Stormwater Management Design Report for:

8 Schofield Street
City of Cambridge

GMBP File: 423127

May 2024

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8 SCHOFIELD STREET

CITY OF CAMBRIDGE

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1. INTRODUCTION

This report has been prepared by GM BluePlan Engineering Limited to document the stormwater management system design for the 0.22-hectare development at 8 Schofield Street in the City of Cambridge.

The Owner is required to have a Professional Engineer design a stormwater management system and have the said Engineer supervise and certify that the stormwater management system was installed in accordance with the approvals given under Section 41 of the Planning Act.

The topographic survey of the site was completed by GM BluePlan Engineering Limited (dated September 27, 2017). The site layout was prepared by MASRI O Inc. Architects (dated March 10, 2023).

2. SITE INFORMATION

The 0.22-hectare site is located at 8 Schofield Street within the City of Cambridge. The site is bound by existing residential lands to the east and west, the Royal Canadian Legion Jacob Hespeler Hall to the south, and Ott's Automotive Repair to the north. The site currently consists of a wooded area.

The intent of the Owner at this time is to develop a five-storey apartment building with a ground-level parking. Following development of the site, the surrounding ground cover on the perimeter of the site will be landscaped.

In September of 2017, GM BluePlan Engineering Limited completed a topographic survey of the site. The site was found to be sloped at approximately 27% down towards the north end of the property line, with runoff from major and minor storms discharging down the slope to the neighboring property.

3. STORMWATER MANAGEMENT

3.1 Stormwater Management Criteria

The stormwater management criteria established by the City of Cambridge are as follows:

1. The post-development runoff generated from the site during the 5 and 100-year design storm events is to be attenuated to the existing condition level.
2. Major storm flows are to be routed overland to an appropriate outlet.
3. Provide enhanced level quality control (80% TSS removal) prior to stormwater discharging from the site.

The City of Cambridge Chicago Rainfall Distribution parameters and the total depth of rainfall used for the 5 and 100-year analysis are as follows:

Table No. 1: City of Cambridge Chicago Rainfall Distribution Parameters

	5-Year	100-Year
a =	1219.8	3015.1
b =	10.5	21.0
c =	0.823	0.870
r =	0.400	0.400
Duration (min) =	180.0	180.0
Rainfall Depth (mm) =	48.647	89.669

The Horton infiltration method was used in the runoff calculations. The parameters used in the MIDUSS modelling are as follows:

Table No. 2: Horton Infiltration Parameters

	Impervious Areas	Pervious Areas
Maximum Infiltration	0.0 mm/hr	75.0 mm/hr
Minimum Infiltration	0.0 mm/hr	12.5 mm/hr
Lag Constant	0.0 hr	0.25 hr
Depression Storage	1.5 mm	5.0 mm

The hydrologic model MIDUSS was used to create the runoff hydrographs and to route the flows. A copy of the hydrologic modelling is included in Appendix A.

3.2 Existing Condition Drainage Area

For the existing condition analysis, the 0.22-hectare site was modelled as one (1) drainage catchment. The existing condition drainage area is outlined on Figure A.

Catchment 100 (0.22-hectares, 0% Impervious) represents the entire site, which is a wooded area that slopes downward at approximately 27% to the north side of the property. Storm water runoff generated from Catchment 10 discharges overland towards the property to the north.

The results of the existing condition routing analysis are as follows:

Table No. 3: Existing Condition Flow Rates

	5-Year	100-Year
Catchment 10	0.023 m^3/s	0.077 m^3/s
Total	**0.023 m^3/s**	**0.077 m^3/s**

3.3 Allowable Release Rate

The allowable release rates from the site have been established by determining the existing condition flow rates during the 5 and 100-year design storm events.

Therefore, the allowable release rates from the site under post-development conditions are as follows:

Table No. 4: Allowable Release Rates

	5-Year	100-Year
Allowable Release Rate	0.023 m^3/s	0.077 m^3/s

3.4 Post-Development Condition

For the post-development condition analysis, the 0.22-hectare site was modelled as four (4) drainage catchments. The post-development condition drainage catchments are outlined in Figure B.

Catchment 200 (0.17-hectares, 100% Impervious) represents the rooftop of the proposed building.

Since the rooftop of the proposed building is flat, and roof drains are provided under the Ontario Building Code, natural storage and attenuation will occur. To recreate the natural storage and attenuation of stormwater on the roof of the proposed building, runoff from Catchment 200 will be attenuated through the use of four (4) roof drains with weir (2) weir open per drain, based on the assumption that there is a roof drain for every 1,300m^2 of rooftop area and that the average depth of water stored on the rooftop will not exceed the design criteria of 100 mm, with a maximum storage depth of 150 mm at the roof drains. Runoff generated by Catchment 100 will discharge to the on-site storm sewers and ultimately to the existing Schofield Street storm sewers.

Catchment 201 (0.05-hectares, 70% Impervious) represents the remainder of the site, which will discharge uncontrolled form the site.

Most of the runoff from the site will be from the rooftop of the proposed building, ultimately discharging the storm sewer system on Schofield Street. The area of paved surface that is not under the roof of the proposed building is less than 40 m^2. As such, quality controls have not been provided given that the vast majority of stormwater discharging form the site is considered clean.

