223 St. Andrew Street East, Fergus

Functional Servicing and Stormwater Management Report

Project Location:
223 St. Andrew Street East, Fergus, ON

Prepared for:
MMDG Health Services Inc.
309 Daniel Crescent, Elora, ON

Prepared by:
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May 17, 2022

MTE File No.: 50389-100

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1.0 Introduction

MTE Consultants Inc. was retained by MMDG Health Services Inc. to complete a Functional Servicing and Stormwater Management Report for a new mixed-use development to be constructed at 223 St. Andrew Street East (herein referred to as 'the Site') in the Township of Centre Wellington in support of the Zoning By-Law Amendment Application. The current zoning of the Site is C1 (Central Business District Commercial). The C1 zoning allows for residential units above ground floor commercial however, the new mixed-use building proposes one residential unit on the ground floor. Moreover, the allowable building height in the C1 zoning is 11m but the proposed building is approximately 15m. As a result, a Zoning By-Law Amendment is required.

The Site is legally described as all of lot 70, north side of north St. Andrew Street, registered plan 55 in the Township of Centre Wellington. The property is bounded to the north and east by existing commercial and residential properties, to the south by St. Andrew Street East, and to the west by Gowrie Street North. For the exact location of the Site refer to Figure 1.0.

The proposed development for the Site is the construction of a new 5-storey mixed-use residential building with commercial suites on the ground floor. The proposed development will have surface parking to the north side of the building and will also include a ground floor patio adjacent to St. Andrew Street East. To construct the proposed development, demolition of the existing dwelling and garage/workshop will be required.

The purpose of this study is to support the Zoning By-Law Amendment Applications. This will be accomplished by reviewing the opportunities and constraints for the subject property with respect to servicing, grading, and stormwater management; reviewing the requirements of the reviewing agencies; describing the development concept; and demonstrating the functional serviceability of the property. Pending approval of the Amendment application, detailed design of the Site will commence and be submitted to the Township in support of Site Plan Approval.

2.0 Existing Conditions

2.1 Existing Topography

The Site encompasses an area of 0.10ha and currently comprises of a dwelling, a garage/workshop, two driveways connecting to Gowrie Street North, and green space. In the existing condition, there is a high point between the east walls of the existing buildings, with drainage at either side of the high point being directed towards the east and west. There is an elevation difference of approximately 0.8m between the north and south property line, and approximately 0.2m between the east and west property line. Currently, a retaining wall exists on the north side of the Site on the neighbouring property. The Site is approximately 33% impervious in the existing condition.

April 1, 2022 — 1:51 p.m. — Plotted By: SDu P:\P\50389\100\50389-100-F1.dwg

2.2 Existing Servicing

2.2.1 Water

There is an existing 300mm diameter municipal watermain along St. Andrew Street East, and an existing 200mm diameter municipal watermain along Gowrie Street North. The closest municipal fire hydrant is near the southwest corner of the Site in the boulevard north of St. Andrew Street East. The Site is currently serviced by an unknown diameter water service off the St. Andrew Street East watermain. There is also an existing 25mm water service off the Gowrie Street North watermain capped with a curb stop at the west property line of the Site. The existing water services off St. Andrew Street East and Gowrie Street North will be decommissioned and capped at the main as a part of the redevelopment of the Site.

2.2.2 Sanitary

There is an existing 450mm diameter sanitary sewer along St. Andrew Street East which drains toward the west. The closest existing manhole is located near the southwest corner of the Site in the northeast boulevard of the St. Andrew Street East and Gowrie Street North intersection. At this manhole, the sewer is approximately 2.3m below the top grate elevation. The Site is currently serviced by an unknown diameter pipe which connects to this St. Andrew Street East sanitary sewer. This service will be capped at the property line as a part of the redevelopment of the Site.

There is also an existing 200mm diameter sanitary sewer along Gowrie Street North which drains toward the south. The closest existing manhole is located near the northwest corner of the Site in the Gowrie Street North right-of-way. At this manhole, the sewer is approximately 2.5m below the top grate elevation. There is an existing 150mm diameter pipe extended to the Site which connects to this Gowrie Street North sanitary sewer and is plugged at the property line with a clean out.

The two sanitary sewers along St. Andrew Street East and Gowrie Street North converge at an existing manhole located in the intersection of the two streets, where a 525mm sanitary sewer continues to drain toward the west. At this manhole, the sewer is approximately 2.2m below the top grate elevation.

2.2.3 Storm

There is a 300mm diameter storm sewer along St. Andrew Street East that upsizes to a 375mm diameter storm sewer and drains toward the west. The closest existing manhole is located next to the drop curb on the south side of the St. Andrew Street East and Gowrie Street North intersection. At this manhole, the sewer is approximately 1.9m below the top grate elevation.

There is also an existing 250mm diameter storm sewer along Gowrie Street North that drains toward the south. The closest existing manhole is located near the west property line, next to the drop curb on the east side of Gowrie Street North right-of-way. At this manhole the sewer is approximately 1.2m below the top grate elevation.

Surface runoff from a majority of the Site is conveyed overland to the west, where it enters the Gowrie Street North storm sewer.

2.3 Existing Soils Information

Geotechnical information for the property is currently not available. A geotechnical investigation may be required during detailed building design to determine the condition of the native soils and recommend appropriate construction methods for the development.

2.4 Reviewing Agencies

Grading, servicing, and stormwater management designs, as well as this Functional Servicing Report will be required for submission to the Township of Centre Wellington in support of the Official Plan Amendment, the Zoning By-Law Amendment, and the Site Plan Applications. The Township will also be responsible for the review and approval of site plans, lighting and landscape design, and ultimately issuing building permits.

3.0 Proposed Grading and Servicing Strategy

Preliminary grading and servicing strategies for the proposed development have been developed based on the topographic survey, plan and profile information, and Conceptual Site Plan prepared by Fryett Turner Architects Inc., dated March 29, 2022.

3.1 Proposed Grading

The proposed development will have 2 commercial units on the ground floor and 17 residential units between the remaining 4 stories. There will also be 11 above-ground parking spaces available to the north of the development. For more details on the building configuration, refer to the Architectural drawings.

The Site will be accessible through a driveway connecting to Gowrie Street North. Pedestrian access will also be available with a connection to the existing sidewalks on St. Andrew Street East and Gowrie Street North. The proposed grading strategy will respect the existing grades along the property line; however, re-grading a portion of Gowrie Street North boulevard will be required to construct the Site's driveway entrance. Due to the proposed and existing elevation differences along the east, south, and west property line, a retaining wall is proposed in addition to risers at connection to the existing sidewalk on St. Andrew Street East. All proposed elevations are subject to change during detailed design. The grading strategy has been developed to ensure water will flow away from the building with a major storm overland flow route towards Gowrie Street North.

3.2 Proposed Servicing

3.2.1 Water

A new connection to the 200mm diameter municipal watermain along Gowrie Street North will be required in order to service the proposed building. The required private water service size will be determined during detailed design, but will likely be 150mm diameter. The private water service will connect to the northwest corner of the proposed building.

3.2.2 Water Demands

Preliminary water demands were calculated for the proposed development and are included in Appendix A. The maximum day domestic water demand was determined to be 0.35L/s.

The proposed development was analyzed using both the OBC and FUS fire flow requirements. The fire flow requirement was determined to be 60L/s and 184L/s based on the OBC and FUS fire flow requirements, respectively.

