

Stormwater Management Report for  
**143 Columbia Street W**  
**143 Columbia Street West, City of Waterloo**

November 03, 2021

Revised August 10, 2023

Project Reference Number 20-261



**K. SMART ASSOCIATES LIMITED**  
CONSULTING ENGINEERS AND PLANNERS

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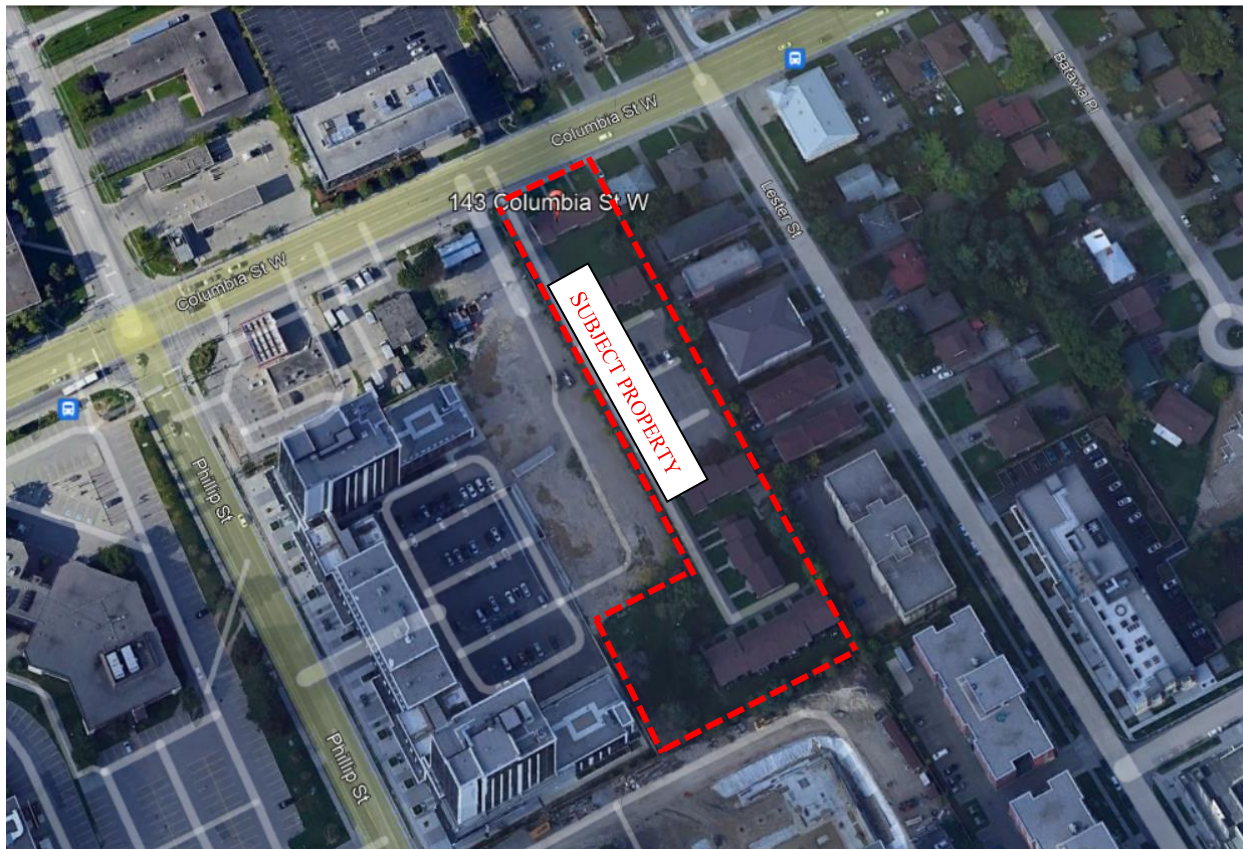
## Introduction

This report provides details on the stormwater management design for the proposed building development on Columbia Street West in City of Waterloo, Ontario.

## Background Information

The subject property includes block 143 on Columbia Street West in City of Waterloo. The 0.8 ha property is located on the south side of Columbia Street West. The site is currently occupied by five (5) apartment buildings. There is a paved parking lot in the middle of the property, and landscaping fills the remainder of the property land. The ground surface has a gentle slope from south to north. The proposed three (3) - 25 story buildings will replace the existing buildings. The subject property is bounded by Columbia Street West to the north, existing residential buildings to the east, existing asphalt path and property lands to the west, and property lands to the south. The site location is shown below.

**Figure 1- Site Location**



## Geotechnical Information

Chung & Vander Doelen Engineering Ltd. (CVD) conducted a geotechnical investigation in September of 2018. In order to investigate the subsurface conditions at the site, nine (9) boreholes were drilled and sampled to depths between 15.70 and 22.56 m below ground surface between July 26 and August 8, 2018.

According to the geotechnical report, the surficial pavement and topsoil were underlain by loose to compact fill materials, followed by compact to very dense fine granular deposits, which in turn, were underlain by stiff to hard clayey sandy silt and compact to very dense sandy silt to silty sand deposit. These deposits were further underlain by very stiff to hard silty clay till.

The water level measured in the monitoring wells ranged in depths between 3.41 and 4.60 m, corresponding to elevations 335.71 and 336.34 m. It is noted that the observed groundwater table will fluctuate seasonally and in response to major weather events.

### Existing Site Drainage Conditions

The site generally drains to Columbia Street West except the landscape of the southwest area that drains to Phillip Street. There are existing catchbasins in Columbia Street West at the north limit of the subject property which inlets the runoff into the municipal 750 mm storm sewer. There are also existing catchbasins in Phillip Street on the west side of the property which inlets the runoff into the municipal 750mm x 1150mm storm sewer.

### Proposed Site Drainage Conditions

The proposed development consists of three (3) - 25 story buildings and parking lots. The east areas of buildings A and B will drain to proposed catchbasin CB1, and catchbasin manhole CBMH1. The southeast area of Building B will drain to the proposed catchbasin CB2. The south backyard will drain to the proposed catchbasin CB3. The parking and promenade areas between buildings A and B will drain to CBMH2. The promenade areas between buildings B and C will drain to catchbasin manhole CBMH4. The parking area between Buildings B and C will drain to catchbasin CB2. The northwest area of Building A will directly drain to Columbia Street West. All rooftop storages, catchbasins, manholes, and catchbasin manholes will be drained to the proposed storm sewer located west of buildings A and B and finally to manhole MH1 in Columbia Street West.

The catchbasin manhole CBMH1 is equipped with 150 mm control orifice and catchbasin CB2 is equipped with a 75 mm orifice for quantity control of the outflow to the storm sewer system of Columbia Street West.

The catchbasin manhole CBMH1 and catchbasin CB2 will discharge to the oil grit separator OGS1 which drains to catchbasin manhole CBMH2. The OGS structure will provide quality control prior to draining to MH1 in Columbia Street West.

The proposed stormwater management will result in a reduction in flows compared to the existing conditions.

### Stormwater Management Design Criteria

The design criteria for the stormwater plan area as stipulated by the City of Waterloo:

1. Provide Quantity control of runoff resulting from the 5 year to 100 year storm events to existing discharge rates.
2. Provide quality control of runoff.

The storm sewers have been sized to convey the 5 year storm event. The storm design sheet is included in Appendix B.

## **Stormwater Management Plan**

A stormwater management plan has been prepared for the proposed development. This plan considers quality and quantity control of stormwater runoff from the entire site.

Quality control of runoff will be provided using an oil grit separator. Due to the size of the site and the resulting proposed storm sewer network, one OGS unit is proposed.

Stormwater quantity control will be achieved using rooftop storages and parking lot ponds equipped with orifice controls.

The stormwater management plan for the proposed development is presented here.

### ***Quality control***

The Stormceptor OGS unit has been sized to provide TSS removal based on a fine particle size distribution. The OGS sizing information for the quality control structures is included in Appendix D. The drainage area serviced by the OGS unit is summarized in the table below.

**Table 1: Oil Grit Separator Summary**

| OGS ID  | Drainage Area | Drainage Area ID   | OGS Model |
|---------|---------------|--------------------|-----------|
| OGS # 1 | 0.221 ha      | 201, 202, 203, 205 | EF4       |

### ***Quantity Control***

The 5-year and 100-year storm events will be attenuated to less than existing discharge rates. The rooftop storages and parking ponds are designed to keep the existing outflow during 5 and 100-year storms. Installed orifices in the outlet of the parking lot ponds restricts outflow from the ponds.

## **Stormwater Modeling**

The MIDUSS Model was used to model the 5 year and 100 year storm events to demonstrate the level of quantity control provided by the proposed stormwater management design.

The design storm hyetographs are derived using the IDF parameters for the City of Waterloo fitted to the 3 hour Chicago Storm distribution.

$$i_{5yr} = \frac{1755}{(t_d + 12.347)^{0.895}}$$

$$i_{100yr} = \frac{4692}{(t_d + 17.437)^{0.956}}$$

### ***Stormwater Model Input Parameters***

Table 2 shows the catchment area input parameters into the model under existing and proposed conditions. Drainage catchment areas for the existing and proposed conditions are shown in Appendix A.

**Table 2: Model Input Parameters**

| <b>Catchment</b>           | <b>Description</b>                                            | <b>Area<br/>(ha)</b> | <b>Percent Impervious<br/>(%)</b> | <b>Overland Slope<br/>(%)</b> | <b>Flow Length<br/>(m)</b> |
|----------------------------|---------------------------------------------------------------|----------------------|-----------------------------------|-------------------------------|----------------------------|
| <b>Existing Conditions</b> |                                                               |                      |                                   |                               |                            |
| 101                        | Columbia Street W. catchment                                  | 0.642                | 53                                | 1.00                          | 150.0                      |
| 102                        | Phillip Street catchment                                      | 0.158                | 11                                | 2.00                          | 40.0                       |
| <b>Proposed Conditions</b> |                                                               |                      |                                   |                               |                            |
| 201                        | East area of Building A to CB1                                | 0.031                | 75                                | 1.38                          | 10.0                       |
| 202                        | East area of Buildings A and B and to CBMH1                   | 0.061                | 75                                | 1.90                          | 18.0                       |
| 203                        | East and south area of Building B to CB2                      | 0.069                | 85                                | 1.50                          | 16.0                       |
| 204                        | Court area to CBMH3                                           | 0.052                | 65                                | 1.24                          | 13.0                       |
| 205                        | Parking between buildings B and C                             | 0.060                | 90                                | 1.00                          | 10.7                       |
| 206                        | Parking and promenade areas between buildings A and B to OGS1 | 0.075                | 80                                | 2.00                          | 21.0                       |
| 207                        | North and west areas of Building A to Columbia Street         | 0.038                | 75                                | 4.40                          | 30                         |
| 208                        | Roof – Building A                                             | 0.077                | 100                               | 0.50                          | 9.0                        |
| 209                        | Roof – Building B                                             | 0.075                | 100                               | 0.50                          | 9.0                        |
| 210                        | Roof– Building C                                              | 0.177                | 100                               | 0.50                          | 7.0                        |
| 211                        | South backyard to CB3                                         | 0.048                | 3                                 | 1.90                          | 80.0                       |
| 212                        | Promenade areas between buildings B and C                     | 0.037                | 85                                | 1.00                          | 13.5                       |

### **Stormwater Model Results**

Table 3 shows the peak flows under the existing and proposed conditions. The overall site peak flow from pre-development conditions to post development has been reduced. The MIDUSS output files are included in Appendix C. Table 4 shows water level and storage of the parking lot ponds and rooftop storages.

