follows:

$$\begin{aligned} \text{Impervious Area Added} &= 1,548 \text{ m}^2 \\ 1,548 \text{ m}^2 * 25\text{mm event} &= 38.7 \text{ m}^3 \end{aligned}$$

Therefore, a volume of about 39 m<sup>3</sup> is required to achieved volume control for the 25mm event from impervious surfaces. Based on the proposed configuration of the SWMF there is about 166 m<sup>3</sup> of infiltration volume provided. Therefore, although not required, Volume Control is achieved for the subject site.

## 2.5 Water Balance

The proposed development will increase the impervious cover of the site, which decreases the infiltration of groundwater. This decrease in infiltration reduces groundwater recharge and soil moisture replenishment. Therefore, it is important to main this natural hydrologic cycle as much as possible. Paragraph 6.3 of the LSRCA Watershed Development Policies state that “the Stormwater Management plan must make every feasible effort to maintain the pre-development infiltration and evapotranspiration rates and temperatures to the receiving waterbody an” watershed”.

Referencing Section 3.2 of the MOE “Stormwater Management Planning and Design Manual (March 2003), and the historical rainfall distribution for the City of Barrie, the following review of the water balance has been completed. The site is approximately 4.46 ha in area and referencing the Simcoe County Soil Maps (Report No. 29), we know that the soil is typically characterised as a Tioga Sandy Loam with a soil group type ‘A’. Referencing the LSRCA water balance spreadsheet, we calculate that under the existing condition the subject property would infiltrate about 8,208 m<sup>3</sup> of infiltration per year.

Calculating the anticipated uncontrolled post-development infiltration, it is anticipated that about 3,393 m<sup>3</sup> surface runoff will infiltrate per year. Therefore, additional onsite methods will be required to maintain the water balance. Referencing the City of Toronto Wet Weather Design Guidelines, we see that the 10mm event is approximately equal to 70% of the total average rainfall depth. It is proposed that this minimum of 10mm of each rainfall event be infiltrated from the rooftop surface as previously indicated using an infiltration gallery facility. This volume will be retained/treated on site.



These methods, in addition to the pervious infiltration across the site, result in a volume of 12,052 m<sup>3</sup> to be infiltrated per year, which well exceeds the current regime of the site. The following table details the various infiltration volumes per year with detailed calculations of these methods included in Appendix A.

	Total Infiltration (m <sup>3</sup> /yr)
Pre-Development	8,208
Uncontrolled Post Development	3,393
Controlled Post Development	12,052

## 2.6 Phosphorus Loading

The existing site generates approximately 3.17 kg of phosphorous annually and the proposed lands will generate approximately 6.15 kg of phosphorous annually. The following chart details the anticipated phosphorous loadings for the pre- and uncontrolled post-development conditions.

	Total P (kg/yr)
Pre-Development	3.17
Uncontrolled Post Development	6.07

As per the Phosphorous Budget Tool documentation as provided by the MOE, the removal efficiency of 87% was selected for the areas (rooftop surfaces) draining towards the infiltration gallery. The following chart details the anticipated phosphorous loading for the post-development treated condition. Phosphorous budget calculations have been included in Appendix A.

	Total P (kg/yr)
Controlled Post- Development	3.45

Based on the post development phosphorus release without the presence of BMP's of 6.15 kg annually, and post development release of 3.45 kg annually with the presence of BMP's, the subject site is able to achieve about 43% in total phosphorus reduction.

## 2.7 Erosion and Sediment Control

To ensure Stormwater runoff quality is controlled during construction, an erosion and sediment control strategy will be implemented to mitigate transportation of silt off-site to the existing roads and sewers. It is imperative that effective controls be put in place and maintained until all areas are stabilized with surface cover.



All erosion and sediment control Best Management Practices (BMP) shall be designed, constructed and maintained in accordance with the SVCA's erosion control requirements.

Items that will be addressed for both temporary and permanent erosion and sediment controls are based on the following:

- Site location description and area;
- Existing and proposed land use;
- Vegetative cover;
- Existing drainage routes;
- Proposed site works;
- Proposed outlets;
- Permits required;
- Sediment filters and barriers - silt fences;
- Construction entrance location;
- Protection to catch basins and ditch inlets;

To prevent construction generated sediments from entering the storm sewers or leaving the site by overland flow, the following measures should be implemented during the construction phase:

- Temporary sediment control fencing should be erected around the perimeter of the grading activities.
- Temporary sediment fabric and stone filters should be installed on existing and proposed catch basins until surface cover has been stabilized.
- A temporary construction access mud mat should be implemented to reduce the amount of materials that may be transported off site.
- Construction during drier months should be monitored for wind-borne transport of sediments. At the direction of the engineer, the contractor may be directed to water down exposed earth areas with an aqueous solution of calcium chloride.
- All disturbed areas not under immediate construction for 30 days, or not intended for building activities within a 3-month time period, should be stabilized with seeding.

Built up sediment should be removed and disposed off-site at least once a month, or more frequently as directed by the engineer.

### 3. Operations & Maintenance

#### 3.1. Inlet Structures

The inlet structures should be inspected in the spring and in the fall, and after every significant rainfall in the first year after construction or until the site has stabilized. The structures should be kept clear of debris, and any offending debris should be removed. A thorough inspection and cleaning of the building's eavestrough and roof leaders connecting to the infiltration gallery should be conducted annually to ensure no obstructions are present.



### 3.2. Outlet Pipe & Outlet Controls

The outlet control orifice should be inspected on an annual basis. The pipe should be kept clear of any possible sedimentation and offending debris should be removed. It is also important to examine the orifice pipe to ensure they are operating properly. Any damage to the grout or pipe should be repaired immediately. Additionally, the infiltration gallery should be inspected on a frequent basis after construction to ensure the system is functioning as intended, and no obstructions are present.

### 3.3. GreenStorm Storage Chamber

The GreenStorm storage chamber will act as underground stormwater detention facility. As previously mentioned, it is sized accordingly to provide an active storage volume for the 100-year storm event. It is recommended that the chamber is inspected on an annual basis. The chamber may be inspected on a more frequent basis recently after construction to ensure the system is functioning as intended, and no obstructions are present. The chamber should be kept clear of any possible sedimentation and offending debris should be removed. When the depth of sediment accumulates over 4-inch (102 mm), cleanout is recommended.

### 3.4. Contech StormFilter

It is recommended that the StormFilter be inspected on a quarterly basis to help and ensure that the unit is cleaned out at the appropriate time. Where site conditions may cause a rapid accumulation of pollutants, more frequent inspections should be carried out. The Contech StormFilter Inspection and Maintenance Procedures Manual has been provided in Appendix C for reference of appropriate procedures, frequency, and process.

### 3.5. Major Repairs

Any repair which is equal or greater than one third of the initial cost of the SWMF is considered a major repair. Major repairs should be designed and inspected by a Civil Engineer.

### 3.6. Infiltration Gallery

The successful functioning of the subsurface infiltration gallery relies on it being kept free of debris and the removal of any sediment that may migrate into the system. The infiltration gallery should be inspected on an annual basis. If debris or a build up of sediment in excess of 5cm is noted along the inlet or outlet, the offending material should be removed. The rooftop collection system should be inspected on an annual basis or after any high winds event that has the potential of damage. A damaged rooftop collection system will increase the chances of debris or sediment migrating into the infiltration gallery.



### 3 Conclusions

Implementation of the designs outlined in this report will ensure that the stormwater drainage from the site complies with the requirements of the reviewing authorities, is of acceptable quality both during and after construction, and further, in the event of a major storm, that proper facilities are in place to protect adjacent infrastructure.

All of which is respectfully submitted,  
**Gerrits Engineering Ltd.**

Jeff McCuaig, P.Eng.  
Director, Civil Engineer





## Appendix A Design Calculations

**GERRITS ENGINEERING LTD.**

**Calculation of Weighted Runoff Coefficient**

**Post Development Areas and Sub-Areas**

Area ID	Total Area	0.10	0.60	0.95	0.95	0.95	0.08	Weighted Rational Coefficient
		Grass	Gravel	Asphalt	Building	Conc.	Treed	
<b>Pre-Development</b>	44560	12036	0	16057	14444	858	1165	0.70
X - 1	5020	1224	0	2333	1300	163	0	0.74
X - 2	18580	7738	0	9007	444	226	1165	0.54
X - 3	4060	1450	0	2375	0	235	0	0.65
X - 4	12700	0	0	0	12700	0	0	0.95
X - 5	3240	1624	0	1382	0	234	0	0.52
X - 6	960	0	0	960	0	0	0	0.95
<b>Post Development</b>	44560	11653	0	15704	16573	630	0	0.73
P - 1	5020	1192	0	2365	1298	165	0	0.75
P - 2	18580	8890	0	8990	475	225	0	0.54
P - 3	3110	527	0	2343	0	240	0	0.81
P - 4	12700	0	0	0	12700	0	0	0.95
P - 5	2270	955	0	1315	0	0	0	0.59
P - 6	330	89	0	241	0	0	0	0.72
P - 7	2100	0	0	0	2100	0	0	0.95
P - 8	450	0	0	450	0	0	0	0.95

# Gerrits Engineering Limited

## Existing Development Runoff Calculation

### Uncontrolled Release Rates

Area	Total Site 4.46 ha	Storm (yrs)	Coeff A	Coeff B	Coeff C
Runoff Coefficient	0.63	2	<b>675.6</b>	<b>4.681</b>	<b>0.78</b>
Time of Concentration	10 min	5	<b>843.0</b>	<b>4.582</b>	<b>0.763</b>
		10	<b>976.9</b>	<b>4.745</b>	<b>0.76</b>
		25	<b>1133.1</b>	<b>4.734</b>	<b>0.756</b>
		50	<b>1251.5</b>	<b>4.847</b>	<b>0.753</b>
		100	<b>1383.6</b>	<b>4.905</b>	<b>0.754</b>
Return Rate	Interpolated 2 year				
Coefficient	1				
Rainfall Intensity	83.1 mm/hr				
Release Rate	0.653 m <sup>3</sup> /s				653 L/s
Return Rate	5 year				
Coefficient	1				
Rainfall Intensity	109.1 mm/hr				
Release Rate	0.857 m <sup>3</sup> /s				857 L/s
Return Rate	10 year				
Coefficient	1				
Rainfall Intensity	126.4 mm/hr				
Release Rate	0.992 m <sup>3</sup> /s				992 L/s
Return Rate	25 year				
Coefficient	1.1				
Rainfall Intensity	148.3 mm/hr				
Release Rate	1.281 m <sup>3</sup> /s				1281 L/s
Return Rate	50 year				
Coefficient	1.2				
Rainfall Intensity	164.1 mm/hr				
Release Rate	1.547 m <sup>3</sup> /s				1547 L/s
Return Rate	100 year				
Coefficient	1.25				
Rainfall Intensity	180.4 mm/hr				
Release Rate	1.771 m <sup>3</sup> /s				1771 L/s

### Modified Rational Method

$$Q = C_i C A I / 360$$

### Where:

- Q - Flow Rate (m<sup>3</sup>/s)
- C<sub>i</sub> - Peaking Coefficient
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)

## Gerrits Engineering Limited

### Proposed Development Runoff Calculation

#### Uncontrolled Release Rates

Area	Total Site 4.46 ha	Storm (yrs)	Coeff A	Coeff B	Coeff C
Runoff Coefficient	0.73	2	<b>675.586</b>	<b>4.681</b>	<b>0.78</b>
Time of Concentration	10 min	5	<b>843.019</b>	<b>4.582</b>	<b>0.763</b>
		10	<b>976.898</b>	<b>4.745</b>	<b>0.76</b>
		25	<b>1133.123</b>	<b>4.734</b>	<b>0.756</b>
		50	<b>1251.473</b>	<b>4.847</b>	<b>0.753</b>
		100	<b>1383.628</b>	<b>4.905</b>	<b>0.754</b>
Return Rate	Interpolated 2 year				
Coefficient	1				
Rainfall Intensity	83.1 mm/hr				
Release Rate	0.749 m <sup>3</sup> /s			749 L/s	
Return Rate	5 year				
Coefficient	1				
Rainfall Intensity	109.1 mm/hr				
Release Rate	0.983 m <sup>3</sup> /s			983 L/s	
Return Rate	10 year				
Coefficient	1				
Rainfall Intensity	126.4 mm/hr				
Release Rate	1.138 m <sup>3</sup> /s			1138 L/s	
Return Rate	25 year				
Coefficient	1.1				
Rainfall Intensity	148.3 mm/hr				
Release Rate	1.469 m <sup>3</sup> /s			1469 L/s	
Return Rate	50 year				
Coefficient	1.2				
Rainfall Intensity	164.1 mm/hr				
Release Rate	1.774 m <sup>3</sup> /s			1774 L/s	
Return Rate	100 year				
Coefficient	1.25				
Rainfall Intensity	180.4 mm/hr				
Release Rate	2.032 m <sup>3</sup> /s			2032 L/s	

#### Modified Rational Method

$$Q = C_i C A I / 360$$

#### Where:

- Q - Flow Rate (m<sup>3</sup>/s)
- C<sub>i</sub> - Peaking Coefficient
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)

