blueprint2build

Stormwater Management Study Report

Prepared For:

North Bay Capital Investment Ltd.

Site:

752 Queen Street East.
St. Marys, Ontario.

Prepared By:

blueprint2build

July 02, 2020 – Rev 2.

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1 Introduction

1.1 Site Information

This report is for the site located at 752 Queen Street East, St. Marys, Ontario. The site is located on the South side of Queen Street approximately 80m. west from intersection of Queen Street East and Industrial Road. Legal description of property is Lot 18, Concession 19 (Geographic Township of Blanshard) Town of St, Marys, County of Perth, Province of Ontario. The existing site is a partially on 1/3 developed lot. The balance of site is undeveloped area with wild vegetation cover.

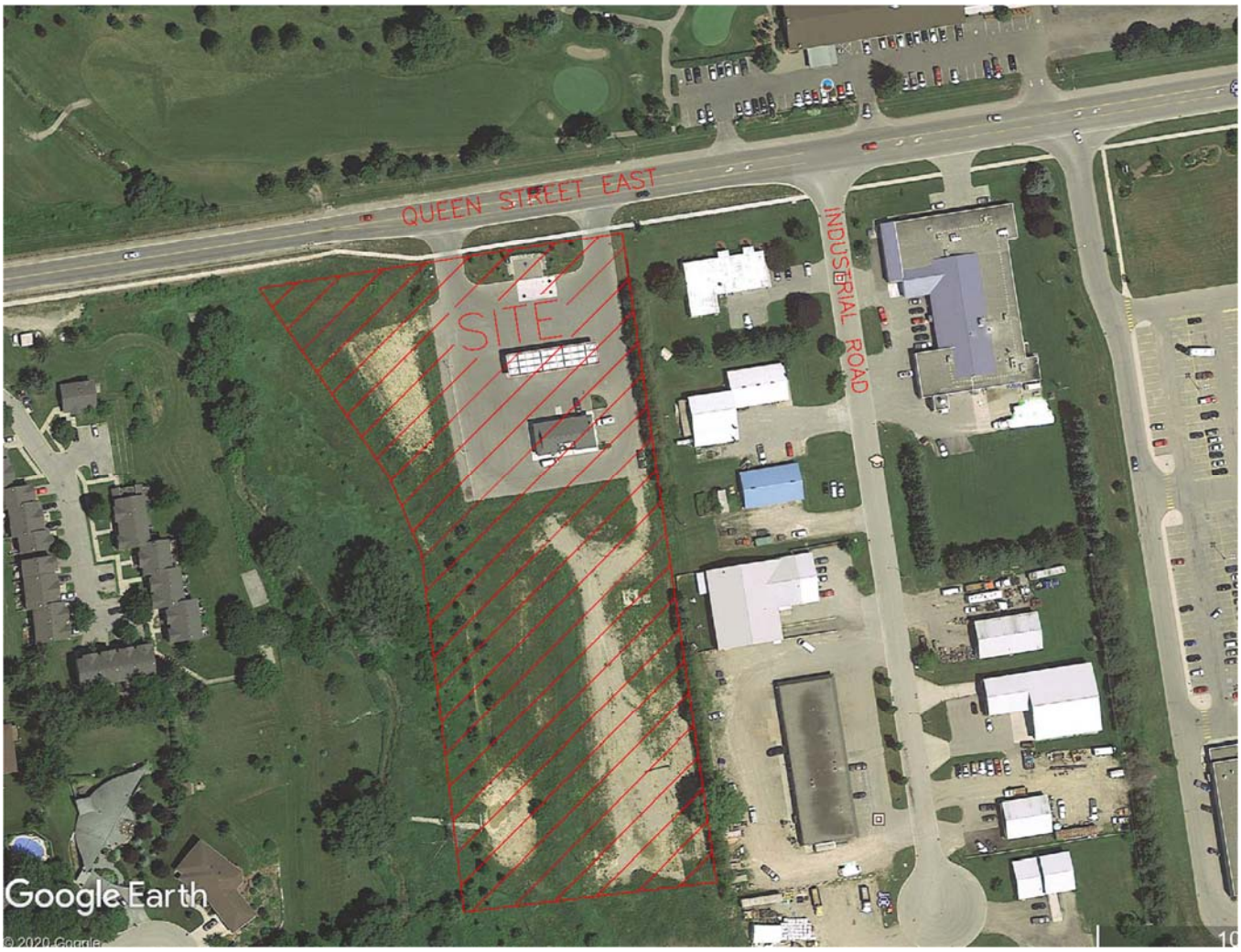


Image 1 - Site Location – Image form Google Earth

The property owner intends to develop the vacant part of existing property the proposed development is to consist of; a restaurant with drive through, carwash, one story plaza stores for multiple tenants, future warehouse building and associated parking area.

1.2 Report Background

This storm water study report is being prepared on behalf of North Bay Capital Investment Ltd. to address the municipal requirements for a Storm Water Management (SWM) report for the Town of St. Marys, Upper Thames River Conservation Authority (UTRCA), County of Perth and Ministry of Environment, Recreation and Park (MERP).

This SWM report will provide details for storm water quality and quantity control to ensure that the proposed development will not have any adverse effects on the existing site drainage conditions.