Many municipalities in Ontario use both the OBC and the FUS fire flow requirements for assessing firefighting water supply requirements. Ideally, fire flow demands for new developments are calculated based on the FUS criteria; however, it is not reasonable to expect that the existing municipal watermain infrastructure always has the operational capacity to supply water at the rates prescribed in the FUS guidelines. As a result, at no time shall the available fire flow be less than that required by the Ontario Building Code. The minimum allowable pressure permitted under fire fighting conditions is 140.0kPa per OBC 2012.

It is anticipated that the existing fire hydrant located near the southwest corner of the Site will be sufficient for the proposed building, as it is located approximately 8m from the proposed fire department connection at the southeast side of the proposed building. If required, a fire flow analysis will be completed at the detailed design stage to ensure that adequate flow and pressure will be available at the existing hydrant.

3.2.3 Sanitary

A sanitary flow design sheet has been prepared to determine the flows anticipated to be generated by the proposed development. With the proposed building having 17 residential units, some commercial space, and a site area of 0.10ha, the resulting peak flow rate from the Site is expected to be 0.56L/s. Refer to Appendix B for sanitary flow calculations.

It is proposed that the Site will be serviced by a new 150mm diameter sanitary sewer connecting to the existing 150mm diameter sanitary plug and clean out located at the west property line. The existing 150mm diameter sanitary plug and clean out connects to the 200mm diameter municipal sewer in the Gowrie Street North right-of-way which has an approximated capacity of 46.4L/s. The proposed private sanitary sewer will connect to the existing sanitary plug and clean out. While the slope of the existing lateral is unknown, it is assumed to have a minimum slope of 2.0%, with a resulting capacity of 21.5L/s. The proposed private sanitary sewer should have an appropriate depth for servicing the building while maintaining adequate capacity. The service sizes and inverts are subject to change during detailed design.

3.2.4 Storm

A private storm sewer system will be installed on-site to collect rooftop runoff from the building and runoff from the common driveway and parking area. The runoff will enter a new catchbasin which will connect to a proposed 200mm diameter storm sewer directed to the OGS unit located at the main entrance of the Site. A new 200mm diameter storm sewer will connect the proposed OGS unit to the existing municipal storm sewer with a new manhole, at a slope of 1.0%. The proposed storm sewer will have a capacity of 32.8L/s and the resulting flow rate from the contributing area is expected to be 8.0L/s during the 5-year storm event with upstream attenuation. The upstream attenuation measures are discussed in more detail in Section 4.2. Refer to Appendix C for preliminary storm sewer sizing details.

4.0 Preliminary Storm Water Management Design

4.1 SWM Criteria

The stormwater management design criteria for the subject Site, established based on best management practices, are assumed to be as follows:

i) Attenuation of the post-development peak flows for the 5- and 100-year storm event to the pre-development (existing) peak flow;

ii) Implementation of Enhanced (Level 1) water quality controls; and,

iii) Implementation of Erosion and Sediment Control measures.

4.2 Water Quantity Control

In order to successfully complete the preliminary stormwater management design for the Site, the following specific tasks were undertaken:

i) Calculate the allowable runoff rates using MIDUSS NET;

ii) Determine the percent impervious of the Site and catchment parameters for inclusion in MIDUSSS modeling; and,

iii) Calculate post-development runoff hydrographs using MIDUSS NET.

The following table summarizes the catchments used in modeling of the Site. The post-development condition was separated into two catchment areas; the controlled area and the uncontrolled area. Figure 2.0 illustrates the limits of the pre-development catchment area. Figure 3.0 illustrates the limits of the post-development catchment areas.

Table 4.1 – Catchment Parameters

#	Catchment	Area (ha)	% Impervious	Pervious CN	Impervious CN	Slope (%)	Flow Length (m)
Pre-Development Catchment Area							
101	Existing	0.10	32.7	78	98	2.0	8.0
Post-Development Catchment Areas							
201	Rooftop Area	0.04	100.0	78	98	2.0	7.5
202	Controlled Area	0.04	100.0	78	98	2.0	9.5
203	Uncontrolled Area	0.02	40.1	78	98	4.5	2.0

A geotechnical investigation was not available for this development at the time this report was published. Therefore, a conservative value of 78 was used for the pervious CN.