**Proposed Development Runoff Calculation**

Area	(P-1, P-3, P-5, P6) Controlled 1.33 ha	Area	(P-4 and P-7) Uncontrolled 1.48 ha	Area	(P-2) Uncontrolled 1.86 ha
Runoff Coefficient	0.77	Runoff Coefficient	0.95	Runoff Coefficient	0.54
Time of Concentration	10 min	Time of Concentration	10 min	Time of Concentration	10 min
Return Rate	Interpolated	Return Rate	Interpolated	Return Rate	Interpolated
Coefficient	2 year	Coefficient	2 year	Coefficient	2 year
Rainfall Intesity	1	Rainfall Intesity	1	Rainfall Intesity	1
Release Rate	83.1 mm/hr	Release Rate	83.1 mm/hr	Release Rate	83.1 mm/hr
	0.237 m <sup>3</sup> /s    237 L/s		0.325 m <sup>3</sup> /s    325 L/s		0.233 m <sup>3</sup> /s    233 L/s
Return Rate	5 year	Return Rate	5 year	Return Rate	5 year
Coefficient	1	Coefficient	1	Coefficient	1
Rainfall Intesity	109.1 mm/hr	Rainfall Intesity	109.1 mm/hr	Rainfall Intesity	109.1 mm/hr
Release Rate	0.311 m <sup>3</sup> /s    311 L/s	Release Rate	0.426 m <sup>3</sup> /s    426 L/s	Release Rate	0.306 m <sup>3</sup> /s    306 L/s
Return Rate	10 year	Return Rate	10 year	Return Rate	10 year
Coefficient	1	Coefficient	1	Coefficient	1
Rainfall Intesity	126.4 mm/hr	Rainfall Intesity	126.4 mm/hr	Rainfall Intesity	126.4 mm/hr
Release Rate	0.360 m <sup>3</sup> /s    360 L/s	Release Rate	0.494 m <sup>3</sup> /s    494 L/s	Release Rate	0.354 m <sup>3</sup> /s    354 L/s
Return Rate	25 year	Return Rate	25 year	Return Rate	25 year
Coefficient	1.1	Coefficient	1.1	Coefficient	1.1
Rainfall Intesity	148.3 mm/hr	Rainfall Intesity	148.3 mm/hr	Rainfall Intesity	148.3 mm/hr
Release Rate	0.465 m <sup>3</sup> /s    465 L/s	Release Rate	0.637 m <sup>3</sup> /s    637 L/s	Release Rate	0.457 m <sup>3</sup> /s    457 L/s
Return Rate	50 year	Return Rate	50 year	Return Rate	50 year
Coefficient	1.2	Coefficient	1.2	Coefficient	1.2
Rainfall Intesity	164.1 mm/hr	Rainfall Intesity	164.1 mm/hr	Rainfall Intesity	164.1 mm/hr
Release Rate	0.562 m <sup>3</sup> /s    562 L/s	Release Rate	0.769 m <sup>3</sup> /s    769 L/s	Release Rate	0.552 m <sup>3</sup> /s    552 L/s
Return Rate	100 year	Return Rate	100 year	Return Rate	100 year
Coefficient	1.25	Coefficient	1.25	Coefficient	1.25
Rainfall Intesity	180.4 mm/hr	Rainfall Intesity	180.4 mm/hr	Rainfall Intesity	180.4 mm/hr
Release Rate	0.643 m <sup>3</sup> /s    643 L/s	Release Rate	0.881 m <sup>3</sup> /s    881 L/s	Release Rate	0.632 m <sup>3</sup> /s    632 L/s

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	675.586	4.681	0.78
5	843.019	4.582	0.763
10	976.898	4.745	0.76
25	1133.123	4.734	0.756
50	1251.473	4.847	0.753
100	1383.628	4.905	0.754

Modified Rational Method  
Q = C<sub>i</sub>C<sub>i</sub>A / 360

Where:

- Q - Flow Rate (m<sup>3</sup>/s)
- C<sub>i</sub> - Peaking Coefficient
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)	
233	1	21.6	0.525	0.22	232.97	233.11	0.03	0	0.03	3%	0.14	
	3	24	0.3	0.07	233.2	233.32	0	0	0.00	0%	0.00	
	4	64.4	0.45	0.16	233.14	233.46	0	0	0.00	0%	0.00	
	5	96.9	0.45	0.16	233.46	233.95	0	0	0.00	0%	0.00	
	6	30	0.3	0.07	233.69	233.91	0	0	0.00	0%	0.00	
	STM CONTROL			1.2	1.13	232.9		0.1				0.11
	EX. STM MH			1.8	2.54	233.12		0				0.00
	EX. STM MH			1.2	1.13	233.69		0				0.00
	EX. CB			0.6	0.36	233.46		0				0.00
	GREENSTORM											0.00

0.25

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)	
233.15	1	21.6	0.525	0.22	232.97	233.11	0.18	0.04	0.21	21%	0.98	
	3	24	0.3	0.07	233.2	233.32	0	0	0.00	0%	0.00	
	4	64.4	0.45	0.16	233.14	233.46	0.01	0	0.01	1%	0.10	
	5	96.9	0.45	0.16	233.46	233.95	0	0	0.00	0%	0.00	
	6	30	0.3	0.07	233.69	233.91	0	0	0.00	0%	0.00	
	STM CONTROL			1.2	1.13	232.9		0.25				0.28
	EX. STM MH			1.8	2.54	233.12		0.03				0.08
	EX. STM MH			1.2	1.13	233.69		0				0.00
	EX. CB			0.6	0.36	233.46		0				0.00
	GREENSTORM											46.37

47.81

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)	
233.4	1	21.6	0.525	0.22	232.97	233.11	0.43	0.29	0.69	69%	3.23	
	3	24	0.3	0.07	233.2	233.32	0.2	0.08	0.47	47%	0.80	
	4	64.4	0.45	0.16	233.14	233.46	0.26	0	0.29	29%	2.97	
	5	96.9	0.45	0.16	233.46	233.95	0	0	0.00	0%	0.00	
	6	30	0.3	0.07	233.69	233.91	0	0	0.00	0%	0.00	
	STM CONTROL			1.2	1.13	232.9		0.5				0.57
	EX. STM MH			1.8	2.54	233.12		0.28				0.71
	EX. STM MH			1.2	1.13	233.69		0				0.00
	EX. CB			0.6	0.36	233.46		0				0.00
	GREENSTORM											123.65

131.92

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)	
233.55	1	21.6	0.525	0.22	232.97	233.11	0.525	0.44	0.92	91%	4.26	
	3	24	0.3	0.07	233.2	233.32	0.3	0.23	0.88	88%	1.49	
	4	64.4	0.45	0.16	233.14	233.46	0.41	0.09	0.56	56%	5.74	
	5	96.9	0.45	0.16	233.46	233.95	0.09	0	0.10	10%	1.54	
	6	30	0.3	0.07	233.69	233.91	0	0	0.00	0%	0.00	
	STM CONTROL			1.2	1.13	232.9		0.65				0.74
	EX. STM MH			1.8	2.54	233.12		0.43				1.09
	EX. STM MH			1.2	1.13	233.69		0				0.00
	EX. CB			0.6	0.36	233.46		0.09				0.03
	GREENSTORM											170.02

184.90

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)	
233.7	1	21.6	0.525	0.22	232.97	233.11	0.525	0.525	1.00	100%	4.68	
	3	24	0.3	0.07	233.2	233.32	0.3	0.3	1.00	100%	1.70	
	4	64.4	0.45	0.16	233.14	233.46	0.45	0.24	0.77	77%	7.89	
	5	96.9	0.45	0.16	233.46	233.95	0.24	0	0.27	27%	4.16	
	6	30	0.3	0.07	233.69	233.91	0.01	0	0.02	2%	0.04	
	STM CONTROL			1.2	1.13	232.9		0.8				0.90
	EX. STM MH			1.8	2.54	233.12		0.58				1.48
	EX. STM MH			1.2	1.13	233.69		0.01				0.01
	EX. CB			0.6	0.36	233.46		0.24				0.09
	GREENSTORM											216.38

237.32

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)	
233.85	1	21.6	0.525	0.22	232.97	233.11	0.525	0.525	1.00	100%	4.68	
	3	24	0.3	0.07	233.2	233.32	0.3	0.3	1.00	100%	1.70	
	4	64.4	0.45	0.16	233.14	233.46	0.45	0.39	0.93	93%	9.53	
	5	96.9	0.45	0.16	233.46	233.95	0.39	0	0.43	43%	6.63	
	6	30	0.3	0.07	233.69	233.91	0.16	0	0.27	27%	0.57	
	STM CONTROL			1.2	1.13	232.9		0.95				1.07
	EX. STM MH			1.8	2.54	233.12		0.73				1.86
	EX. STM MH			1.2	1.13	233.69		0.16				0.18
	EX. CB			0.6	0.36	233.46		0.39				0.14
	GREENSTORM											262.75

289.10

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)	
234	1	21.6	0.525	0.22	232.97	233.11	0.525	0.525	1.00	100%	4.68	
	3	24	0.3	0.07	233.2	233.32	0.3	0.3	1.00	100%	1.70	
	4	64.4	0.45	0.16	233.14	233.46	0.45	0.45	1.00	100%	10.24	
	5	96.9	0.45	0.16	233.46	233.95	0.45	0.05	0.56	56%	8.63	
	6	30	0.3	0.07	233.69	233.91	0.3	0.09	0.65	65%	1.38	
	STM CONTROL			1.2	1.13	232.9		1.1				1.24
	EX. STM MH			1.8	2.54	233.12		0.88				2.24
	EX. STM MH			1.2	1.13	233.69		0.31				0.35
	EX. CB			0.6	0.36	233.46		0.54				0.19
	GREENSTORM											309.12

339.77

STAGE - STORAGE - DISCHARGE

Elevation (m)	Cum. Volume (m <sup>3</sup> )	Storage Vol. (m <sup>3</sup> )	Depth 1 (m)	Flow 1 (m <sup>3</sup> /s)	Major Storm Control Weir				Total Flow (m <sup>3</sup> /s)
					Depth 3 (m)	Overflow (x)	Rectangular 'C'	Flow (m <sup>3</sup> /s)	
233.00	0.3	0.3	0.00	0.0000	0.00	0.00		0.0000	0.0000
233.15	48	47.8	0.08	0.0248	0.00	0.00		0.0000	0.0248
233.40	132	131.9	0.33	0.0504	0.00	0.00		0.0000	0.0504
233.55	185	184.9	0.48	0.0607	0.00	0.00		0.0000	0.0607
233.70	237	237.3	0.63	0.0696	0.00	0.00		0.0000	0.0696
233.85	289	289.1	0.78	0.0774	0.00	0.00		0.0000	0.0774
234.00	340	339.8	0.93	0.0845	0.00	0.00		0.0000	0.0845

Orifice 1	
Diameter	200 mm
Elevation	232.97 m
Orifice Constant	0.63
Orifice Centroid	233.07 m

	Allowable	Release	Storage
2	0.718	0.586	115
5	0.942	0.766	153
10	1.091	0.886	179
25	1.408	1.140	235
50	1.701	1.374	287
100	1.948	1.570	331

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	Storage (m3)
233.00	0.0000	0.0	0
233.15	0.0248	0.00478	48
233.40	0.0504	0.01319	132
233.55	0.0607	0.01849	185
233.70	0.0696	0.02373	237
233.85	0.0774	0.02891	289
234.00	0.0845	0.03398	340

Rectangular C Equation	
$y=(a+bx)/(1+cx+dx^2)$	
a	-1.04E+04
b	3.42E+06
c	2.13E+06
d	-2.35E+05

**CHECKING STORAGE RELEASE CHARACTERISTICS OF SURFACE PONDING  
- CITY OF BARRIE IDF EQUATIONS -**

**CONTROLLED RELEASE FROM SUBJECT SITE**

2 Year Post Development Flow 0.237 m3/sec

Storm Duration 20 min

**Subsurface Storage**

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	Storage (m3)
233.00	0.00	0.000	0.25
233.15	0.02	0.005	47.81
233.40	0.05	0.013	131.92
233.55	0.06	0.018	184.90
233.70	0.07	0.024	237.32
233.85	0.08	0.029	289.10
234.00	0.08	0.034	339.77

**Hydrograph Data**

Minute	In Flow (m3/sec)	Out Flow (m3/sec)	Del_Storage (m3)	Cumulative Storage (m3)
(1)	(2)	(4)	(5)	(6)
0	0.00	0.000	0	0
1	0.02	0.000	1	1
2	0.05	0.001	3	4
3	0.07	0.002	4	8
4	0.09	0.004	5	14
5	0.12	0.007	7	20
6	0.14	0.011	8	28
7	0.17	0.015	9	37
8	0.19	0.019	10	48
9	0.21	0.025	11	59
10	0.24	0.028	13	72
11	0.21	0.032	11	82
12	0.19	0.035	9	92
13	0.17	0.038	8	99
14	0.14	0.040	6	105
15	0.12	0.042	5	110
16	0.09	0.044	3	113
17	0.07	0.045	2	115
18	0.05	0.045	0	115
19	0.02	0.045	-1	114
20	0.00	0.045	-3	111
21	0.00	0.044	-3	108
22	0.00	0.043	-3	106
23	0.00	0.042	-3	103
24	0.00	0.042	-2	101
25	0.00	0.041	-2	98
26	0.00	0.040	-2	96
27	0.00	0.039	-2	93
28	0.00	0.039	-2	91
29	0.00	0.038	-2	89
30	0.00	0.037	-2	87
31	0.00	0.037	-2	84
32	0.00	0.036	-2	82
33	0.00	0.035	-2	80
34	0.00	0.035	-2	78
35	0.00	0.034	-2	76
36	0.00	0.033	-2	74
37	0.00	0.033	-2	72
38	0.00	0.032	-2	70
39	0.00	0.032	-2	68
40	0.00	0.031	-2	66
41	0.00	0.030	-2	64
42	0.00	0.030	-2	63
43	0.00	0.029	-2	61
44	0.00	0.029	-2	59
45	0.00	0.028	-2	57
46	0.00	0.028	-2	56
47	0.00	0.027	-2	54
48	0.00	0.027	-2	53
49	0.00	0.026	-2	51
50	0.00	0.026	-2	49

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

2 Year Post Development Flow 0.325 m3/sec

Storm Duration 20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.032
2	0.065
3	0.097
4	0.130
5	0.162
6	0.195
7	0.227
8	0.260
9	0.292
10	0.325
11	0.292
12	0.260
13	0.227
14	0.195
15	0.162
16	0.130
17	0.097
18	0.065
19	0.032
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

2 Year Post Development Flow 0.233 m3/sec

Storm Duration 20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.023
2	0.047
3	0.070
4	0.093
5	0.117
6	0.140
7	0.163
8	0.186
9	0.210
10	0.233
11	0.210
12	0.186
13	0.163
14	0.140
15	0.117
16	0.093
17	0.070
18	0.047
19	0.023
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**Outflow from SITE**

Minute	Flow (m3/sec)
(1)	(2)
0	0.000
1	0.056
2	0.112
3	0.169
4	0.227
5	0.286
6	0.345
7	0.405
8	0.465
9	0.527
10	0.586
11	0.534
12	0.481
13	0.428
14	0.375
15	0.321
16	0.267
17	0.212
18	0.157
19	0.101
20	0.045
21	0.044
22	0.043
23	0.042
24	0.042
25	0.041
26	0.040
27	0.039
28	0.039
29	0.038
30	0.037
31	0.037
32	0.036
33	0.035
34	0.035
35	0.034
36	0.033
37	0.033
38	0.032
39	0.032
40	0.031
41	0.030
42	0.030
43	0.029
44	0.029
45	0.028
46	0.028
47	0.027
48	0.027
49	0.026
50	0.026

**CHECKING STORAGE RELEASE CHARACTERISTICS OF SURFACE PONDING  
- CITY OF BARRIE IDF EQUATIONS -**

**CONTROLLED RELEASE FROM SUBJECT SITE**

5 Year Post Development Flow	0.311 m3/sec
Storm Duration	20 min

**Subsurface Storage**

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	Storage (m3)
233.00	0.00	0.000	0.25
233.15	0.02	0.005	47.81
233.40	0.05	0.013	131.92
233.55	0.06	0.018	184.90
233.70	0.07	0.024	237.32
233.85	0.08	0.029	289.10
234.00	0.08	0.034	339.77

