7081 McLeod Road
5-Storey Building

Municipal Servicing & Stormwater Management Report

Project Location:
7081 McLeod Road, Niagara Fall, ON

Prepared for:
Reid's Heritage Construction
485 Pinebush Road, Suite 102, Cambridge, ON

Prepared by:
MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, ON N2B 3X9

January 27, 2023

MTE File No.: 52470-200

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1.0 Introduction

1.1 Overview

MTE Consultants Inc. was retained by Reid's Heritage Construction to complete the site grading, servicing, stormwater management design as well as the Municipal Servicing Study for the proposed development located in Niagara Falls at the intersection of McLeod Road and Sharon Avenue (see Figure 1.0 for Location Plan). This design will be in support of Zoning By-law Amendment (ZBA), Official Plan Amendment (OPA) followed by Site Plan Approval (SPA). The proposed development is a 5-storey mid-rise residential building consisting of 50 apartment units. The total site is approximately 0.36ha. The site is bounded by residential houses to the north, open field to the west, Sharon Avenue to the east and McLeod Road to the south. Under existing conditions, the site is fully developed and consists of an institutional building with associated parking and landscape areas.

The servicing described in this report will provide additional detailed information on the proposed servicing scheme for the site. Please refer to the Architectural Site Plan and the enclosed civil drawings prepared by MTE for additional information.

1.2 Background Information

The following documents were referenced in the preparation of this report:

- Ref. 1: *Ontario Building Code* (2020).
- Ref. 2: *Engineering Design Guidelines Manual* (The City of Niagara Falls, April 2016).
- Ref. 3: *Niagara Region Project Design and Technical Specifications Manual*, January 2013).
- Ref. 4: *Design Guidelines for Sewage Works* (Ministry of the Environment, 2008).
- Ref. 5: *Design Guidelines for Drinking-Water Systems* (Ministry of the Environment, 2008).
- Ref. 6: *Erosion & Sediment Control Guideline for Urban Construction (December, 2006).*
- Ref. 7: *MOE Stormwater Management Practices Planning and Design Manual* (Ministry of the Environment, March 2003).
- Ref. 8: *Water Supply for Public Fire Protection* (Fire Underwriters Survey, 1999).

FIGURE 1.0 Date: JAN.26, 2023 Scale: NTS

SITE LOCATION PLAN

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2.0 Stormwater Management

The following sections will describe the proposed stormwater management (SWM) plan for the proposed development.

2.1 Stormwater Management Criteria

The stormwater management design criteria for the subject site as established by the City of Niagara Falls and Niagara Peninsula Conservation Authority (NPCA) are as follows.

2.1.1 Quantity Control

- Attenuation of the proposed condition peak flow to the pre-development peak flow for the 5-year storm event at OPA/ZBA stage.
- Attenuation of the proposed condition peak flow to the pre-development peak flow for all storms up to and including the 100-year storm event at SPA stage since the site will discharge to a Regional Road.

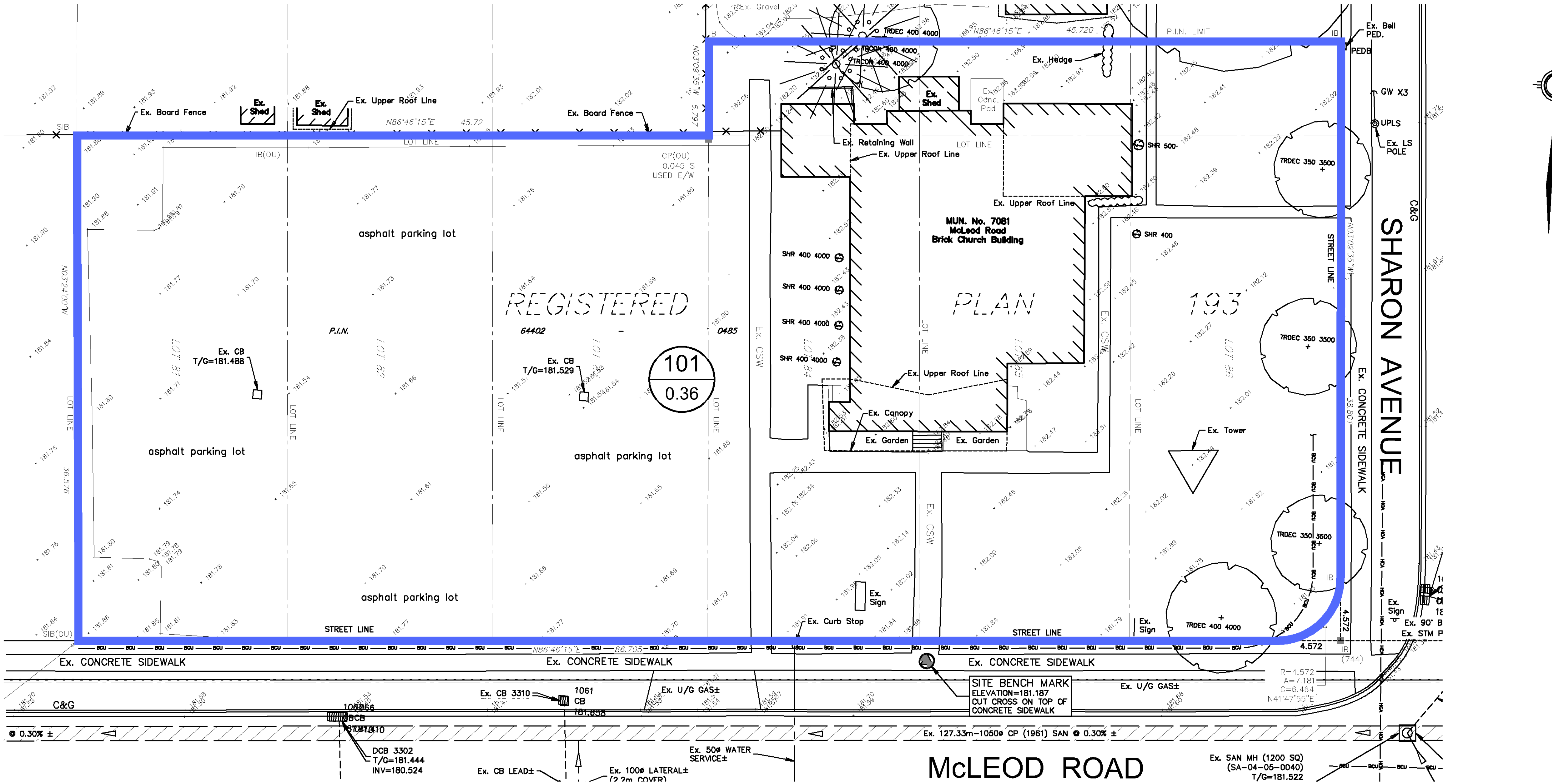
2.1.2 Quality Control

- Achieve “Normal” (70% TSS removal) quality treatment.

2.2 Existing Conditions

In the existing condition, the site is comprised of a building, landscaped areas, and an asphalt parking lot. There is an existing 375mm diameter concrete storm sewer within the McLeod Road Right-of-Way (ROW)at approximately 0.95% conveying flow towards the east. Additionally, there is an existing 1500mm diameter concrete storm sewer within the McLeod Road ROW, sloping west at approximately 0.4%. The 375mm storm sewer discharges into the 1500mm storm sewer just southeast of the Sharon Avenue and McLeod intersection (MH 3730). All stormwater runoff from Sharron Avenue ultimately flows into the storm sewer network on McLeod Road.

There are two existing catchbasins on site that collect stormwater and convey drainage to the existing municipal storm system. There is an existing catchbasin (CB 3310) within the grass boulevard, to the south of the site, assumed to be connected to the 375mm diameter municipal storm sewer. There are no known existing stormwater management quantity or quality controls on-site. The existing condition has been defined by one catchment area (see Table 2.1 and Figure 2.0).



LEGEND

SITE BOUNDARY

CATCHMENT 101

101 — SUB-CATCHMENT NUMBER

0.365 — AREA (ha.)