**Table 3: MIDUSS Model Results Summary**

| <b>Design Storm</b> | <b>Existing Condition</b>                                |                                                    |                                                            | <b>Proposed Condition</b>                                |                                                    |                                                            |
|---------------------|----------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------|
|                     | <i>Total to Columbia Street West (m<sup>3</sup>/sec)</i> | <i>Total to Phillip Street (m<sup>3</sup>/sec)</i> | <i>Total to Municipal Sewer System (m<sup>3</sup>/sec)</i> | <i>Total to Columbia Street West (m<sup>3</sup>/sec)</i> | <i>Total to Phillip Street (m<sup>3</sup>/sec)</i> | <i>Total to Municipal Sewer System (m<sup>3</sup>/sec)</i> |
| 5 year              | 0.097                                                    | 0.006                                              | <b>0.103</b>                                               | 0.092                                                    | 0.00                                               | <b>0.092</b>                                               |
| 100 year            | 0.195                                                    | 0.028                                              | <b>0.210</b>                                               | 0.158                                                    | 0.00                                               | <b>0.158</b>                                               |

**Table 4: Parking Lot Pond and Rooftop - Water Level (W.L.) and Storage (S.)**

| Design Storm | Ponds                 |                         |                       |                         | Rooftop Storages |                         |             |                         |             |                         |
|--------------|-----------------------|-------------------------|-----------------------|-------------------------|------------------|-------------------------|-------------|-------------------------|-------------|-------------------------|
|              | Catchment<br>201, 202 |                         | Catchment<br>203, 205 |                         | Building A       |                         | Building B  |                         | Building C  |                         |
|              | W.L.<br>(m)           | S.<br>(m <sup>3</sup> ) | W.L.<br>(m)           | S.<br>(m <sup>3</sup> ) | W.L.<br>(m)      | S.<br>(m <sup>3</sup> ) | W.L.<br>(m) | S.<br>(m <sup>3</sup> ) | W.L.<br>(m) | S.<br>(m <sup>3</sup> ) |
| 5<br>year    | 337.70                | 0.10                    | 339.89                | 7.52                    | 0.059            | 20.25                   | 0.059       | 19.61                   | 0.074       | 53.81                   |
| 100<br>year  | 338.16                | 0.92                    | 339.95                | 33.78                   | 0.100            | 43.36                   | 0.099       | 42.04                   | 0.119       | 113.22                  |

During the 5-year storm event, the total peak flow to the municipal storm sewer system is 0.092 m<sup>3</sup>/sec, which is less than the peak flow of 0.103 m<sup>3</sup>/sec under the existing condition. During the 100-year storm event, the total peak flow to the municipal storm sewer system is 0.158 m<sup>3</sup>/sec, which is less than the peak flow of 0.210 m<sup>3</sup>/sec under the existing condition.

During the 5-year and 100 year storm events, there is no flow to the storm sewer system of Phillip Street.

The proposed storm sewer system demonstrates sufficient capacity to service the proposed development and convey the 5 year and 100 year storm events without surcharging.

## Conclusions

In summary, the overall site peak flow from pre-development conditions to post development has been reduced and proposed development will not result in an increase in peak discharge rates to the existing storm sewer.

Hossein Moarefi, P.Eng.

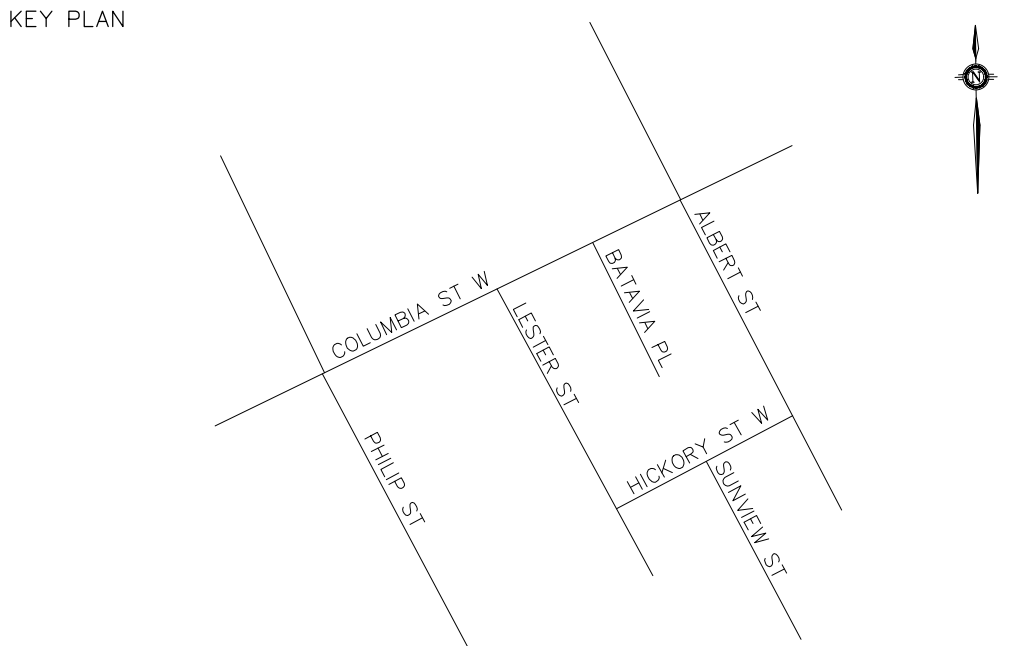
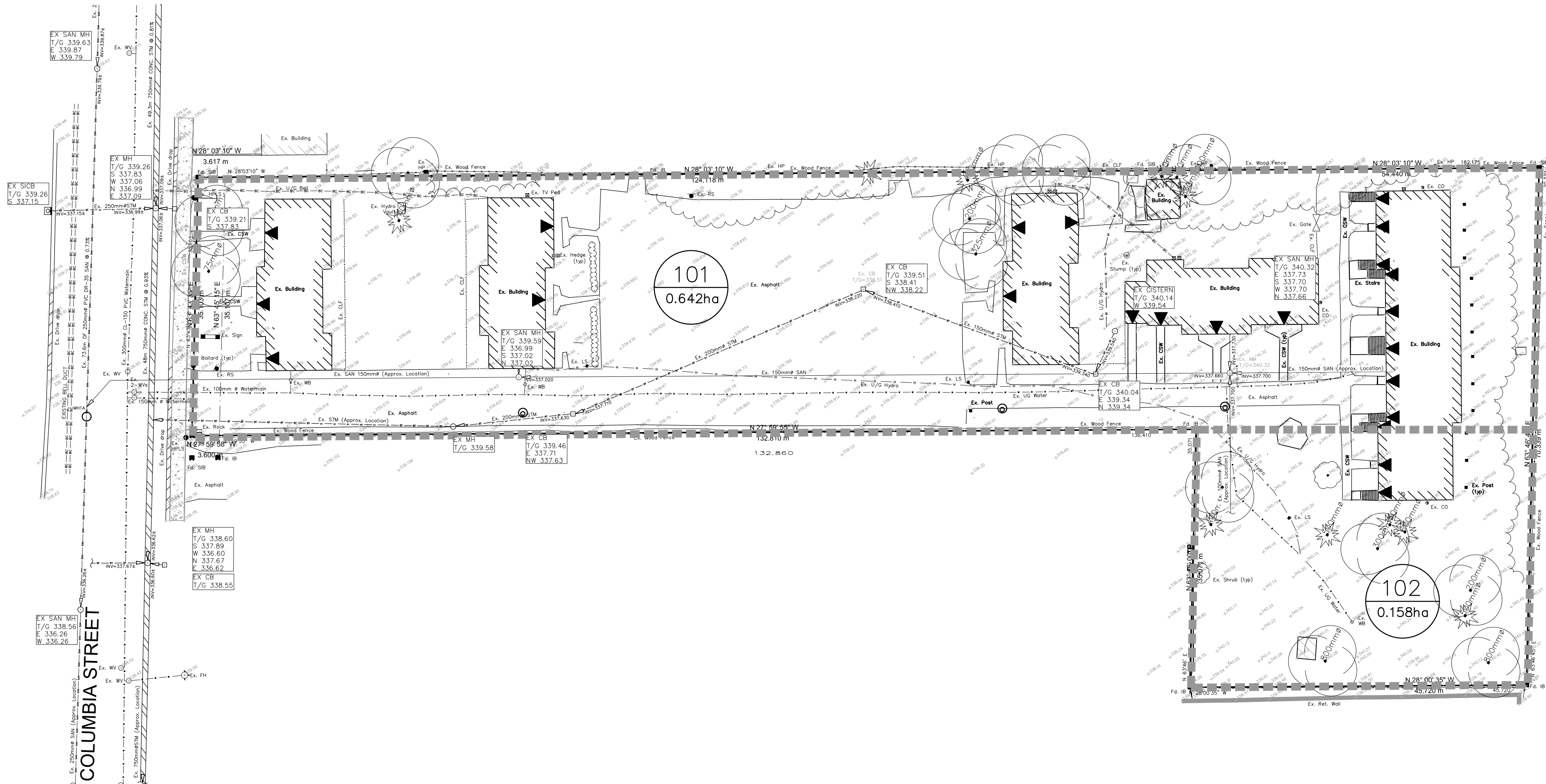
K. Smart Associates Limited



# Appendix A

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Drainage Catchment Areas for Existing and Proposed Conditions



- NOTES:
- 101  
0.000ha  
EXISTING CATCHMENT AREA I.D.  
CATCHMENT AREA
  - CATCHMENT AREA BOUNDARY

|     |                     |    |      |
|-----|---------------------|----|------|
| No. | REVISIONS           | BY | DATE |
|     | CONSTRUCTION        |    |      |
|     | TENDER              |    |      |
|     | ISSUE FOR APPROVALS |    |      |
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143 COLUMBIA STREET W