**Hydrograph Data**

Minute	In Flow (m3/sec)	Out Flow (m3/sec)	Del_Storage (m3)	Cumulative Storage (m3)
(1)	(2)	(4)	(5)	(6)
0	0.00	0.000	0	0
1	0.03	0.000	2	2
2	0.06	0.001	4	6
3	0.09	0.003	5	11
4	0.12	0.006	7	18
5	0.16	0.009	9	27
6	0.19	0.014	10	37
7	0.22	0.019	12	49
8	0.25	0.025	13	63
9	0.28	0.029	15	78
10	0.31	0.034	17	94
11	0.28	0.039	14	109
12	0.25	0.043	12	121
13	0.22	0.047	10	131
14	0.19	0.050	8	140
15	0.16	0.052	6	146
16	0.12	0.053	4	150
17	0.09	0.054	2	152
18	0.06	0.054	0	153
19	0.03	0.054	-1	151
20	0.00	0.054	-3	148
21	0.00	0.054	-3	145
22	0.00	0.053	-3	142
23	0.00	0.052	-3	139
24	0.00	0.052	-3	136
25	0.00	0.051	-3	133
26	0.00	0.050	-3	129
27	0.00	0.050	-3	127
28	0.00	0.049	-3	124
29	0.00	0.048	-3	121
30	0.00	0.047	-3	118
31	0.00	0.046	-3	115
32	0.00	0.045	-3	112
33	0.00	0.044	-3	110
34	0.00	0.044	-3	107
35	0.00	0.043	-3	105
36	0.00	0.042	-3	102
37	0.00	0.041	-2	100
38	0.00	0.041	-2	97
39	0.00	0.040	-2	95
40	0.00	0.039	-2	92
41	0.00	0.038	-2	90
42	0.00	0.038	-2	88
43	0.00	0.037	-2	86
44	0.00	0.036	-2	83
45	0.00	0.036	-2	81
46	0.00	0.035	-2	79
47	0.00	0.034	-2	77
48	0.00	0.034	-2	75
49	0.00	0.033	-2	73
50	0.00	0.032	-2	71

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

5 Year Post Development Flow	0.426 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.043
2	0.085
3	0.128
4	0.170
5	0.213
6	0.256
7	0.298
8	0.341
9	0.384
10	0.426
11	0.384
12	0.341
13	0.298
14	0.256
15	0.213
16	0.170
17	0.128
18	0.085
19	0.043
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

5 Year Post Development Flow	0.306 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.031
2	0.061
3	0.092
4	0.122
5	0.153
6	0.184
7	0.214
8	0.245
9	0.275
10	0.306
11	0.275
12	0.245
13	0.214
14	0.184
15	0.153
16	0.122
17	0.092
18	0.061
19	0.031
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**Outflow from SITE**

Minute	Flow (m3/sec)
(1)	(2)
0	0.000
1	0.073
2	0.147
3	0.222
4	0.298
5	0.375
6	0.453
7	0.532
8	0.611
9	0.688
10	0.766
11	0.698
12	0.629
13	0.560
14	0.489
15	0.418
16	0.346
17	0.274
18	0.201
19	0.128
20	0.054
21	0.054
22	0.053
23	0.052
24	0.052
25	0.051
26	0.050
27	0.050
28	0.049
29	0.048
30	0.047
31	0.046
32	0.045
33	0.044
34	0.044
35	0.043
36	0.042
37	0.041
38	0.041
39	0.040
40	0.039
41	0.038
42	0.038
43	0.037
44	0.036
45	0.036
46	0.035
47	0.034
48	0.034
49	0.033
50	0.032

**CHECKING STORAGE RELEASE CHARACTERISTICS OF SURFACE PONDING  
- CITY OF BARRIE IDF EQUATIONS -**

**CONTROLLED RELEASE FROM SUBJECT SITE**

10 Year Post Development Flow	0.360 m3/sec
Storm Duration	20 min

**Subsurface Storage**

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	Storage (m3)
233.00	0.00	0.000	0.25
233.15	0.02	0.005	47.81
233.40	0.05	0.013	131.92
233.55	0.06	0.018	184.90
233.70	0.07	0.024	237.32
233.85	0.08	0.029	289.10
234.00	0.08	0.034	339.77

**Hydrograph Data**

Minute	In Flow (m3/sec)	Out Flow (m3/sec)	Del_Storage (m3)	Cumulative Storage (m3)
(1)	(2)	(4)	(5)	(6)
0	0.00	0.000	0	0
1	0.04	0.000	2	2
2	0.07	0.001	4	6
3	0.11	0.003	6	13
4	0.14	0.007	8	21
5	0.18	0.011	10	31
6	0.22	0.016	12	43
7	0.25	0.022	14	57
8	0.29	0.028	16	73
9	0.32	0.032	18	90
10	0.36	0.038	19	109
11	0.32	0.044	17	126
12	0.29	0.049	14	141
13	0.25	0.052	12	153
14	0.22	0.054	10	162
15	0.18	0.056	7	170
16	0.14	0.058	5	175
17	0.11	0.059	3	178
18	0.07	0.059	1	179
19	0.04	0.060	-1	177
20	0.00	0.059	-4	174
21	0.00	0.059	-4	170
22	0.00	0.058	-3	167
23	0.00	0.057	-3	163
24	0.00	0.057	-3	160
25	0.00	0.056	-3	157
26	0.00	0.055	-3	153
27	0.00	0.055	-3	150
28	0.00	0.054	-3	147
29	0.00	0.053	-3	144
30	0.00	0.053	-3	140
31	0.00	0.052	-3	137
32	0.00	0.051	-3	134
33	0.00	0.051	-3	131
34	0.00	0.050	-3	128
35	0.00	0.049	-3	125
36	0.00	0.048	-3	122
37	0.00	0.047	-3	120
38	0.00	0.047	-3	117
39	0.00	0.046	-3	114
40	0.00	0.045	-3	111
41	0.00	0.044	-3	109
42	0.00	0.043	-3	106
43	0.00	0.042	-3	103
44	0.00	0.042	-3	101
45	0.00	0.041	-2	99
46	0.00	0.040	-2	96
47	0.00	0.039	-2	94
48	0.00	0.039	-2	91
49	0.00	0.038	-2	89
50	0.00	0.037	-2	87

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

10 Year Post Development Flow	0.494 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.049
2	0.099
3	0.148
4	0.197
5	0.247
6	0.296
7	0.346
8	0.395
9	0.444
10	0.494
11	0.444
12	0.395
13	0.346
14	0.296
15	0.247
16	0.197
17	0.148
18	0.099
19	0.049
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

10 Year Post Development Flow	0.354 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.035
2	0.071
3	0.106
4	0.142
5	0.177
6	0.213
7	0.248
8	0.283
9	0.319
10	0.354
11	0.319
12	0.283
13	0.248
14	0.213
15	0.177
16	0.142
17	0.106
18	0.071
19	0.035
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**Outflow from SITE**

Minute	Flow (m3/sec)
(1)	(2)
0	0.000
1	0.085
2	0.171
3	0.258
4	0.346
5	0.435
6	0.525
7	0.616
8	0.706
9	0.795
10	0.886
11	0.807
12	0.727
13	0.646
14	0.563
15	0.480
16	0.397
17	0.313
18	0.229
19	0.144
20	0.059
21	0.059
22	0.058
23	0.057
24	0.057
25	0.056
26	0.055
27	0.055
28	0.054
29	0.053
30	0.053
31	0.052
32	0.051
33	0.051
34	0.050
35	0.049
36	0.048
37	0.047
38	0.047
39	0.046
40	0.045
41	0.044
42	0.043
43	0.042
44	0.042
45	0.041
46	0.040
47	0.039
48	0.039
49	0.038
50	0.037

**CHECKING STORAGE RELEASE CHARACTERISTICS OF SURFACE PONDING  
- CITY OF BARRIE IDF EQUATIONS -**

**CONTROLLED RELEASE FROM SUBJECT SITE**

25 Year Post Development Flow	0.465 m3/sec
Storm Duration	20 min

**Subsurface Storage**

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	Storage (m3)
233.00	0.00	0.000	0.25
233.15	0.02	0.005	47.81
233.40	0.05	0.013	131.92
233.55	0.06	0.018	184.90
233.70	0.07	0.024	237.32
233.85	0.08	0.029	289.10
234.00	0.08	0.034	339.77

**Hydrograph Data**

Minute	In Flow (m3/sec)	Out Flow (m3/sec)	Del_Storage (m3)	Cumulative Storage (m3)
(1)	(2)	(4)	(5)	(6)
0	0.00	0.000	0	0
1	0.05	0.000	3	3
2	0.09	0.001	6	8
3	0.14	0.004	8	16
4	0.19	0.008	11	27
5	0.23	0.014	13	40
6	0.28	0.021	15	56
7	0.33	0.027	18	74
8	0.37	0.033	20	94
9	0.42	0.039	23	117
10	0.47	0.046	25	142
11	0.42	0.052	22	164
12	0.37	0.057	19	183
13	0.33	0.060	16	199
14	0.28	0.063	13	212
15	0.23	0.065	10	222
16	0.19	0.067	7	229
17	0.14	0.068	4	233
18	0.09	0.069	1	235
19	0.05	0.069	-1	233
20	0.00	0.069	-4	229
21	0.00	0.068	-4	225
22	0.00	0.068	-4	221
23	0.00	0.067	-4	217
24	0.00	0.066	-4	213
25	0.00	0.065	-4	209
26	0.00	0.065	-4	205
27	0.00	0.064	-4	201
28	0.00	0.064	-4	198
29	0.00	0.063	-4	194
30	0.00	0.062	-4	190
31	0.00	0.062	-4	186
32	0.00	0.061	-4	183
33	0.00	0.060	-4	179
34	0.00	0.060	-4	175
35	0.00	0.059	-4	172
36	0.00	0.058	-3	168
37	0.00	0.058	-3	165
38	0.00	0.057	-3	162
39	0.00	0.056	-3	158
40	0.00	0.056	-3	155
41	0.00	0.055	-3	152
42	0.00	0.054	-3	148
43	0.00	0.054	-3	145
44	0.00	0.053	-3	142
45	0.00	0.052	-3	139
46	0.00	0.052	-3	136
47	0.00	0.051	-3	133
48	0.00	0.051	-3	130
49	0.00	0.050	-3	127
50	0.00	0.049	-3	124

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

25 Year Post Development Flow	0.637 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.064
2	0.127
3	0.191
4	0.255
5	0.318
6	0.382
7	0.446
8	0.510
9	0.573
10	0.637
11	0.573
12	0.510
13	0.446
14	0.382
15	0.318
16	0.255
17	0.191
18	0.127
19	0.064
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

25 Year Post Development Flow	0.457 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.046
2	0.091
3	0.137
4	0.183
5	0.229
6	0.274
7	0.320
8	0.366
9	0.412
10	0.457
11	0.412
12	0.366
13	0.320
14	0.274
15	0.229
16	0.183
17	0.137
18	0.091
19	0.046
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**Outflow from SITE**

Minute	Flow (m3/sec)
(1)	(2)
0	0.000
1	0.109
2	0.220
3	0.332
4	0.446
5	0.561
6	0.677
7	0.793
8	0.908
9	1.024
10	1.140
11	1.037
12	0.932
13	0.826
14	0.720
15	0.612
16	0.505
17	0.396
18	0.288
19	0.179
20	0.069
21	0.068
22	0.068
23	0.067
24	0.066
25	0.065
26	0.065
27	0.064
28	0.064
29	0.063
30	0.062
31	0.062
32	0.061
33	0.060
34	0.060
35	0.059
36	0.058
37	0.058
38	0.057
39	0.056
40	0.056
41	0.055
42	0.054
43	0.054
44	0.053
45	0.052
46	0.052
47	0.051
48	0.051
49	0.050
50	0.049

**CHECKING STORAGE RELEASE CHARACTERISTICS OF SURFACE PONDING  
- CITY OF BARRIE IDF EQUATIONS -**

**CONTROLLED RELEASE FROM SUBJECT SITE**

50 Year Post Development Flow	0.562 m3/sec
Storm Duration	20 min

**Subsurface Storage**

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	Storage (m3)
233.00	0.00	0.000	0.25
233.15	0.02	0.005	47.81
233.40	0.05	0.013	131.92
233.55	0.06	0.018	184.90
233.70	0.07	0.024	237.32
233.85	0.08	0.029	289.10
234.00	0.08	0.034	339.77

**Hydrograph Data**

Minute	In Flow (m3/sec)	Out Flow (m3/sec)	Del_Storage (m3)	Cumulative Storage (m3)
(1)	(2)	(4)	(5)	(6)
0	0.00	0.000	0	0
1	0.06	0.000	3	3
2	0.11	0.002	7	10
3	0.17	0.005	10	20
4	0.22	0.010	13	33
5	0.28	0.017	16	49
6	0.34	0.025	19	67
7	0.39	0.031	22	89
8	0.45	0.037	25	114
9	0.51	0.045	28	141
10	0.56	0.052	31	172
11	0.51	0.058	27	199
12	0.45	0.063	23	222
13	0.39	0.067	20	242
14	0.34	0.070	16	258
15	0.28	0.073	12	270
16	0.22	0.075	9	279
17	0.17	0.076	6	285
18	0.11	0.077	2	287
19	0.06	0.077	-1	285
20	0.00	0.077	-5	281
21	0.00	0.076	-5	276
22	0.00	0.075	-5	272
23	0.00	0.075	-4	267
24	0.00	0.074	-4	263
25	0.00	0.073	-4	258
26	0.00	0.073	-4	254
27	0.00	0.072	-4	250
28	0.00	0.071	-4	245
29	0.00	0.071	-4	241
30	0.00	0.070	-4	237
31	0.00	0.070	-4	233
32	0.00	0.069	-4	229
33	0.00	0.068	-4	225
34	0.00	0.067	-4	221
35	0.00	0.067	-4	217
36	0.00	0.066	-4	213
37	0.00	0.065	-4	209
38	0.00	0.065	-4	205
39	0.00	0.064	-4	201
40	0.00	0.063	-4	197
41	0.00	0.063	-4	193
42	0.00	0.062	-4	190
43	0.00	0.062	-4	186
44	0.00	0.061	-4	182
45	0.00	0.060	-4	179
46	0.00	0.060	-4	175
47	0.00	0.059	-4	172
48	0.00	0.058	-3	168
49	0.00	0.057	-3	165
50	0.00	0.057	-3	161

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

50 Year Post Development Flow	0.769 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.077
2	0.154
3	0.231
4	0.308
5	0.385
6	0.462
7	0.538
8	0.615
9	0.692
10	0.769
11	0.692
12	0.615
13	0.538
14	0.462
15	0.385
16	0.308
17	0.231
18	0.154
19	0.077
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