1.3 Objective of SWM Study

The objectives of the SWM study are:

- Identify the storm water runoff (quality and quantity) impacts to the existing drainage networks from the developed site.
- Address any concerns from the Town of St Marys, Upper Thames River Conservation Authority (UTRCA), County of Perth and Ministry of Environment, Recreation and Park (MERP) regarding quality and quantity control.
- Demonstrate that the proposed new site development complete with new drainage system is safe for operational use and will not have any adverse effects to the site and the surrounding existing drainage system.

1.4 Information Sources

This report is based on information that was obtained from the following agencies.

- Stormwater Management report for this property prepared by BaseTech Consulting Inc. Dated February 2014.
- Revision of BaseTech Consulting Inc. SWM report prepared by Three Hills Engineering Ltd. Dated May 10th 2017
- Upper Thames River Conservation Authority Draft Stormwater Management Submission Guidelines, February 2009.
- Stormwater Management Policy Guidline for the Town of St. Marys prepared by R. J. Burnside and Associates Limited dated April 25, 2012.
- Stormwater Management Planning and Design Manual by the Ministry of Environment, dated March 2003.
- Birches Creek 250 Year Backwater Analysis prepared by MTE Consultants Inc.
- Slope Stability Assessment prepared by LVM Inc.

- The direction and feedback provided during the pre-consult meeting for this property which was completed on February 10, 2020.

2 SWM Design

2.1 Site Design

Stormwater management servicing strategy proposed for the development has been prepared utilizing the above listed documents, abiding by the following guidelines.

- Post-Development Flow for **250-years** storm must not exceed Pre-Development Flow for a **2-Year** storm event.
- On-site storm infrastructure must have a capacity to accommodate a **1 in 5 Year** storm event with a planned and designed **100-Year** over-land flow route.
- Run off from site to be treated to Enhance Level of protection established by MOE **80%** of TSS to be removed with **90%** of all run off to be treated.

2.2 Pre-Development Conditions

The project site within the property boundary is 3.5921ha, site located at 752 Queen Street East, St. Marys, Ontario, on the South side of Queen Street approximately 80m west from intersection of Queen Street East and Industrial Road. At present, the site is a partially approximately 1/3 developed lot with convenience store and gas bar canopy, underground fuel tanks with associated asphalt cover, the balance of the site is storm water management structures and undeveloped land with vegetation cover. A Town storm sewer runs through the site towards the west lot line within an easement in favour of the Town of St. Marys. Under predevelopment condition there are the storm water management system designed by BaseTech Consulting Inc. and alternate by Three Hills Engineering Ltd, the storm water management features proposed by BeseTech Consulting consist from pond, swale and outlet structure to Birches Creek presented by “V” notched retaining wall. For details of SWM report see above listed reports. The site does not accept run off from any properties and does not drain towards the adjacent lands. The overland flow is directed towards the Birch Creek. For additional details see Figure 1.

2.3 Post Development Conditions

The client intends re-develop the entire site to include the following:

- one story restaurant with drive through,
- car wash
- one storey commercial building for multiple tenants
- future warehouse
- and, all new parking and landscaped areas.
- existing gas bar and convenience store will remain and will be integrated in to new design.

For access and egress to the site will use existing two entrances from Queen Street East. The new addition development includes new curbs to properly delineate site entrances, accesses, and parking areas. The site will

be re-graded to ensure that it is self-contained in terms of stormwater flow management. Proposed development situated at the existing storm structure. It is proposed to remove all existing structures including outlet into a Birch Creek and introduce a new system providing quantity and quality control for existing and for proposed development. For quantity control calculation predevelopment condition will be assumed "Green field" conditions with runoff coefficient 0.25 as it was assumed in initial SWM report by BaseTech Consulting Inc. Due to existing drainage conditions, site position and a significant (up to 8.0m) drop in site elevations, the site will continue to direct uncontrolled runoff from the 1.7742 m^2 of west and south. The south part appr 0.47ha will be occupied by storm water management quantity control pond, no increase in runoff is proposed for this part of property and the balance west part of uncontrolled portion of site appr 1.2806ha is presented by Birch Creek and erosion hazard area, nothing is allowed to build in this area, this area will remain as is. No overland flow control compensation of runoff from these areas is deemed necessary and or is feasible for this area. For storm water management calculations, the area within the drainage boundary (control area) of site 1.8179ha will be compared.

For design purposes the run off from the post development drainage boundary of site 18,179m^2 (1.8179ha), will be compared with same corresponding area for pre-development condition. The resulting overland flow will be directed to the Birch Creek. It is proposed to introduce a new storm system in the new and existing developed area. The new storm system will collect all the onsite water from the site including the roof top of all new structures and divert the flows to the Birch Creek through quantity control dry pond on south side limit. This dry pond will provide additional infiltration and sediment removal from site, improving downstream condition in receiving watercourse. For further details see drawing C01.1, C01.2, C02.1, C02.2 and Figure 2. This runoff from the gas bar (including all roof tops) and will be treated in the proposed new Oil / Grit separator Stormceptor (STC 1000) to Enhance levels of protection.

The proposed new storm sewer system for the site is designed to convey peak flow rates for the 5-year storm event under post-development conditions.