FIGURE 2.0

Date: JAN.26/23
Scale: 1:300

PRE-DEVELOPMENT CATCHMENT AREAS

MTE
Engineers, Scientists, Surveyors

Project No.: 52470-200

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Table 2.1 – Existing Condition Catchment Area Parameters

Catchment ID	Description	Area (ha)	% Imp.	Runoff Coef.
101	Existing site	0.36	62	0.63
	TOTAL	**0.36**	**62**	**0.63**

The existing condition was assessed using the Rational Method and the 5-year IDF parameters for the City of Niagara Falls design storm event. Table 2.2 summarizes the site allowable release rate for the 5-year design storm event which was calculated as follows:

$$Q = 0.00278CiA$$

Where:

- Q = runoff rate (m^3/s)
- C = runoff coefficient
- i = rainfall intensity (mm/hr)
- A = Catchment area (ha)

Table 2.2 – Existing Conditions 5-Year Peak Flow Rate

Design Storm Event	IDF Parameters [A]			Allowable Release Rate Q (m^3/s)
	A	B	C	
5-year	719.5	6.34	0.7687	0.054 [B]

[A] IDF parameters from NPCA Stormwater Management Guidelines Table 8.1.2 provided in Appendix C

[B] $i=\frac{a}{(T_c+b)^c}$, T_c= 10 min, Q = 0.00278CiA

2.3 Proposed Conditions

In the proposed condition, the proponent plans to construct a 5-storey mid-rise apartment building for a new residential development. The proposed condition drainage pattern is delineated by three catchment areas. A private storm sewer system will be installed on-site to collect runoff from the driveway and parking areas. The rooftop runoff will be collected by internal plumbing within the building and conveyed to the private storm sewer system. The runoff collected from the on-site storm sewers will be directed to an OGS unit within the site and into the 375mm diameter municipal sewer along McLeod Road.

Table 2.3 provides a brief description of each catchment area as well as the size and impervious cover associated with each. Figure 3.0 provides an illustration of the post-development catchment areas. Appendix A contains detailed information pertaining to the stormwater management model.

Table 2.3 – Proposed Condition Catchment Areas Parameters

Catchment ID	Description	Area (ha)	%Imp.
201	Building roof (Controlled with FCRD)	0.09	99
202	Controlled Parking lot and Landscape to McLeod Road	0.21	87
203	Uncontrolled Perimeter Drainage	0.06	25
	Total	**0.36**	**78**

Catchment 201

Catchment 201 represents the building roof. Stormwater runoff from this area will be attenuated via five flow control roof drains before discharging into the on-site storm sewer network constructed as part of Catchment 202.

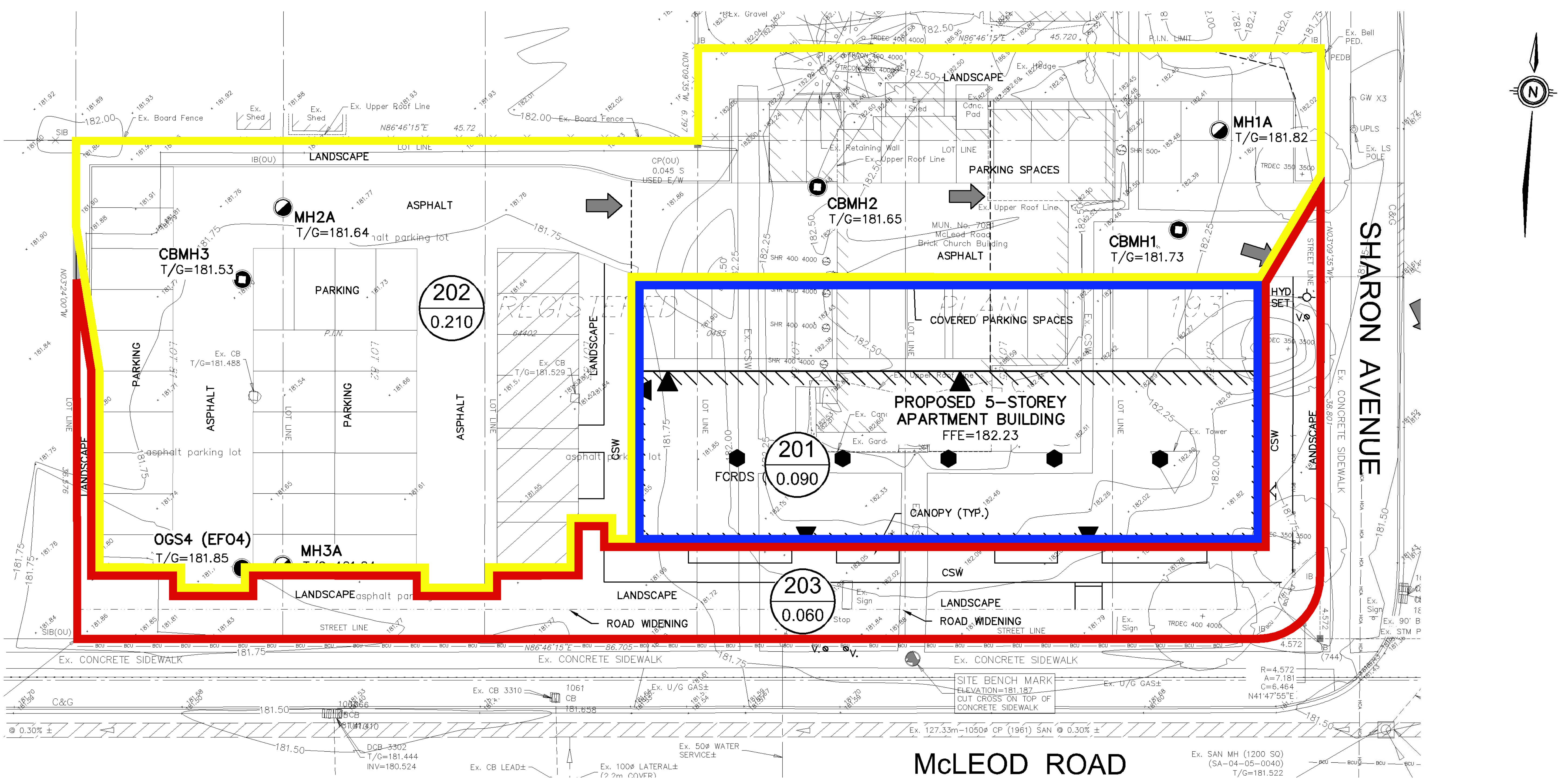
Catchment 202

Catchment 202 represents the surface parking lot, driveway, walkways and landscape areas draining into the on-site storm sewer network and subsequently towards McLeod Road. An on-line orifice plate will be installed in the storm sewer network to attenuate the runoff further.

Catchment 203

Catchment 203 represents the small area along the west, south and east limits of the site which will drain uncontrolled towards McLeod Road and Sharon Avenue. This area will include landscaped areas and pedestrian walkways as well as a small portion of the site access driveway. As noted above, all stormwater runoff draining to the Sharon Avenue ROW ultimately discharges to the existing downstream 375mm storm sewer on McLeod Road and ultimately into the 1500mm diameter trunk storm sewer within McLeod Road.

Table 2.4 summarizes the stage-storage-discharge relationship for the proposed flow control roof drains. Table 2.5 summarizes the stage-storage-discharge relationship for the proposed orifice plate and surface ponding. This information was used in the hydrologic model.



LEGEND

(grey line)	SITE BOUNDARY
(blue line)	CATCHMENT 201
(yellow line)	CATCHMENT 202
(red line)	CATCHMENT 203

201 — SUB-CATCHMENT NUMBER
0.060 — AREA (ha.)

FIGURE 3.0

Date: JAN.26/23
Scale: 1:300

POST DEVELOPMENT CATCHMENT AREAS

MTE
Engineers, Scientists, Surveyors

Project No.: 52470-200

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Table 2.4 – Stage-Storage-Discharge Calculations for Flow Control Roof Drains (Catchment 201)

Head, H (mm)	Cumulative Storage Volume (m^3)[A]	Discharge Q (m^3/s)[B]	Comments
0.00	0.0	0.0000	Roof Drain Elevation
50	2.3	0.0037	
100	13.0	0.0075	
150	43.0	0.0112	Max Allowable Ponding

[A] Storage volume based on roof area with 5 drains. See Appendix A for more details.
[B] Refer to Appendix B for sample calculation

Table 2.5 – Stage-Storage-Discharge Calculations for Surface Ponding (Catchment 202)

Elevation (m)	Head, H (m)	Cumulative Storage Volume (m^3)[A]	Discharge Q (m^3/s)[B]	Comments
180.53	0.00	0.0	0.0000	C/L of Orifice
181.53	0	0.0	0.0000	T/G
181.58	1.052	1.0	0.0351	
181.63	1.101	5.0	0.0359	10cm Contour
181.68	1.152	15.0	0.0367	
181.73	1.201	34.0	0.0375	20cm Contour
181.76	1.231	50.0	0.0380	Overflow Elev.