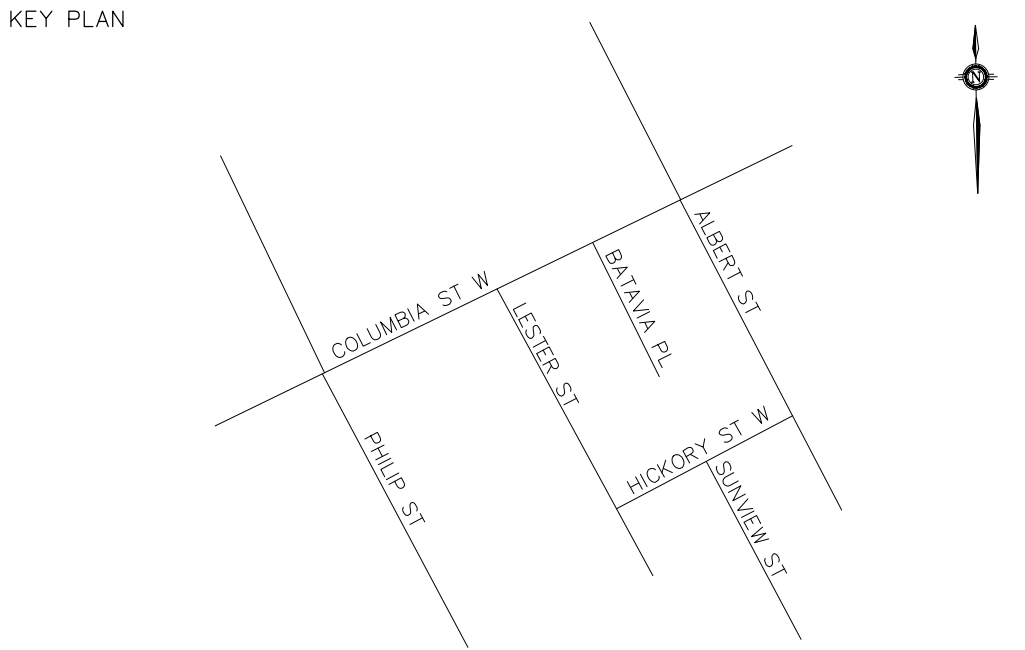
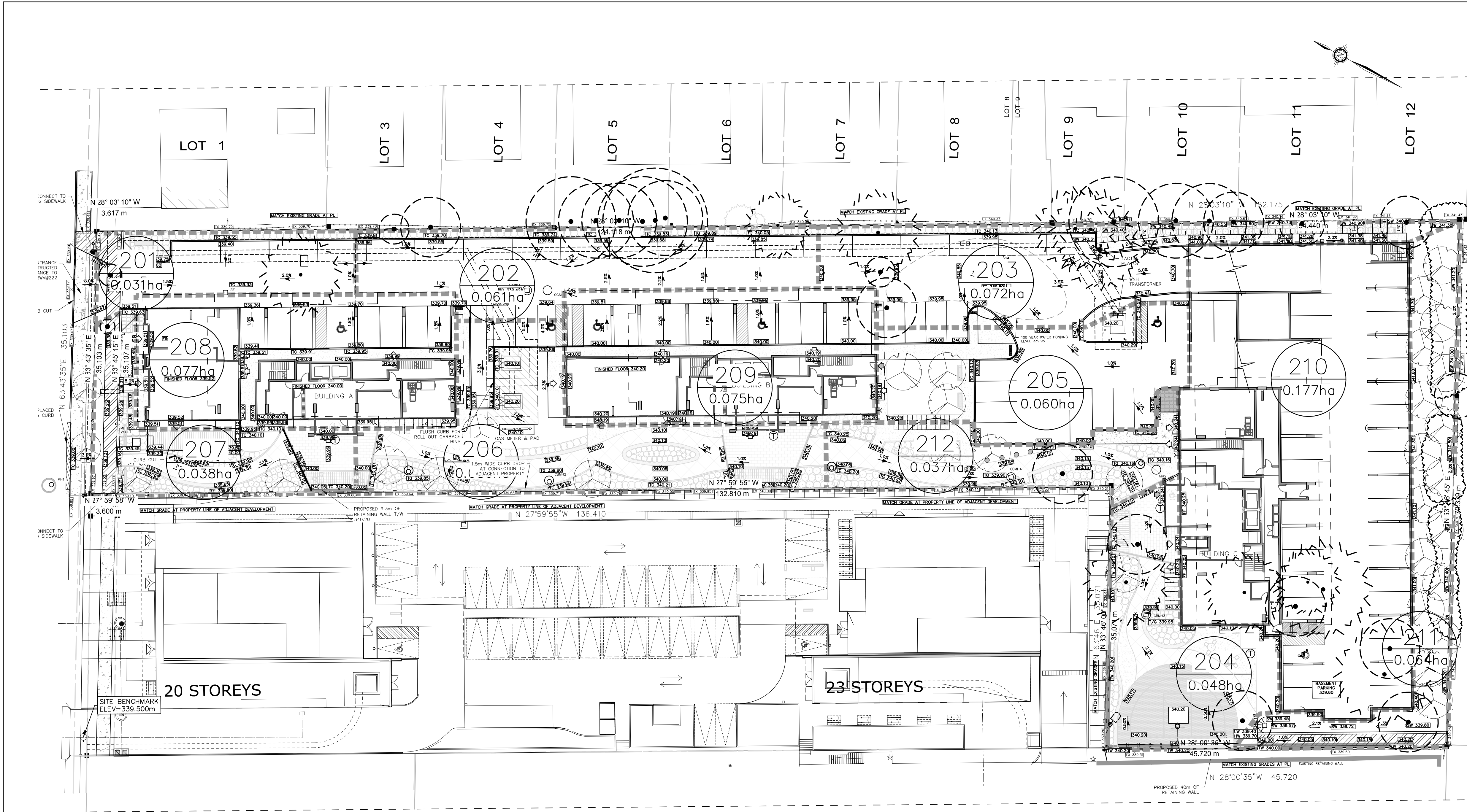
REGION OF WATERLOO CITY OF KITCHENER

EXISTING CATCHMENT PLAN

**K. SMART ASSOCIATES LIMITED**  
CONSULTING ENGINEERS AND PLANNERS  
KITCHENER SUDBURY



|                    |              |                   |
|--------------------|--------------|-------------------|
| DESIGNED BY: S.L.  | 0 8 16       | DATE: NOV 3, 2021 |
| CHECKED BY: D.A.H. | SCALE 1:400  | SHEET             |
| DRAWN BY: S.L.     |              | 1 OF 2            |
| CHECKED BY: D.A.H. | REVISION No. |                   |
| FILE No. 20-261    |              |                   |



- NOTES:
- 101 0.000ha PROPOSED CATCHMENT AREA I.D.
  - CATCHMENT AREA
  - CATCHMENT AREA BOUNDARY

|     |                                   |    |              |
|-----|-----------------------------------|----|--------------|
| 3   | 3rd SITE PLAN SUBMISSION COMMENTS | SL | AUG 11, 2023 |
| 2   | 2nd SITE PLAN SUBMISSION COMMENTS | SL | MAR 23, 2023 |
| 1   | SITE PLAN SUBMISSION COMMENTS     | SL | DEC 13, 2021 |
| No. | REVISIONS                         | BY | DATE         |
|     | CONSTRUCTION                      |    |              |
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143 COLUMBIA STREET W

REGION OF WATERLOO CITY OF KITCHENER

PROPOSED CATCHMENT PLAN

**K. SMART ASSOCIATES LIMITED**  
CONSULTING ENGINEERS AND PLANNERS  
KITCHENER SUDBURY



|                    |                |                   |
|--------------------|----------------|-------------------|
| DESIGNED BY: S.L.  | 0 6 12         | DATE: NOV 3, 2021 |
| CHECKED BY: D.A.H. | SCALE 1:300    | SHEET             |
| DRAWN BY: S.L.     | REVISION No. 3 | 2 OF 2            |
| CHECKED BY: D.A.H. |                |                   |
| FILE No. 20-261    |                |                   |

# Appendix B

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Storm Design Sheet

**143 Columbia Street W., City of Waterloo**  
**STORM SEWER DESIGN SHEETS**

|                             |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |                                   |  |
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| K. Smart Associates Limited |  | 20-261                  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | IDF Parameters - City of Waterloo |  |
| Project Number              |  | 20-261                  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 5 Year Storm Event                |  |
| Designed By                 |  | Hosein Moarefi, P. Eng. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | A 1755                            |  |
| Checked By                  |  | David Harsch, P. Eng.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | B 12.347                          |  |
| Date                        |  | Aug-23                  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | C 0.895                           |  |
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|                             |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |                                   |  |

# Appendix C

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MIDUSS Output Files

" " MIDUSS Output ----->"  
" " MIDUSS version Version 2.25 rev. 473"  
" " MIDUSS created February 7, 2010"  
" " 10 Units used: C:\Users\Administrator\Desktop\ie METRIC"  
" " ADD COMMENT===== "  
" " 1 Lines of comment"  
" " 143 Columbia Street West- post development-5 year- run 12"  
" " 31 TIME PARAMETERS"  
" " 5.000 Time Step"  
" " 180.000 Max. Storm length"  
" " 1500.000 Max. Hydrograph"  
" " 32 STORM Chicago storm"  
" " 1 Chicago storm"  
" " 1755.000 Coefficient A"  
" " 12.347 Constant B"  
" " 0.895 Exponent C"  
" " 0.400 Fraction R"  
" " 180.000 Duration"  
" " 1.000 Time step multiplier"  
" " Maximum intensity 136.512 mm/hr"  
" " Total depth 47.549 mm"  
" " 4 Shyd Hydrograph extension used in this file"  
" " 33 CATCHMENT 201"  
" " 1 Triangular SCS"  
" " 1 Equal length"  
" " 1 SCS method"  
" " 201 East area of Building A to CBI"  
" " 75.000 % Impervious"  
" " 0.031 Total Area"  
" " 10.000 Flow length"  
" " 1.380 Overland Slope"  
" " 0.008 Pervious Area"  
" " 10.000 Pervious length"  
" " 1.380 Pervious slope"  
" " 0.023 Impervious Area"  
" " 10.000 Impervious length"  
" " 1.380 Impervious slope"  
" " 0.250 Pervious Manning 'n'"  
" " 75.000 Pervious SCS Curve No."  
" " 0.259 Pervious Runoff coefficient"  
" " 0.100 Pervious Ia/S coefficient"  
" " 8.467 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"  
" " Catchment 201 Pervious Impervious Total Area "  
" " 0.007 0.000 0.000  
" " 0.000 c.m/sec"

" " Surface Area 0.008 0.023 0.031 hectare"  
" " Time of concentration 11.120 1.154 2.054 minutes"  
" " Time to Centroid 111.441 87.457 89.624 minutes"  
" " Rainfall depth 47.549 47.549 47.549 mm"  
" " Rainfall volume 3.69 11.06 14.74 c.m"  
" " Rainfall losses 35.226 6.189 13.448 mm"  
" " Runoff depth 12.323 41.360 34.101 mm"  
" " Runoff volume 0.96 9.62 10.57 c.m"  
" " Runoff coefficient 0.259 0.870 0.717 "  
" " Maximum flow 0.000 0.007 0.007 c.m/sec"  
" " 40 HYDROGRAPH Add Runoff "  
" " 4 Add Runoff " 0.007 0.000 0.000 "  
" " 33 CATCHMENT 202"  
" " 1 Triangular SCS"  
" " 1 Equal length"  
" " 1 SCS method"  
" " 202 East area of Buildings A and B to CBWH1"  
" " 75.000 % Impervious"  
" " 0.061 Total Area"  
" " 18.000 Flow length"  
" " 1.900 Overland Slope"  
" " 0.015 Pervious Area"  
" " 18.000 Pervious length"  
" " 1.900 Pervious slope"  
" " 0.046 Impervious Area"  
" " 18.000 Impervious length"  
" " 1.900 Impervious slope"  
" " 0.250 Pervious Manning 'n'"  
" " 75.000 Pervious SCS Curve No."  
" " 0.259 Pervious Runoff coefficient"  
" " 0.100 Pervious Ia/S coefficient"  
" " 8.467 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"  
" " Catchment 202 Pervious Impervious Total Area "  
" " 0.014 0.007 0.000 c.m/sec"  
" " Surface Area 0.015 0.046 0.061 hectare"  
" " Time of concentration 14.375 1.492 2.647 minutes"  
" " Time to Centroid 115.436 87.864 90.336 minutes"  
" " Rainfall depth 47.549 47.549 47.549 mm"  
" " Rainfall volume 7.25 21.75 29.00 c.m"  
" " Rainfall losses 35.223 5.826 13.175 mm"  
" " Runoff depth 12.327 41.723 34.374 mm"  
" " Runoff volume 1.88 19.09 20.97 c.m"  
" " Runoff coefficient 0.259 0.877 0.723 "  
" " Maximum flow 0.001 0.014 0.014 c.m/sec"