2.4 Allowable Flow

As per the stormwater management strategy outlined for the post development condition, the stormwater runoff generated on site will be collected by the storm drainage system and then the treated flows will be directed to the Birch Creek through a restrictor plate for quantity flow controls. The stormwater will then run through an Oil/Grit Separator (STC-5000) that provides the quality control before discharging to the natural watercourse.

Post and Pre-development hydrologic conditions for the controlled portion of the site were established utilizing the current 2-Year to 250-Year Rainfall intensities have been based on the City of Stratford IDF curves.

A conservative surface run-off coefficient of 0.90 was used for impervious surfaces (i.e. Roof drainage and parking area), and 0.25 was used for pervious surfaces (i.e. landscape areas). The weighted surface run-off coefficient calculated to be 0.25 for existing (before first phase development) and 0.85 for proposed conditions respectfully.

Table 1. Below shows the pre and post development coefficients for the site controlled area.

Surface Composition		Impervious	Pervious	Combined
Existing Condition	(m^2)	0.000	18179.00	18179.00
	(ha)	0.000	1.818	1.818
Runoff Coefficient		0.900	0.250	0.250

Surface Composition		Impervious	Pervious	Combined
Proposed Condition	(m^2)	16572.10	1606.90	18179.00
	(ha)	1.657	0.161	1.818
Runoff Coefficient		0.900	0.300	0.847

Table 1-Pre and Post Development Runoff Coefficients

The Post-Development Impermeability Factor for the 2 – 10 year storms will be 0.85 as recommended by R. J. Burnside and Associates Limited dated April 25, 2012. The impermeability factors for the lower figures have been increased for the 25, 50 and 100 year storms by 10%, 20% and 25% respectively up to a limit of 0.95 as recommended by MTO Design Chart 1.07. The 250 year factor has been increased by 30%.:

Runoff Coefficient Adjustment for 25-yr to 250-yr Storms

Return Period Runoff Coefficient "C"

25 years C25 = 1.1 x C10

50 years C50 = 1.2 x C10

100 years C100 = 1.25 x C10

250 years C250=1.3 x C10

Then adjusted runoff coefficient calculated in Table 2:

Table 2. Below shows the adjusted runoff coefficient for the site controlled area.

RUNOFF COEFFICIENTS	2 Year	5 Year	10 Year	25 Year (10yr+10%)	50 Year (10yr+20%)	100 Year (10yr+25%)	250 Year (10yr+30%)
Existing Condition	0.250	0.250	0.250	0.275	0.300	0.313	0.325
Proposed Condition	0.847	0.847	0.847	0.932	0.950	0.950	0.950

Table 2-Adjusted Runoff Coefficients

The adjusted runoff coefficients will be used in calculation above.

Rainfall intensity (I) is calculated based on the City of Stratford IDF curves.

$$I2 = \frac{A}{(T+B)^C}$$

Where I5: Rainfall Intensity
A,B: Coefficient
C: Exponent
T: Time of concentration in minutes (The initial time of concentration (td) shall be 10 minutes) as per Town of St. Mary standard.

$$I2 = \frac{595.248}{(10+4.841)^{0.766}}$$

$$I2 = 75.4\ mm/hr$$

The 2-Year pre-development peak flow is:

$$Q = 0.00278\ C\ I\ A \quad \leftarrow Equation\,(1)$$

$$Where\ Q := Maximum\ Runoff\ \ Rate\,(m^3/sec)$$

$$C := Runoff\ \ Coefficient$$

$$I := Rainfall\ Intensity\,(mm/hr)$$

$$A := Drainage\ Area\,(ha)$$

$Q = 0.00278\ x\ 0.25\ x\ \frac{75.40mm}{hr}\ x\ 1.8179ha = \ 0.0952\frac{m^3}{sec}$, the results of peak flow rates Q (m^3/sec) for the time of concentration 10 min generated by the "Rational Method" for existing and proposed conditions are shown on Table 3.

Storm Event	Rainfall Intensity (mm/hr)				Flow Rate (m^3/sec)		
	a	b	c	I	Existing	Proposed	Excess Flow
2-Year	595.248	4.841	0.766	75.40	0.0952	0.3225	0.2273
5-Year	860.463	7.382	0.759	98.51	0.1244	0.4213	0.2970
10-Year	1060.397	8.954	0.760	113.35	0.1431	0.4848	0.3417
25-Year	1136.383	10.833	0.763	112.03	0.1556	0.5270	0.3715
50-Year	1546.625	11.945	0.766	145.19	0.2199	0.6965	0.4765
100-Year	1717.698	12.472	0.764	159.33	0.2514	0.7643	0.5129
250-Year	2075.001	14.000	0.770	179.58	0.2947	0.8615	0.5668

Table 3-Controlled Area Peak Flows 2 to 250 Years Storm Events

2.5 Quantity Control

To satisfy the proposed requirements, the runoff generated by storms for post-development condition up to and including the 250-year event must be controlled to the 2 year storm event on predevelopment conditions. Maximum allowable release rate is generated by 100 years storm:

$$Q_{allowable} = 0.0952\ m^3/sec$$

To mitigate the impacts of the proposed development, onsite storage and flow control is provided using an orifice plate restrictor located at the outlet of proposed manhole STMH#5 to limit the release rate to the 250-Year pre-development condition.