[A] Storage volume based on surface parking lot grading. See Appendix A for more details.
[B] From orifice equation $Q = CA\,(2gH)^{0.5}$ for a 125mm diameter orifice plate
Where: C = 0.63, A = cross-sectional area, g = 9.81, H = pressure head

The proposed conditions were assessed using the SWMHYMO hydrologic modeling program developed by J.F. Sabourin & Associates for the 5-year City of Niagara Falls design storm. Appendix A contains detailed hydrologic modeling parameters and input/output printouts for the proposed condition.

Table 2.6 summarizes the proposed condition 5-year peak discharge rate for the site with the aforementioned stormwater management controls and compares it to the 5-year existing condition discharge rate (i.e., allowable discharge rate). Table 2.7 summarizes the proposed condition storage volume requirements and storage volume provided on the roof and parking lot. The roof and parking lot will provide sufficient storage volume to retain stormwater runoff up to the 5-year storm event prior to being released into the existing 375mm diameter storm sewer along McLeod Road. Major flows will be safely conveyed to Sharon Avenue and subsequently McLeod Road.

Table 2.6 – Proposed Condition Peak Discharge Rate

Storm Event	Proposed Condition				Allowable 5-Year Existing Condition Peak Discharge Rate (Catchment 101) (m^3/s) [B]
	Peak Discharge Rate (Catchment 201 - Attenuated) (m^3/s) [A]	Peak Discharge Rate (Catchment 201 and 202 Attenuated) (m^3/s) [A]	Peak Discharge Rate (Catchment 203) (m^3/s) [A]	Total Peak Discharge Rate from Site (m^3/s) [A]	
5-Year	**0.007**	**0.036**	**0.006**	**0.36**	**0.054**

[A] Discharge rate taken from SWMHYMO Output (See Appendix A).
[B] See Table 2.2

The 5-year proposed condition peak discharge rate for the site are within the 5-year allowable release rate as illustrated in Table 2.6.

Table 2.7 – Proposed Conditions Storage Volume Requirements Summary

	Storage Volume Req.[A] (m^3)	Total Storage Volume Provided (m^3)[B]	Ponding Depth
Roof	12.05	43.0	95mm
Parking Lot	8.46	50.0	120mm

[A] Storage volume taken from SWMHYMO Output (see Appendix A).
[B] See Table 2.4

The analysis indicates the following:

- The total proposed condition peak discharge rate is less than the existing condition peak discharge rate for the 5-year storm event as illustrated in Table 2.6.
- Sufficient storage volume is provided on the roof to contain the 5-year storm event.
- Remaining storm events will be modeled as part of the SPA submission and orifice plate sizing as well as number of roof drains will be optimized.

2.3.1 Private Storm Service Connection

As previously mentioned, a private storm sewer system will be installed on-site to collect runoff from the proposed building, driveway and parking areas. A 250mm diameter private storm sewer connection is proposed at a slope of approximately 0.44% and will outlet into the existing 375mm diameter municipal sewer within the McLeod Road ROW, complete with a new manhole. The proposed storm service will have a full flow capacity of approximately 39.5L/s, which can adequately convey the attenuated 5-year storm design flow rate of 36L/s generated on the site. Runoff from the eastern portion of the property will flow towards Sharon Avenue and runoff from the southern portion of the property will flow towards McLeod Road. Please see Drawing C2.2 for further site servicing details

2.3.2 Water Quality Control

A Stormceptor Model EF04 will be installed on the storm sewer system to provide water quality control for the site. The chosen unit is expected to provide Level 1 water quality control (Refer to Appendix A for the sizing output.)

2.4 Sediment and Erosion Control

Sediment and erosion control measures will be implemented on site during construction and will conform to the Erosion & Sediment Control Guideline for Urban Construction (Ref 6).

Sediment and erosion control measures will include:

- Installation of silt control fencing at strategic locations around the perimeter of the site where feasible;
- Preventing silt or sediment laden water from entering inlets (catchbasins / catchbasin manholes) by installing silt sacks; and,
- Maintaining sediment and erosion control structures in good repair (including periodic cleaning as required) until such time that the Engineer or City of Niagara Falls approves their removal. Erosion control measures to be inspected daily and after any rainfall event.

Additional details will be provided on the engineering drawings at the time of detailed design.

3.0 Sanitary Sewer Servicing

3.1 Existing Conditions

There is an existing 1050mm diameter municipal sanitary sewer flowing west along McLeod Road at a slope of approximately 0.30% across the frontage of the site. This sewer has a full flow capacity of approximately 1,495L/s. All capacities are based on Manning's Roughness of 0.013.

3.2 Sanitary Demands

The anticipated sanitary discharge rate from the proposed building was estimated using the Ontario Building Code (OBC) (Ref.1). The estimated population count is summarized in Table 3.1. The estimated population count is used to calculate the peaking factor. The sanitary sewer discharge rates from the development are summarized in Table 3.2 and detailed calculations are found in Appendix B.

Table 3.1 – Population Estimate

Occupancy Types	Total Number of Units[A]	People per Unit [B]	Occupancy Factor	Population (people)
Proposed Condo Mix				
1 Bedroom units	32	2	-	64[C]
2 Bedroom units	18	4	-	72[C]
			Total Estimated Population	**136**

[A] Number of units provided on BIM and Stubbe's site plan dated November 25, 2022
[B] Population density based on OBC Occupancy Loads Section 3.1.17.1. clause 1b) (2 persons per bedroom)
[C] Population calculated as (Total # of Units) X (Persons per Unit)

Table 3.2 – Sanitary Sewer Discharge from Site

Occupancy Types	Population Estimate [A]	Average Flow (L/s)[B]	Peak Flow (L/s)[C]
Proposed Condo Mix			
1 bedroom units	64	0.33	2.49
2 bedroom units	72	0.38	2.79
Total Peak Sanitary Demand for Site			5.28 [D]
Total Peak Sanitary Demand for Site (with infiltration allowance)			**5.38 [E]**

[A] Room and population estimate: see Table 3.1
[B] Average flow for residential based on 275 L/d/person. (OBC Table 8.2.1.3.A)
[C] Peak flow = Average Flow*PF, where Harmon Peaking Factor (PF) = 1+(14/(4+P^(1/2))) where P = design population in thousands
[D] Total Peak flow = Peak flow from Condo Mix = 2.49 + 2.79 = 5.28 L/s
[E] Total Peak flow with infiltration = Total Peak flow + infiltration allowance = 5.28 + 0.101 = 5.38 L/s
Where infiltration is based on 0.18 l/s/ha (City of Niagara Falls). Area site area (0.36 ha), I = 0.28*0.36= 0.101 L/s

3.3 Proposed Sanitary Servicing Plan and Capacity Analysis

As calculated in Table 3.2, the total peak sanitary discharge from the site is 5.38L/s. The proposed building will be serviced by a 200mm diameter sanitary service at 2.0% slope with a full flow capacity of 46.3L/s. As per the City of Niagara Falls policy, the above calculated discharge rate will be inputted into a third-party infrastructure model. The third-party infrastructure modelling will determine if the local sanitary infrastructure servicing the site can sufficiently support the proposed development in conjunction with current flows. Third party infrastructure modelling can be facilitated through the Engineering Department and is subject to The City's Schedule of Fee's.

4.0 Domestic and Fire Water Supply Servicing

4.1 Existing Condition

The existing municipal water distribution system around the site consists of a 300mm diameter municipal watermain within the McLeod Road ROW.

4.2 Domestic Water Demands

The expected domestic water demand for the proposed development was estimated using the Niagara Region design criteria and Ontario Building Code. Table 4.1 summarizes the domestic water demand requirements for the Average Day, Maximum Day and Peak Hour demand scenarios.

Table 4.1 – Domestic Water Demands

Proposed Apartment Demands		
Population:	136 people (see Table 3.1)	
Average Day Demand: [1]	0.229 m^3/day/person x 136 people =	***0.361 L/s***
Maximum Day Demand: [1]	1.58 x 0.361 L/s =	***0.570 L/s***
Peak Hour Demand: [1]	4.00 x 0.361 L/s =	***1.441 L/s***

[1] Refer to Appendix B for detailed calculations.

4.3 Fire Flow Demands

Fire flow demands for the proposed development were determined using the methodology outlined in Water Supply for Public Fire Protection (Fire Underwriters Survey (FUS), 1999). The fire flow for the proposed building was evaluated. The fire demand is summarized in Table 4.2 and detailed calculations are provided in Appendix C.