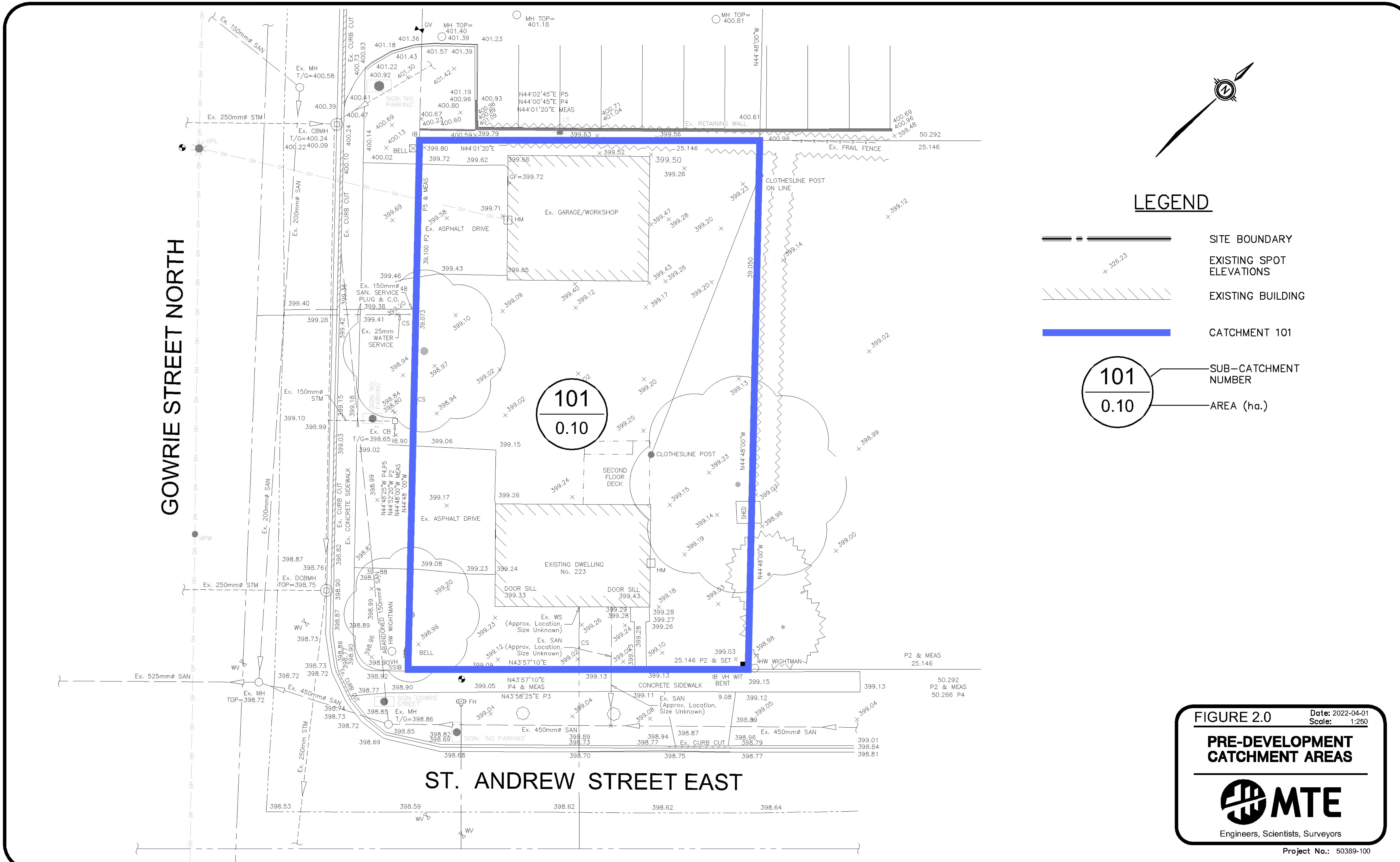

FIGURE 2.0
PRE-DEVELOPMENT CATCHMENT AREAS

April 1, 2022 — 2:36 p.m. — Plotted By: SDu

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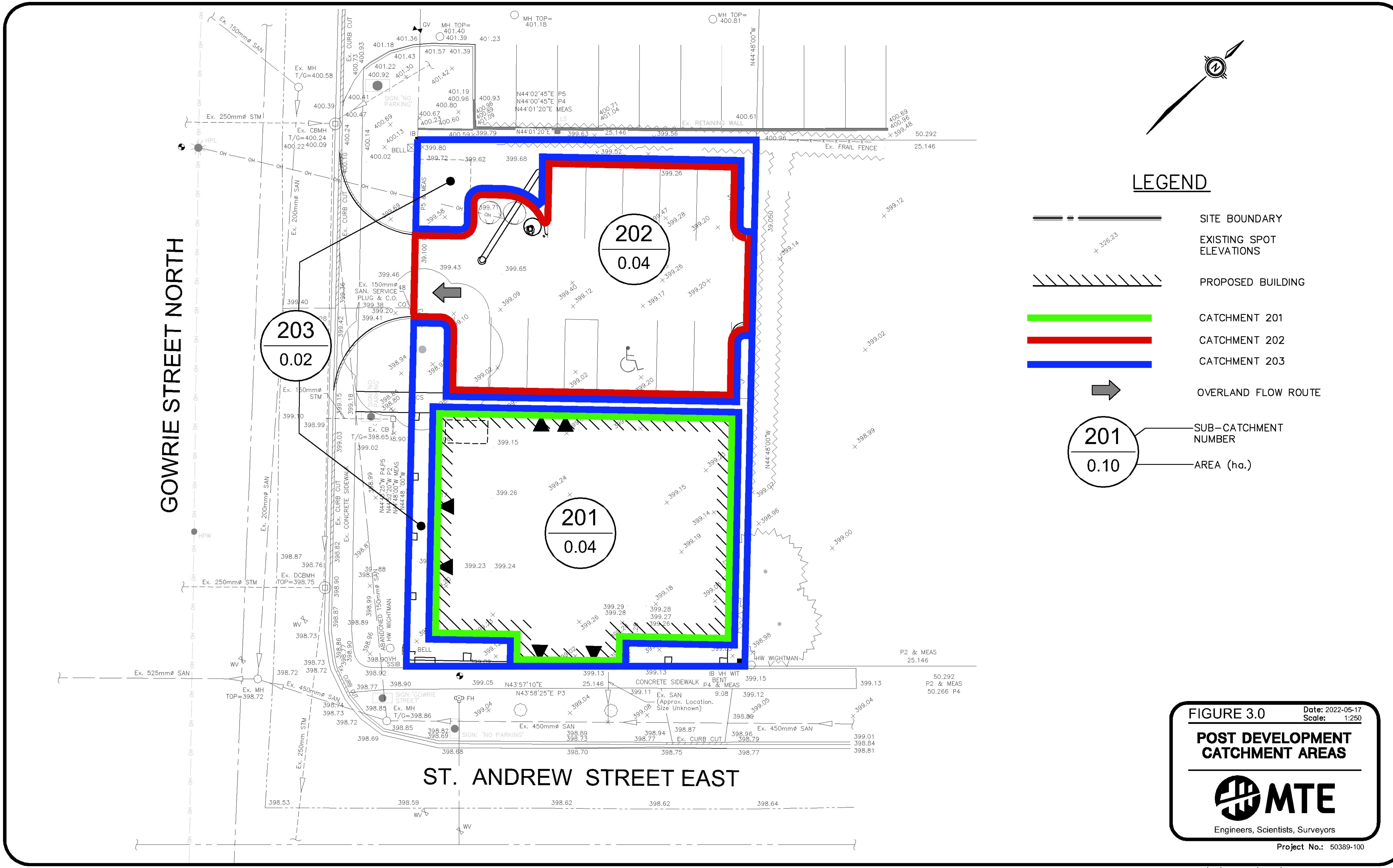
GOWRIE STREET NORTH
ST. ANDREW STREET EAST
LEGEND
SITE BOUNDARY
EXISTING SPOT ELEVATIONS
PROPOSED BUILDING
CATCHMENT 201
CATCHMENT 202
CATCHMENT 203
OVERLAND FLOW ROUTE
SUB-CATCHMENT NUMBER
AREA (ha.)
201
0.10
202
0.04
203
0.02
201
0.04
FIGURE 3.0
Date: 2022-05-17
Scale: 1:250
POST DEVELOPMENT CATCHMENT AREAS
MTE
Engineers, Scientists, Surveyors
Project No.: 50389-100

In order to achieve the stormwater management requirements for the Site, runoff generated from the parking areas will be controlled with a 60mm diameter orifice plate. Furthermore, runoff generated from the roof area will be controlled using two flow control roof drains. The following table summarizes the expected flows that will be generated by the whole Site. Please note that these flows are subject to change at the detailed design stage.

Table 4.2 – Summary of Flows

Modeling Condition	5-Year Storm Event (m^3/s)	100-Year Storm Event (m^3/s)
Pre-Development	0.012	0.030
Post-Development	0.011	0.016

With the installation of the orifice plate and flow control roof drains, the post-development runoff from the controlled portion of the Site for the 5- and 100-year storm event is controlled to $0.008m^3/s$ for both events. The maximum ponding depth on the rooftop as well as in the parking lot is 0.15m for the 100-year storm event. As above, the ponding values are subject to change at detailed design. Refer to Appendix D for the MIDUSS output.

4.3 Water Quality Control

A Stormceptor Model EFO4 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 (Enhanced) water quality control. Refer to Appendix E for the sizing output from the Stormceptor Expert program. The Stormceptor will require regular annual maintenance to ensure it is operating properly. The owner may be required to enter into a maintenance agreement with a suitable contractor to complete this work. In addition, all the storm structures will have a 600mm sump.

4.4 Erosion & Sediment Control

Precautions will need to be taken during construction to limit erosion and sedimentation. Typically, the following measures are recommended during construction for erosion and sedimentation control:

i) Erosion and sedimentation facilities are to be installed prior to any site preparation or demolition;

ii) All erosion control measures are to be inspected and monitored by the contractor and repairs are to be completed as required;

iii) All materials and equipment used for the purpose of site preparation and project completion should be operated and stored in a manner that prevents any deleterious substance from leaving the site; and,

iv) To minimize the amount of mud being tracked onto the roadway, a mud mat should be installed at the primary construction entrance.