Sizing of the orifice is given by the formula:

$$Q = CA\sqrt[2]{2gh}$$

Were Q= Flow rate through orifice (m^3/sec) = $Q_{allowable}$
C= Contraction coefficient =0.6 (for orifice plate)
A= Area of orifice pipe cross section (m^2)
g= Acceleration due to gravity (m/sec^2) = 9.81(m/sec^2)
h= Pressure head to be dissipated (m)

The maximum possible water level of on-site ponding during a major storm event is 310.06 m. By trial and error calculations a 235mm diameter orifice plate installed at invert elevation 309.29 is required to control the flow rate to 250 Year Storm Event pre-development levels (0.0964 m^3/s).

$$Q(_{orifice}) = (0.6)\pi\left(\frac{0.235}{2}\right)^2\sqrt{2(9.81)(310.06-(309.29+0.235/2))}$$

=0.0931 m^3/sec ≤ 0.0952 m^3/sec (Predevelopment 2-Year Storm Allowable Rate)

Based on the chosen 235mm diameter orifice pipe the actual required retention volume is calculated using the "Modified Rational Method" as shown on Table 4.

Stm Event	Td	Id	Qpost	Qorifice	Excess Flow	Volume
	min	mm/hr	m^3/sec	m^3/sec	m^3/sec	m^3
250 Year	45	90	0.4313	0.0931	0.3382	913.16
	50	84	0.4051	0.0931	0.3120	936.06
	55	80	0.3823	0.0931	0.2892	954.42
	60	75	0.3623	0.0931	0.2692	969.01
	65	72	0.3445	0.0931	0.2514	980.39
	70	68	0.3286	0.0931	0.2355	989.02
	75	65	0.3143	0.0931	0.2212	995.28
	80	63	0.3013	0.0931	0.2082	999.45
	85	60	0.2895	0.0931	0.1964	1001.80
	90	58	0.2788	0.0931	0.1857	1002.52
	95	56	0.2689	0.0931	0.1758	1001.79
				Max Volume Required	cum	**1002.52**

Table 4-Required Storage Volume (250 Year Storm Event)

As per Table 4 above 1002.52 m^3 of on-site storage is required during the 250 Year Storm Event.

The required storage will be achieved by utilizing dry pond storage only, drainage structures and pipe(s) are available but will not be account for storage calculation.

Provided dry pond storage is 1094m^3 depth of pond storage is 0.56m bottom area 1645m^2 bottom elevation 309.50m top of storage area 2265m^2 top of berm elevation 310.06m side slopes 6:1 or 15% slope bottom and slopes will be lined with 0.3m clay

The maximum storage provided on site is 1094 m^3 which exceeds the required storage volume of 1002.52m^3.

When the Storm Event exceeds the 250 Year Storm the water level reaches elevation of 310.06 m and all the storage capacity of the system is exceeded, the overland flow will be directed south towards Berch Creek.

2.6 Quality Control

For quality control purposes, installation of a Stormceptor STC 1000 unit at system discharge is proposed for the "ENHANCE LEVEL" of total suspended solids (TSS) removal. Sizing of the Stormceptor is based on guidelines provided by the manufacturer. The Stomseptor was sized putting in to consideration upstream flow attenuation provided by dry pond The "*Stormceptor STC 1000*" sizing report is attached for reference.

Based on the Stormceptor sizing calculations, it is determined that use of the STC 1000 as a standalone device for 82% removal of total suspended solids (TSS) and 97% of runoff capture for the SWM area under consideration is sufficient (Appendix – PCSWMM detail report).

As defined by the MOE in the Certificate of Approval the operation and maintenance of the Stormceptor is the responsibility of the owner which states:

> "*The Owner shall design, construct and operate the oil/grit separator with the objective that no visible oil sheens occur in the effluent discharged from the oil/grit separator.*
>
> *The Owner shall carry out and maintain an annual inspection and maintenance program on the operation of the oil/grit separator in accordance with the manufacturer's recommendation.*
>
> *After a two (2) year period, the District Manager of the MOE District Office may alter the frequency of inspection of the oil/grit separator if he/she is requested to do so by the Owner and considers it acceptable upon review of information submitted in support of the request."*

2.7 Erosion and Sediment Control during Construction

The erosion potential of the study area was assessed using methods described in the "*MTO Drainage Management Manual*" of temporary erosion and sediment control measures suitable for construction sites close to highways.

During Site construction, various temporary measures will be implemented to prevent the discharge of sediment laden Stormwater from the Site. These measures include silt fencing, catch basin buffers and mud-mats as shown on C01 - Grading Plan.

In addition to the above, the following "good housekeeping" measures are recommended:

- All exposed soil shall be stabilized as soon as possible with a seed and mulch application as directed by the Engineer.
- No construction activity or machinery shall intrude beyond the silt/snow fence or limit of construction area. All construction vehicles shall leave the site at designated locations as shown on the plans.
- Stockpiles of soil shall be set back from any watercourse and stabilized against erosion as soon as possible. A set back of at least 15m from any top-of-bank, watercourse or pond is required.
- Cleaning and repairs of mud-mats and any other temporary sediment control measures shall be completed as deemed necessary through regular inspection.
- Sediment/silt shall be removed from the sediment control devices after storm events and deposited in areas as approved by the engineer.

- All re-graded areas within the development which are not occupied by buildings, roadways, sidewalks, or driveways shall be top-soiled and sodded/seeded immediately after completion of final grading operations as directed by the engineer.