Table 4.2 – FUS Fire Flow Requirements

Building	Fire Underwriters Survey (FUS) Flow Rate
Proposed building	133L/s (7980 L/min)

4.4 Proposed Water Servicing Plan and Analysis

The water service for the site will connect to the existing 300mm diameter municipal watermain within the McLeod ROW. The service for the proposed building will split into a dual 200mm diameter fire service and 200mm diameter domestic service at the southern property line. At the detailed design stage, the Mechanical consultant will confirm the watermain size requirements. The City of Niagara Falls requires water distribution systems to maintain a minimum residual pressure of 140kPa (20psi) when subject to fire flow demands and 275kPa (40psi) when subject to normal operating conditions. A hydrant flow test will be required during detailed design to confirm that the available system pressure meets these requirements.

5.0 Conclusions

Based on the information provided herein, it is concluded that the development can be constructed to meet the requirements of the City of Niagara Falls and Niagara Region. Therefore, it is recommended that:

i. Erosion and sediment controls be installed as described in Section 2.4 of this report;

ii. Sanitary servicing for the development be installed as described in Section 3.3 of this report;

iii. Water servicing for the development be installed as described in Section 4.4 of this report; and,

iv. The proposed stormwater management plan presented in this report and the site servicing works described in this report and as shown on Drawings C1.1, C2.1 and C2.2 be accepted in support of the Zoning By-Law Application and Official Plan Amendment.

We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

All of which is respectfully submitted,

MTE Consultants Inc.

Yorsaliem Haile, BASc.
Designer
519-743-6500 ext. 1479
yhaile@mte85.com

Andrei Tchoumatchev, P.Eng
Design Engineer
519-743-6500 ext. 1377
atchoumatchev@mte85.com

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Appendix A

Stormwater Management Information

MTE

7081 McLeod Road
City of Niagra Falls
STORMWATER MANAGEMENT

Design Storm Information and Allowable Release Rate

Design storm information used in the hydrologic modeling was based on Chicago Storm distribution Intensity-Duration-Frequency (IDF) equations for the City of Niagara Falls [A] in the form:

$$i = \frac{A}{(t+B)^C}$$

Where: i = Rainfall intensity (mm/hr)
t = Time of duration (min)
A, B and C = Constant (see below)

The value of the parameters for the various storm events is provided below:

Constant	2-Yr. [B]	5-Yr.	10-Yr.	25-Yr.	100-Yr.
A	522.0	719.5	577.9	1020.7	1264.6
B	5.28	6.34	2.48	7.29	7.72
C	0.7588	0.7687	0.6690	0.7790	0.7814

[A] IDF parameters from NPCA Stormwater Management Guidelines Table 8.1.2 provided

[B] IDF equations used to generate rainfall files with Duration (TD) = 3 hours

$$Q = 0.002778\ CiA$$

Site Area= 0.365 ha
C = 0.63

Existing Conditions Peak Flow Rates

	2-Yr. [B]	5-Yr.	10-Yr.	25-Yr.	100-Yr.
i (mm/hr)	65.93754	84.02411	106.7672	110.8285	133.7807
Q (m^3/s)	0.042	0.054	0.068	0.071	0.085

The rainfall intensity is generally taken from Intensity Duration Frequency (IDF) curves derived for the study area from historical rainfall data (see Section 8.3) at a nearby rain gauge. **Table 8.2** gives some sample standard IDF coefficients (a, b, c) for three locations in the Niagara Region where the intensity can be calculated using:

$$i = \frac{a}{(t_c + b)^c}$$

Table 8.1.2
Sample IDF coefficients in the Niagara Region

Location	**Storm Frequency (years)**	**a**	**b**	**c**
St. Catherines	2	567	5.2	0.746
	5	664	4.7	0.744
	10	724	4.3	0.739
	25	821	4.0	0.735
	50	900	3.8	0.734
	100	980	3.7	0.732
Welland	2	755	8	0.789
	5	830	7.3	0.777
	10	860	6.5	0.763
	25	900	5.2	0.745
	50	960	5.1	0.736
	100	1020	4.7	0.731
Niagara Falls	2	521.97	5.28	0.7588
	5	719.50	6.34	0.7687
	10	577.93	2.483	0.669
	25	1020.69	7.29	0.779
	100	1264.57	7.72	0.7814
Grimsby	2	603.25	6.00	0.79
	5	785.59	6.00	0.79
	10	953.64	7.00	0.79
	25	1119.02	7.00	0.79
	50	1301.80	8.00	0.80
	100	1426.13	8.00	0.80

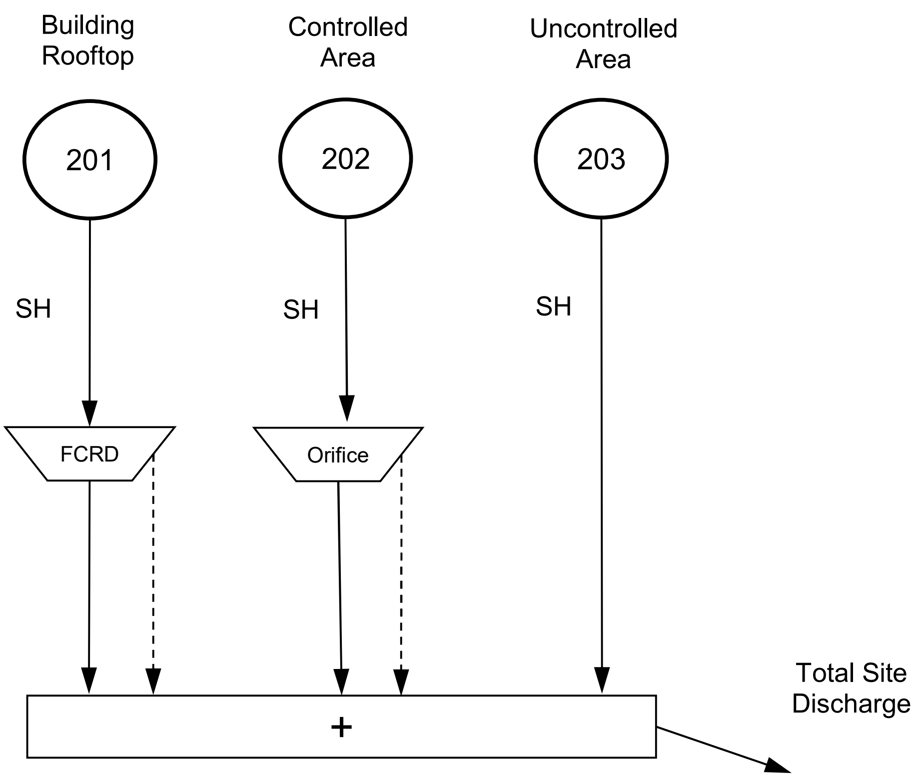
Additional IDF curves generated by Environment Canada can be found on the following pages.

7081 McLeod Road
City of Niagra Falls
STORMWATER MANAGEMENT

PROPOSED CONDITIONS HYDROLOGIC MODELING PARAMETERS														
Catchment ID	Catchment Description	Hydrograph Method	Area (ha)	Perv. CN	Perv. Ia (mm)	Impervious (%)		Flow Length (m)		Manning "n"		Slope (%)		Time to Peak Tp (hrs)
						TIMP	XIMP	Perv.	Imperv.	Perv.	Imperv.	Perv.	Imperv.	
201	Building roof (Controlled with FCRD)	STANDHYD	0.090	74	5.00	99%	99%	10	10	0.250	0.013	1.0	1.5	
202	Controlled Parking Lot and Landscape to McLeod Road	STANDHYD	0.210	74	5.00	87%	87%	2	15	0.250	0.013	10.0	1.5	
203	Uncontrolled Perimeter Drainage	STANDHYD	0.060	74	5.00	25%	25%	5	5	0.250	0.013	2.0	1.0	
	TOTAL AREA	**TOTAL**	**0.360**			**79.7%**								

7081 McLeod Road
City of Niagra Falls
STORMWATER MANAGEMENT

<u>Post-Development Conditions Hydrologic Modeling Schematic</u>



LEGEND

201 Catchment Area

Pond Route Reservoir

\+ Add Hydrographs

Overflow Direction

-"NH" denotes NASHYD hydrograph command
-"SH" denotes STANDHYD hydrograph command

7081 McLeod Road
City of Niagra Falls
STORMWATER MANAGEMENT

Project: 52470-200
Date: January 26, 2023
Designer: AXT
File: Q:\52470\200\SWM\52470-200 SWM Design 2023-01-26.xlsx