50 Year Post Development Flow	0.552 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.055
2	0.110
3	0.166
4	0.221
5	0.276
6	0.331
7	0.387
8	0.442
9	0.497
10	0.552
11	0.497
12	0.442
13	0.387
14	0.331
15	0.276
16	0.221
17	0.166
18	0.110
19	0.055
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**Outflow from SITE**

Minute	Flow (m3/sec)
(1)	(2)
0	0.000
1	0.132
2	0.266
3	0.402
4	0.539
5	0.678
6	0.818
7	0.956
8	1.094
9	1.234
10	1.374
11	1.248
12	1.120
13	0.992
14	0.863
15	0.733
16	0.603
17	0.472
18	0.341
19	0.209
20	0.077
21	0.076
22	0.075
23	0.075
24	0.074
25	0.073
26	0.073
27	0.072
28	0.071
29	0.071
30	0.070
31	0.070
32	0.069
33	0.068
34	0.067
35	0.067
36	0.066
37	0.065
38	0.065
39	0.064
40	0.063
41	0.063
42	0.062
43	0.062
44	0.061
45	0.060
46	0.060
47	0.059
48	0.058
49	0.057
50	0.057

**CHECKING STORAGE RELEASE CHARACTERISTICS OF SURFACE PONDING  
- CITY OF BARRIE IDF EQUATIONS -**

**CONTROLLED RELEASE FROM SUBJECT SITE**

100 Year Post Development Flow	0.643 m3/sec
Storm Duration	20 min

**Subsurface Storage**

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	Storage (m3)
233.00	0.00	0.000	0.25
233.15	0.02	0.005	47.81
233.40	0.05	0.013	131.92
233.55	0.06	0.018	184.90
233.70	0.07	0.024	237.32
233.85	0.08	0.029	289.10
234.00	0.08	0.034	339.77

**Hydrograph Data**

Minute	In Flow (m3/sec)	Out Flow (m3/sec)	Del. Storage (m3)	Cumulative Storage (m3)
(1)	(2)	(4)	(5)	(6)
0	0.00	0.000	0	0
1	0.06	0.000	4	4
2	0.13	0.002	8	11
3	0.19	0.006	11	23
4	0.26	0.012	15	37
5	0.32	0.019	18	56
6	0.39	0.027	22	77
7	0.45	0.034	25	102
8	0.51	0.041	28	130
9	0.58	0.050	32	162
10	0.64	0.056	35	197
11	0.58	0.063	31	228
12	0.51	0.068	27	255
13	0.45	0.072	23	278
14	0.39	0.076	19	297
15	0.32	0.078	15	311
16	0.26	0.081	11	322
17	0.19	0.082	7	328
18	0.13	0.083	3	331
19	0.06	0.083	-1	330
20	0.00	0.083	-5	325
21	0.00	0.082	-5	320
22	0.00	0.082	-5	315
23	0.00	0.081	-5	310
24	0.00	0.080	-5	305
25	0.00	0.080	-5	301
26	0.00	0.079	-5	296
27	0.00	0.078	-5	291
28	0.00	0.078	-5	287
29	0.00	0.077	-5	282
30	0.00	0.076	-5	277
31	0.00	0.076	-5	273
32	0.00	0.075	-4	268
33	0.00	0.074	-4	264
34	0.00	0.074	-4	259
35	0.00	0.073	-4	255
36	0.00	0.072	-4	251
37	0.00	0.072	-4	246
38	0.00	0.071	-4	242
39	0.00	0.070	-4	238
40	0.00	0.070	-4	234
41	0.00	0.069	-4	230
42	0.00	0.068	-4	226
43	0.00	0.068	-4	221
44	0.00	0.067	-4	217
45	0.00	0.066	-4	213
46	0.00	0.066	-4	210
47	0.00	0.065	-4	206
48	0.00	0.064	-4	202
49	0.00	0.064	-4	198
50	0.00	0.063	-4	194

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

100 Year Post Development Flow	0.881 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.088
2	0.176
3	0.264
4	0.352
5	0.440
6	0.529
7	0.617
8	0.705
9	0.793
10	0.881
11	0.793
12	0.705
13	0.617
14	0.529
15	0.440
16	0.352
17	0.264
18	0.176
19	0.088
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**UNCONTROLLED RELEASE FROM SUBJECT SITE**

100 Year Post Development Flow	0.632 m3/sec
Storm Duration	20 min

**Hydrograph Data**

Minute	In Flow (m3/sec)
(1)	(2)
0	0.000
1	0.063
2	0.126
3	0.190
4	0.253
5	0.316
6	0.379
7	0.443
8	0.506
9	0.569
10	0.632
11	0.569
12	0.506
13	0.443
14	0.379
15	0.316
16	0.253
17	0.190
18	0.126
19	0.063
20	0.000
21	0.000
22	0.000
23	0.000
24	0.000
25	0.000
26	0.000
27	0.000
28	0.000
29	0.000
30	0.000
31	0.000
32	0.000
33	0.000
34	0.000
35	0.000
36	0.000
37	0.000
38	0.000
39	0.000
40	0.000
41	0.000
42	0.000
43	0.000
44	0.000
45	0.000
46	0.000
47	0.000
48	0.000
49	0.000
50	0.000

**Outflow from SITE**

Minute	Flow (m3/sec)
(1)	(2)
0	0.000
1	0.151
2	0.305
3	0.460
4	0.617
5	0.776
6	0.935
7	1.093
8	1.252
9	1.412
10	1.570
11	1.425
12	1.279
13	1.132
14	0.984
15	0.835
16	0.686
17	0.536
18	0.386
19	0.235
20	0.083
21	0.082
22	0.082
23	0.081
24	0.080
25	0.080
26	0.079
27	0.078
28	0.078
29	0.077
30	0.076
31	0.076
32	0.075
33	0.074
34	0.074
35	0.073
36	0.072
37	0.072
38	0.071
39	0.070
40	0.070
41	0.069
42	0.068
43	0.068
44	0.067
45	0.066
46	0.066
47	0.065
48	0.064
49	0.064
50	0.063

**Table 3.2 Water Quality Storage Requirements based on Receiving Waters<sup>1, 2</sup>**

Protection Level	SWMP Type	Storage Volume (m <sup>3</sup> /ha) for Impervious Level			
		35%	55%	70%	85%
<i>Enhanced</i> 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
<i>Normal</i> 70% long-term S.S. removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
<i>Basic</i> 60% long-term S.S. removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

Site Area: 44560 m<sup>2</sup>  
 Site Impervious Area: 32907 m<sup>2</sup>  
 Impervious Level of Site: 73.8%  
 Volume Req'd for Quality Control: 36.3 m<sup>3</sup>/ha  
 Volume Required: 161.7 m<sup>3</sup>

Infiltration Gallery

Width = 4.00 m  
 Height = 0.7 m  
 Cross Section Area ( $A_T$ ) = 2.64 sq.m.  
 Surface Area ( $A_T$ ) = 92 sq.m.

Length ( $L_T$ ) = 23 m

# Of Units = 1  
 Total Volume ( $V_p$ ) = 58.291 m<sup>3</sup>  
 Total Infiltrated Volume = 58.2912 m<sup>3</sup>

**Determine Minimum Sizing of Infiltration Gallery**

**Table 4.4: Minimum Soil Percolation Rates**

Soil Type	Percolation Rate (mm/h)
sand	210
loamy sand	60
sandy loam	25
loam	15

Soil Type  
 Fine to medium-grained sand, trace silt

Volume Required: 58.291 m<sup>3</sup>  
 Assumed Porosity: 0.96  
 Percolation Rate: 104 mm/h  
 Percolation Rate with SF (2.5): 41.6 mm/h  
 Area Req'd (24hr): 60.8 m<sup>2</sup>  
 Area Req'd (48hr): 30.4 m<sup>2</sup>  
 Maximum Depth: 2.101895 m

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

**Equation 4.3: Infiltration Trench Bottom Area**

where A = bottom area of the trench (m<sup>2</sup>)  
 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)  
 $\Delta t$  = retention time (24 to 48 hours)

$$d = \frac{PT}{1,000}$$

**Equation 4.2: Maximum Allowable Soakaway Pit Depth**

where d = maximum allowable depth of the soakaway pit (m)  
 P = percolation rate (Table 4.1) (mm/h)  
 T = drawdown time (24 - 48 h) (h)

Infiltration Gallery

Width = 10.00 m  
 Height = 0.7 m  
 Cross Section Area ( $A_T$ ) = 6.6 sq.m.  
 Surface Area ( $A_T$ ) = 170 sq.m.

Length ( $L_T$ ) = 17 m

# Of Units = 1  
 Total Volume ( $V_p$ ) = 107.712 m<sup>3</sup>  
 Total Infiltrated Volume = 107.712 m<sup>3</sup>

**Determine Minimum Sizing of Infiltration Gallery**

**Table 4.4: Minimum Soil Percolation Rates**

Soil Type	Percolation Rate (mm/h)
sand	210
loamy sand	60
sandy loam	25
loam	15

Soil Type  
 Fine to medium-grained sand, trace silt

Volume Required: 107.712 m<sup>3</sup>  
 Assumed Porosity: 0.96  
 Percolation Rate: 104 mm/h  
 Percolation Rate with SF (2.5): 41.6 mm/h  
 Area Req'd (24hr): 112.4 m<sup>2</sup>  
 Area Req'd (48hr): 56.2 m<sup>2</sup>  
 Maximum Depth: 2.101895 m

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

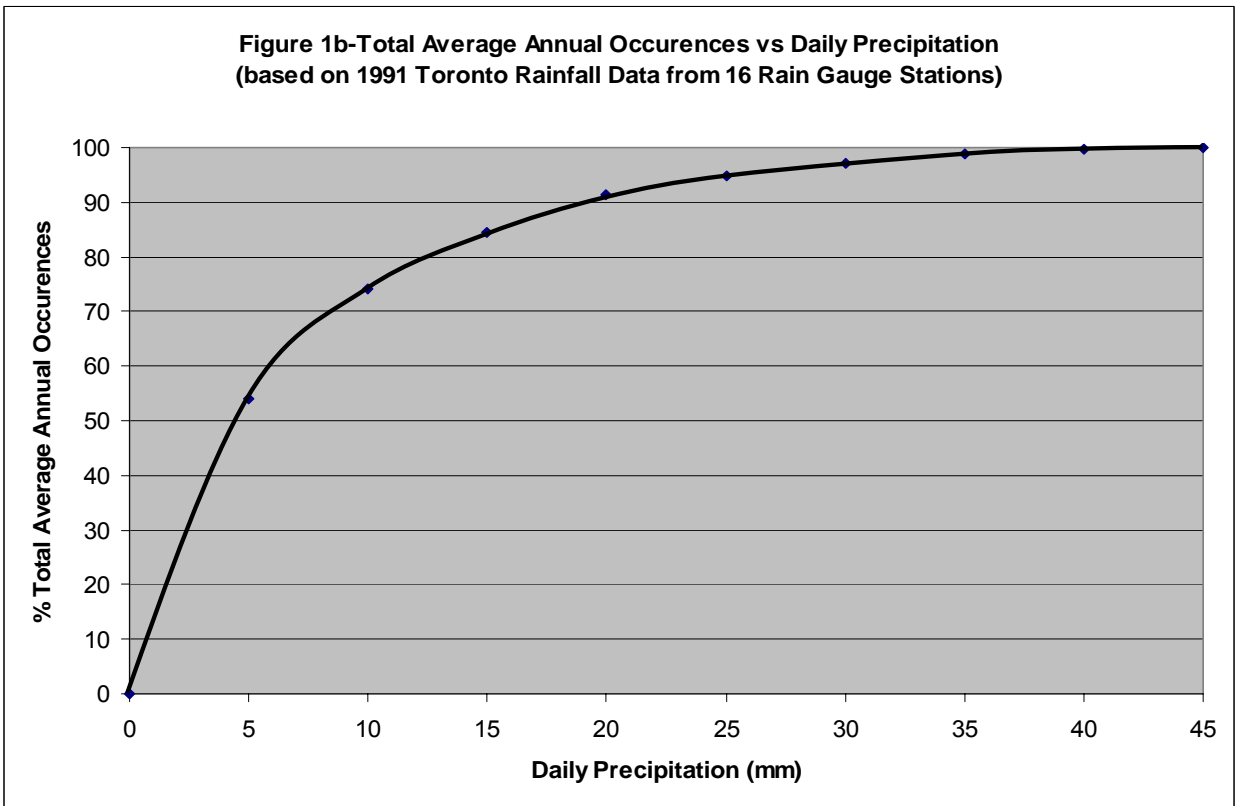
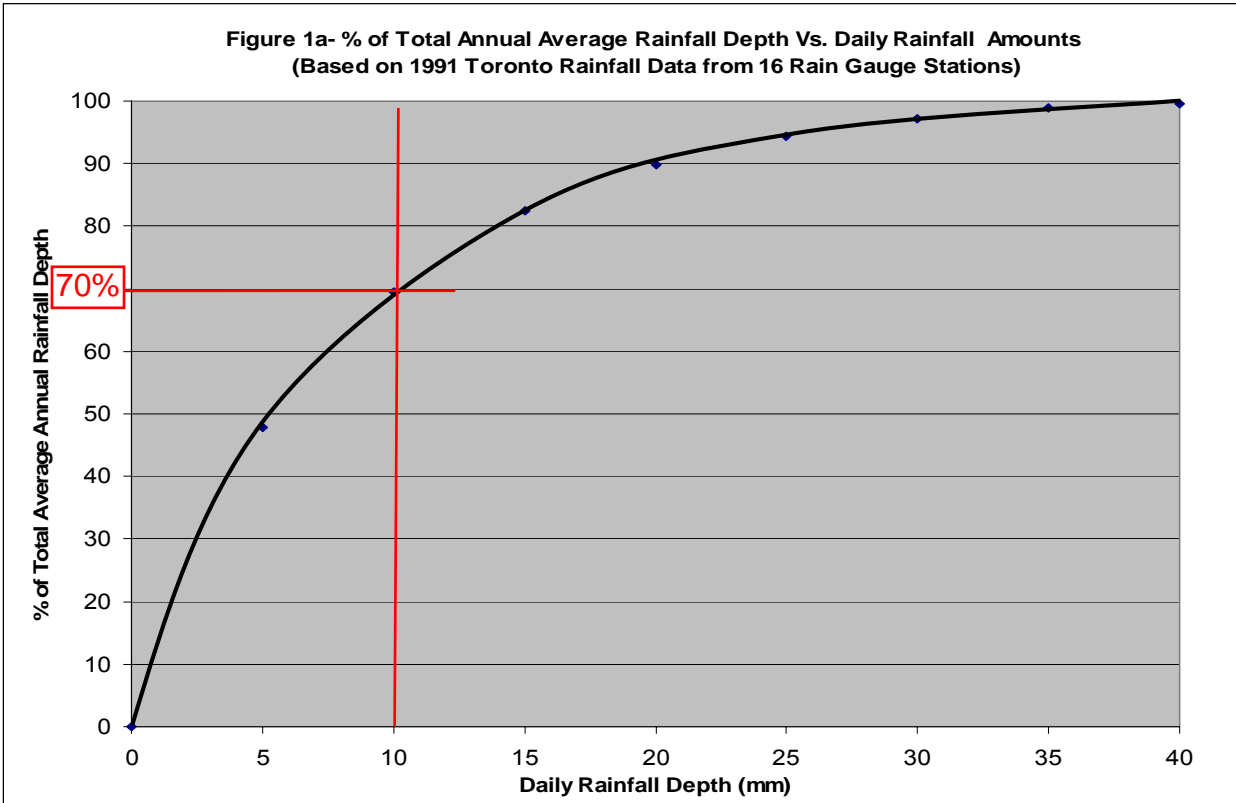
**Equation 4.3: Infiltration Trench Bottom Area**

where A = bottom area of the trench (m<sup>2</sup>)  
 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)  
 $\Delta t$  = retention time (24 to 48 hours)

$$d = \frac{PT}{1,000}$$

**Equation 4.2: Maximum Allowable Soakaway Pit Depth**

where d = maximum allowable depth of the soakaway pit (m)  
 P = percolation rate (Table 4.1) (mm/h)  
 T = drawdown time (24 - 48 h) (h)