3 Summary and Conclusions

In summary, all required conditions of the Town of St. Marys, Upper Thames River Conservation Authority (UTRCA), County of Perth and Ministry of Environment, Recreation and Park (MERP) and have been satisfied as follows:

- There is no increase in Stormwater flow from the Site.
- The SWM facilities provide Enhanced Level of treatment.
- Phosphorous loading does not exceed predevelopment level.
- The Sediment and Erosion Control Plan demonstrates how erosion and sedimentation will be minimized during construction

This SWM Report satisfies all requirements for stormwater quantity, quality, and sedimentation and erosion control.

If you have any questions, please do not hesitate to contact the undersigned.

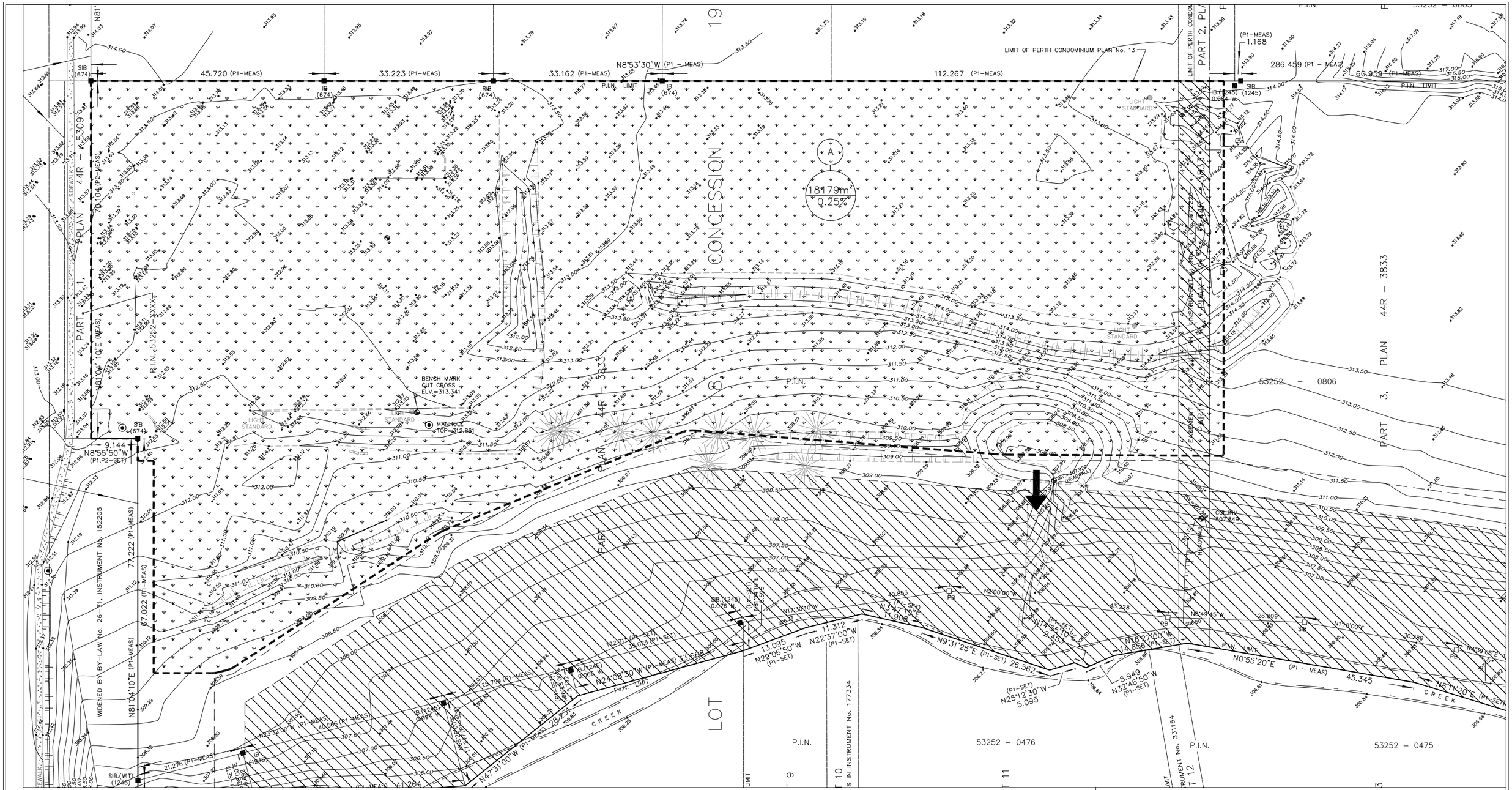
Respectfully submitted,

Blueprint2build

July 02, 2020

Sergey Kiselyov, P.Eng.