Stage-Storage-Discharge Relationship Rooftop Flow Controls

Proposed Building Roof (Catchment 204)

Total Roof Area = 0.09 ha
Total Roof Area Avail for Ponding= 0.086 ha
Number of roof drains = 5

Drain discharge = 0.015 l/s/mm head (0.378 l/s per inch of head per notch) - 1 Notch on each

Head	Area	Incremental Volume	Cumulative Volume	Total Discharge
(mm)	(m^2)	(m^3)	(m^3)	(m^3/s)
0	0	0	0.0	0
50	90	2.3	2.3	0.0037
100	342	10.8	13.0	0.0075
150	855	29.9	43.0	0.0112

Notes:

-Ponding areas at each stage were estimated based on roof roof areas and a slope of 1.5%

Sample Calculations (for when head = 50 mm):

Head (mm) = water level above the top of drain = 50 mm
Area (m^2) = surface area of water at corrosponding head = 90 m^2
Incremental volume (m^3) = (change in head)(average surface area) = [(50-0)/1000][(90+0)/2] = 2.3 m^3
Cumulative Volume (m^3) = current volume + prevous volume = 2.3 + 0 = 2.3 m^3
Total Discharge (m^3/s) = (# roof drains)(discharge/roof drain)(total head) = (5)(0.015)(50/1000) = 0.0037m ^{3}/s)

STAGE-STORAGE-DISCHARGE CALCULATIONS FOR SURFACE PONDING

Outlet Device No. 1 (Quantity)

Type:	Circular Orifice
Diameter (mm)	125
Area (m^2)	0.01227
Invert Elev. (m)	180.47
C/L Elev. (m)	180.53
Disch. Coeff. (C_d)	0.63
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

		SWM Pond Volumes			Outlet No. 1		Outlet No. 2		
	Elevation m	Area m^2	Incremental Volume m^3	Cumulative Volume m^3	H m	Discharge m^3/s	H m	Discharge m^3/s	Total Discharge m^3/s
T/G	181.53	0	0	0	0.000	0.0000			
	181.58	32	1	1	1.052	0.0351			
10cm Ponding	181.63	119	4	5	1.101	0.0359			
	181.68	289	10	15	1.152	0.0367			
20cm Ponding	181.73	482	19	34	1.201	0.0375			
Overflow Elev.	181.76	585	16	50	1.231	0.0380			

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2     Metric units
*#*************************************************************************|
*#  Project Name: 7081 McLeod Street
*#             NIAGARA FALLS, ONTARIO
*#  JOB NUMBER  : 52470-100
*#       Date   : January 2023
*#  Modeller    : AXT
*#    Company   : MTE CONSULTANTS INC.
*#       File   :
52470-100.DAT
*
*%-----------------|---------------------------------------------------------|
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
                    ["3H_005.stm"]
READ STORM          STORM_FILENAME=["STORM.001"]
*##########################################################################|
*#
*#                      POST DEVELOPMENT HYDROLOGIC MODELING
*#                 ====================================================
*#
*##########################################################################|

*#*************************************************************************|
*# CATCHMENT 201 - Building Roof (Controlled with Flow Control Roof Drains)
*#*************************************************************************|
CALIB STANDHYD      ID=[1], NHYD=["201"], DT=[1.0](min), AREA=[0.09](ha),
                    XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[74],
                    Pervious   surfaces: IAper=[5.00](mm), SLPP=[1.0](%),
                                         LGP=[10](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1](mm), SLPI=[1.5](%),
                                         LGI=[10](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|---------------------------------------------------------|
*#-----------------| 5 ZURN Z105 FLO CONTROL ROOF DRAINS, SINGLE NOTCH---------|
*#-----------------|---------------------------------------------------------|

ROUTE RESERVOIR     IDout=[2],   NHYD=["FCRD"],  IDin=[1],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                     (cms) - (ha-m)
                                    [ 0,0 ]
                                    [ 0.0037,0.0002 ]
                                    [ 0.0075,0.0013 ]
                                    [ 0.0112,0.0043 ]
                                    [   -1  ,  -1  ]  (max twenty pts)
                          IDovf=[3], NHYDovf=["201_OV"]
*%-----------------|---------------------------------------------------------|
*#*************************************************************************|
*# CATCHMENT 202 - Controlled Parking Lot and Landscape to McLeod Road
*#*************************************************************************|
CALIB STANDHYD      ID=[4], NHYD=["202"], DT=[1.0](min), AREA=[0.21](ha),
                    XIMP=[0.87], TIMP=[0.87], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[74],
                    Pervious   surfaces: IAper=[5.00](mm), SLPP=[10.0](%),
                                         LGP=[2](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.5](%),
                                         LGI=[15](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*#*************************************************************************|
*%-----------------|---------------------------------------------------------|
*Attenuated 201 + Unattenuated 202 to Orifice Plate
ADD HYD             IDsum=[5], NHYD=["SITE"], IDs to add=[2,3,4]
*%-----------------|---------------------------------------------------------|
*%-----------------|---------------------------------------------------------|
*#-----------------| Parking Lot Ponding with Orifice Plate--------------------|
*#-----------------|---------------------------------------------------------|

ROUTE RESERVOIR     IDout=[6],   NHYD=["Orifice"],  IDin=[5],
                    RDT=[1](min),
                          TABLE of ( OUTFLOW-STORAGE ) values
                                      (cms) - (ha-m)
                                    [ 0,0 ]
                                    [ 0.0351,0.0001 ]
                                    [ 0.0359,0.0005 ]
                                    [ 0.0367,0.0015 ]
                                    [ 0.0375,0.0034 ]
                                    [ 0.0380,0.0050 ]
                                    [   -1  ,  -1  ]  (max twenty pts)
                          IDovf=[7], NHYDovf=["OVF"]
*%-----------------|---------------------------------------------------------|
*#*************************************************************************|
*# CATCHMENT 203 - Uncontrolled Perimeter Drainage
*#*************************************************************************|
CALIB STANDHYD      ID=[8], NHYD=["203"], DT=[1.0](min), AREA=[0.06](ha),
                    XIMP=[0.25], TIMP=[0.25], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[74],
                    Pervious   surfaces: IAper=[5.00](mm), SLPP=[2.0](%),
                                         LGP=[5](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[1.0](%),
                                         LGI=[5](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*#*************************************************************************|
*%-----------------|---------------------------------------------------------|
*TOTAL FLOW LEAVING THE SITE
ADD HYD             IDsum=[9], NHYD=["SITE"], IDs to add=[6,7,8]
*%-----------------|---------------------------------------------------------|
*
* RUN REMAINING DESIGN STORMS (City of Niagara Falls 3-hour 5 -YR)
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
                    ["3H_005.stm"]
*%-----------------|---------------------------------------------------------|
FINISH
```

```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9   =========
                                                        9   9  9   9   # 3057174
        StormWater Management HYdrologic Model           999    999    =========

 ******************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                OTTHYMO-83 and OTTHYMO-89.                   *********
 ******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.           *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ******************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: MTE Consultants Inc.                         +++++++++
 +++++++++               Kitchener             SERIAL#:3057174         +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ******************************************************************************
 *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++            *********
 *********           Maximum value for ID numbers  :      10           *********
 *********           Max. number of rainfall points: 105408            *********
 *********           Max. number of flow points    : 105408            *********
 ******************************************************************************


 **********************   D E T A I L E D   O U T P U T   **********************
 ******************************************************************************
 *         DATE: 2023-01-26     TIME: 18:16:46     RUN COUNTER: 000101         *
 ******************************************************************************
 * Input   filename: Q:\52470\200\SWM\52470-~1.DAT                             *
 * Output  filename: Q:\52470\200\SWM\52470-~1.out                             *
 * Summary filename: Q:\52470\200\SWM\52470-~1.sum                             *
 * User comments:                                                              *
 * 1:__________________________________________________________________________*
 * 2:__________________________________________________________________________*
 * 3:__________________________________________________________________________*
 ******************************************************************************

----------------------------------------------------------------------------------
001:0001--------------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 7081 McLeod Street
*#            NIAGARA FALLS, ONTARIO
*#  JOB NUMBER  : 52470-100
*#       Date   : January 2023
*#  Modeller    :
AXT
*#    Company   : MTE CONSULTANTS INC.
*#       File   :
52470-100.DAT
*
  ** END OF RUN :    4