EXISTING DEVELOPMENT	Site		
	Pasture/Open Space	Imperviousness	TOTALS
Catchment Designation			
Area (m <sup>2</sup> )	28,052	16,513	44,565
Pervious Area (m <sup>2</sup> )	28,045	0	28,045
Impervious Area (m <sup>2</sup> )	0	16,513	16,513
<b>MOE Infiltration Factors</b>			
Topography Infiltration Factor	0.20	0.10	
Soil Infiltration Factor	0.40	0.10	
Land Cover Infiltration Factor	0.10	0.10	
MOE Total Infiltration Factor	0.70	0	
Runoff Coefficient	0.30	1	
Runoff from Impervious Surfaces	0	0.8	
<b>Inputs (per Unit Area)</b>			
Precipitation (mm/yr)	933	933	933
<b>TOTAL INPUTS (mm/yr)</b>	<b>933</b>	<b>933</b>	<b>933</b>
<b>Outputs (per Unit Area)</b>			
Precipitation Surplus (mm/yr)	418	746	
Evapotranspiration (mm/yr)	515	187	
Infiltration (mm/yr)	293	0	
Rooftop Infiltration (mm/yr)	0	0	
Total Infiltration (mm/yr)	293	0	
Runoff Pervious Areas (mm/yr)	125	0	
Runoff Impervious Areas (mm/yr)	0	746	
Total Runoff (mm/yr)	125	746	
<b>TOTAL OUTPUTS (mm/yr)</b>	<b>933</b>	<b>933</b>	<b>933</b>
<b>Difference (INPUTS-OUTPUTS)</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Inputs (Volumes)</b>			
Precipitation (m <sup>3</sup> /yr)	26,173	15,407	41,579
<b>TOTAL INPUTS (m<sup>3</sup>/yr)</b>	<b>26,173</b>	<b>15,407</b>	<b>41,579</b>
<b>Outputs (Volumes)</b>			
Precipitation Surplus (m <sup>3</sup> /yr)	11,726	12,325	24,051
Evapotranspiration (m <sup>3</sup> /yr)	14,443	3,081	17,525
Infiltration (m <sup>3</sup> /yr)	8,208	0	8,208
Rooftop Infiltration (m <sup>3</sup> /yr)	0	0	0
Total Infiltration (m <sup>3</sup> /yr)	8,208	0	8,208
Runoff Pervious Areas (m <sup>3</sup> /yr)	3,518	0	3,518
Runoff Impervious Areas (m <sup>3</sup> /yr)	0	12,325	12,325
Total Runoff (m <sup>3</sup> /yr)	3,518	12,325	15,843
<b>TOTAL OUTPUTS (m<sup>3</sup>/yr)</b>	<b>26,169</b>	<b>15,407</b>	<b>41,576</b>
<b>Difference (INPUTS-OUTPUTS)</b>	<b>4</b>	<b>0</b>	<b>4</b>

PROPOSED DEVELOPMENT	Site			
	Grass/Open Space	Paved	Building	TOTALS
Catchment Designation				
Area (m <sup>2</sup> )	11,597	16,395	16,573	44,565
Pervious Area (m <sup>2</sup> )	11,597	0	0	11,597
Impervious Area (m <sup>2</sup> )	0	16,395	15,488	31,883
<b>MOE Infiltration Factors</b>				
Topography Infiltration Factor	0.20	0.10	0.10	
Soil Infiltration Factor	0.40	0.10	0.10	
Land Cover Infiltration Factor	0.10	0.10	0.10	
MOE Total Infiltration Factor	0.7	0	0	
Runoff Coefficient	0.3	1	1	
Runoff from Impervious Surfaces	0	0.8	0.8	
<b>Inputs (per Unit Area)</b>				
Precipitation (mm/yr)	933	933	933	933
<b>TOTAL INPUTS (mm/yr)</b>	<b>933</b>	<b>933</b>	<b>933</b>	<b>933</b>
<b>Outputs (per Unit Area)</b>				
Precipitation Surplus (mm/yr)	418	746	746	
Evapotranspiration (mm/yr)	515	187	187	
Infiltration (mm/yr)	293	0	0	
Rooftop Infiltration (mm/yr)	0	0	0	
Total Infiltration (mm/yr)	293	0	0	
Runoff Pervious Areas (mm/yr)	125	0	0	
Runoff Impervious Areas (mm/yr)	0	746	746	
Total Runoff (mm/yr)	125	746	746	
<b>TOTAL OUTPUTS (mm/yr)</b>	<b>933</b>	<b>933</b>	<b>933</b>	
<b>Difference (INPUTS-OUTPUTS)</b>	<b>0</b>	<b>0</b>	<b>0</b>	
<b>Inputs (Volumes)</b>				
Precipitation (m <sup>3</sup> /yr)	10,820	15,297	15,463	41,579
<b>TOTAL INPUTS (m<sup>3</sup>/yr)</b>	<b>10,820</b>	<b>15,297</b>	<b>15,463</b>	<b>41,579</b>
<b>Outputs (Volumes)</b>				
Precipitation Surplus (m <sup>3</sup> /yr)	4,848	12,237	12,370	29,455
Evapotranspiration (m <sup>3</sup> /yr)	5,972	3,059	3,093	12,124
Infiltration (m <sup>3</sup> /yr)	3,393	0	0	3,393
Rooftop Infiltration (m <sup>3</sup> /yr)	0	0	0	0
Total Infiltration (m <sup>3</sup> /yr)	3,393	0	0	3,393
Runoff Pervious Areas (m <sup>3</sup> /yr)	1,454	0	0	1,454
Runoff Impervious Areas (m <sup>3</sup> /yr)	0	12,237	11,560	23,797
Total Runoff (m <sup>3</sup> /yr)	1,454	12,237	11,560	25,252
<b>TOTAL OUTPUTS (m<sup>3</sup>/yr)</b>	<b>10,820</b>	<b>15,297</b>	<b>15,463</b>	<b>41,579</b>
<b>Difference (INPUTS-OUTPUTS)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

POST-DEVELOPMENT with MITIGATION	Site			
	Grass/Open Space	Paved	Building	TOTALS
Catchment Designation				
Area (m <sup>2</sup> )	11,597	16,395	16,573	44,565
Pervious Area (m <sup>2</sup> )	11,597	0	0	11,597
Impervious Area (m <sup>2</sup> )	0	16,387	16,573	32,960
<b>MOE Infiltration Factors</b>				
Topography Infiltration Factor	0.20	0.10	0.10	
Soil Infiltration Factor	0.40	0.10	0.10	
Land Cover Infiltration Factor	0.10	0.10	0.10	
MOE Total Infiltration Factor	0.7	0	0	
Runoff Coefficient	0.3	1	1	
Runoff from Impervious Surfaces	0	0.8	0.8	
<b>Inputs (per Unit Area)</b>				
Precipitation (mm/yr)	933	933	933	933
<b>TOTAL INPUTS (mm/yr)</b>	<b>933</b>	<b>933</b>	<b>933</b>	<b>933</b>
<b>Outputs (per Unit Area)</b>				
Precipitation Surplus (mm/yr)	418	746	746	
Evapotranspiration (mm/yr)	515	187	187	
Infiltration (mm/yr)	293	0	0	
Impervious Infiltration (mm/yr)	0	0	522	
Total Infiltration (mm/yr)	293	0	522	
Runoff Pervious Areas (mm/yr)	125	746	746	
Runoff Impervious Areas (mm/yr)	418	746.4	746.4	
Total Runoff (mm/yr)	543	1493	1493	
<b>TOTAL OUTPUTS (mm/yr)</b>	<b>933</b>	<b>933</b>	<b>933</b>	
<b>Difference (INPUTS-OUTPUTS)</b>	<b>0</b>	<b>0</b>	<b>0</b>	
<b>Inputs (Volumes)</b>				
Precipitation (m <sup>3</sup> /yr)	10,820	15,297	15,463	41,579
<b>TOTAL INPUTS (m<sup>3</sup>/yr)</b>	<b>10,820</b>	<b>15,297</b>	<b>15,463</b>	<b>41,579</b>
<b>Outputs (Volumes)</b>				
Precipitation Surplus (m <sup>3</sup> /yr)	4,848	12,237	12,370	29,455
Evapotranspiration (m <sup>3</sup> /yr)	5,972	3,059	3,093	12,124
Infiltration (m <sup>3</sup> /yr)	3,393	0	0	3,393
Impervious Infiltration (m <sup>3</sup> /yr)	0	0	8,659	8,659
Total Infiltration (m <sup>3</sup> /yr)	3,393	0	8,659	12,052
Runoff Pervious Areas (m <sup>3</sup> /yr)	1,454	0	0	1,454
Runoff Impervious Areas (m <sup>3</sup> /yr)	0	12,231	12,370	24,601
Total Runoff (m <sup>3</sup> /yr)	1,454	12,231	12,370	26,056
<b>TOTAL OUTPUTS (m<sup>3</sup>/yr)</b>	<b>10,820</b>	<b>15,297</b>	<b>15,463</b>	<b>41,579</b>
<b>Difference (INPUTS-OUTPUTS)</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Phosphorous Concentrations by Land Use**

	High Intensity	Transition	Low Intensity	Forest
Average Total P (kg/ha/year) Barrie Creeks	1.82	0.06	0.13	0.06

<b>Pre-Development Condition</b>				
Total Annual Rainfall Percipitation	933.0	mm		
	High Intensity	Transition	Low Intensity	Forest
Area (ha):	1.6513	2.8052	0	0
Total P (kg/yr) :	3.00537	0.16831	0.00000	0.00000
<b>Total Pre-Development P (kg) :</b>	<b>3.17368</b>			

<b>Post Development Condition - Untreated</b>			
	High Intensity Pavement	High Intensity Building	Transition
Area (ha):	1.6395	1.6573	1.1597
Total P (kg/yr) :	2.98389	3.01629	0.06958
<b>Total Post Development P (kg/yr) :</b>	<b>6.06976</b>		

<b>Post Development Condition - Treated</b>			
	High Intensity Pavement	High Intensity Building	Transition
Area (ha):	1.6395	1.6573	1.1597
Total P (kg/yr) :	2.98389	3.02	0.06958
<b><u>Without Treatment</u></b>			
Total Post Development P (kg/yr) :	6.06976		
<b><u>With Treatment</u></b>			
Treatment Train Approach Efficiency :	0	93	0
P Removed (kg/yr) :	0.00	2.81	0.00
<b>Total Post Development P (kg/yr) :</b>	<b>3.26461</b>		



## Appendix B OGS Unit Sizing



# Determining Number of Cartridges for Flow Based Systems

Date

Novemebr 3, 2022

## Site Information

Project Name  
 Project Location  
 OGS ID  
 Drainage Area, Ad  
 Impervious Area, Ai  
 Pervious Area, Ap  
 % Impervious  
 Runoff Coefficient, Rc  
 Treatment storm flow rate,  $Q_{treat}$   
 Peak storm flow rate,  $Q_{peak}$

**31 Patterson Rd, Canplas Building**  
**Barrie, ON**  
**OGS**  
**2.76** ac (1.1185 ha)  
**2.10** ac  
**0.66**  
**76%**  
**0.74**  
**0.83** cfs (23.5 L/s)  
**2.97** cfs (84 L/s)

## Filter System

Filtration brand  
 Cartridge height  
 Specific Flow Rate  
 Flow rate per cartridge

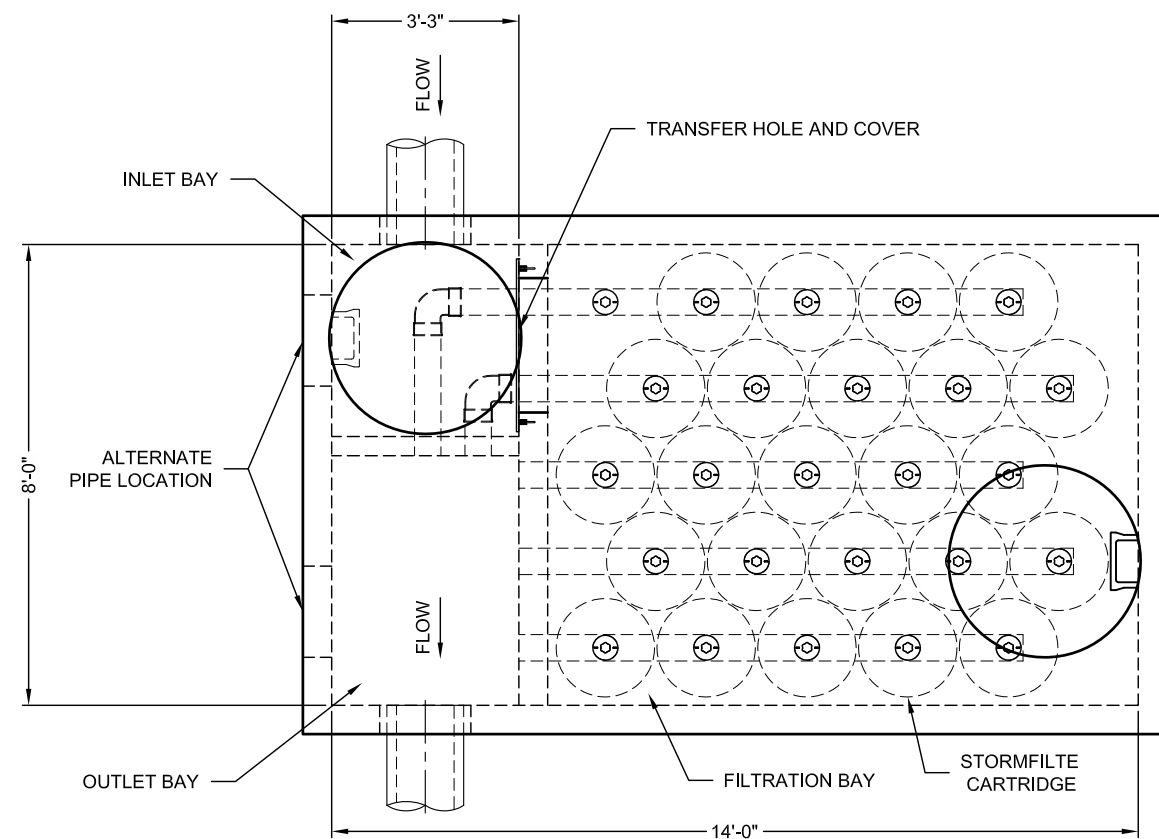
**StormFilter**  
**27** in  
**1.67** gpm/ft<sup>2</sup>  
**18.79** gpm