5.0 Conclusions

Based on the foregoing analysis, it is concluded that:

- The proposed grading design will respect the existing grades along the property lines;
- Existing municipal infrastructure for water, sanitary, and storm is available along St. Andrew Street East and Gowrie Street North;
- Service connections for water, sanitary, and storm are proposed off of Gowrie Street North;
- The anticipated maximum day domestic water demand is 0.35L/s and the maximum fire flow demand is 60L/s based on OBC calculations. If required, a fire flow analysis will be completed during detailed design to confirm that the minimum residual pressure of 140kPa is achieved at the existing municipal hydrant;
- The proposed sanitary flow rate is expected to be 0.56L/s and the proposed piped stormwater flow rate is expected to be 8.0L/s during the 5-year storm event;
- Stormwater management quantity controls can be provided through two flow control roof drains and an on-line orifice plate; and,
- Stormwater quality control can be provided with the installation of a Stormceptor Model EFO4.

Additional grading, servicing and stormwater management details will be provided during detailed design.

All of which is respectfully submitted,

MTE Consultants Inc.

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Appendix A

Water Demand Calculation

223 St Andrew Street East

FIRE FLOW DEMANDS

Township of Centre Wellington, Ontario

Project #: 50389-100
Date: March 25, 2022
Date Printed: 3/25/2022
Design By: DXN
Checked By: LEI

Development Information[1]								Fire Flow[2] – Ontario Building Code						Fire Flow[2] – Fire Underwriters Survey									Domestic Flow[3,4]							
Node ID / Area ID / Building #	F.F.E. (m.a.s.l.)	Description	# of Units	Population	Bldg Area (1st Floor)	Total Bldg Area	Building Volume	K	V	S_{tot}	Q	F	F	C	A	F	(2) Occupancy Reduction	(3) Sprinkler Protection	(4) Building Exposure	F	F	Fire Flow (Max OBC/FUS)	MOE Guidelines	ICI (Tri-City)	Total	Average Day	Max Day	Peak Hour	Minimum Hour	Max Day + Fire Flow
				# of people	m^2	m^2	m^3		m^3		L	L/min	L/s		m^2	L/min				L/min	L/s	L/s	L/s	L/s		L/s	L/s	L/s	L/s	L/s
Prop. Bldg.	399.60	Mix-Use Residential	17	30	368	2,391	6,535	10	6,535	2.00	130,694	3,600	60	0.80	2,391	8,606	-15%	-30%	75%	11,000	183	183	0.078	0.048	0.126	0.126	0.348	0.522	0.051	184
		TOTALS FOR SITE	**17**	**30**	**368**	**2391**	**6535**					**Max Fire Flow =**	**60**							**Max Fire Flow =**	**183**	**183**	**0.08**			**0.13**	**0.35**	**0.52**	**0.05**	**184**

Sum of Maximum Day Flows + OBC Fire Flow (L/s) =	**60**
Sum of Maximum Day Flows + FUS Fire Flow (L/s) =	**184**

Assumptions:

1 The building area is based on the Site Plan by Fryett Turner Architects Inc. dated 2022-03-16. Assumed 1.77 persons per unit as per Region of Waterloo Water and Wastewater Monitoring Report 2017
2 The proposed building is assumed to be classified as occupancy group C (Residential Occupancy).
3 The proposed building will be non-combustible construction and be sprinklered.
4 Average Daily Demands for each building are based on "*Tri City Water Distribution Master Plan Final Report" by AECOM, Dated May 2009*:
Residential = 225 L/cap/day
5 Average Daily Demands for Industrial, Commercial, Institutional based on zone "WAT 4" in Table 3.12 of "Tri City Water Distribution Master Plan Final Report" by AECOM, Dated May 2009 and an assumption of 25 individuals:
ICI= 166 L/cap/day x 25 cap / 24 / 60 /60
6 Peaking Factors based on "*Design Guidelines for Drinking-Water Systems*" (MOE, 2008):
Average Day = 1
Maximum Day = 2.75
Peak Hour = 4.13
Minimum Hour = 0.4

Appendix B

Sanitary Sewer Design Calculation

MTE

223 St Andrew Street East
Township of Centre Wellington

SANITARY SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Project Number: 50389-100
Date: April 1, 2022
Design By: DXN
Checked By: LEI
File: Q:\50389\100\Sanitary Sewer Design Sheet Waterloo (SSMS) Rev7.xls

Drainage Area Plan No:

Design Parameters

Average Daily Flow		Mannings "n"	0.013
Residential	0.004 L/s/c	Min. Velocity	0.6 m/sec
Commercial	0.60 L/s/ha	Max. Velocity	3.0 m/sec
Industrial	0.50 L/s/ha	Residential Harmon Peaking Factor (F) $F = 1 + 14/(4 + P^{0.5})$	
Inst. / School	2.50 L/s/ha	Commercial Peaking Factor = 2.5	
		Residential Areas Infiltration	0.25 L/s/ha

LOCATION				RESIDENTIAL AREAS AND POPULATION							SCHOOL, INSTITUTIONAL (HECTARES AND FLOW OF EACH ZONING) 2.50 L/s/ha			COMMERCIAL 0.60 L/s/ha			INDUSTRIAL 0.50 L/s/ha				INFILTRATION			DESIGN					
STREET	AREA NO.	MANHOLE LOCATION FROM MH	TO MH	AREA	No. UNITS @ 1.76 PPU	No. UNITS @ PPU	POPUL.	CUMUL POPUL.	PEAK FACTOR "F"	PEAK RES. FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	TOTALS-C-I FLOW	AREA	CUMUL AREA	INFIL FLOW	TOTAL VOLUME FLOW	LENGTH	SLOPE	PIPE SIZE	CAPACITY	FULL FLOW VELOCITY
				ha			1000s	1000s		L/sec	ha	ha	L/sec	ha	ha	L/sec	ha	ha	L/sec	L/sec	ha	ha	L/sec	L/sec	m	%	mm	L/sec.	m/s
223 St Andrew St E		Bldg	MH1A		17.00		0.030	0.030	4.354921	0.5212				0.01	0.01	0.0150				0.0150	0.10	0.10	0.0245	0.5607	7.8	2.00	150	21.5267	1.219
		MH1A	Ex. Stub					0.030	4.354921	0.5212					0.01	0.0150				0.0150	0.00	0.10	0.0245	0.5607	6.5	2.00	150	21.5267	1.219
Capacity Check		Ex. Stub	ROW																		0.10	0.10	0.0245	0.5852	9.7	2.00	200	46.3604	1.476

Appendix C

Storm Sewer Design Calculation

223 St Andrew Street East
Township of Centre Wellington

Project Number: 50389-100
Date: April 1, 2022
Design By: DXN
Checked By: LEI
File: Q:\50389\100\Storm Sewer Design Sheet Kitchener_Rev10.xlsx

STORM SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Drainage Area Plan No:

Design Parameters

5 YEAR STORM

Q=kAIC, k=0.00278
Intensity (I) = $a/(tc+b)^c$
a = 1593
b = 11
c = 0.8789

Manning's "n" 0.013
Min. Velocity 0.800 m/s
Max. Velocity 6.000 m/s

LOCATION				STORMWATER FLOW								DESIGN					
STREET	AREA NUMBER	MANHOLE LOCATION FROM MH	TO MH	AREA (A)	RUNOFF COEFF. (C)	A x C	CUMUL. A x C	CONCENTRATION TIME TOTAL	IN PIPE	RAIN INTENSITY (I)	FLOW (Q)	PIPE SIZE	LENGTH	SLOPE	CAPACITY	FULL FLOW VELOCITY	PIPE FULL
				ha		ha	ha	min	min	mm/hr	L/s	mm	m	%	L/s	m/s	%
223 St Andrew St E		Roof	CBMH1	0.040				5-year flow taken from MIDUSS model			3.00000	150	10.0	2.00	21.53765	1.2188	13.93
		CBMH1	OGS2	0.040				5-year flow taken from MIDUSS model			8.00000	200	12.0	1.00	32.79844	1.0440	24.39
		OGS2	MH3	0.040				5-year flow taken from MIDUSS model			8.00000	200	7.2	1.00	32.79844	1.0440	24.39

Appendix D

MIDUSS Output

MTE

Pre-Development

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"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                          Version 2.25  rev. 473"
"               MIDUSS created                        Sunday, February 7, 2010"
"          10   Units used:                                          ie METRIC"
"               Job folder:                         Q:\50389\100\SWM\2022-04-01"
"               Output filename:                                5 Year Pre.out"
"               Licensee name:                                               A"
"               Company                                                       "
"               Date & Time last used:                     4/1/2022 at 1:56:29 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1593.000   Coefficient A"
"       11.000   Constant B"
"        0.879   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           139.250    mm/hr"
"             Total depth                  47.240    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   Existing"
"       32.700   % Impervious"
"        0.100   Total Area"
"        8.000   Flow length"
"        2.000   Overland Slope"
"        0.067   Pervious Area"
"        8.000   Pervious length"
"        2.000   Pervious slope"
"        0.033   Impervious Area"
"        8.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       78.000   Pervious SCS Curve No."
"        0.303   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        7.164   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.853   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.012     0.000     0.000     0.000 c.m/sec"
```

```
"              Catchment 101          Pervious   Impervious Total Area "
"              Surface Area           0.067      0.033      0.100      hectare"
"              Time of concentration  7.932      0.896      3.870      minutes"
"              Time to Centroid       107.070    87.237     95.619     minutes"
"              Rainfall depth         47.240     47.240     47.240     mm"
"              Rainfall volume        31.79      15.45      47.24      c.m"
"              Rainfall losses        32.903     6.933      24.411     mm"
"              Runoff depth           14.337     40.307     22.829     mm"
"              Runoff volume          9.65       13.18      22.83      c.m"
"              Runoff coefficient     0.303      0.853      0.483      "
"              Maximum flow           0.005      0.011      0.012      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.012     0.012     0.000     0.000"
" 38           START/RE-START TOTALS 101"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                     0.100    hectare"
"              Total Impervious area                    0.033    hectare"
"              Total % impervious                      32.700"
" 19           EXIT"
```

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                          Version 2.25  rev. 473"
"               MIDUSS created                        Sunday, February 7, 2010"
"          10   Units used:                                          ie METRIC"
"               Job folder:                         Q:\50389\100\SWM\2022-04-01"
"               Output filename:                               100 Year Pre.out"
"               Licensee name:                                                A"
"               Company                                                       "
"               Date & Time last used:                    4/1/2022 at 1:57:32 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4688.000   Coefficient A"
"       17.000   Constant B"
"        0.962   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           239.650    mm/hr"
"             Total depth                  87.263    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   Existing"
"       32.700   % Impervious"
"        0.100   Total Area"
"        8.000   Flow length"
"        2.000   Overland Slope"
"        0.067   Pervious Area"
"        8.000   Pervious length"
"        2.000   Pervious slope"
"        0.033   Impervious Area"
"        8.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       78.000   Pervious SCS Curve No."
"        0.482   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        7.164   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.877   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.030     0.000     0.000     0.000 c.m/sec"
```

```
"              Catchment 101          Pervious   Impervious Total Area "
"              Surface Area           0.067      0.033      0.100      hectare"
"              Time of concentration  5.067      0.712      3.023      minutes"
"              Time to Centroid       98.495     85.009     92.165     minutes"
"              Rainfall depth         87.263     87.263     87.263     mm"
"              Rainfall volume        58.73      28.54      87.26      c.m"
"              Rainfall losses        45.221     10.722     33.940     mm"
"              Runoff depth           42.043     76.541     53.324     mm"
"              Runoff volume          28.29      25.03      53.32      c.m"
"              Runoff coefficient     0.482      0.877      0.611      "
"              Maximum flow           0.018      0.019      0.030      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.030     0.030     0.000     0.000"
" 38           START/RE-START TOTALS 101"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                    0.100    hectare"
"              Total Impervious area                   0.033    hectare"
"              Total % impervious                     32.700"
" 19           EXIT"
```

Post-Development

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                            Version 2.25  rev. 473"
"               MIDUSS created                           Sunday, February 7, 2010"
"          10   Units used:                                           ie METRIC"
"               Job folder:                         Q:\50389\100\SWM\2022-04-01"
"               Output filename:                                 5 Year Post.out"
"               Licensee name:                                                A"
"               Company                                                        "
"               Date & Time last used:                    4/1/2022 at 1:36:10 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1593.000   Coefficient A"
"       11.000   Constant B"
"        0.879   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          139.250    mm/hr"
"             Total depth                 47.240    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Rooftop Area"
"      100.000   % Impervious"
"        0.040   Total Area"
"        7.500   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"        7.500   Pervious length"
"        2.000   Pervious slope"
"        0.040   Impervious Area"
"        7.500   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       78.000   Pervious SCS Curve No."
"        0.000   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        7.164   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.850   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.013     0.000     0.000     0.000 c.m/sec"
```

```
"              Catchment 201          Pervious   Impervious Total Area "
"              Surface Area           0.000      0.040      0.040      hectare"
"              Time of concentration  7.630      0.862      0.862      minutes"
"              Time to Centroid       106.692    87.203     87.203     minutes"
"              Rainfall depth         47.240     47.240     47.240     mm"
"              Rainfall volume        0.00       18.90      18.90      c.m"
"              Rainfall losses        32.916     7.065      7.065      mm"
"              Runoff depth           14.324     40.175     40.175     mm"
"              Runoff volume          0.00       16.07      16.07      c.m"
"              Runoff coefficient     0.000      0.850      0.850      "
"              Maximum flow           0.000      0.013      0.013      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.013     0.013     0.000     0.000"
" 54           POND DESIGN"
"         0.013   Current peak flow    c.m/sec"
"         0.030   Target outflow    c.m/sec"
"          16.1   Hydrograph volume    c.m"
"           10.   Number of stages"
"         0.000   Minimum water level    metre"
"         0.150   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000     0.000"
"                 0.01667   0.00050   0.02316"
"                 0.03333   0.00100    0.1851"
"                 0.05000   0.00150    0.6250"
"                 0.06667   0.00200     1.482"
"                 0.08333   0.00250     2.893"
"                  0.1000   0.00300     5.000"
"                  0.1167   0.00350     7.947"
"                  0.1333   0.00400    11.843"
"                  0.1500   0.00450    16.716"
"            1.   ROOFTOP"
"                 Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                   hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                     0.040       0.030     200.000      22.500      50.000"
"              Using 2 roofdrains on roofstorage area of 300. square metre"
"              Peak outflow                  0.003    c.m/sec"
"              Maximum level                 0.108    metre"
"              Maximum storage               6.442    c.m"
"              Centroidal lag                1.799   hours"
"                   0.013     0.013     0.003     0.000 c.m/sec"
" 40           HYDROGRAPH Next link "
"             5   Next link "
"                      0.013     0.003     0.003     0.000"
" 33           CATCHMENT 202"
"             1   Triangular SCS"
"             1   Equal length"
```