|   |                                        |          |            |            |                |   |         |                                        |                             |
|---|----------------------------------------|----------|------------|------------|----------------|---|---------|----------------------------------------|-----------------------------|
| " | Rainfall volume                        | 4.92     | 27.89      | 32.81      | c.m"           | " | 0.035   | Current peak flow                      | c.m/sec"                    |
| " | Rainfall losses                        | 35.223   | 5.826      | 10.235     | mm"            | " | 0.075   | Target outflow                         | c.m/sec"                    |
| " | Runoff depth                           | 12.326   | 41.723     | 37.314     | mm"            | " | 49.0    | Hydrograph volume                      | c.m"                        |
| " | Runoff volume                          | 1.28     | 24.47      | 25.75      | c.m"           | " | 21.     | Number of stages"                      |                             |
| " | Runoff coefficient                     | 0.259    | 0.877      | 0.785      | "              | " | 337.700 | Minimum water level                    | metre"                      |
| " | Maximum flow                           | 0.001    | 0.018      | 0.018      | c.m/sec"       | " | 340.000 | Maximum water level                    | metre"                      |
| " | HYDROGRAPH Add Runoff "                |          |            |            |                | " | 337.700 | Starting water level                   | metre"                      |
| " | 4 Add Runoff "                         | 0.018    | 0.018      | 0.021      | 0.021"         | " | 0       | Keep Design Data: 1 = True; 0 = False" |                             |
| " | CATCHMENT 205"                         |          |            |            |                | " |         | Level Discharge                        | Volume"                     |
| " | 1 Triangular SCS"                      |          |            |            |                | " |         | 337.700                                | 0.000                       |
| " | 1 Equal length"                        |          |            |            |                | " |         | 337.815                                | 0.00314 1.00E-07"           |
| " | 1 SCS method"                          |          |            |            |                | " |         | 337.930                                | 0.03959"                    |
| " | 205 Parking between buildings B and C" |          |            |            |                | " |         | 338.045                                | 0.00670                     |
| " | 90.000 % Impervious"                   |          |            |            |                | " |         | 338.160                                | 0.00789                     |
| " | 0.060 Total Area"                      |          |            |            |                | " |         | 338.275                                | 0.1638"                     |
| " | 10.700 Flow length"                    |          |            |            |                | " |         | 338.390                                | 0.00986                     |
| " | 1.000 Overland Slope"                  |          |            |            |                | " |         | 338.505                                | 0.01071                     |
| " | 0.006 Pervious Area"                   |          |            |            |                | " |         | 338.620                                | 0.01150                     |
| " | 10.700 Pervious length"                |          |            |            |                | " |         | 338.735                                | 0.01224                     |
| " | 1.000 Pervious slope"                  |          |            |            |                | " |         | 338.850                                | 0.01293                     |
| " | 0.054 Impervious Area"                 |          |            |            |                | " |         | 338.965                                | 0.01359                     |
| " | 10.700 Impervious length"              |          |            |            |                | " |         | 339.080                                | 0.01422                     |
| " | 1.000 Impervious slope"                |          |            |            |                | " |         | 339.195                                | 0.01482                     |
| " | 0.250 Pervious Manning 'n'"            |          |            |            |                | " |         | 339.310                                | 0.01540                     |
| " | 75.000 Pervious SCS Curve No."         |          |            |            |                | " |         | 339.425                                | 0.01596                     |
| " | 0.259 Pervious Runoff coefficient"     |          |            |            |                | " |         | 339.540                                | 0.01649                     |
| " | 0.100 Pervious Ia/S coefficient"       |          |            |            |                | " |         | 339.655                                | 0.01702                     |
| " | 8.467 Pervious Initial abstraction"    |          |            |            |                | " |         | 339.770                                | 0.01752                     |
| " | 0.015 Impervious Manning 'n'"          |          |            |            |                | " |         | 339.885                                | 0.01801                     |
| " | 98.000 Impervious SCS Curve No."       |          |            |            |                | " |         | 340.000                                | 0.01849                     |
| " | 0.875 Impervious Runoff coefficient"   |          |            |            |                | " | 1.      | WEIRS"                                 | 54.758"                     |
| " | 0.100 Impervious Ia/S coefficient"     |          |            |            |                | " |         | Crest Weir                             |                             |
| " | 0.518 Impervious Initial abstraction"  |          |            |            |                | " |         | elevation coefficient                  |                             |
| " |                                        | 0.017    | 0.018      | 0.021      | 0.021 c.m/sec" | " |         | 340.000                                | 0.900                       |
| " | Catchment 205                          | Pervious | Impervious | Total Area | "              | " | 1.      | ORIFICES"                              |                             |
| " | Surface Area                           | 0.006    | 0.054      | 0.060      | hectare"       | " |         | Orifice                                | Orifice Number of"          |
| " | Time of concentration                  | 12.755   | 1.324      | 1.687      | minutes"       | " |         | Invert coefficient                     | diameter orifices"          |
| " | Time to Centroid                       | 113.478  | 87.674     | 88.494     | minutes"       | " | 1.      | LAYERS"                                | 0.0750 1.000"               |
| " | Rainfall depth                         | 47.549   | 47.549     | 47.549     | mm"            | " |         | Bottom                                 |                             |
| " | Rainfall volume                        | 2.85     | 25.68      | 28.53      | c.m"           | " |         | Aspect                                 | Top Average"                |
| " | Rainfall losses                        | 35.253   | 5.930      | 8.863      | mm"            | " |         | ratio                                  | elevation sideslope"        |
| " | Runoff depth                           | 12.296   | 41.619     | 38.686     | mm"            | " | 4.      | area                                   | Bottom Top                  |
| " | Runoff volume                          | 0.74     | 22.47      | 23.21      | c.m"           | " |         | 1.000                                  | 337.820 339.800             |
| " | Runoff coefficient                     | 0.259    | 0.875      | 0.814      | "              | " |         | WEDGES"                                | 0.000"                      |
| " | Maximum flow                           | 0.000    | 0.017      | 0.017      | c.m/sec"       | " |         | Grade 1                                | Angle Number"               |
| " | 4 Add Runoff "                         | 0.017    | 0.035      | 0.021      | 0.021"         | " |         | invert                                 | g2H:1V subtended of wedges" |
| " | HYDROGRAPH Add Runoff "                |          |            |            |                | " |         | 339.800                                | 29.000 90.000               |
| " | 40                                     |          |            |            |                | " |         | 339.800                                | 100.000 90.000              |
| " |                                        |          |            |            |                | " |         | 339.800                                | 100.000 90.000              |
| " |                                        |          |            |            |                | " |         | 339.800                                | 100.000 90.000              |
| " | POND DESIGN"                           |          |            |            |                | " |         | 339.800                                | 100.000 90.000              |
| " |                                        |          |            |            |                | " |         | 339.800                                | 100.000 90.000              |
| " |                                        |          |            |            |                | " |         | 339.800                                | 100.000 90.000              |
| " |                                        |          |            |            |                | " |         | 339.800                                | 100.000 90.000              |
| " |                                        |          |            |            |                | " |         | 339.800                                |                             |

[illegible]





[illegible]

[illegible]

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" " MIDUSS Output ----->
" " MIDUSS version Version 2.25 rev. 473"
" " MIDUSS created February 7, 2010"
" " 10 Units used: ie METRIC"
" " Job folder: C:\Users\Administrator\Desktop"
" " ADD COMMENT=====
" " 1 Lines of comment"
" " 143 Columbia Street West- post development-100 year- run 12"
" " TIME PARAMETERS"
" " 31 5.000 Time Step"
" " 180.000 Max. Storm length"
" " 1500.000 Max. Hydrograph"
" " 32 STORM Chicago storm"
" " 1 Chicago storm"
" " 4692.000 Coefficient A"
" " 17.437 Constant B"
" " 0.956 Exponent C"
" " 0.400 Fraction R"
" " 180.000 Duration"
" " 1.000 Time step multiplier"
" " Maximum intensity 239.793 mm/hr"
" " Total depth 89.960 mm"
" " 6 100hyd Hydrograph extension used in this file"
" " 33 CATCHMENT 201"
" " 1 Triangular SCS"
" " 1 Equal length"
" " 1 SCS method"
" " 201 East area of Building A to CBI"
" " 75.000 % Impervious"
" " 0.031 Total Area"
" " 10.000 Flow length"
" " 1.380 Overland Slope"
" " 0.008 Pervious Area"
" " 10.000 Pervious length"
" " 1.380 Pervious slope"
" " 0.023 Impervious Area"
" " 10.000 Impervious length"
" " 1.380 Impervious slope"
" " 0.250 Pervious Manning 'n'"
" " 75.000 Pervious SCS Curve No."
" " 0.440 Pervious Runoff coefficient"
" " 8.467 Pervious Ia/S coefficient"
" " 0.015 Pervious Initial abstraction"
" " 98.000 Impervious Manning 'n'"
" " 0.919 Impervious SCS Curve No."
" " 0.100 Impervious Runoff coefficient"
" " 0.518 Impervious Ia/S coefficient"
" " Catchment 201 Pervious 0.000 c.m/sec"
" " 0.014 0.000 0.000 Impervious Total Area "

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" " Surface Area 0.008 0.023 0.031 hectare"
" " Time of concentration 6.754 0.910 1.726 minutes"
" " Time to Centroid 101.751 85.364 87.654 minutes"
" " Rainfall depth 89.960 89.960 89.960 mm"
" " Rainfall volume 6.97 20.92 27.89 c.m"
" " Rainfall losses 50.419 8.827 19.225 mm"
" " Runoff depth 39.541 81.133 70.735 mm"
" " Runoff volume 3.06 18.86 21.93 c.m"
" " Runoff coefficient 0.440 0.902 0.786 "
" " Maximum flow 0.002 0.013 0.014 c.m/sec"
" " 40 HYDROGRAPH Add Runoff "
" " 4 Add Runoff " 0.014 0.014 0.000 0.000"
" " 33 CATCHMENT 202"
" " 1 Triangular SCS"
" " 1 Equal length"
" " 1 SCS method"
" " 202 East area of Buildings A and B to CBWH1"
" " 75.000 % Impervious"
" " 0.061 Total Area"
" " 18.000 Flow length"
" " 1.900 Overland Slope"
" " 0.015 Pervious Area"
" " 18.000 Pervious length"
" " 1.900 Pervious slope"
" " 0.046 Impervious Area"
" " 18.000 Impervious length"
" " 1.900 Impervious slope"
" " 0.250 Pervious Manning 'n'"
" " 75.000 Pervious SCS Curve No."
" " 0.442 Pervious Runoff coefficient"
" " 0.100 Pervious Ia/S coefficient"
" " 8.467 Pervious Initial abstraction"
" " 0.015 Impervious Manning 'n'"
" " 98.000 Impervious SCS Curve No."
" " 0.919 Impervious Runoff coefficient"
" " 0.100 Impervious Ia/S coefficient"
" " 0.518 Impervious Initial abstraction"
" " Catchment 202 Pervious 0.000 c.m/sec"
" " 0.028 0.014 0.000 Impervious Total Area "
" " Surface Area 0.015 0.046 0.061 hectare"
" " Time of concentration 8.731 1.176 2.221 minutes"
" " Time to Centroid 104.078 85.696 88.237 minutes"
" " Rainfall depth 89.960 89.960 89.960 mm"
" " Rainfall volume 13.72 41.16 54.88 c.m"
" " Rainfall losses 50.171 7.290 18.010 mm"
" " Runoff depth 39.789 82.670 71.950 mm"
" " Runoff volume 6.07 37.82 43.89 c.m"
" " Runoff coefficient 0.442 0.919 0.800 "
" " Maximum flow 0.003 0.026 0.028 c.m/sec"