*******************************************************************************
```

```
--------------------
| START            |  Project  dir.:
Q:\52470\200\SWM\
--------------------  Rainfall dir.:
Q:\52470\200\SWM\
    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 005
    NSTORM=   1
           #  1=3H_005.stm
----------------------------------------------------------------------------------
005:0002--------------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 7081 McLeod Street
*#            NIAGARA FALLS, ONTARIO
*#  JOB NUMBER  : 52470-100
*#       Date   : January 2023
*#  Modeller    :
AXT
*#    Company   : MTE CONSULTANTS INC.
*#       File   :
52470-100.DAT
*
----------------------------------------------------------------------------------
005:0002--------------------------------------------------------------------------
--------------------
| READ STORM       |    Filename: 3 HOUR 5 YEAR CHICAGO STORM
| Ptotal=  38.81 mm|    Comments: 3 HOUR 5 YEAR CHICAGO STORM
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .08   3.603 |    .83  18.297 |   1.58   9.701 |   2.33   4.686
               .17   3.913 |    .92  40.363 |   1.67   8.605 |   2.42   4.449
               .25   4.289 |   1.00 111.263 |   1.75   7.746 |   2.50   4.237
               .33   4.759 |   1.08  51.420 |   1.83   7.055 |   2.58   4.047
               .42   5.363 |   1.17  29.796 |   1.92   6.486 |   2.67   3.875
               .50   6.170 |   1.25  20.894 |   2.00   6.010 |   2.75   3.719
               .58   7.307 |   1.33  16.119 |   2.08   5.605 |   2.83   3.577
               .67   9.039 |   1.42  13.160 |   2.17   5.256 |   2.92   3.446
               .75  12.007 |   1.50  11.152 |   2.25   4.953 |   3.00   3.325

----------------------------------------------------------------------------------
005:0003--------------------------------------------------------------------------
*#########################################################################|
*#
*#                     POST DEVELOPMENT HYDROLOGIC MODELING
*#                ====================================================
*#
*#########################################################################|
*#*************************************************************************|
*# CATCHMENT 201 - Building Roof (Controlled with Flow Control Roof Drains)
*#*************************************************************************|
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .09
| 01:201    DT= 1.00 |   Total Imp(%)=   99.00   Dir. Conn.(%)=   99.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .09          .00
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.50         1.00
     Length            (m)=      10.00        10.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     111.26        17.79
                over (min)        1.00         8.00
     Storage Coeff.  (min)=        .54 (ii)    8.09 (ii)
     Unit Hyd. Tpeak (min)=       1.00         8.00
     Unit Hyd. peak  (cms)=       1.43          .14
                                                         *TOTALS*
```

```
     PEAK FLOW        (cms)=        .03          .00           .028 (iii)
     TIME TO PEAK     (hrs)=       1.00         1.17          1.000
     RUNOFF VOLUME     (mm)=      37.81         9.29         37.522
     TOTAL RAINFALL    (mm)=      38.81        38.81         38.808
     RUNOFF COEFFICIENT   =         .97          .24           .967

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN* =  74.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
005:0004-----------------------------------------------------------------------------
*#-----------------| 5 ZURN Z105 FLO CONTROL ROOF DRAINS, SINGLE NOTCH---------|
*#-----------------|-----------------------------------------------------------|
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<02:(FCRD  )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)   |    (cms)     (ha.m.)
                            .000  .0000E+00   |      .007  .1300E-02
                            .004  .2000E-03   |      .011  .4300E-02


     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)      (cms)     (hrs)        (mm)
     INFLOW >01: (201   )        .09       .028     1.000      37.522
     OUTFLOW<02: (FCRD  )        .09       .007     1.167      37.522
    OVERFLOW<03: (201_OV)        .00       .000      .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   26.029
                   TIME SHIFT OF PEAK FLOW          (min)=    10.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.1205E-02

-------------------------------------------------------------------------------------
005:0005-----------------------------------------------------------------------------
*#**************************************************************************|
*# CATCHMENT 202 - Controlled Parking Lot and Landscape to McLeod Road
*#**************************************************************************|
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .21
| 04:202    DT= 1.00 |   Total Imp(%)=   87.00   Dir. Conn.(%)=   87.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=        .18          .03
     Dep. Storage      (mm)=       1.00         5.00
     Average Slope      (%)=       1.50        10.00
     Length             (m)=      15.00         2.00
     Mannings n           =        .013         .250

     Max.eff.Inten.(mm/hr)=     111.26        24.80
                over (min)        1.00         2.00
     Storage Coeff.  (min)=        .69 (ii)     1.96 (ii)
     Unit Hyd. Tpeak (min)=       1.00         2.00
     Unit Hyd. peak  (cms)=       1.30          .57
                                                          *TOTALS*
     PEAK FLOW        (cms)=        .06          .00           .058 (iii)
     TIME TO PEAK     (hrs)=       1.00         1.02          1.000
     RUNOFF VOLUME     (mm)=      37.81         9.29         34.100
     TOTAL RAINFALL    (mm)=      38.81        38.81         38.808
     RUNOFF COEFFICIENT   =         .97          .24           .879

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN* =  74.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------------
005:0006-----------------------------------------------------------------------------
*#**************************************************************************|
*Attenuated 201 + Unattenuated 202 to Orifice Plate
------------------------
| ADD HYD (SITE      ) | ID: NHYD         AREA     QPEAK    TPEAK    R.V.     DWF
------------------------                   (ha)      (cms)    (hrs)    (mm)    (cms)
                        ID1 02:FCRD            .09      .007     1.17   37.52    .000
                       +ID2 03:201_OV          .00      .000      .00     .00    .000  **DRY**
                       +ID3 04:202             .21      .058     1.00   34.10    .000
                        ===========================================================
                        SUM 05:SITE            .30      .064     1.00   35.13    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------------
005:0007-----------------------------------------------------------------------------
*#-----------------| Parking Lot Ponding with Orifice Plate--------------------|
*#-----------------|-----------------------------------------------------------|
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>05:(SITE  )   |
| OUT<06:(Orific)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)     (ha.m.)   |    (cms)     (ha.m.)
                            .000  .0000E+00   |      .037  .1500E-02
                            .035  .1000E-03   |      .038  .3400E-02
                            .036  .5000E-03   |      .038  .5000E-02


     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)      (cms)     (hrs)        (mm)
     INFLOW >05: (SITE  )        .30       .064     1.000      35.127
     OUTFLOW<06: (Orific)        .30       .036     1.033      35.127
    OVERFLOW<07: (OVF   )        .00       .000      .000        .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   56.407
                   TIME SHIFT OF PEAK FLOW          (min)=     2.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.8462E-03

-------------------------------------------------------------------------------------
005:0008-----------------------------------------------------------------------------
*#**************************************************************************|
*# CATCHMENT 203 - Uncontrolled Perimeter Drainage
*#**************************************************************************|
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .06
| 08:203    DT= 1.00 |   Total Imp(%)=   25.00   Dir. Conn.(%)=   25.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area      (ha)=        .01          .05
     Dep. Storage      (mm)=       1.00         5.00
     Average Slope      (%)=       1.00         2.00
     Length             (m)=       5.00         5.00
     Mannings n           =        .013         .250

     Max.eff.Inten.(mm/hr)=     111.26        21.45
                over (min)        1.00         4.00
     Storage Coeff.  (min)=        .41 (ii)     4.16 (ii)
     Unit Hyd. Tpeak (min)=       1.00         4.00
```

```
     Unit Hyd. peak  (cms)=       1.55          .28
                                                         *TOTALS*
     PEAK FLOW       (cms)=        .00          .00           .006 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.05          1.000
     RUNOFF VOLUME    (mm)=      37.81         9.29         16.418
     TOTAL RAINFALL   (mm)=      38.81        38.81         38.808
     RUNOFF COEFFICIENT   =        .97          .24           .423