```
"            1   SCS method"
"          202   Controlled Area"
"      100.000   % Impervious"
"        0.040   Total Area"
"        9.500   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"        9.500   Pervious length"
"        2.000   Pervious slope"
"        0.040   Impervious Area"
"        9.500   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       78.000   Pervious SCS Curve No."
"        0.000   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        7.164   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.860   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                        0.013     0.003     0.003     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.040      0.040      hectare"
"             Time of concentration  8.793      0.993      0.993      minutes"
"             Time to Centroid       108.104    87.366     87.366     minutes"
"             Rainfall depth         47.240     47.240     47.240     mm"
"             Rainfall volume        0.00       18.90      18.90      c.m"
"             Rainfall losses        32.934     6.595      6.595      mm"
"             Runoff depth           14.306     40.645     40.645     mm"
"             Runoff volume          0.00       16.26      16.26      c.m"
"             Runoff coefficient     0.000      0.860      0.860      "
"             Maximum flow           0.000      0.013      0.013      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                        0.013     0.015     0.003     0.000"
" 54          POND DESIGN"
"        0.015   Current peak flow    c.m/sec"
"        0.030   Target outflow    c.m/sec"
"         32.3   Hydrograph volume    c.m"
"           8.   Number of stages"
"      398.330   Minimum water level    metre"
"      399.500   Maximum water level    metre"
"      398.330   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                398.330     0.000     0.000"
"                399.280   0.00753  1.01E-05"
"                399.330   0.00773    0.7400"
```

```
"                399.380   0.00793     4.310"
"                399.430   0.00812    13.240"
"                399.480   0.00831    26.810"
"                399.500   0.00839    32.970"
"                399.550   0.00857    49.750"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                398.330     0.630    0.0600     1.000"
"             Peak outflow                 0.008    c.m/sec"
"             Maximum level              399.365    metre"
"             Maximum storage              3.260    c.m"
"             Centroidal lag               1.665   hours"
"                  0.013     0.015     0.008     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.008    c.m/sec"
"             Hydrograph volume           31.993    c.m"
"                     0.013     0.015     0.008     0.008"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.013     0.000     0.008     0.008"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   Uncontrolled Area"
"       40.100   % Impervious"
"        0.020   Total Area"
"        2.000   Flow length"
"        4.500   Overland Slope"
"        0.012   Pervious Area"
"        2.000   Pervious length"
"        4.500   Pervious slope"
"        0.008   Impervious Area"
"        2.000   Impervious length"
"        4.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       78.000   Pervious SCS Curve No."
"        0.299   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        7.164   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.773   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.003     0.000     0.008     0.008 c.m/sec"
```

```
"              Catchment 203          Pervious   Impervious Total Area "
"              Surface Area           0.012      0.008      0.020      hectare"
"              Time of concentration  2.707      0.306      1.184      minutes"
"              Time to Centroid       100.448    86.499     91.601     minutes"
"              Rainfall depth         47.240     47.240     47.240     mm"
"              Rainfall volume        5.66       3.79       9.45       c.m"
"              Rainfall losses        33.137     10.716     24.147     mm"
"              Runoff depth           14.102     36.524     23.093     mm"
"              Runoff volume          1.69       2.93       4.62       c.m"
"              Runoff coefficient     0.299      0.773      0.489      "
"              Maximum flow           0.001      0.003      0.003      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.003     0.003     0.008     0.008"
" 40           HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                     0.003     0.003     0.003     0.008"
" 40           HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 Total Site"
"              Maximum flow                  0.011    c.m/sec"
"              Hydrograph volume            36.612    c.m"
"                     0.003     0.003     0.003     0.011"
" 38           START/RE-START TOTALS 203"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                        0.100    hectare"
"              Total Impervious area                       0.088    hectare"
"              Total % impervious                         88.020"
" 19           EXIT"
```

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                          Version 2.25  rev. 473"
"               MIDUSS created                        Sunday, February 7, 2010"
"          10   Units used:                                          ie METRIC"
"               Job folder:                         Q:\50389\100\SWM\2022-04-01"
"               Output filename:                             100 Year Post.out"
"               Licensee name:                                               A"
"               Company                                                      "
"               Date & Time last used:                  4/1/2022 at 1:40:35 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4688.000   Coefficient A"
"       17.000   Constant B"
"        0.962   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          239.650    mm/hr"
"             Total depth                 87.263    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          201   Rooftop Area"
"      100.000   % Impervious"
"        0.040   Total Area"
"        7.500   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"        7.500   Pervious length"
"        2.000   Pervious slope"
"        0.040   Impervious Area"
"        7.500   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       78.000   Pervious SCS Curve No."
"        0.000   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        7.164   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.873   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.023     0.000     0.000     0.000 c.m/sec"
```

```
"              Catchment 201          Pervious   Impervious Total Area "
"              Surface Area           0.000      0.040      0.040      hectare"
"              Time of concentration  4.875      0.685      0.685      minutes"
"              Time to Centroid       98.249     85.004     85.004     minutes"
"              Rainfall depth         87.263     87.263     87.263     mm"
"              Rainfall volume        0.00       34.91      34.91      c.m"
"              Rainfall losses        45.246     11.072     11.072     mm"
"              Runoff depth           42.017     76.191     76.191     mm"
"              Runoff volume          0.00       30.48      30.48      c.m"
"              Runoff coefficient     0.000      0.873      0.873      "
"              Maximum flow           0.000      0.023      0.023      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.023     0.023     0.000     0.000"
" 54           POND DESIGN"
"        0.023   Current peak flow    c.m/sec"
"        0.030   Target outflow    c.m/sec"
"         30.5   Hydrograph volume    c.m"
"          10.   Number of stages"
"        0.000   Minimum water level    metre"
"        0.150   Maximum water level    metre"
"        0.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                  0.000     0.000     0.000"
"                0.01667   0.00050   0.02316"
"                0.03333   0.00100    0.1851"
"                0.05000   0.00150    0.6250"
"                0.06667   0.00200     1.482"
"                0.08333   0.00250     2.893"
"                 0.1000   0.00300     5.000"
"                 0.1167   0.00350     7.947"
"                 0.1333   0.00400    11.843"
"                 0.1500   0.00450    16.716"
"           1.   ROOFTOP"
"                Roof area  Store area  Area/drain  Drain flow  Roof slope"
"                  hectare     hectare    sq.metre  L/min/25mm      g H:1V"
"                    0.040       0.030     200.000      22.500      50.000"
"              Using 2 roofdrains on roofstorage area of 300. square metre"
"              Peak outflow                  0.004    c.m/sec"
"              Maximum level                 0.145    metre"
"              Maximum storage              15.144    c.m"
"              Centroidal lag                2.058   hours"
"                   0.023     0.023     0.004     0.000 c.m/sec"
" 40           HYDROGRAPH Next link "
"             5   Next link "
"                      0.023     0.004     0.004     0.000"
" 33           CATCHMENT 202"
"             1   Triangular SCS"
"             1   Equal length"
```

```
"              1   SCS method"
"            202   Controlled Area"
"        100.000   % Impervious"
"          0.040   Total Area"
"          9.500   Flow length"
"          2.000   Overland Slope"
"          0.000   Pervious Area"
"          9.500   Pervious length"
"          2.000   Pervious slope"
"          0.040   Impervious Area"
"          9.500   Impervious length"
"          2.000   Impervious slope"
"          0.250   Pervious Manning 'n'"
"         78.000   Pervious SCS Curve No."
"          0.000   Pervious Runoff coefficient"
"          0.100   Pervious Ia/S coefficient"
"          7.164   Pervious Initial abstraction"
"          0.015   Impervious Manning 'n'"
"         98.000   Impervious SCS Curve No."
"          0.887   Impervious Runoff coefficient"
"          0.100   Impervious Ia/S coefficient"
"          0.518   Impervious Initial abstraction"
"                       0.023     0.004     0.004     0.000 c.m/sec"
"              Catchment 202          Pervious   Impervious Total Area "
"              Surface Area           0.000      0.040      0.040      hectare"
"              Time of concentration  5.618      0.790      0.790      minutes"
"              Time to Centroid       99.197     85.061     85.061     minutes"
"              Rainfall depth         87.263     87.263     87.263     mm"
"              Rainfall volume        0.00       34.91      34.91      c.m"
"              Rainfall losses        45.262     9.829      9.829      mm"
"              Runoff depth           42.001     77.434     77.434     mm"
"              Runoff volume          0.00       30.97      30.97      c.m"
"              Runoff coefficient     0.000      0.887      0.887      "
"              Maximum flow           0.000      0.023      0.023      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"              4   Add Runoff "
"                       0.023     0.026     0.004     0.000"
" 54          POND DESIGN"
"          0.026   Current peak flow    c.m/sec"
"          0.030   Target outflow    c.m/sec"
"           61.5   Hydrograph volume    c.m"
"             8.   Number of stages"
"        398.330   Minimum water level    metre"
"        399.500   Maximum water level    metre"
"        398.330   Starting water level    metre"
"              0   Keep Design Data: 1 = True; 0 = False"
"                    Level Discharge    Volume"
"                  398.330     0.000     0.000"
"                  399.280   0.00753  1.01E-05"
"                  399.330   0.00773    0.7400"
```

```
"                399.380   0.00793     4.310"
"                399.430   0.00812    13.240"
"                399.480   0.00831    26.810"
"                399.500   0.00839    32.970"
"                399.550   0.00857    49.750"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                398.330     0.630    0.0600     1.000"
"             Peak outflow                 0.008    c.m/sec"
"             Maximum level              399.428    metre"
"             Maximum storage             12.961    c.m"
"             Centroidal lag               1.968   hours"
"                  0.023     0.026     0.008     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                 0.008    c.m/sec"
"             Hydrograph volume           61.825    c.m"
"                     0.023     0.026     0.008     0.008"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.023     0.000     0.008     0.008"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          203   Uncontrolled Area"
"       40.100   % Impervious"
"        0.020   Total Area"
"        2.000   Flow length"
"        4.500   Overland Slope"
"        0.012   Pervious Area"
"        2.000   Pervious length"
"        4.500   Pervious slope"
"        0.008   Impervious Area"
"        2.000   Impervious length"
"        4.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       78.000   Pervious SCS Curve No."
"        0.479   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        7.164   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.808   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.008     0.000     0.008     0.008 c.m/sec"
```

```
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.012      0.008      0.020      hectare"
"             Time of concentration  1.729      0.243      0.941      minutes"
"             Time to Centroid       93.995     83.941     88.663     minutes"
"             Rainfall depth         87.263     87.263     87.263     mm"
"             Rainfall volume        10.45      7.00       17.45      c.m"
"             Rainfall losses        45.488     16.798     33.983     mm"
"             Runoff depth           41.775     70.466     53.280     mm"
"             Runoff volume          5.00       5.65       10.66      c.m"
"             Runoff coefficient     0.479      0.808      0.611      "
"             Maximum flow           0.003      0.005      0.008      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.008     0.008     0.008     0.008"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.008     0.008     0.008     0.008"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total Site"
"             Maximum flow                  0.016    c.m/sec"
"             Hydrograph volume            72.481    c.m"
"                    0.008     0.008     0.008     0.016"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.100    hectare"
"             Total Impervious area                     0.088    hectare"
"             Total % impervious                       88.020"
" 19          EXIT"
```