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|   |   |                                       |                |                |          |          |                                                        |                   |        |          |          |
|---|---|---------------------------------------|----------------|----------------|----------|----------|--------------------------------------------------------|-------------------|--------|----------|----------|
| " | " | Maximum level                         | 339.952        | metre"         | "        | "        | Maximum flow                                           | 0.004             | 0.020  | 0.021    | c.m/sec" |
| " | " | Maximum storage                       | 33.785         | c.m"           | "        | "        | HYDROGRAPH Add Runoff "                                | "                 | "      | "        | "        |
| " | " | Centroidal lag                        | 1.703          | hours"         | "        | "        | 4 Add Runoff "                                         | 0.021             | 0.018  | 0.056"   | "        |
| " | " | 0.032 0.066                           | 0.018          | 0.038 c.m/sec" | "        | "        | CATCHMENT 211"                                         | "                 | "      | "        | "        |
| " | " | HYDROGRAPH Combine                    | 1"             | "              | "        | "        | 1 Triangular SCS"                                      | "                 | "      | "        | "        |
| " | " | 6 Combine "                           | "              | "              | "        | "        | 1 Equal length"                                        | "                 | "      | "        | "        |
| " | " | 1 Node #"                             | "              | "              | "        | "        | 1 SCS method"                                          | "                 | "      | "        | "        |
| " | " | Columbia Street"                      | "              | "              | "        | "        | 211 South backyard to CB3"                             | "                 | "      | "        | "        |
| " | " | Maximum flow                          | 0.056          | c.m/sec"       | "        | "        | 3.000 % Impervious"                                    | "                 | "      | "        | "        |
| " | " | Hydrograph volume                     | 164.192        | c.m"           | "        | "        | 0.048 Total Area"                                      | "                 | "      | "        | "        |
| " | " | 0.032 0.066                           | 0.018          | 0.056"         | "        | "        | 80.000 Flow length"                                    | "                 | "      | "        | "        |
| " | " | HYDROGRAPH Start - New Tributary"     | "              | "              | "        | "        | 1.900 Overland Slope"                                  | "                 | "      | "        | "        |
| " | " | 2 Start - New Tributary"              | 0.018          | 0.056"         | "        | "        | 0.047 Pervious Area"                                   | "                 | "      | "        | "        |
| " | " | 0.032 0.000                           | 0.018          | 0.056"         | "        | "        | 80.000 Pervious length"                                | "                 | "      | "        | "        |
| " | " | CATCHMENT 204"                        | "              | "              | "        | "        | 1.900 Pervious slope"                                  | "                 | "      | "        | "        |
| " | " | 1 Triangular SCS"                     | "              | "              | "        | "        | 80.000 Impervious Area"                                | "                 | "      | "        | "        |
| " | " | 1 Equal length"                       | "              | "              | "        | "        | 1.900 Impervious length"                               | "                 | "      | "        | "        |
| " | " | 1 SCS method"                         | "              | "              | "        | "        | 0.250 Impervious slope"                                | "                 | "      | "        | "        |
| " | " | 204 Court area to CBMH3"              | "              | "              | "        | "        | 0.250 Pervious Manning 'n'"                            | "                 | "      | "        | "        |
| " | " | 65.000 % Impervious"                  | "              | "              | "        | "        | 75.000 Pervious SCS Curve No."                         | "                 | "      | "        | "        |
| " | " | 0.052 Total Area"                     | "              | "              | "        | "        | 0.444 Pervious Runoff coefficient"                     | "                 | "      | "        | "        |
| " | " | 13.000 Flow length"                   | "              | "              | "        | "        | 0.100 Pervious Ia/S coefficient"                       | "                 | "      | "        | "        |
| " | " | 1.240 Overland Slope"                 | "              | "              | "        | "        | 8.467 Pervious Initial abstraction"                    | "                 | "      | "        | "        |
| " | " | 0.018 Pervious Area"                  | "              | "              | "        | "        | 0.015 Impervious Manning 'n'"                          | "                 | "      | "        | "        |
| " | " | 13.000 Pervious length"               | "              | "              | "        | "        | 98.000 Impervious SCS Curve No."                       | "                 | "      | "        | "        |
| " | " | 1.240 Pervious slope"                 | "              | "              | "        | "        | 0.918 Impervious Runoff coefficient"                   | "                 | "      | "        | "        |
| " | " | 0.034 Impervious Area"                | "              | "              | "        | "        | 0.100 Impervious Ia/S coefficient"                     | "                 | "      | "        | "        |
| " | " | 13.000 Impervious length"             | "              | "              | "        | "        | 0.518 Impervious Initial abstraction"                  | "                 | "      | "        | "        |
| " | " | 1.240 Impervious slope"               | "              | "              | "        | "        | 0.007 0.021 0.018                                      | 0.056 c.m/sec"    | "      | "        | "        |
| " | " | 0.250 Pervious Manning 'n'"           | "              | "              | "        | "        | Catchment 211                                          | Impervious        | 0.001  | 0.048    | hectare" |
| " | " | 75.000 Pervious SCS Curve No."        | "              | "              | "        | "        | Surface Area                                           | 0.047             | 20.257 | minutes" | "        |
| " | " | 0.443 Pervious Runoff coefficient"    | "              | "              | "        | "        | Time of concentration                                  | 21.368            | 88.113 | 118.012  | minutes" |
| " | " | 0.100 Pervious Ia/S coefficient"      | "              | "              | "        | "        | Time to Centroid                                       | 119.925           | 89.960 | 89.960   | mm"      |
| " | " | 8.467 Pervious Initial abstraction"   | "              | "              | "        | "        | Rainfall depth                                         | 41.89             | 1.30   | 43.18    | c.m"     |
| " | " | 0.015 Impervious Manning 'n'"         | "              | "              | "        | "        | Rainfall volume                                        | 50.018            | 7.366  | 48.739   | mm"      |
| " | " | 98.000 Impervious SCS Curve No."      | "              | "              | "        | "        | Rainfall losses                                        | 39.942            | 82.594 | 41.221   | mm"      |
| " | " | 0.915 Impervious Runoff coefficient"  | "              | "              | "        | "        | Runoff depth                                           | 18.60             | 1.19   | 19.79    | c.m"     |
| " | " | 0.100 Impervious Ia/S coefficient"    | "              | "              | "        | "        | Runoff volume                                          | 0.444             | 0.918  | 0.458    | "        |
| " | " | 0.518 Impervious Initial abstraction" | "              | "              | "        | "        | Runoff coefficient                                     | 0.007             | 0.001  | 0.007    | c.m/sec" |
| " | " | 0.021 0.000 0.018                     | 0.056 c.m/sec" | "              | "        | "        | Maximum flow                                           | "                 | "      | "        | "        |
| " | " | Catchment 204                         | Impervious     | 0.034          | 0.052    | hectare" | HYDROGRAPH Add Runoff "                                | "                 | "      | "        | "        |
| " | " | Surface Area                          | 0.108          | 0.052          | minutes" | "        | 4 Add Runoff "                                         | 0.007 0.022 0.018 | 0.056" | "        | "        |
| " | " | Time of concentration                 | 8.164          | 2.559          | minutes" | "        | CATCHMENT 212"                                         | "                 | "      | "        | "        |
| " | " | Time to Centroid                      | 103.433        | 85.602         | mm"      | "        | 1 Triangular SCS"                                      | "                 | "      | "        | "        |
| " | " | Rainfall depth                        | 89.960         | 89.960         | c.m"     | "        | 1 Equal length"                                        | "                 | "      | "        | "        |
| " | " | Rainfall volume                       | 16.37          | 30.41          | mm"      | "        | 1 SCS method"                                          | "                 | "      | "        | "        |
| " | " | Rainfall losses                       | 50.130         | 7.612          | mm"      | "        | 212 Prominate areas between building B and C to CBMH4" | "                 | "      | "        | "        |
| " | " | Runoff depth                          | 39.830         | 82.349         | c.m"     | "        | 85.000 % Impervious"                                   | "                 | "      | "        | "        |
| " | " | Runoff volume                         | 7.25           | 27.83          | c.m"     | "        | "                                                      | "                 | "      | "        | "        |
| " | " | Runoff coefficient                    | 0.443          | 0.915          | 0.750    | "        | "                                                      | "                 | "      | "        | "        |

|   |                         |                                                               |        |                         |                                 |                |                |
|---|-------------------------|---------------------------------------------------------------|--------|-------------------------|---------------------------------|----------------|----------------|
| " | 0.037                   | Total Area"                                                   | "      | 75.000                  | Pervious SCS Curve No."         | "              | 0.056 c.m/sec" |
| " | 13.500                  | Flow length"                                                  | "      | 0.442                   | Pervious Runoff coefficient"    | "              | 0.075          |
| " | 1.000                   | Overland Slope"                                               | "      | 0.100                   | Pervious Ia/S coefficient"      | "              | 0.075          |
| " | 0.006                   | Pervious Area"                                                | "      | 8.467                   | Pervious Initial abstraction"   | "              | 2.144          |
| " | 13.500                  | Pervious length"                                              | "      | 0.015                   | Impervious Manning 'n'"         | "              | 87.852         |
| " | 1.000                   | Pervious slope"                                               | "      | 98.000                  | Impervious SCS Curve No."       | "              | 89.960         |
| " | 0.031                   | Impervious Area"                                              | "      | 0.922                   | Impervious Runoff coefficient"  | "              | 67.47          |
| " | 13.500                  | Impervious length"                                            | "      | 0.100                   | Impervious Ia/S coefficient"    | "              | 15.628         |
| " | 1.000                   | Impervious slope"                                             | "      | 0.518                   | Impervious Initial abstraction" | "              | 74.332         |
| " | 0.250                   | Pervious Manning 'n'"                                         | "      | 0.036                   | 0.041                           | 0.018          | 55.75          |
| " | 75.000                  | Pervious SCS Curve No."                                       | "      | Catchment 206           | Pervious                        | 0.056 c.m/sec" | 0.036          |
| " | 0.442                   | Pervious Runoff coefficient"                                  | "      | Surface Area            | 0.015                           | 0.060          | 0.075          |
| " | 0.100                   | Pervious Ia/S coefficient"                                    | "      | Time of concentration   | 9.431                           | 1.270          | 2.144          |
| " | 8.467                   | Pervious Initial abstraction"                                 | "      | Time to Centroid        | 104.974                         | 85.801         | 87.852         |
| " | 0.015                   | Impervious Manning 'n'"                                       | "      | Rainfall depth          | 89.960                          | 89.960         | 89.960         |
| " | 98.000                  | Impervious SCS Curve No."                                     | "      | Rainfall volume         | 13.49                           | 53.98          | 67.47          |
| " | 0.031                   | Impervious Area"                                              | "      | Rainfall losses         | 50.188                          | 6.988          | 15.628         |
| " | 13.500                  | Impervious length"                                            | "      | Runoff depth            | 39.772                          | 82.972         | 74.332         |
| " | 1.000                   | Impervious slope"                                             | "      | Runoff volume           | 5.97                            | 49.78          | 55.75          |
| " | 0.250                   | Pervious Manning 'n'"                                         | "      | Runoff coefficient      | 0.442                           | 0.922          | 0.826          |
| " | 75.000                  | Pervious SCS Curve No."                                       | "      | Maximum flow            | 0.003                           | 0.035          | 0.036          |
| " | 0.442                   | Pervious Runoff coefficient"                                  | "      | HYDROGRAPH Add Runoff " |                                 |                |                |
| " | 0.100                   | Pervious Ia/S coefficient"                                    | "      | 4 Add Runoff "          | 0.036                           | 0.076          | 0.056"         |
| " | 0.518                   | Impervious Initial abstraction"                               | "      |                         |                                 |                |                |
| " | 0.019                   | 0.022                                                         | 0.018  |                         |                                 |                |                |
| " | Catchment 212           | Pervious                                                      |        |                         |                                 |                |                |
| " | Surface Area            | 0.006                                                         | 0.031  | 0.037                   | 0.036                           | 0.018          | 0.056"         |
| " | Time of concentration   | 8.907                                                         | 1.200  | 1.802                   |                                 |                |                |
| " | Time to Centroid        | 104.306                                                       | 85.726 | 87.179                  |                                 |                |                |
| " | Rainfall depth          | 89.960                                                        | 89.960 | 89.960                  |                                 |                |                |
| " | Rainfall volume         | 4.99                                                          | 28.29  | 33.29                   |                                 |                |                |
| " | Rainfall losses         | 50.177                                                        | 7.207  | 13.653                  |                                 |                |                |
| " | Runoff depth            | 39.783                                                        | 82.753 | 76.307                  |                                 |                |                |
| " | Runoff volume           | 2.21                                                          | 26.03  | 28.23                   |                                 |                |                |
| " | Runoff coefficient      | 0.442                                                         | 0.920  | 0.848                   |                                 |                |                |
| " | Maximum flow            | 0.001                                                         | 0.018  | 0.019                   |                                 |                |                |
| " | HYDROGRAPH Add Runoff " |                                                               |        |                         |                                 |                |                |
| " | 4 Add Runoff "          | 0.019                                                         | 0.041  | 0.018                   | 0.056"                          |                |                |
| " |                         |                                                               |        |                         |                                 |                |                |
| " | CATCHMENT 206"          |                                                               |        |                         |                                 |                |                |
| " | 1 Triangular SCS"       |                                                               |        |                         |                                 |                |                |
| " | 1 Equal length"         |                                                               |        |                         |                                 |                |                |
| " | 1 SCS method"           |                                                               |        |                         |                                 |                |                |
| " | 206                     | Parking and promenade areas between Building A and B to 0651" |        |                         |                                 |                |                |
| " | 80.000                  | % Impervious"                                                 |        |                         |                                 |                |                |
| " | 21.000                  | Total Area"                                                   |        |                         |                                 |                |                |
| " | 0.075                   | Flow length"                                                  |        |                         |                                 |                |                |
| " | 2.000                   | Overland Slope"                                               |        |                         |                                 |                |                |
| " | 0.015                   | Pervious Area"                                                |        |                         |                                 |                |                |
| " | 21.000                  | Pervious length"                                              |        |                         |                                 |                |                |
| " | 2.000                   | Pervious slope"                                               |        |                         |                                 |                |                |
| " | 0.060                   | Impervious Area"                                              |        |                         |                                 |                |                |
| " | 21.000                  | Impervious length"                                            |        |                         |                                 |                |                |
| " | 2.000                   | Impervious slope"                                             |        |                         |                                 |                |                |
| " | 0.250                   | Pervious Manning 'n'"                                         |        |                         |                                 |                |                |