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  74.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------------
005:0009------------------------------------------------------------------------------
*#***********************************************************************|
*TOTAL FLOW LEAVING THE SITE
------------------------
| ADD HYD (SITE      ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 06:Orifice         .30     .036    1.03  35.13    .000
                    +ID2 07:OVF             .00     .000     .00    .00    .000  **DRY**
                    +ID3 08:203             .06     .006    1.00  16.42    .000
                     ==========================================================
                     SUM 09:SITE            .36     .042    1.00  32.01    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------------
005:0010------------------------------------------------------------------------------
*
* RUN REMAINING DESIGN STORMS (City of Niagara Falls 3-hour 5 -YR)
*
--------------------------------------------------------------------------------------
005:0002------------------------------------------------------------------------------
      FINISH
--------------------------------------------------------------------------------------
**************************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2023-01-26     at 18:16:47
======================================================================================
```

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

01/27/2023

Province:	Ontario
City:	Niagara Falls
Nearest Rainfall Station:	ST CATHARINES AP
Climate Station Id:	6137287
Years of Rainfall Data:	33
Site Name:	
Drainage Area (ha):	0.30
% Imperviousness:	91.00
Runoff Coefficient 'c':	0.84
Particle Size Distribution:	Fine
Target TSS Removal (%):	70.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	7.89
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	36.00
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	7081 McLeod Road
Project Number:	52470-200
Designer Name:	Yorsaliem Haile
Designer Company:	MTE Consultants Inc.
Designer Email:	yhaille@mte85.com
Designer Phone:	519-743-6500
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	91
EFO6	96
EFO8	99
EFO10	99
EFO12	100

Recommended Stormceptor EFO Model: EFO4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 91

Water Quality Runoff Volume Capture (%): > 90

THIRD-PARTY TESTING AND VERIFICATION

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

PERFORMANCE

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

PARTICLE SIZE DISTRIBUTION (PSD)

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

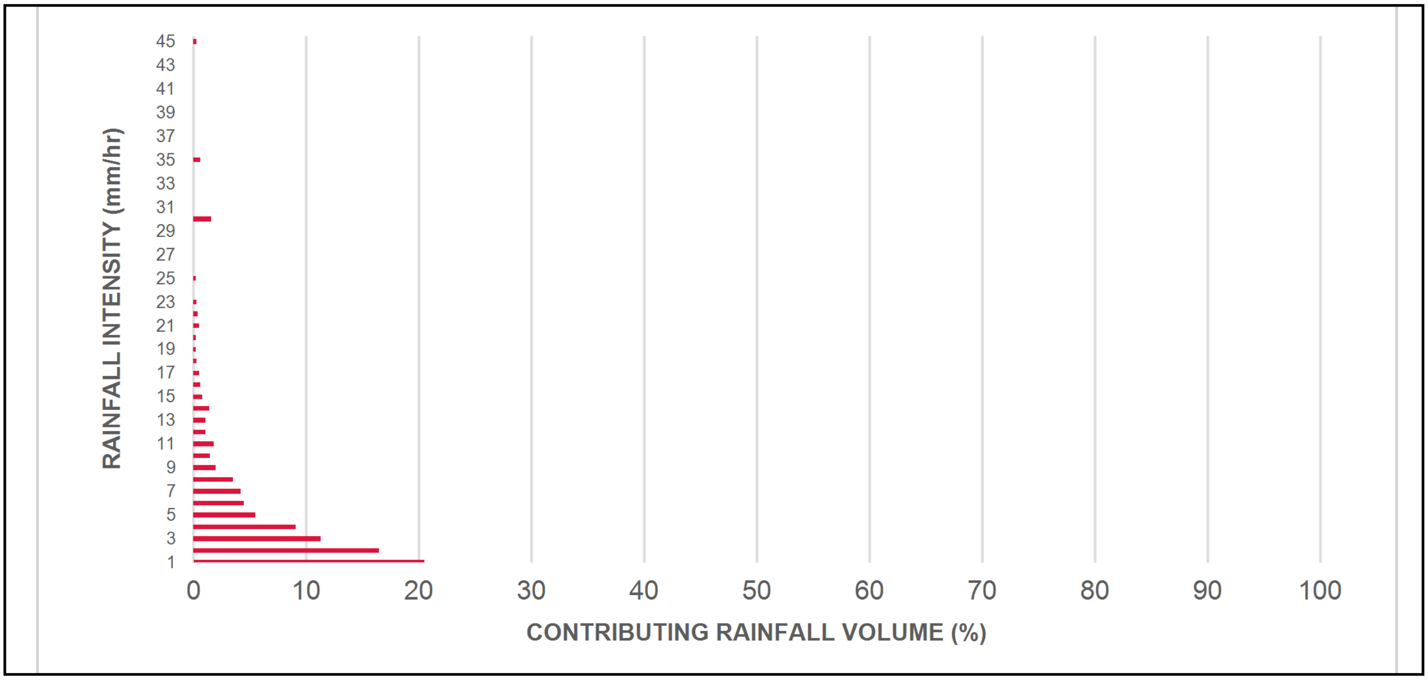
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Upstream Flow Controlled Results

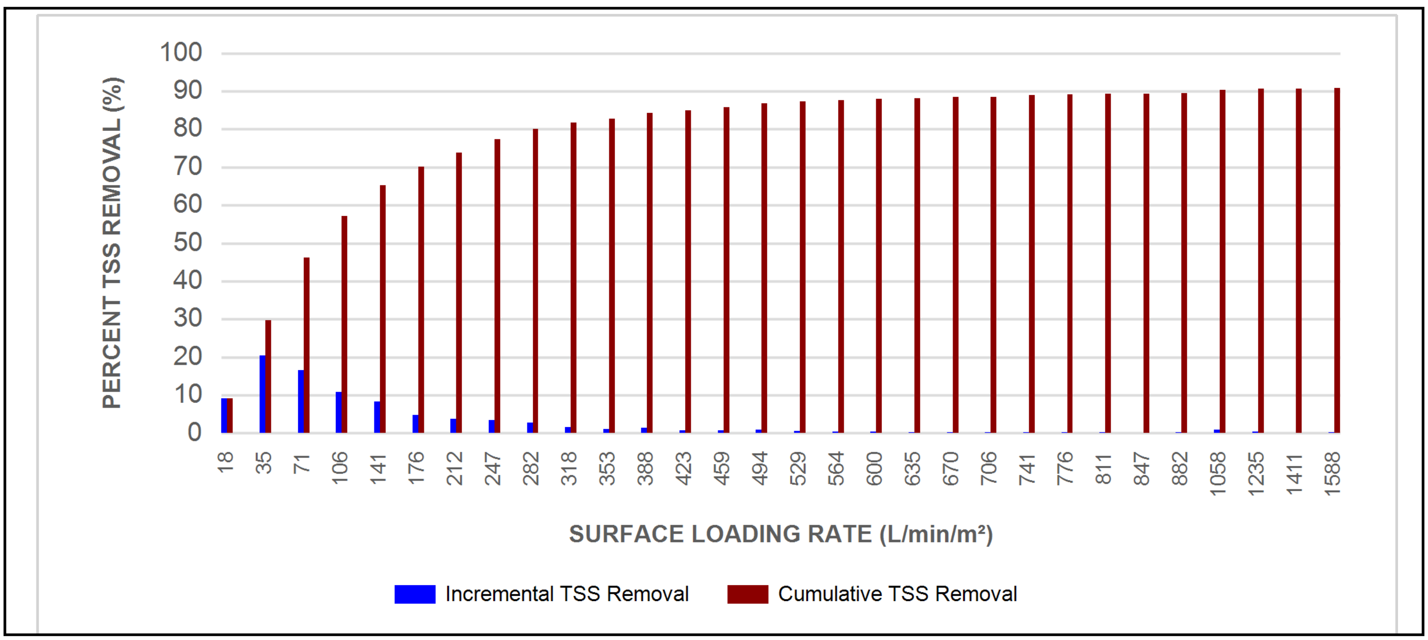
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	9.2	9.2	0.35	21.0	18.0	100	9.2	9.2
1	20.5	29.7	0.71	42.0	35.0	100	20.5	29.7
2	16.5	46.2	1.41	85.0	71.0	100	16.5	46.2
3	11.3	57.5	2.12	127.0	106.0	96	10.9	57.1
4	9.1	66.7	2.82	169.0	141.0	91	8.3	65.3
5	5.5	72.2	3.53	212.0	176.0	87	4.8	70.1
6	4.5	76.7	4.23	254.0	212.0	83	3.7	73.9
7	4.2	80.9	4.94	296.0	247.0	81	3.4	77.3
8	3.5	84.4	5.64	339.0	282.0	79	2.8	80.1
9	2.0	86.5	6.35	381.0	318.0	78	1.6	81.7
10	1.5	88.0	7.06	423.0	353.0	76	1.1	82.8
11	1.8	89.8	7.76	466.0	388.0	75	1.4	84.2
12	1.1	90.9	8.47	508.0	423.0	73	0.8	85.0
13	1.1	92.0	9.17	550.0	459.0	72	0.8	85.8
14	1.4	93.4	9.88	593.0	494.0	70	1.0	86.8
15	0.8	94.2	10.58	635.0	529.0	68	0.5	87.3
16	0.6	94.8	11.29	677.0	564.0	66	0.4	87.7
17	0.5	95.3	11.99	720.0	600.0	65	0.3	88.0
18	0.3	95.6	12.70	762.0	635.0	64	0.2	88.2
19	0.2	95.9	13.41	804.0	670.0	64	0.1	88.4
20	0.2	96.1	14.11	847.0	706.0	64	0.2	88.5
21	0.5	96.6	14.82	889.0	741.0	64	0.3	88.9
22	0.4	97.0	15.52	931.0	776.0	63	0.3	89.1
23	0.3	97.3	16.23	974.0	811.0	63	0.2	89.3
24	0.0	97.3	16.93	1016.0	847.0	63	0.0	89.3
25	0.2	97.4	17.64	1058.0	882.0	62	0.1	89.4
30	1.6	99.1	21.17	1270.0	1058.0	60	1.0	90.4
35	0.6	99.7	24.69	1482.0	1235.0	56	0.4	90.7
40	0.0	99.7	28.22	1693.0	1411.0	52	0.0	90.7
45	0.3	100.0	31.75	1905.0	1588.0	46	0.1	90.9
Estimated Net Annual Sediment (TSS) Load Reduction =								**91 %**

Climate Station ID: 6137287 *Years of Rainfall Data*: 33

RAINFALL DATA FROM ST CATHARINES AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

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

SCOUR PREVENTION AND ONLINE CONFIGURATION

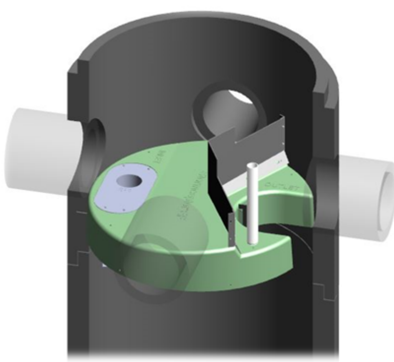
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test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

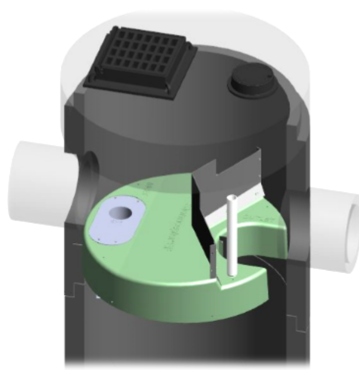
DESIGN FLEXIBILITY

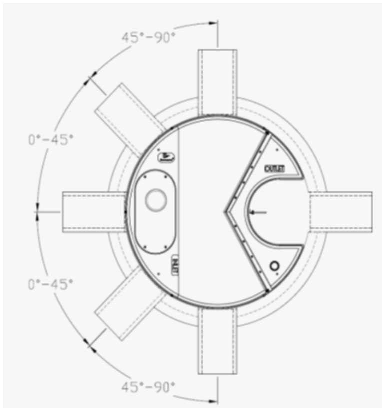
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend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

OIL CAPTURE AND RETENTION

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







INLET-TO-OUTLET DROP

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

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

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

HEAD LOSS

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

Pollutant Capacity

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

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

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

STANDARD STORMCEPTOR EF/EFO DRAWINGS

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

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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

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

PART 1 – GENERAL

1.1 WORK INCLUDED