Appendix E

Stormceptor Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

02/23/2022

Province:	Ontario
City:	Fergus
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
Climate Station Id:	6149387
Years of Rainfall Data:	34
Site Name:	
Drainage Area (ha):	0.08
% Imperviousness:	100.00

Runoff Coefficient 'c': 0.90

Project Name:	223 St. Andrew
Project Number:	50389-100
Designer Name:	Dain Na
Designer Company:	MTE Consultants Inc.
Designer Email:	dna@mte85.com
Designer Phone:	519-743-6500
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	2.87
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	95
EFO6	99
EFO8	100
EFO10	100
EFO12	100

Recommended Stormceptor EFO Model: EFO4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 95

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.

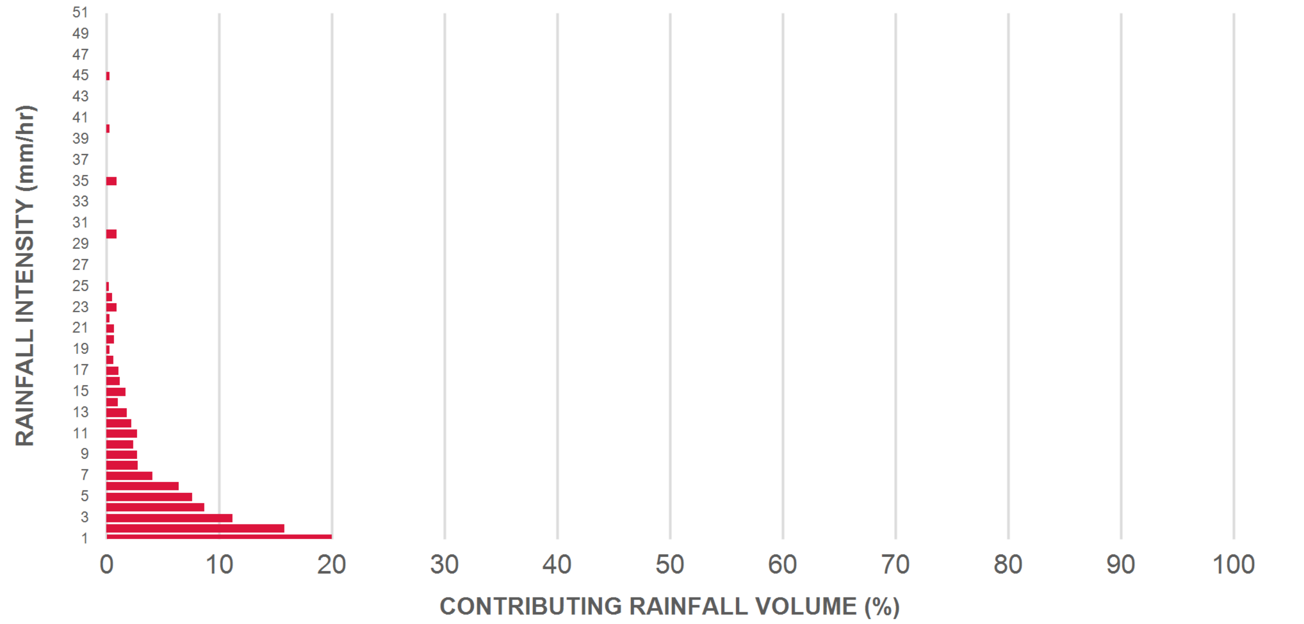
Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