[illegible]

[illegible]

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" " MIDUSS created February 7, 2010"  
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" " Licensee name: Sandra Swanton"  
" " Company K. Smart Associates Limited"  
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" " 1.000 Impervious slope"  
" " 0.250 Pervious Manning 'n'"  
" " 75.000 Pervious SCS Curve No."  
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" " 0.100 Pervious Ia/S coefficient"  
" " 8.467 Pervious Initial abstraction"  
" " 0.015 Impervious Manning 'n'"  
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" " 0.872 Impervious Runoff coefficient"

" " 0.100 Impervious Ia/S coefficient"  
" " 0.518 Impervious Initial abstraction"  
" " 0.097 0.000 0.000 0.000 c.m/sec"  
" " Catchment 101 Pervious Impervious Total Area "  
" " Surface Area 0.302 0.340 0.642 hectare"  
" " Time of concentration 25.972 2.695 7.551 minutes"  
" " Time to centroid 129.580 89.723 98.038 mm"  
" " Rainfall depth 47.549 47.549 47.549 mm"  
" " Rainfall volume 143.47 161.79 305.26 c.m"  
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" " 0.097 0.097 0.097 "  
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" " 1 Equal length"  
" " 1 SCS method"  
" " 102 Phillip Street catchment"  
" " 11.000 % Impervious"  
" " 0.158 Total Area"  
" " 40.000 Flow length"  
" " 2.000 Overland Slope"  
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" " 40.000 Pervious length"  
" " 2.000 Pervious slope"  
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" " 2.000 Impervious slope"  
" " 0.250 Pervious Manning 'n'"  
" " 75.000 Pervious SCS Curve No."  
" " 0.259 Pervious Runoff coefficient"  
" " 0.100 Pervious Ia/S coefficient"  
" " 8.467 Pervious Initial abstraction"



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" " MIDUSS created February 7, 2010"
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" " 1 Chicago storm"
" " 4692.000 Coefficient A"
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" " 101 Columbia Street West catchment"
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" " 0.642 Total Area"
" " 35.000 Flow length"
" " 1.000 Overland Slope"
" " 0.302 Pervious Area"
" " 35.000 Pervious length"
" " 1.000 Pervious slope"
" " 0.340 Impervious Area"
" " 35.000 Impervious length"
" " 1.000 Impervious slope"
" " 0.250 Pervious Manning 'n'"
" " 75.000 Pervious SCS Curve No."
" " 0.444 Pervious Runoff coefficient"
" " 0.100 Pervious Ia/S coefficient"
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" " 0.015 Impervious Manning 'n'"
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" " 0.925 Impervious Runoff coefficient"
" " 0.100 Impervious Ia/S coefficient"
" " 0.518 Impervious Initial abstraction"
" " 0.195 0.000 0.000
" " Catchment 101 Pervious Impervious Total Area "

```

```

" " Surface Area 0.302 0.340 0.642 hectare"
" " Time of concentration 15.775 2.125 6.196 minutes"
" " Time to Centroid 112.940 86.976 94.721 minutes"
" " Rainfall depth 89.960 89.960 89.960 mm"
" " Rainfall volume 271.45 306.10 577.54 c.m"
" " Rainfall losses 50.057 6.708 27.082 mm"
" " Runoff depth 39.903 83.252 62.878 mm"
" " Runoff volume 120.40 283.27 403.68 c.m"
" " Runoff coefficient 0.444 0.925 0.699 "
" " Maximum flow 0.050 0.186 0.195 c.m/sec"
" " 40 HYDROGRAPH Add Runoff "
" " 4 Add Runoff "
" " 0.195 0.195 0.000 0.000"
" " 40 HYDROGRAPH Copy to Outflow"
" " 8 Copy to Outflow"
" " 0.195 0.195 0.195 0.000"
" " 40 HYDROGRAPH Combine 1"
" " 6 Combine "
" " 1 Node #"
" " Columbia Street West"
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" " Hydrograph volume 403.677 c.m"
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" " 40 HYDROGRAPH Start - New Tributary"
" " 2 Start - New Tributary"
" " 0.195 0.000 0.195 0.195"
" " 33 CATCHMENT 102"
" " 1 Triangular SCS"
" " 1 Equal length"
" " 1 SCS method"
" " 102 Phillip Street catchment"
" " 11.000 % Impervious"
" " 0.158 Total Area"
" " 40.000 Flow length"
" " 2.000 Overland Slope"
" " 0.141 Pervious Area"
" " 40.000 Pervious length"
" " 2.000 Pervious slope"
" " 0.017 Impervious Area"
" " 40.000 Impervious length"
" " 2.000 Impervious slope"
" " 0.250 Pervious Manning 'n'"
" " 75.000 Pervious SCS Curve No."
" " 0.443 Pervious Runoff coefficient"
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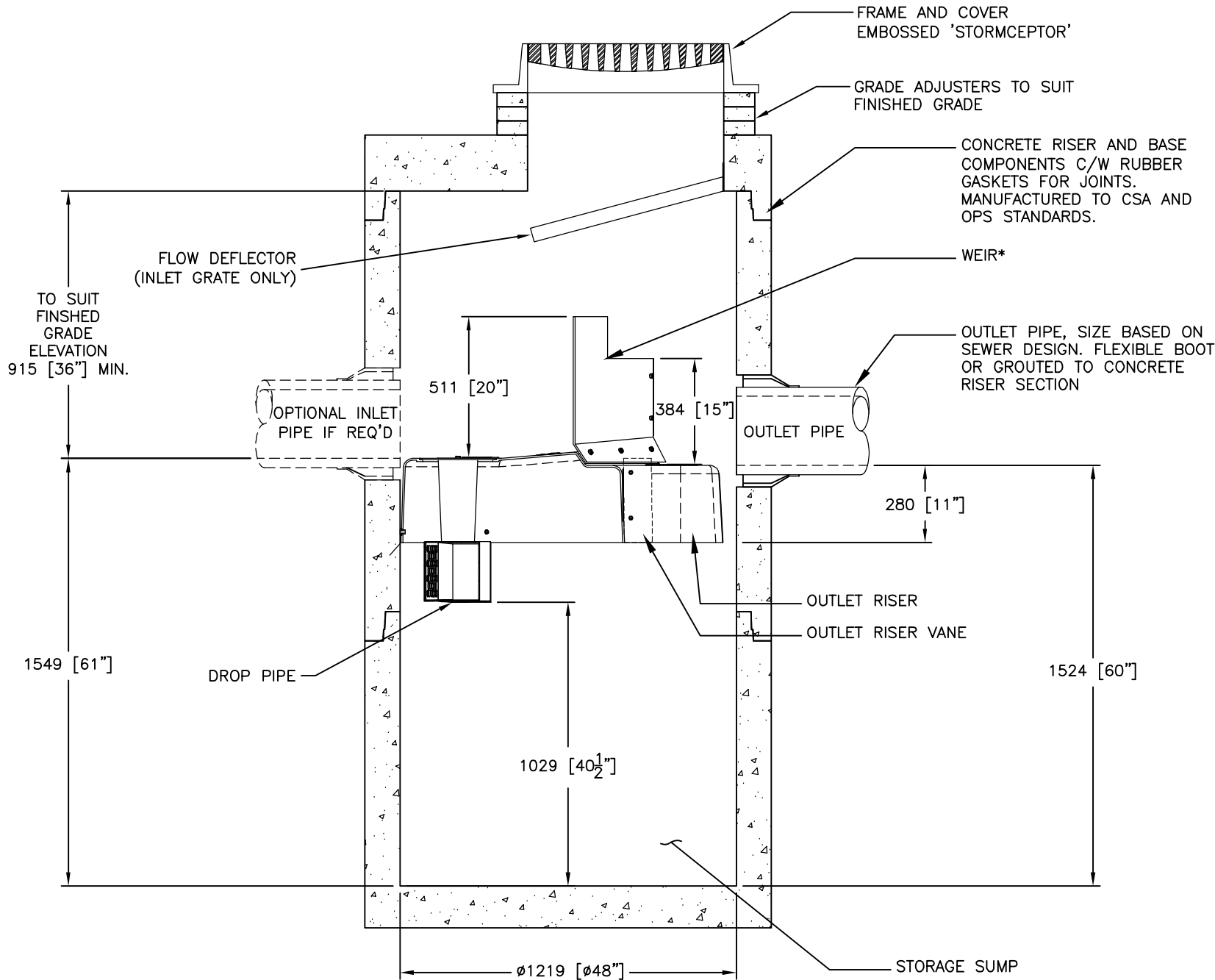
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# Appendix D

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OGS Sizing Information



SECTION VIEW

GENERAL NOTES:

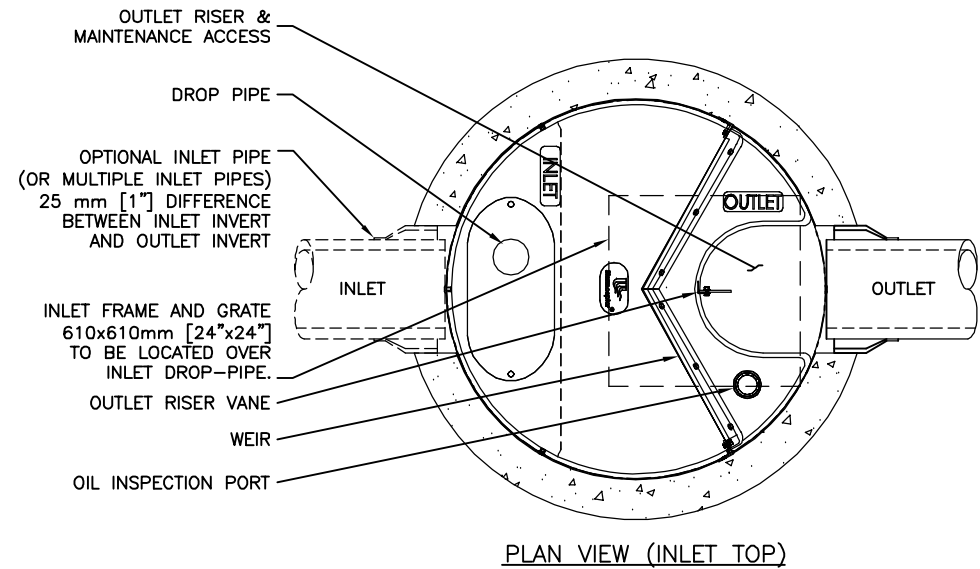
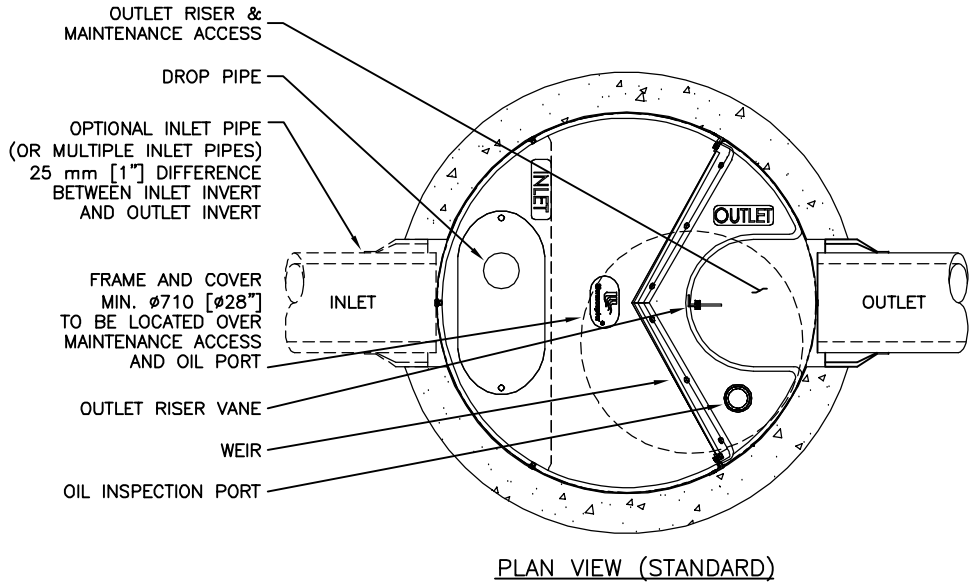
- \* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m<sup>2</sup> (27.9 gpm/ft<sup>2</sup>) FOR STORMCEPTOR EF4 AND 535 L/min/m<sup>2</sup> (13.1 gpm/ft<sup>2</sup>) FOR STORMCEPTOR EFO4 (OIL CAPTURE CONFIGURATION). WEIR HEIGHT IS 150 mm (6 INCH) FOR EF04.
1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
  2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
  3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
  4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
  5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

- A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
- C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
- D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
- E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

# STANDARD DETAIL

# NOT FOR CONSTRUCTION



FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

| SITE SPECIFIC DATA REQUIREMENTS  |      |       |     |         |     |
|----------------------------------|------|-------|-----|---------|-----|
| STORMCEPTOR MODEL                |      | EF4   |     |         |     |
| STRUCTURE ID                     |      | *     |     |         |     |
| WATER QUALITY FLOW RATE (L/s)    |      | *     |     |         |     |
| PEAK FLOW RATE (L/s)             |      | *     |     |         |     |
| RETURN PERIOD OF PEAK FLOW (yrs) |      | *     |     |         |     |
| DRAINAGE AREA (HA)               |      | *     |     |         |     |
| DRAINAGE AREA IMPERVIOUSNESS (%) |      | *     |     |         |     |
| PIPE DATA:                       | I.E. | MAT'L | DIA | SLOPE % | HGL |
| INLET #1                         | *    | *     | *   | *       | *   |
| INLET #2                         | *    | *     | *   | *       | *   |
| OUTLET                           | *    | *     | *   | *       | *   |
| * PER ENGINEER OF RECORD         |      |       |     |         |     |

The design and information shown on this drawing is provided as a service to the project owner, engineer and contractor by Imbrium Systems ("Imbrium"). Neither this drawing, nor any part thereof, may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without the prior written consent of Imbrium. Imbrium expressly disclaims any liability or responsibility for such use.

If discrepancies between the supplied information upon which this drawing is based and actual field conditions are encountered in site work progress, these are to be resolved by the engineer of record. Imbrium accepts no liability for designs based on missing, incomplete or inaccurate information supplied by others.

|      |      |      |      |         |                 |                      |
|------|------|------|------|---------|-----------------|----------------------|
| #### | #### | #### | #### | JSK     | JSK             | BY                   |
| #### | #### | #### | #### | UPDATES | INITIAL RELEASE | REVISION DESCRIPTION |
| #### | #### | #### | #### | 6/8/18  | 5/26/17         | DATE                 |
| #### | #### | #### | 1    | 0       | MARK            |                      |

# Stormceptor® EF

7037 RIDGE ROAD, SUITE 350, HANOVER, MD 21075  
USA 888-278-8828 CA 800-588-4801 INTL +1-410-560-5600

THE STORMCEPTOR SYSTEM IS REGISTERED BY THE U.S. PATENT AND TRADEMARK OFFICE. IMBRIUM SYSTEMS, INC. IS THE EXCLUSIVE MANUFACTURER OF THE STORMCEPTOR SYSTEM. NO OTHER COMPANY IS PERMITTED TO USE THE NAME STORMCEPTOR OR IMBRIUM FOR ANY OTHER PRODUCT. IMBRIUM SYSTEMS, INC. IS NOT RESPONSIBLE FOR ANY REVISIONS OR CHANGES TO THE STORMCEPTOR SYSTEM. IMBRIUM SYSTEMS, INC. IS NOT RESPONSIBLE FOR ANY REVISIONS OR CHANGES TO THE STORMCEPTOR SYSTEM. IMBRIUM SYSTEMS, INC. IS NOT RESPONSIBLE FOR ANY REVISIONS OR CHANGES TO THE STORMCEPTOR SYSTEM.

DATE: 5/26/2017

|                  |                 |
|------------------|-----------------|
| DESIGNED: JSK    | DRAWN: JSK      |
| CHECKED: BSF     | APPROVED: SP    |
| PROJECT No.: EF4 | SEQUENCE No.: * |
| SHEET: 1         | OF 1            |

# Stormceptor® EF Sizing Report

## Imbrium® Systems

### ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

08/11/2023

|                              |                        |                   |                            |
|------------------------------|------------------------|-------------------|----------------------------|
| Province:                    | Ontario                | Project Name:     | 143 Columbia Street        |
| City:                        | Waterloo               | Project Number:   | 20-261                     |
| Nearest Rainfall Station:    | WATERLOO WELLINGTON AP | Designer Name:    | Hossein Moarefi            |
| Climate Station Id:          | 6149387                | Designer Company: | K.Smart Associates Limited |
| Years of Rainfall Data:      | 34                     | Designer Email:   | hmoarefi@ksmart.ca         |
|                              |                        | Designer Phone:   | 705-222-6175               |
| Site Name:                   |                        | EOR Name:         |                            |
|                              |                        | EOR Company:      |                            |
| Drainage Area (ha):          | 0.22                   | EOR Email:        |                            |
| % Imperviousness:            | 82.00                  | EOR Phone:        |                            |
| Runoff Coefficient 'c': 0.79 |                        |                   |                            |

|                             |      |
|-----------------------------|------|
| Particle Size Distribution: | Fine |
| Target TSS Removal (%):     | 80.0 |

|                                                   |       |
|---------------------------------------------------|-------|
| Required Water Quality Runoff Volume Capture (%): | 90.00 |
| Estimated Water Quality Flow Rate (L/s):          | 6.60  |
| Oil / Fuel Spill Risk Site?                       | No    |
| Upstream Flow Control?                            | No    |
| Peak Conveyance (maximum) Flow Rate (L/s):        |       |
| Influent TSS Concentration (mg/L):                | 200   |
| Estimated Average Annual Sediment Load (kg/yr):   | 222   |
| Estimated Average Annual Sediment Volume (L/yr):  | 181   |

### Net Annual Sediment (TSS) Load Reduction Sizing Summary

| Stormceptor Model | TSS Removal Provided (%) |
|-------------------|--------------------------|
| EF4               | 93                       |
| EF6               | 98                       |
| EF8               | 99                       |
| EF10              | 100                      |
| EF12              | 100                      |

Recommended Stormceptor EF Model: **EF4**  
Estimated Net Annual Sediment (TSS) Load Reduction (%): **93**  
Water Quality Runoff Volume Capture (%): **> 90**