## SUMMARY

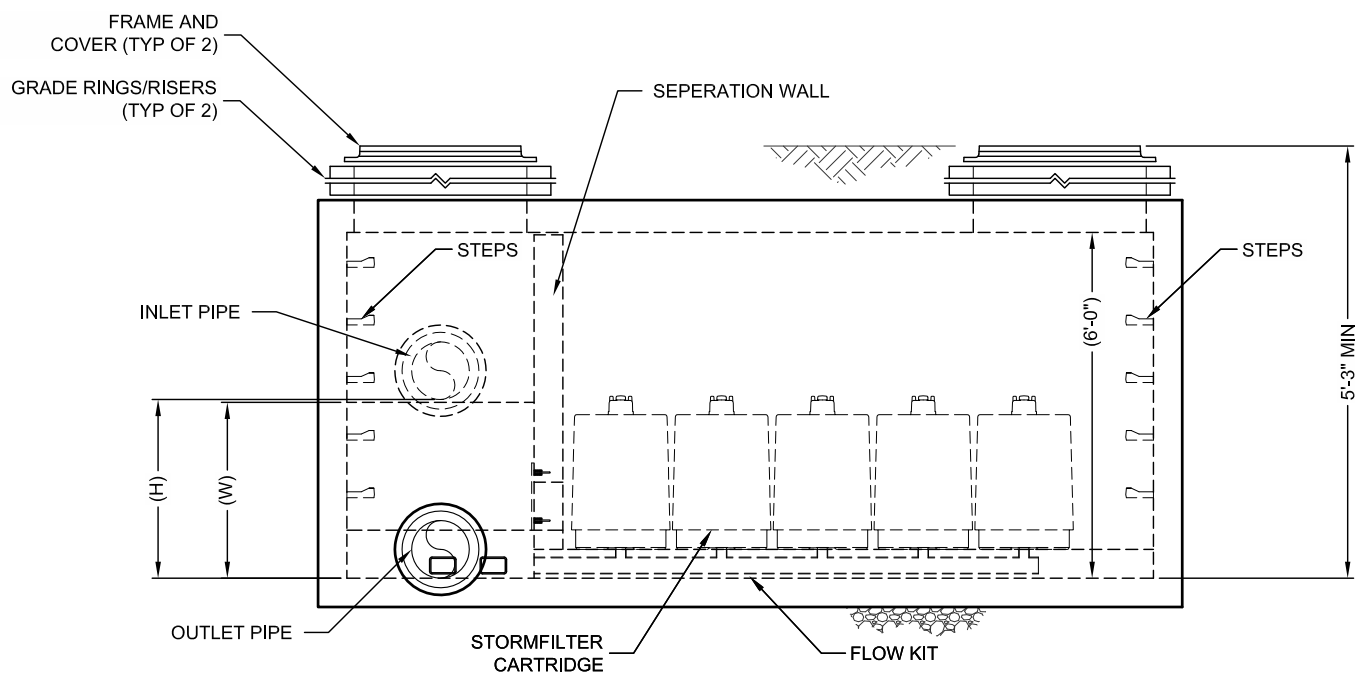
Number of Cartridges	22
Media Type	Perlite

Event Mean Concentration (EMC) **110** mg/L  
 Annual TSS Removal **80%**  
 Percent Runoff Capture **90%**

Recommend SFPD0814 vaults or CIP



**PLAN**

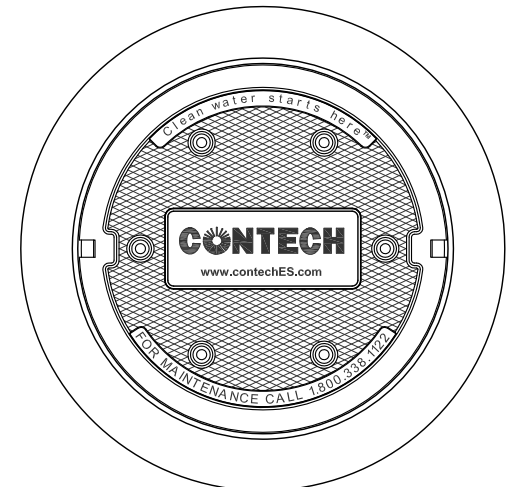


**ELEVATION**

**STORMFILTER DESIGN TABLE**

- THE 8' x 14' PEAK DIVERSION STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD.
- THE PEAK DIVERSION STORMFILTER IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR RIGHT INLET CONFIGURATION.
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS OTHERWISE NOTED.

CARTRIDGE HEIGHT	27"		18"		LOW DROP	
SYSTEM HYDRAULIC DROP (H - REQ'D. MIN.)	3.05'		2.3'		1.8'	
HEIGHT OF WEIR (W)	3.00'		2.25'		1.75'	
TREATMENT BY MEDIA SURFACE AREA	2 gpm/ft <sup>2</sup>	1 gpm/ft <sup>2</sup>	2 gpm/ft <sup>2</sup>	1 gpm/ft <sup>2</sup>	2 gpm/ft <sup>2</sup>	1 gpm/ft <sup>2</sup>
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	15	7.5	10	5



**FRAME AND COVER**  
(DIAMETER VARIES)  
N.T.S.

**SITE SPECIFIC DATA REQUIREMENTS**

STRUCTURE ID	*		
WATER QUALITY FLOW RATE (cfs)	*		
PEAK FLOW RATE (cfs)	*		
RETURN PERIOD OF PEAK FLOW (yrs)	*		
# OF CARTRIDGES REQUIRED	*		
CARTRIDGE FLOW RATE	*		
MEDIA TYPE (CSF, PERLITE, ZPG)	*		
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE	*	*	*
OUTLET PIPE	*	*	*
INLET BAY RIM ELEVATION	*		
FILTER BAY RIM ELEVATION	*		
ANTI-FLOTATION BALLAST	WIDTH	HEIGHT	
	*	*	
NOTES/SPECIAL REQUIREMENTS:			

**PERFORMANCE SPECIFICATION**

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **37 SECONDS**. SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM)**.

**GENERAL NOTES**

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. [www.contechES.com](http://www.contechES.com)
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

**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 STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
- C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
- D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
- E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
- F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.



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THE STORMWATER MANAGEMENT STORMFILTER  
8' x 14' PEAK DIVERSION STORMFILTER  
STANDARD DETAIL



## Appendix C

### StormFilter Inspection & Maintenance Procedures

## StormFilter Inspection and Maintenance Procedures



## Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

## Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

### 1. Inspection

- Inspection of the vault interior to determine the need for maintenance.

### 2. Maintenance

- Cartridge replacement
- Sediment removal

## Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

## Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..





## Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

**Warning:** In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

**Important:** Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit and the unit's role, relative to detention or retention facilities onsite.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

## Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered).

Please note Stormwater Management StormFilter devices installed downstream of, or integrated within, a stormwater storage facility typically have different operational parameters (i.e. draindown time). In these cases, the inspector must understand the relationship between the retention/detention facility and the treatment system by evaluating site specific civil engineering plans, or contacting the engineer of record, and make adjustments to the below guidance as necessary. Sediment deposition depths and patterns within the StormFilter are likely to be quite different compared to systems without upstream storage and therefore shouldn't be used exclusively to evaluate a need for maintenance.

1. Sediment loading on the vault floor.
  - a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
  - a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
  - a. If >4" of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
  - a. While not required in all cases, inspection of the media within the cartridge may provide valuable additional information.
  - b. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
  - a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
  - a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
  - a. If pronounced scum line (say  $\geq 1/4$ " thick) is present above top cap, maintenance is required.

## Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

**Important:** If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

**Warning:** In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

### Method 1:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

- B. Remove the used cartridges (up to 250 lbs. each) from the vault.



**Important:** Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

- C. Set the used cartridge aside or load onto the hauling truck.
- D. Continue steps a through c until all cartridges have been removed.

### Method 2:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.
- B. Unscrew the cartridge cap.
- C. Remove the cartridge hood and float.
- D. At location under structure access, tip the cartridge on its side.
- E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.
- F. Set the empty, used cartridge aside or load onto the hauling truck.
- G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

## Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

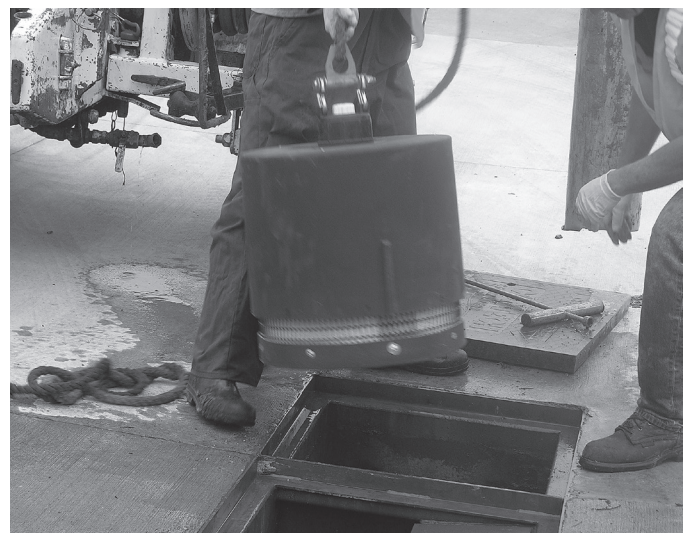
In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

## Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.



# Inspection Report

Date: \_\_\_\_\_ Personnel: \_\_\_\_\_

Location: \_\_\_\_\_ System Size: \_\_\_\_\_ Months in Service: \_\_\_\_\_

System Type: Vault  Cast-In-Place  Linear Catch Basin  Manhole  Other: \_\_\_\_\_

Sediment Thickness in Forebay: \_\_\_\_\_ Date: \_\_\_\_\_

Sediment Depth on Vault Floor: \_\_\_\_\_

Sediment Depth on Cartridge Top(s): \_\_\_\_\_

Structural Damage: \_\_\_\_\_

Estimated Flow from Drainage Pipes (if available): \_\_\_\_\_

Cartridges Submerged: Yes  No  Depth of Standing Water: \_\_\_\_\_

StormFilter Maintenance Activities (check off if done and give description)

Trash and Debris Removal: \_\_\_\_\_

Minor Structural Repairs: \_\_\_\_\_

Drainage Area Report \_\_\_\_\_

Excessive Oil Loading: Yes  No  Source: \_\_\_\_\_

Sediment Accumulation on Pavement: Yes  No  Source: \_\_\_\_\_

Erosion of Landscaped Areas: Yes  No  Source: \_\_\_\_\_

Items Needing Further Work: \_\_\_\_\_

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

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Review the condition reports from the previous inspection visits.

# StormFilter Maintenance Report

Date: \_\_\_\_\_ Personnel: \_\_\_\_\_

Location: \_\_\_\_\_ System Size: \_\_\_\_\_

System Type: Vault  Cast-In-Place  Linear Catch Basin  Manhole  Other: \_\_\_\_\_

List Safety Procedures and Equipment Used: \_\_\_\_\_

## System Observations

Months in Service: \_\_\_\_\_

Oil in Forebay (if present): Yes  No

Sediment Depth in Forebay (if present): \_\_\_\_\_

Sediment Depth on Vault Floor: \_\_\_\_\_

Sediment Depth on Cartridge Top(s): \_\_\_\_\_

Structural Damage: \_\_\_\_\_

## Drainage Area Report

Excessive Oil Loading: Yes  No  Source: \_\_\_\_\_

Sediment Accumulation on Pavement: Yes  No  Source: \_\_\_\_\_

Erosion of Landscaped Areas: Yes  No  Source: \_\_\_\_\_

## StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes  No  Details: \_\_\_\_\_

Replace Cartridges: Yes  No  Details: \_\_\_\_\_

Sediment Removed: Yes  No  Details: \_\_\_\_\_

Quantity of Sediment Removed (estimate?): \_\_\_\_\_

Minor Structural Repairs: Yes  No  Details: \_\_\_\_\_

Residuals (debris, sediment) Disposal Methods: \_\_\_\_\_

Notes:

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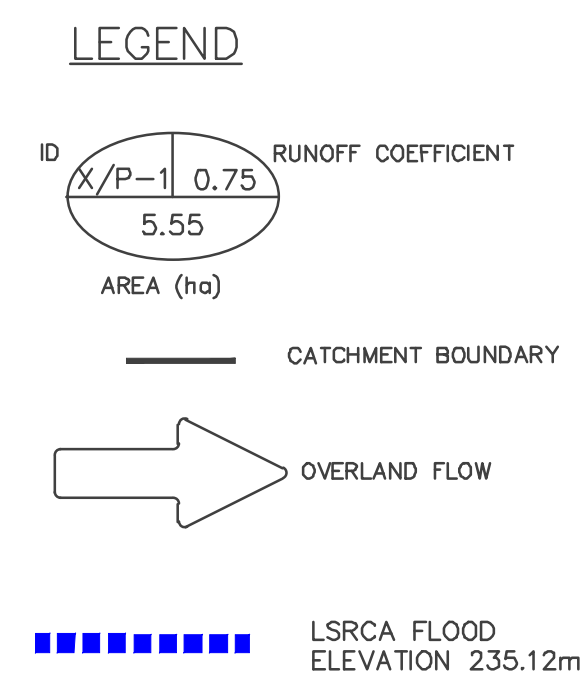
#### Support

- Drawings and specifications are available at [www.conteches.com](http://www.conteches.com).
- Site-specific design support is available from our engineers.