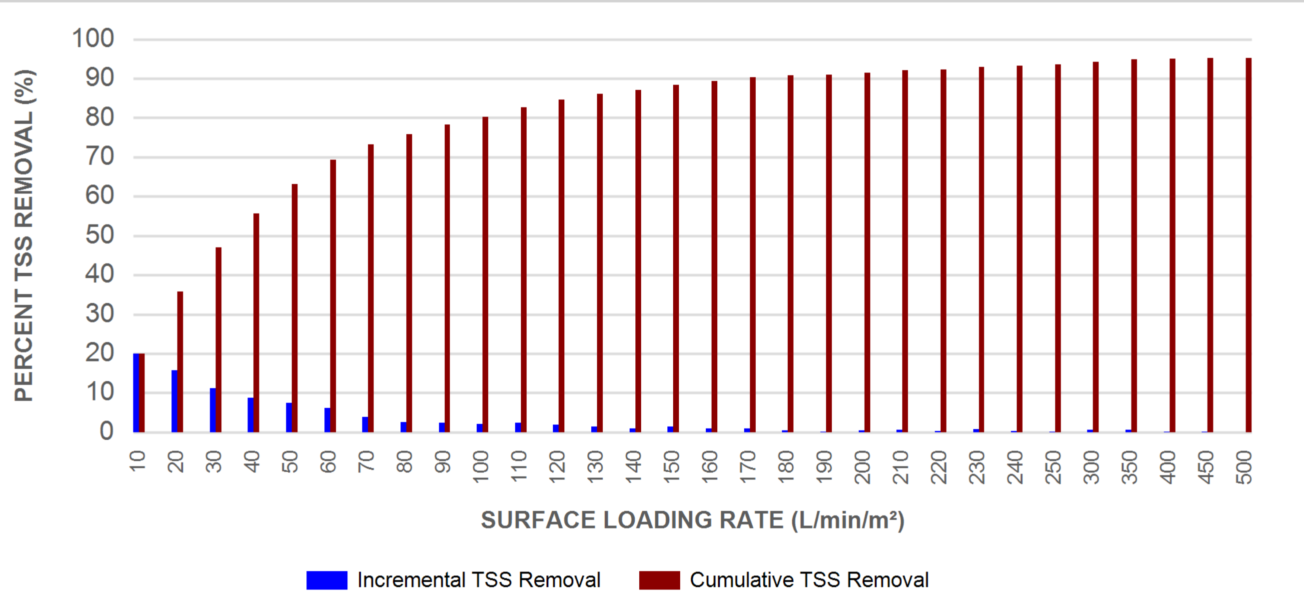
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	20.0	20.0	0.20	12.0	10.0	100	20.0	20.0
2	15.8	35.8	0.40	24.0	20.0	100	15.8	35.8
3	11.2	47.0	0.60	36.0	30.0	100	11.2	47.0
4	8.7	55.7	0.80	48.0	40.0	100	8.7	55.7
5	7.6	63.3	1.00	60.0	50.0	98	7.4	63.1
6	6.4	69.7	1.20	72.0	60.0	96	6.2	69.3
7	4.1	73.8	1.40	84.0	70.0	94	3.9	73.2
8	2.8	76.7	1.60	96.0	80.0	91	2.6	75.8
9	2.7	79.4	1.80	108.0	90.0	90	2.4	78.2
10	2.4	81.7	2.00	120.0	100.0	89	2.1	80.3
11	2.7	84.5	2.20	132.0	110.0	88	2.4	82.7
12	2.2	86.7	2.40	144.0	120.0	87	1.9	84.6
13	1.8	88.4	2.60	156.0	130.0	85	1.5	86.1
14	1.0	89.5	2.80	168.0	140.0	84	0.9	87.0
15	1.7	91.2	3.00	180.0	150.0	83	1.4	88.4
16	1.2	92.3	3.20	192.0	160.0	82	1.0	89.4
17	1.1	93.5	3.40	204.0	170.0	81	0.9	90.3
18	0.6	94.1	3.60	216.0	180.0	80	0.5	90.8
19	0.3	94.3	3.80	228.0	190.0	78	0.2	91.0
20	0.7	95.0	4.00	240.0	200.0	77	0.5	91.5
21	0.7	95.7	4.20	252.0	210.0	77	0.5	92.1
22	0.3	96.0	4.40	264.0	220.0	76	0.2	92.3
23	0.9	96.9	4.60	276.0	230.0	76	0.7	93.0
24	0.5	97.4	4.80	288.0	240.0	75	0.4	93.3
25	0.2	97.6	5.00	300.0	250.0	75	0.1	93.5
30	0.9	98.5	6.00	360.0	300.0	73	0.7	94.2
35	0.9	99.4	7.01	420.0	350.0	71	0.6	94.8
40	0.3	99.7	8.01	480.0	400.0	69	0.2	95.0
45	0.3	100.0	9.01	540.0	450.0	66	0.2	95.2
50	0.0	100.0	10.01	600.0	500.0	64	0.0	95.2
Estimated Net Annual Sediment (TSS) Load Reduction =								**95 %**

Climate Station ID: 6149387 *Years of Rainfall Data*: 34

RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter (m)	Model Diameter (ft)	Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter (mm)	Max Inlet Pipe Diameter (in)	Max Outlet Pipe Diameter (mm)	Max Outlet Pipe Diameter (in)	Peak Conveyance Flow Rate (L/s)	Peak Conveyance Flow Rate (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

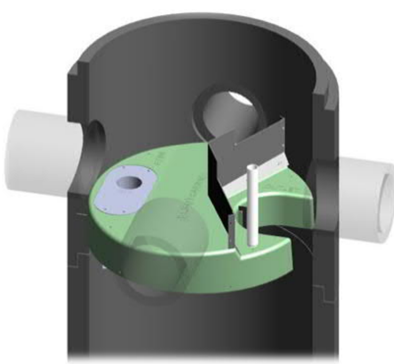
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test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

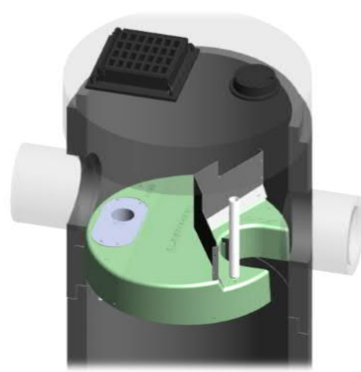
DESIGN FLEXIBILITY

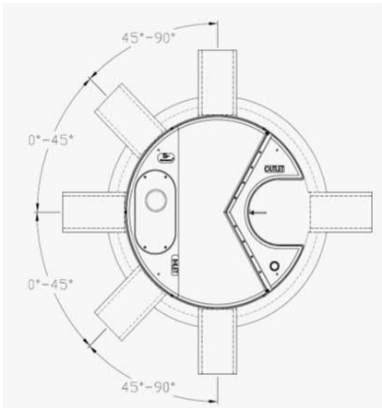
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend 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, and only rainfall intensities greater than 0.5 mm/hr shall be included in sizing calculations. 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.