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

1.2 REFERENCE STANDARDS & PROCEDURES

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

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

1.3 SUBMITTALS

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

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

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

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

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

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

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

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

3.2 SIZING METHODOLOGY

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

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

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

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

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

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

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

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

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

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

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

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

Appendix B

Sanitary Servicing

MTE

7081 McLeod Rd - Apartment
Niagara Falls, Ontario
MTE Project #: 52470-200
1/27/2023

Sanitary Demand Calculations

Land Use	Residential					Commercial		Totals (Residential + Commercial)		
	Units [1]	Population Density [2]	Occupancy	Population (persons)	Demand (L/s)	Floor Area (ha)	Demand (L/s)	Total Average Demand (L/s)	Total Peaked Demand (L/s)	Total Peaked Demand + Infiltration (L/s)
Proposed Apartment										
1 Bedroom	32	2.0	-	64	0.333			0.333	2.484	
2 Bedroom	18	4.0	-	72	0.375			0.375	2.794	
Total				**136**	**0.708**		**0.000**	**0.708**	**5.278**	**5.278**

Sanitary Demand		
Residential Daily Demands[3]	450	L/d/person
	0.0052	L/ca/s
Babbit Factor (Residential) [4]	7.452	
Site Area	0.36	ha
Infiltration Allowance [5]	0.28	L/s/ha
	0.101	L/s

Note 1: Room/Unit count breakdown provided by architect

Note 2: Design population based on the occupant load (Refer to OBC Table 3.1.17.1)

Note 3: Residential daily demands based on 2020 OBC, Table 8.2.1.3.A, Apartments, condominiums, other multi-family dwellings, per person

Note 4: Babbit Peaking Factor Kh = (5/(P^(0.2))) where P = Condo Mix population in thousands

Note 5: Infiltration allowance based on City of Niagara Falls Design Standards Ch. 2 Sanitary Sewers

Appendix C

WTM Servicing

7081 Mcleod Rd - Apartment

Niagara Falls, Ontario

MTE Project #:52470-200

1/27/2023

MTE

Residential Peaking Factors[1]:	
Avg. Day	1.0
Max. Day	1.58
Peak Hour	4.00

Water Demand Calculations

	Residential					Commercial				Final (Residential + Commercial) Demand		
Location	Units (ea)	Population Density (persons/unit) [2]	Occupancy	Population (persons)	Demand (L/s)	Floor Area (ha)	Population Density (person/ha) [3]	Population (persons)	Demand (L/s)	Avg Day Demand Qavg (L/s)	Max Day Demand Qmax.day (L/s)	Peak Hour Demand Qpeak (L/s)
Proposed Condo Mix												
1 Bedroom	32	2.0	-	64	0.170					0.170	0.268	0.679
2 Bedroom	18	4.0	-	72	0.191					0.191	0.302	0.763
										0.360	**0.570**	**1.442**
Total Condo Mix										***0.360***	***0.570***	***1.442***

Water Demand		
Average Residential Daily Demands [4]	0.229	m3/day/person
	0.0027	L/s/person

Max Day + Fire Flow Demand		
Qmax.day+fire	133.90	L/s

Note 1: Peaking factor for Residential based on Niagara Region Design criteria (Section 4.2.4 Design Factors)
Note 2: Design population based on 2 people per room (Refer to OBC 3.1.17.1 (b)
Note 3: Population density for commercial based on Niagara region Standards (person/hectare),Section 5.2.4
Note 4: Residential demands based on Niagara Region Design Criteria (Section 4.2.4 Design Factors)

Fire Flow [1]		
Fire Flow	133	L/s

7081 Mcleod Rd - Apartment
Niagara Falls, Ontario
MTE Project #:52470-200
1/27/2023

FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

An estimate of the fire flow required is given by the following formula:

$$F = 220\,C\sqrt{A}$$

where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres

Adjustments to the calculated fire flow can be made based on occupancy, sprinkler protection and exposure to other structures. The table below summarizes the adjustments made to the basic fire flow demand.

Building	Area "A" [A] (m^2)	C [B]	(1) Fire Flow "F" (l/min)	(1) Fire Flow "F" (l/s)	(2) Occupancy %	(2) Occupancy Adjusted Fire Flow (L/min)	(3) Sprinkler %	(3) Sprinkler Adjustment (L/min)	(4) Exposure %	(4) Exposure Adjustment (L/min)	**Final Adjusted Fire Flow (L/min)**	**Final Adjusted Fire Flow Rounded(L/min)**	**Final Adjusted Fire Flow (L/s)**
Proposed Building	4,604	0.8	12,000	200.0	0	12,000	-30	-3,600	60%	72	8,472	8,000	**133**

Note A: Area "A" represents the Gross Floor Area of two largest adjoinitng floors (floor 7 & 8) plus 50 percent of the 8 floors immediately above.
Note [B]: Construction type confirmed by the Architect

(2) Occupancy

Non-Combustible	-25%
Limited Combustible	-15%
Combustible	No charge
Free Burning	15%
Rapid Burning	25%

(3) Sprinkler

30% credit for adequately designed system per NFPA 13. Additional 10% if water supply standard for both the system and fire department hose lines.

(4) Exposure

0 to 3m	25%
3.1 to 10m	20%
10.1 to 20m	15%
20.1 to 30m	10%
30.1 to 45m	5%

Calculate for all sides. Maximum charge shall not exceed 75%

Exposure Distances

N	16m	15%
E	7.5m	20%
S	7.5m	20%
W	38.6m	5%
	Total	**60%**