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## Appendix D Drawing Set

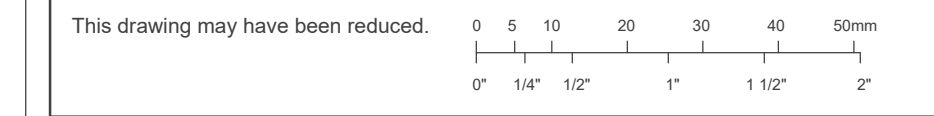


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No.	Issuance Description	YYMMDD
1.	SITE PLAN APPROVAL	22/05/10
2.	SITE PLAN APPROVAL REV-1	22/11/03
3.	LSRCA SPA COMMENTS	23/01/06
4.	SITE PLAN APPROVAL REV-2	23/02/14

Issued For:

**SITE PLAN APPROVAL  
 REV-2**

Client: **canplas**  
 INDUSTRIES LTD.

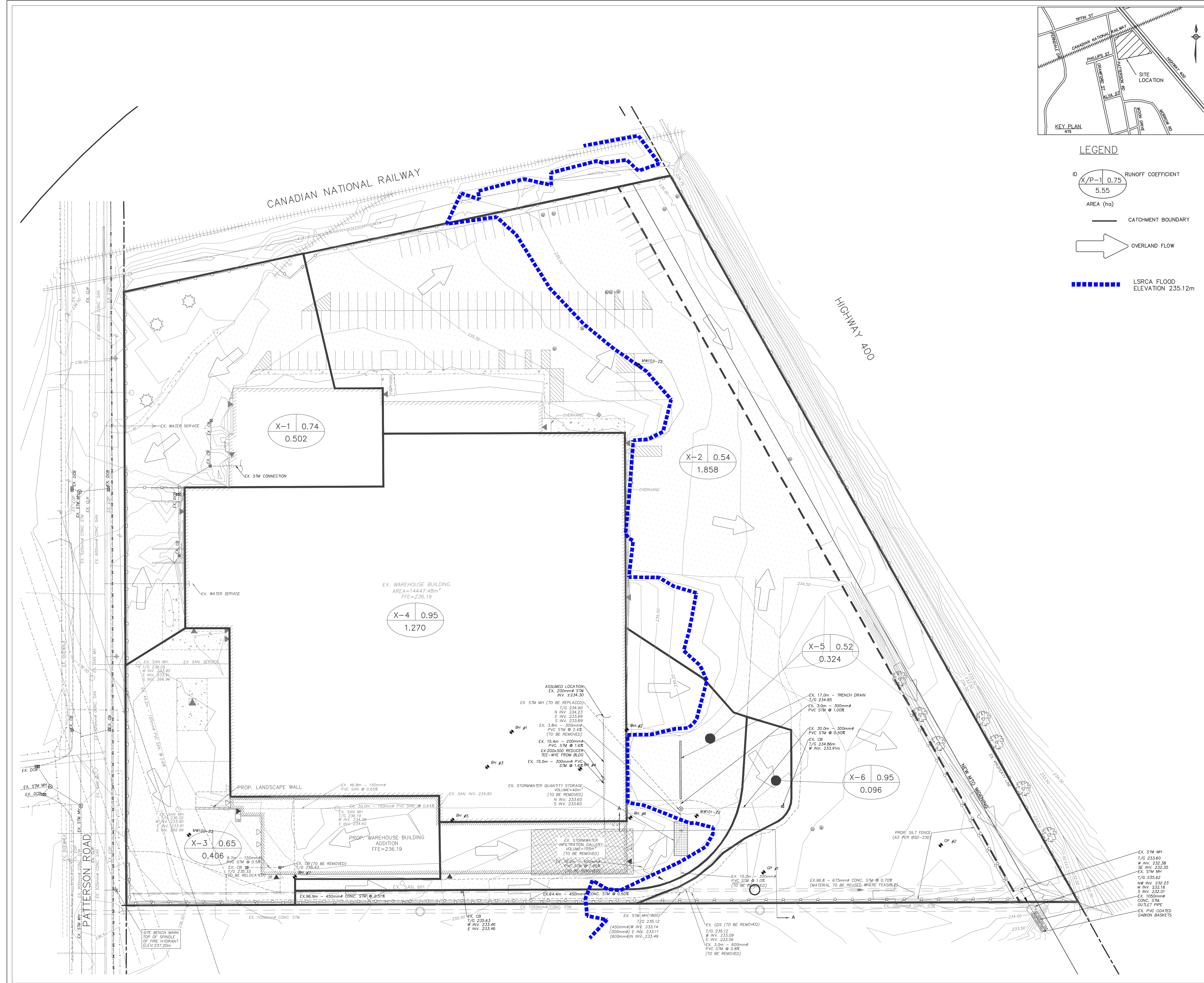
Project: **CANPLAS WAREHOUSE  
 ADDITION**  
 31 Patterson Rd., Barrie, ON L4N 3V9

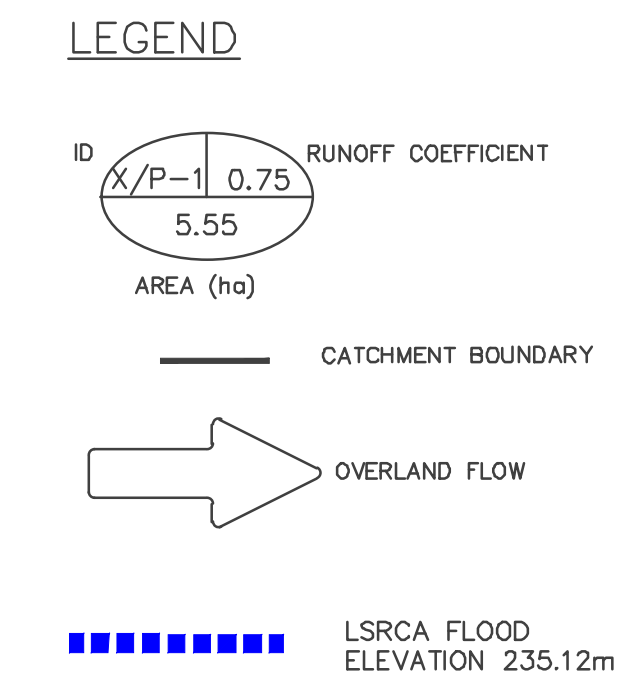
Drawing: **PRE-DEVELOPMENT  
 STORMWATER  
 DRAINAGE PLAN**

Project No. 873-009 | Designed by: KF | Checked by: KF  
 Scale: 1:500 | Drawn by: RM | Approved by: JDM

Orientation: Stamp

Drawing No. **STM-1**



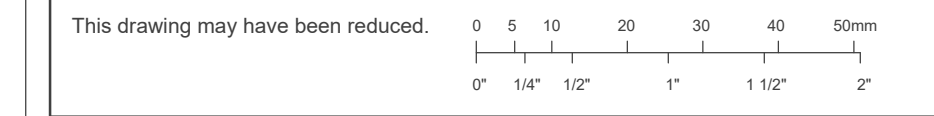


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3.	LSRCA SPA COMMENTS	23/01/06
4.	SITE PLAN APPROVAL REV-2	23/02/14

Issued For:

**SITE PLAN APPROVAL  
REV-2**

Client: **canplas**  
INDUSTRIES LTD.

Project: **CANPLAS WAREHOUSE  
ADDITION**  
31 Patterson Rd., Barrie, ON L4N 3V9

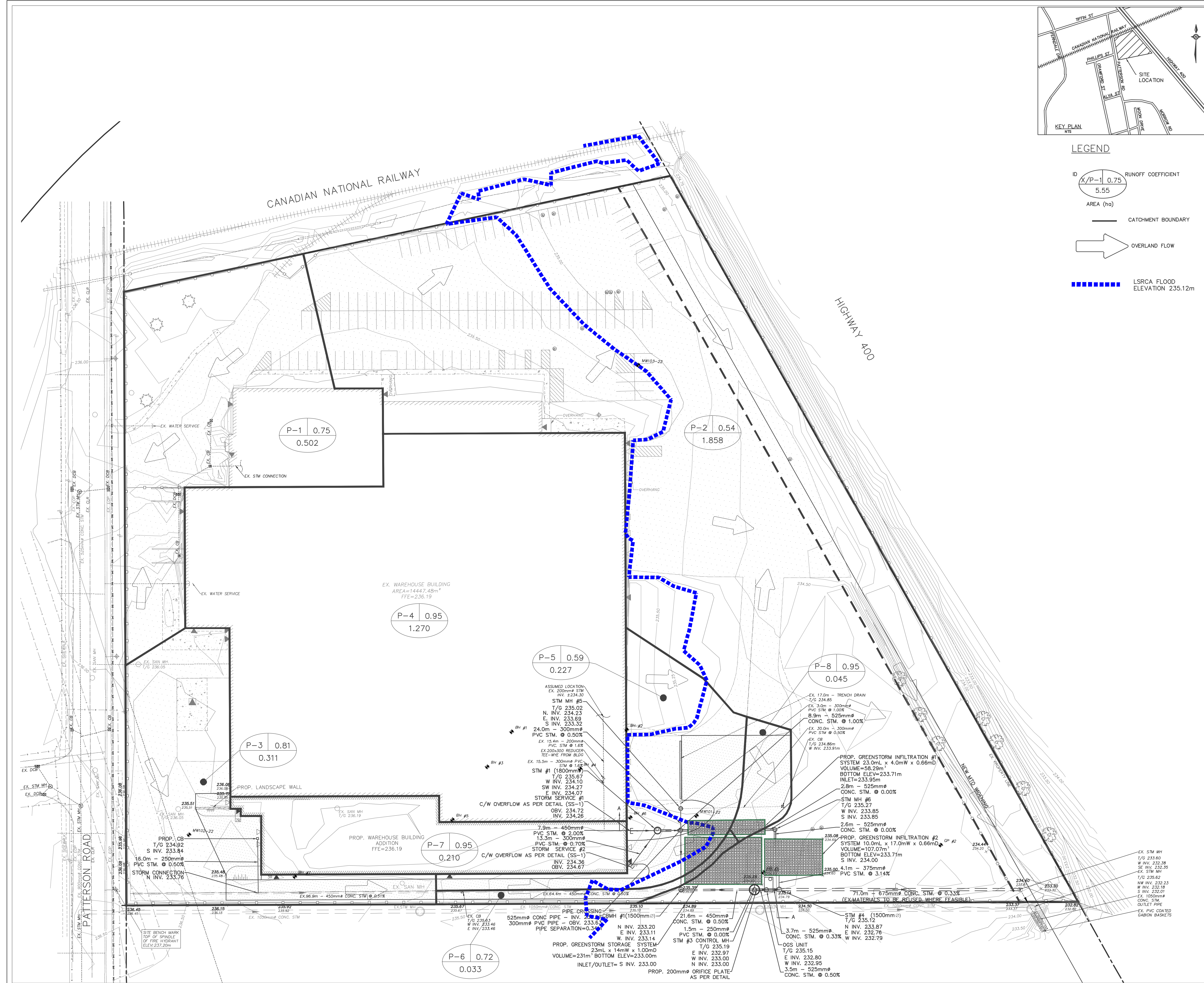
**POST DEVELOPMENT  
STORMWATER  
DRAINAGE PLAN**

Project No. 873-009 | Designed by: KF | Checked by: KF  
Scale: 1:500 | Drawn by: RM | Approved by: JDM