Appendix A – Figure 1. Pre Development Condition



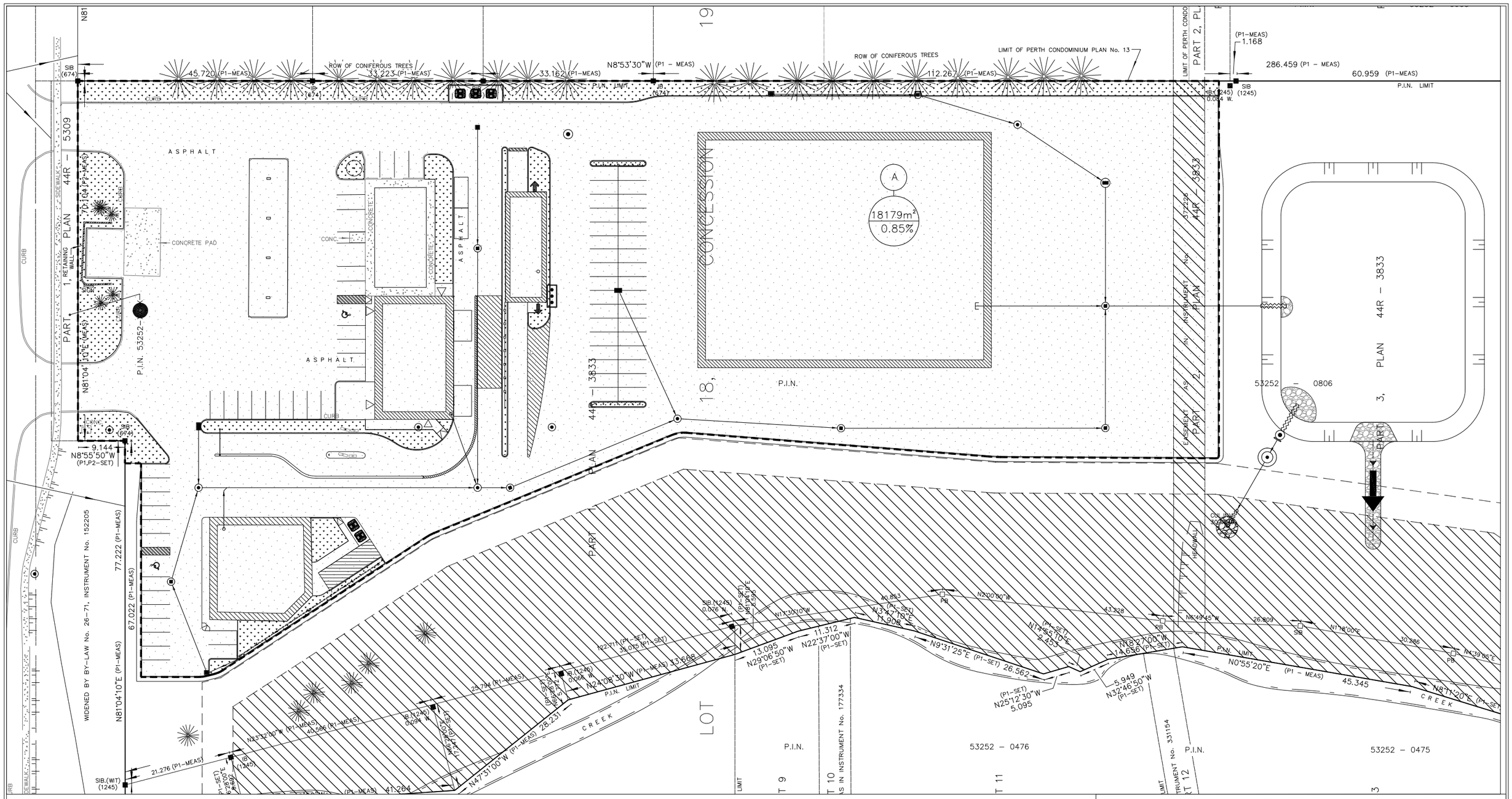
LEGEND:

- A1 — CATCHMENT ID
- 1385m² / 56% — CATCHMENT AREA / % IMPERVIOUSNESS
- DRAINAGE BOUNDARY UNDER CONSIDERATION
- OVERLAND FLOW
- GRASS COVER
- HARDSCAPE COVER ASPHALT, CONCRETE, ROOF, ETC.
- GRAVEL

EXISTING STORM DRAINAGE

DRAWN BY: S.K.	SCALE: N.T.S.
CHECKED BY: S.J.	FIGURE NO. : 1
DATED: JULY 2020	

Appendix B – Figure 2. Post Development Condition.



LEGEND:

- A1 / 1385m² / 56% — CATCHMENT ID; CATCHMENT AREA; % IMPERVIOUSNESS
- DRAINAGE BOUNDARY UNDER CONSIDERATION
- PROPOSED STORM SEWER
- OVERLAND FLOW
- GRASS COVER
- HARDSCAPE COVER ASPHALT, CONCRETE, ROOF, ETC.

PROPOSED STORM DRAINAGE

DRAWN BY: S.K.	SCALE: N.T.S.
CHECKED BY: S.J.	FIGURE NO. : 2
DATED: APRIL 2020	

Appendix C – Stormceptor Sizing Report

Detailed Stormceptor Sizing Report – 752 Queen Street, St Marys

Project Information & Location			
Project Name	St Marys Queen Street Development	**Project Number**	1905-246-00
City	St. Marys	**State/ Province**	Ontario
Country	Canada	**Date**	4/14/2020
Designer Information		**EOR Information (optional)**	
Name	Sergey Kiselyov	**Name**	
Company	Blueprint2build Inc.	**Company**	
Phone #	905-888-0800	**Phone #**	
Email	skiselyov@blueprint2build.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	752 Queen Street, St Marys
Recommended Stormceptor Model	STC 750
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	82
PSD	Fine Distribution
Rainfall Station	SAULT STE MARIE A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	73	89
STC 750	82	97
STC 1000	82	97
STC 1500	82	97
STC 2000	84	99
STC 3000	84	99
STC 4000	87	100
STC 5000	87	100
STC 6000	89	100
STC 9000	92	100
STC 10000	91	100
STC 14000	93	100
StormceptorMAX	Custom	Custom