## Stormceptor® EF Sizing Report

### 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       |

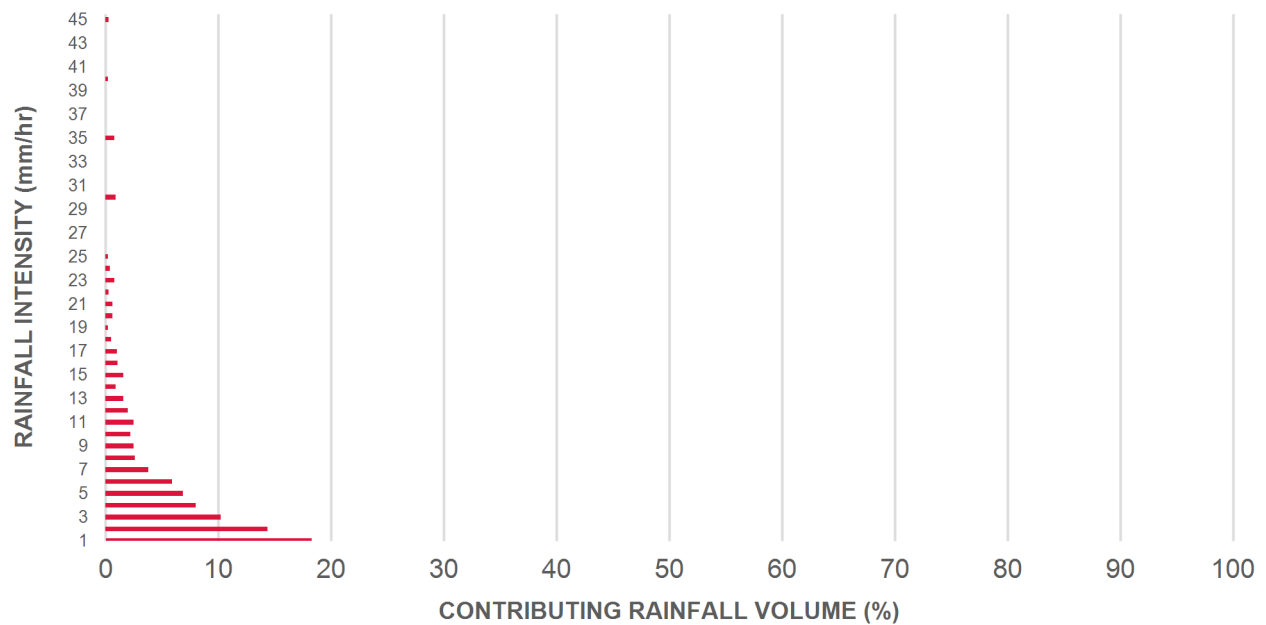
# Stormceptor®EF Sizing Report

| 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 (%) |
|------------------------------------------------------|-----------------------------|--------------------------------|-----------------|-------------------|---------------------------------|------------------------|-------------------------|------------------------|
| 0.50                                                 | 8.5                         | 8.5                            | 0.24            | 15.0              | 12.0                            | 100                    | 8.5                     | 8.5                    |
| 1.00                                                 | 18.3                        | 26.8                           | 0.48            | 29.0              | 24.0                            | 100                    | 18.3                    | 26.8                   |
| 2.00                                                 | 14.4                        | 41.3                           | 0.97            | 58.0              | 48.0                            | 100                    | 14.4                    | 41.3                   |
| 3.00                                                 | 10.2                        | 51.5                           | 1.45            | 87.0              | 73.0                            | 100                    | 10.2                    | 51.5                   |
| 4.00                                                 | 8.0                         | 59.5                           | 1.94            | 116.0             | 97.0                            | 97                     | 7.8                     | 59.2                   |
| 5.00                                                 | 6.9                         | 66.4                           | 2.42            | 145.0             | 121.0                           | 93                     | 6.5                     | 65.7                   |
| 6.00                                                 | 5.9                         | 72.3                           | 2.91            | 174.0             | 145.0                           | 91                     | 5.3                     | 71.0                   |
| 7.00                                                 | 3.8                         | 76.1                           | 3.39            | 203.0             | 170.0                           | 87                     | 3.3                     | 74.3                   |
| 8.00                                                 | 2.6                         | 78.7                           | 3.88            | 233.0             | 194.0                           | 84                     | 2.2                     | 76.5                   |
| 9.00                                                 | 2.5                         | 81.1                           | 4.36            | 262.0             | 218.0                           | 83                     | 2.0                     | 78.6                   |
| 10.00                                                | 2.2                         | 83.3                           | 4.84            | 291.0             | 242.0                           | 81                     | 1.8                     | 80.3                   |
| 11.00                                                | 2.5                         | 85.8                           | 5.33            | 320.0             | 266.0                           | 80                     | 2.0                     | 82.3                   |
| 12.00                                                | 2.0                         | 87.8                           | 5.81            | 349.0             | 291.0                           | 79                     | 1.6                     | 83.9                   |
| 13.00                                                | 1.6                         | 89.4                           | 6.30            | 378.0             | 315.0                           | 78                     | 1.3                     | 85.2                   |
| 14.00                                                | 0.9                         | 90.4                           | 6.78            | 407.0             | 339.0                           | 77                     | 0.7                     | 85.9                   |
| 15.00                                                | 1.6                         | 91.9                           | 7.27            | 436.0             | 363.0                           | 76                     | 1.2                     | 87.1                   |
| 16.00                                                | 1.1                         | 93.0                           | 7.75            | 465.0             | 388.0                           | 75                     | 0.8                     | 87.9                   |
| 17.00                                                | 1.0                         | 94.0                           | 8.23            | 494.0             | 412.0                           | 74                     | 0.8                     | 88.7                   |
| 18.00                                                | 0.5                         | 94.6                           | 8.72            | 523.0             | 436.0                           | 73                     | 0.4                     | 89.1                   |
| 19.00                                                | 0.2                         | 94.8                           | 9.20            | 552.0             | 460.0                           | 73                     | 0.2                     | 89.2                   |
| 20.00                                                | 0.6                         | 95.4                           | 9.69            | 581.0             | 484.0                           | 73                     | 0.5                     | 89.7                   |
| 21.00                                                | 0.6                         | 96.1                           | 10.17           | 610.0             | 509.0                           | 72                     | 0.5                     | 90.1                   |
| 22.00                                                | 0.3                         | 96.4                           | 10.66           | 639.0             | 533.0                           | 72                     | 0.2                     | 90.3                   |
| 23.00                                                | 0.8                         | 97.2                           | 11.14           | 668.0             | 557.0                           | 72                     | 0.6                     | 90.9                   |
| 24.00                                                | 0.4                         | 97.6                           | 11.63           | 698.0             | 581.0                           | 71                     | 0.3                     | 91.3                   |
| 25.00                                                | 0.2                         | 97.8                           | 12.11           | 727.0             | 605.0                           | 71                     | 0.1                     | 91.4                   |
| 30.00                                                | 0.9                         | 98.7                           | 14.53           | 872.0             | 727.0                           | 70                     | 0.6                     | 92.0                   |
| 35.00                                                | 0.8                         | 99.5                           | 16.95           | 1017.0            | 848.0                           | 69                     | 0.6                     | 92.5                   |
| 40.00                                                | 0.2                         | 99.7                           | 19.38           | 1163.0            | 969.0                           | 68                     | 0.2                     | 92.7                   |
| 45.00                                                | 0.3                         | 100.0                          | 21.80           | 1308.0            | 1090.0                          | 69                     | 0.2                     | 92.9                   |
| Estimated Net Annual Sediment (TSS) Load Reduction = |                             |                                |                 |                   |                                 |                        |                         | 93 %                   |

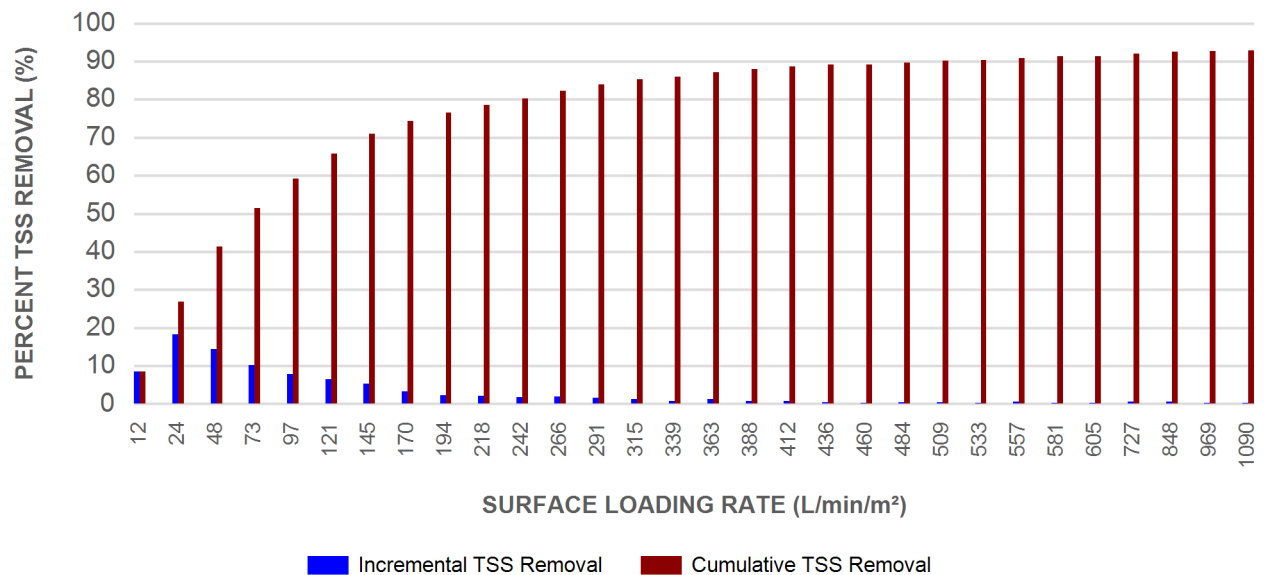
Climate Station ID: 6149387 Years of Rainfall Data: 34

# Stormceptor®EF Sizing Report

## RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



## INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



## Stormceptor® EF Sizing Report

### Maximum Pipe Diameter / Peak Conveyance

| Stormceptor<br>EF / EFO | Model Diameter |      | Min Angle Inlet /<br>Outlet Pipes | Max Inlet Pipe<br>Diameter |      | Max Outlet Pipe<br>Diameter |      | Peak Conveyance<br>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

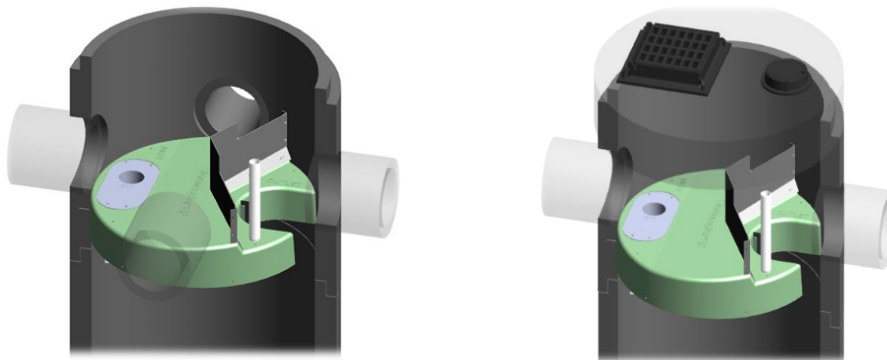
► Stormceptor® EF and EFO feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance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

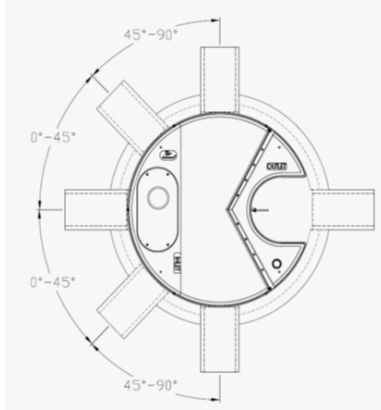
► Stormceptor® EF and EFO offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle,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



## Stormceptor® EF Sizing Report



### 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>

## Stormceptor®EF Sizing Report

### 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 <sup>3</sup> sediment / 265 L oil    |
|       | 6 ft (1829 mm) Diameter OGS Units:  | 3.48 m <sup>3</sup> sediment / 609 L oil    |
|       | 8 ft (2438 mm) Diameter OGS Units:  | 8.78 m <sup>3</sup> sediment / 1,071 L oil  |
|       | 10 ft (3048 mm) Diameter OGS Units: | 17.78 m <sup>3</sup> sediment / 1,673 L oil |
|       | 12 ft (3657 mm) Diameter OGS Units: | 31.23 m <sup>3</sup> sediment / 2,476 L oil |

#### PART 3 – PERFORMANCE & DESIGN

##### 3.1 GENERAL

## Stormceptor®EF Sizing Report

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<sup>2</sup> to 1400 L/min/m<sup>2</sup>, 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<sup>2</sup> and 1400 L/min/m<sup>2</sup> 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<sup>2</sup> shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m<sup>2</sup>. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m<sup>2</sup>.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m<sup>2</sup> shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m<sup>2</sup>, and shall be calculated using a simple proportioning formula, with 1400 L/min/m<sup>2</sup> 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<sup>2</sup>.

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<sup>2</sup>.