Orientation: Stamp



Drawing No. **STM-2**



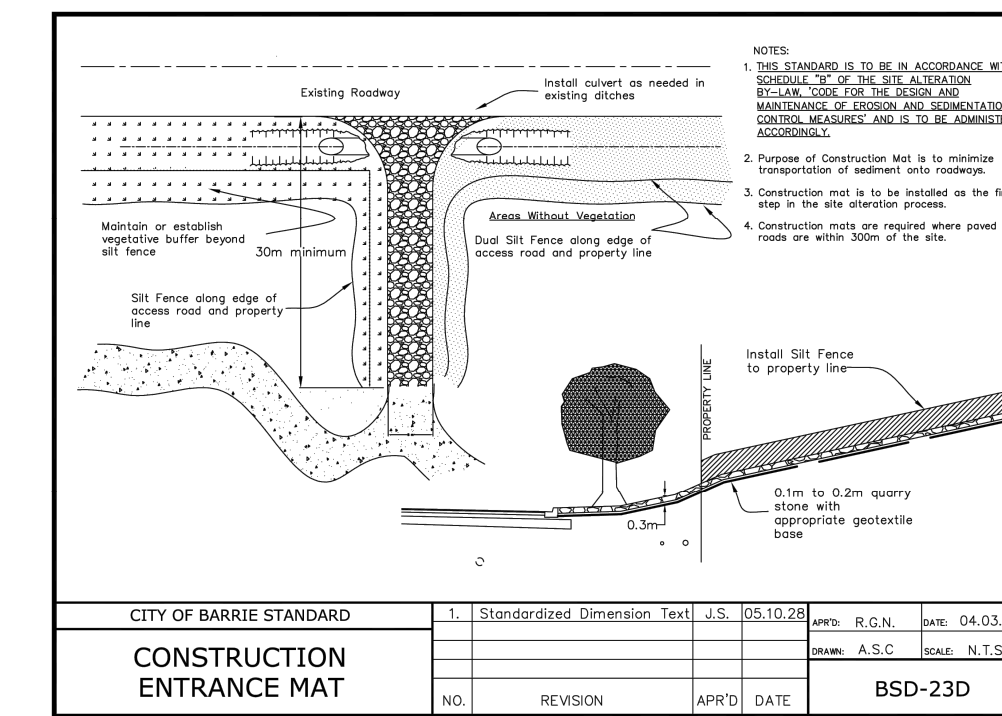
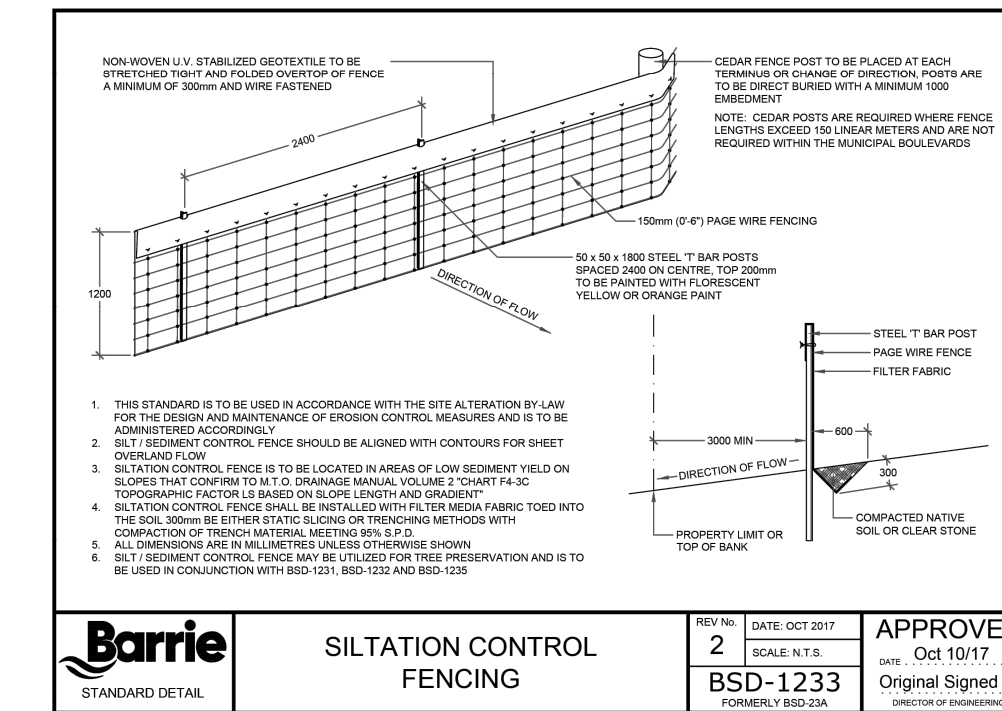
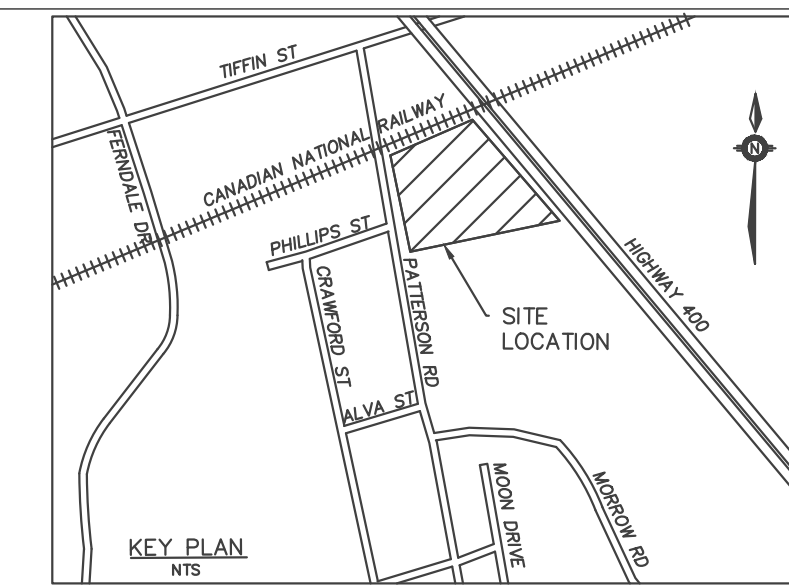
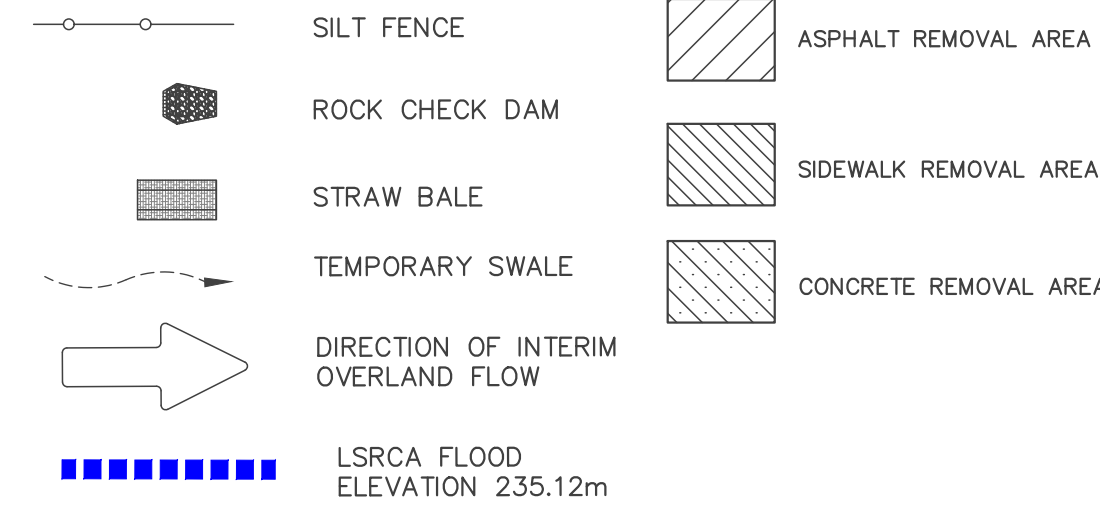
**NOTES FOR SEDIMENT & EROSION CONTROL**

1. DISTURBED AREAS THAT HAVE FAILED TO HAVE STABLE GROUND COVER ESTABLISHED BY OCTOBER 30TH SHALL BE PROTECTED WITH A SILTATION CONTROL FENCE OR STRAW MULCH ETC. AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION BECOMES ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
2. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30 M FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE ADMINISTRATOR.
3. SILT FENCE SHALL BE PUT IN PLACE PRIOR TO AND MAINTAINED DURING ALL GRADING. SILT FENCE SHALL COMPLY WITH OPSD 219.110 FOR LIGHT DUTY AND / OR OPSD 219.130 FOR HEAVY DUTY; UNLESS NOTED OTHERWISE. SILT FENCE TO BE INSPECTED PRIOR TO COMMENCEMENT OF EARTH GRADING ACTIVITIES. SILT FENCE TO BE INSPECTED AND REPAIRED OR REPLACED IF DAMAGED AS DIRECTED BY THE SITE ADMINISTRATOR. SILT CONTROLS TO BE INSPECTED ON A REGULAR BASIS AND AFTER EVERY RAIN EVENT. INSTALLATION SHALL BE TO THE MANUFACTURER'S SUGGESTED SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE A WEEK, AND AFTER EVERY RAINFALL EVENT.
5. MUD MATS WHERE CONSTRUCTION TRAFFIC ENTERS OR LEAVES THE SITE SHALL BE USED. MUD MATS TO BE 300mm IN DEPTH, 6.0m WIDE BY 20.0m LONG, FIRST 10.0m TO 150mm# CLEAR STONE WITH THE REMAINING 10.0m CONSISTING OF 50mm# CLEAR STONE, OR MEET MUNICIPAL STANDARDS WHERE IDENTIFIED.
6. CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 805, CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AS WELL AS ALL APPLICABLE MUNICIPAL STANDARDS.
7. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES. SUCH MEASURES SHOULD BE PRESENTED IN WRITING FOR APPROVAL OF THE SITE ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE CONSERVATION AUTHORITY.
8. THE TOPS OF ALL FILTER FABRIC MUST BE A MINIMUM OF 1.0 METRES ABOVE THE GROUND LEVEL AND ATTACHED TO THE FENCE WITH A CONTINUOUS STEEL WIRE. ALTERNATIVELY, THE FILTER FABRIC MUST BE FOLDED OVER THE TOP OF THE FENCE AND ATTACHED TO THE FENCE WITH WIRE LOOPED THROUGH THE FABRIC ON BOTH SIDES OF THE FENCE. FILTER FABRIC IS TO BE TERRAFIX 270R OR EQUIVALENT.
9. ALL DISTURBED GROUND LEFT INACTIVE SHALL BE STABILIZED BY SEEDING, SODDING, MULCHING, OR COVERING OR OTHER EQUIVALENT CONTROL MEASURES. THIS PERIOD OF INACTIVITY SHALL BE AT THE DISCRETION OF THE MUNICIPAL DIRECTOR OF ENGINEERING BUT SHALL NOT EXCEED (30) DAYS OR SUCH LONGER PERIOD DEEMED ADVISABLE BY THE MUNICIPAL DIRECTOR OF ENGINEERING.
10. CONTRACTOR SHALL INSTALL AND MAINTAIN CATCHBASIN SEDIMENT BARRIERS THROUGHOUT THE SITE DURING ALL CONSTRUCTION ACTIVITIES IN ORDER TO MITIGATE SEDIMENT ENTERING THE STORM STORM SEWERS.
11. NO FUEL TO BE STORED ON SITE. IN CASE OF A SPILL PLEASE CONTACT: MOECC SPILLS ACTION CENTER 1-800-268-6060.
12. SEDIMENT CONTROLS ARE TO REMAIN IN PLACE UNTIL WRITTEN DIRECTION IS RECEIVED FROM THE ENGINEER REGARDING THEIR REMOVAL.
13. EROSION AND SEDIMENT CONTROLS WILL BE INSPECTED ON AS PER MUNICIPAL REQUIREMENTS OR AFTER SIGNIFICANT RAINFALL EVENTS.
14. CONTRACTOR TO MONITOR LOCAL ROAD FOR SEDIMENT BUILT UP, CONTRACTOR TO CLEAN LOCAL ROAD AS NEEDED.

**SEQUENCE OF CONSTRUCTION**

1. ENGINEER TO BE NOTIFIED PRIOR TO INITIATION OF ANY ON SITE WORKS.
2. SILT FENCE AND CONSTRUCTION ACCESS MATS TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY WORKS ON SITE.
3. VEGETATION REMOVAL MAY COMMENCE AFTER ALL SILT FENCE IS INSTALLED AND APPROVED BY THE ENGINEER.
4. COMMENCE WITH EARTH EXCAVATION AND SITE SERVICING (TO BE REMOVED FROM SITE - NO STOCKPILE).
5. EROSION CONTROL MEASURES TO BE MAINTAINED AS DIRECTED BY THE ENGINEER DURING THE CONSTRUCTION PERIOD. ADDITIONAL CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE ENGINEER.
6. ALL DISTURBED GROUND LEFT INACTIVE FOR MORE THAN 30 DAYS SHALL BE STABILIZED WITH SEED, SOD, MULCH OR OTHER ADEQUATE COVERING, AS INSTRUCTED BY THE ENGINEER.

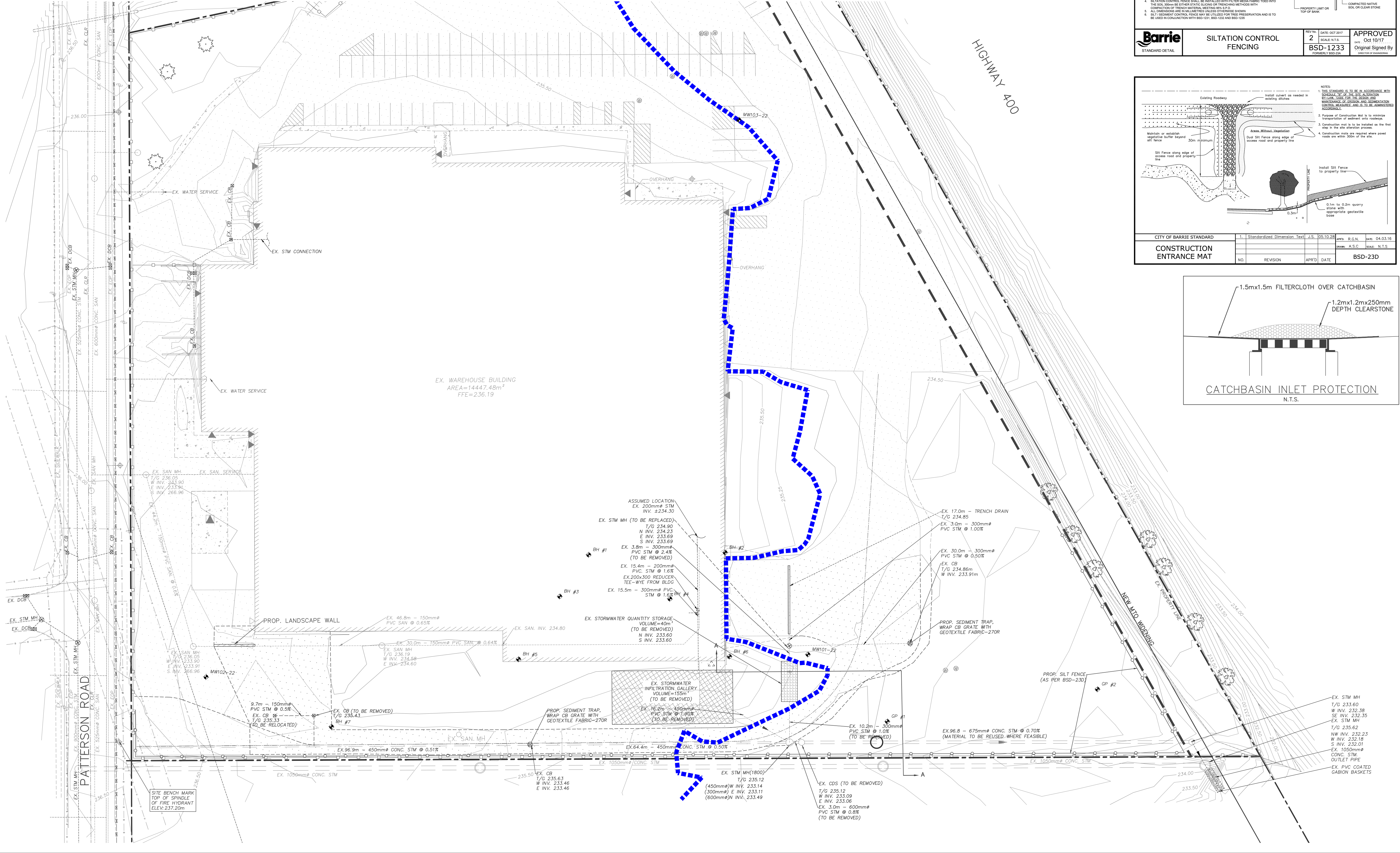
**LEGEND**



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No.	Issuance Description	YYMMDD
1.	SITE PLAN APPROVAL	22/05/10
2.	SITE PLAN APPROVAL REV-1	22/11/03
3.	LSRCA SPA COMMENTS	23/01/06
4.	SITE PLAN APPROVAL REV-2	23/02/14

Issued For:

**SITE PLAN APPROVAL REV-2**

Client: **canplas INDUSTRIES LTD.**

Project: **CANPLAS WAREHOUSE ADDITION**  
31 Patterson Rd., Barrie, ON L4N 3V9

Drawing: **EROSION & SEDIMENT CONTROL PLAN & REMOVALS PLAN**

Project No.	873-009	Designed by:	KF	Checked by:	KF
Scale:	1:500	Drawn by:	RM	Approved by:	JDM
Orientation:	Stamp				

Stamp: **PROFESSIONAL ENGINEER**  
J.D.L. McCuaig  
100064895  
2023/02/13  
PROVINCE OF ONTARIO

Drawing No: **ESC & RM-1**