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis
PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station			
State/Province	Ontario	**Total Number of Rainfall Events**	4561
Rainfall Station Name	SAULT STE MARIE A	**Total Rainfall (mm)**	21932.4
Station ID #	7592	**Average Annual Rainfall (mm)**	510.1
Coordinates	46°29'N, 84°31'W	**Total Evaporation (mm)**	2090.4
Elevation (ft)	623	**Total Infiltration (mm)**	1931.0
Years of Rainfall Data	43	**Total Rainfall that is Runoff (mm)**	17911.0

Notes
• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules. • Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed. • For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	1.817
Imperviousness %	91.16

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000
0.034	0.032
0.067	0.064
0.100	0.093

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	309.20
Stormceptor Outlet Invert Elev (m)	309.17
Stormceptor Rim Elev (m)	312.00
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	350
Pipe Material	PVC - plastic
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	752 Queen Street, St Marys

Site Details

Drainage Area

Total Area (ha)	1.817
Imperviousness %	91.16

Surface Characteristics

Width (m)	270.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (lps)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

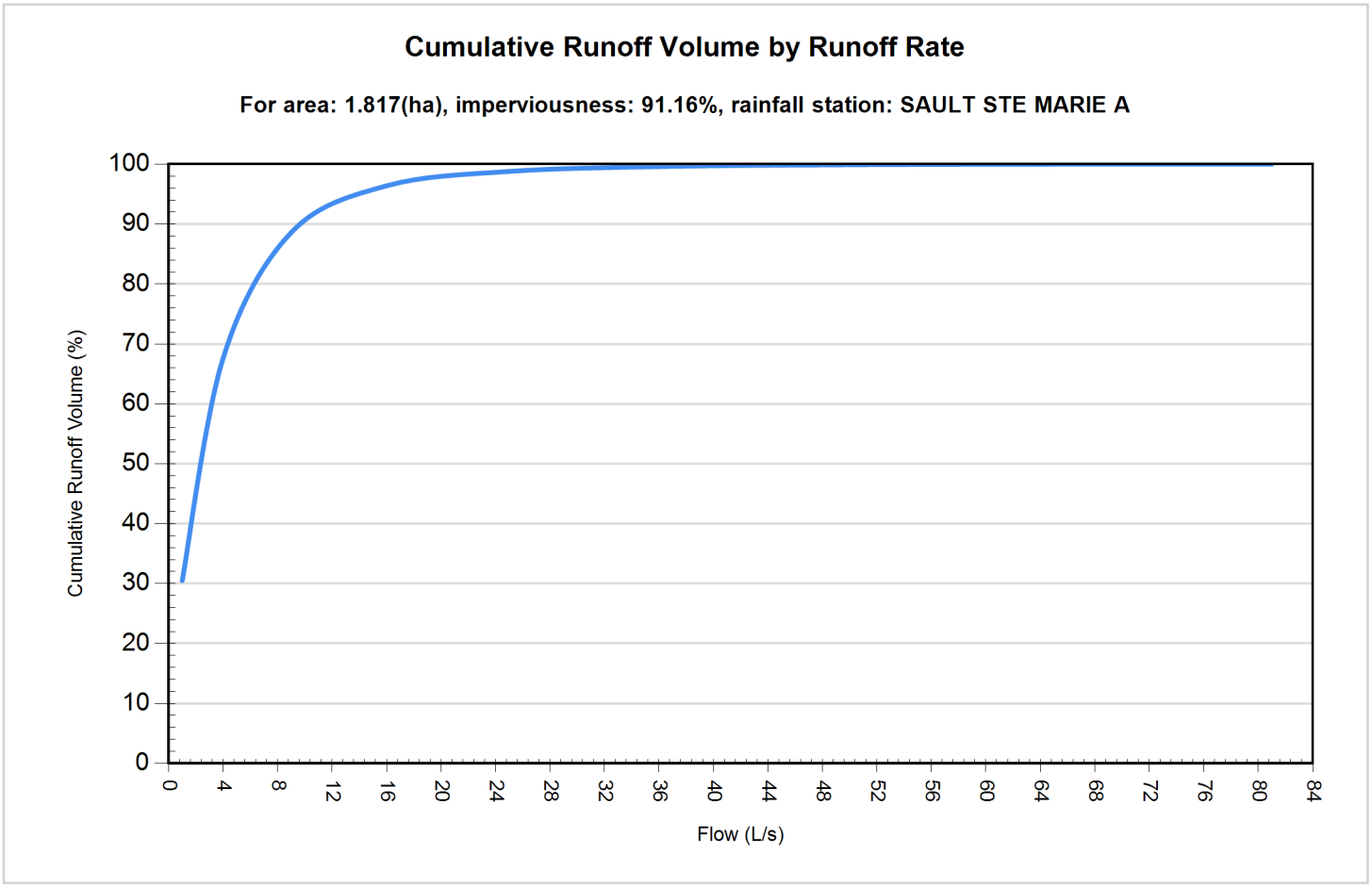
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

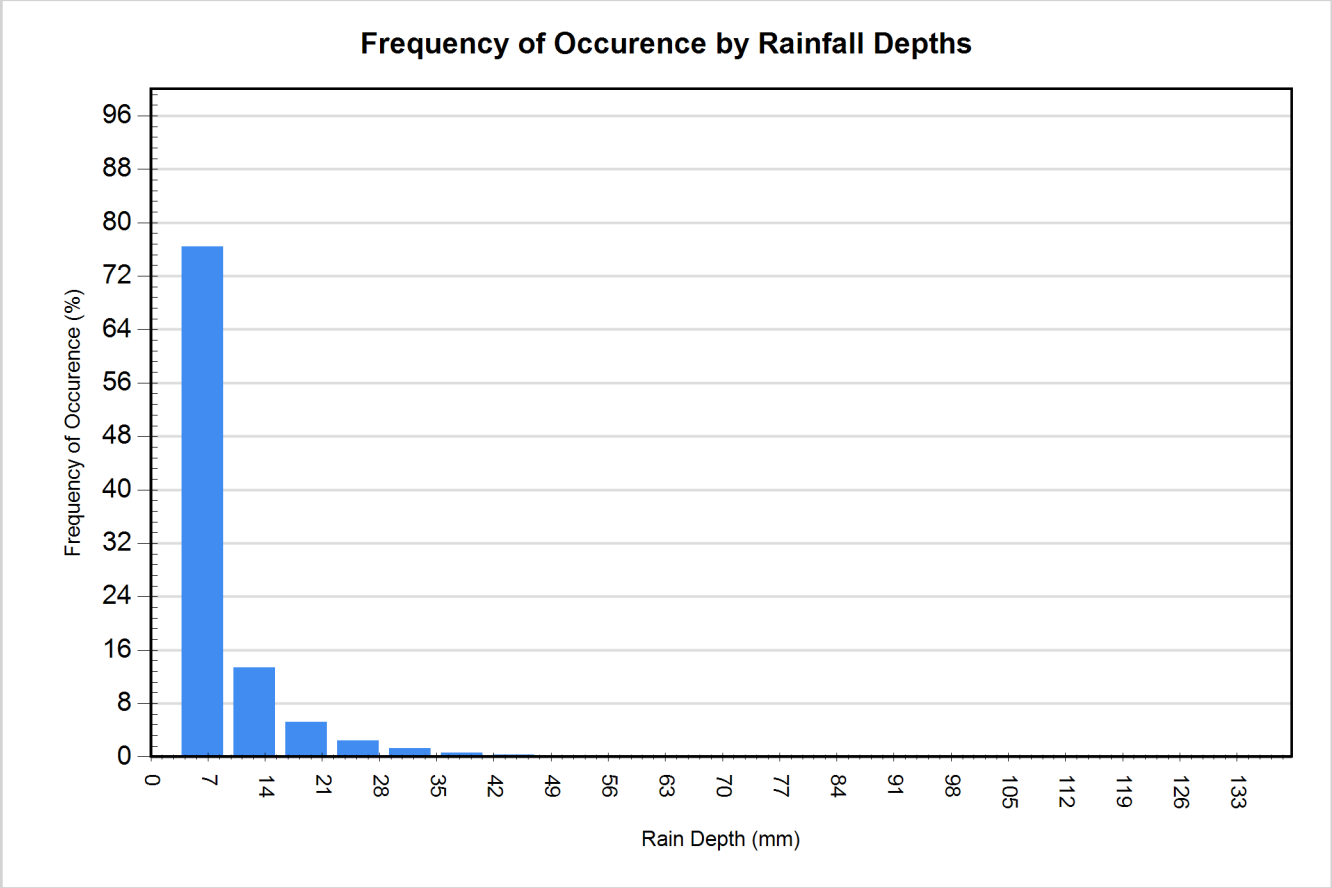
TSS Availability Parameters

Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	**Runoff Volume (m^3)**	**Volume Over (m^3)**	**Cumulative Runoff Volume (%)**
1	99535	227741	30.5
4	220907	105940	67.6
9	289334	37467	88.6
16	314892	11812	96.4
25	322622	4069	98.8
36	325304	1386	99.6
49	326263	424	99.9
64	326665	22	100.0
81	326687	0	100.0



Rainfall Event Analysis				
Rainfall Depth (mm)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (mm)**	**Percentage of Annual Volume (%)**
6.35	3483	76.4	5799	26.4
12.70	609	13.4	5553	25.3
19.05	239	5.2	3736	17.0
25.40	111	2.4	2440	11.1
31.75	58	1.3	1657	7.6
38.10	27	0.6	947	4.3
44.45	14	0.3	573	2.6
50.80	6	0.1	289	1.3
57.15	6	0.1	331	1.5
63.50	2	0.0	118	0.5
69.85	2	0.0	133	0.6
76.20	1	0.0	70	0.3
82.55	0	0.0	0	0.0
88.90	2	0.0	172	0.8
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	0	0.0	0	0.0
120.65	1	0.0	115	0.5
127.00	0	0.0	0	0.0
133.35	0	0.0	0	0.0



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