3.5 Routing

The hydrologic model MIDUSS was used to create the design storm runoff hydrographs and to route the hydrographs. A copy of the final printout of the hydrologic modelling is included in Appendix A. The results of the analysis are as follows:

Table No. 5: Catchment 100 Rooftop Stage/Storage/Discharge Capabilities

	Available Capacity			**Actual Capacity Used**		
	Peak Flow m^3/s	**Storage Volume m^3**	**Storage Elevation m**	**Peak Flow m^3/s**	**Storage Volume m^3**	**Storage Elevation m**
Rooftop	0.000	0.0	0.000	---	---	---
5-Year	---	---	---	0.005	34.07	0.026
100-Year	---	---	---	0.010	65.03	0.050
Overflow	0.020	170.0	0.100	---	---	---

In summary, the post-development flows from the site for the 5 and 100-year design storm events are as follows:

Table 7: Post-Development Condition Flow Rates

Post-development Conditions	**5 Year Design Storm**	**100 Year Design Storm**
Catchment 200 (controlled)	0.005 m^3/s	0.010 m^3/s
Catchment 201 (uncontrolled)	0.021 m^3/s	0.032 m^3/s
Total to Schofield Street	**0.023 m^3/s**	**0.037 m^3/s**

Table 8: Comparison of Allowable Release Rates and Post-Development Flow Rates

	5 Year	**100 Year**
Allowable Release Rates	0.023 m^3/s	0.077 m^3/s
Post Development Flow Rate	0.023 m^3/s	0.037 m^3/s

Therefore, the post-development flow rate during the 5 and 100-year design storm events has been attenuated to equal to or less than the allowable release rates.

3.6 Water Balance

A water balance analysis has been completed on the subject site using the catchment information and assumptions from Geotechnical investigation from 2017 Infrastructure Replacement/Rehabilitation Projects Assignment No.2 Edward Street (February 2016, WSP Canada Inc).

According to the Canadian Climate Normals for the Waterloo Wellington Airport from 1981 to 2010, the average annual precipitation for the area in which the site is located is estimated to be 916.3 mm.

Based on the hydrologic components described in Table 3.1 of the Ministry of Environment Stormwater Management Design and Planning Manual (2003), a Type B Silt Loam (Mature forests) has been selected to be similar to the soils identified on-site and the current ground cover. The following pervious characteristics with a base annual precipitation of 916.3 mm were utilized for the water budget review:

> Evapotranspiration of 534 mm/year, runoff of 115 mm, and infiltration (including baseflow) of 267 mm. An infiltration factor of 0.7 was applied to identify the approximate actual annual infiltration (recharge) as 187 mm/year.

For impervious surfaces within the development, the annual evapotranspiration is estimated to be 183 mm, resulting in approximately 534 mm available for infiltration and runoff.

Under existing conditions, the average annual recharge volume and runoff volume for the 0.22-hectare site is estimated to be 411 m^3/year and 429 m^3/year respectively.

Under post-development conditions, the average annual natural recharge and runoff volume for the site is estimated to be 28 m^3/year and 1,532 m^3/year respectively.

As noted above, the reduction in infiltration under post-development conditions is approximately 383 m^3 annually. Per the Ontario Source Protection Information Atlas, this area of this site is not in a significant groundwater recharge area, and as such, the reduction in annual infiltration is not considered a significant change. Given the tightness of the existing subsurface soils, and the limited space available on-site, infiltration has not been included in the proposed design.

The water budget is summarized in Appendix A.

3.7 Maintenance Plan

To ensure that the stormwater management system functions as designed and constructed, we recommend that the following inspections and maintenance activities be completed on an annual basis:

1. Inspect all roof drains and associated piping. Remove and dispose of any accumulated sediment, trash/littler debris (i.e. leaves)
2. Inspect all swales and overflow locations. Remove and dispose of any accumulated sediment, trash/litter, debris (i.e. sediment, garbage, leaves. etc.).
3. Inspect all catchbasins. Remove and dispose of any accumulated sediment, trash/litter, debris (i.e. sediment, garbage, leaves, etc.).

Please note that any structures identified during the annual inspection to be worn, missing or damaged are to be repaired or replaced within 48 hours.

3.8 Sediment and Erosion Control Plan

During construction, a silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. The silt fence will serve to minimize the opportunity for water borne sediments to be washed on to the adjacent properties.

Inspection and maintenance of all silt fencing will start after installation is complete. The fence will be inspected on a weekly basis during active construction or after a rainfall event of 13 mm or greater. Maintenance will be carried out, within 48 hours, on any part of the facility found to need repair.

Once construction and landscaping has been substantially completed, the silt fence will be removed, any accumulated sediment will be removed, and the landscaping will be completed.

After construction of the complete development, erosion will not occur, and sediment transport will be minimal.

4. CONCLUSIONS

In summary:

- The proposed on-site stormwater management controls will attenuate the post-development runoff for the 5 and 100-year design storm events to the existing condition levels.
- Prior to construction, a silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. This will minimize the transport of sediment off-site during the construction period.
- There is very little runoff from the site that is not from clean surfaces, and as such stormwater quality control has not bee provided.

All of which is respectfully submitted.

GM BLUEPLAN ENGINEERING LIMITED

Per:

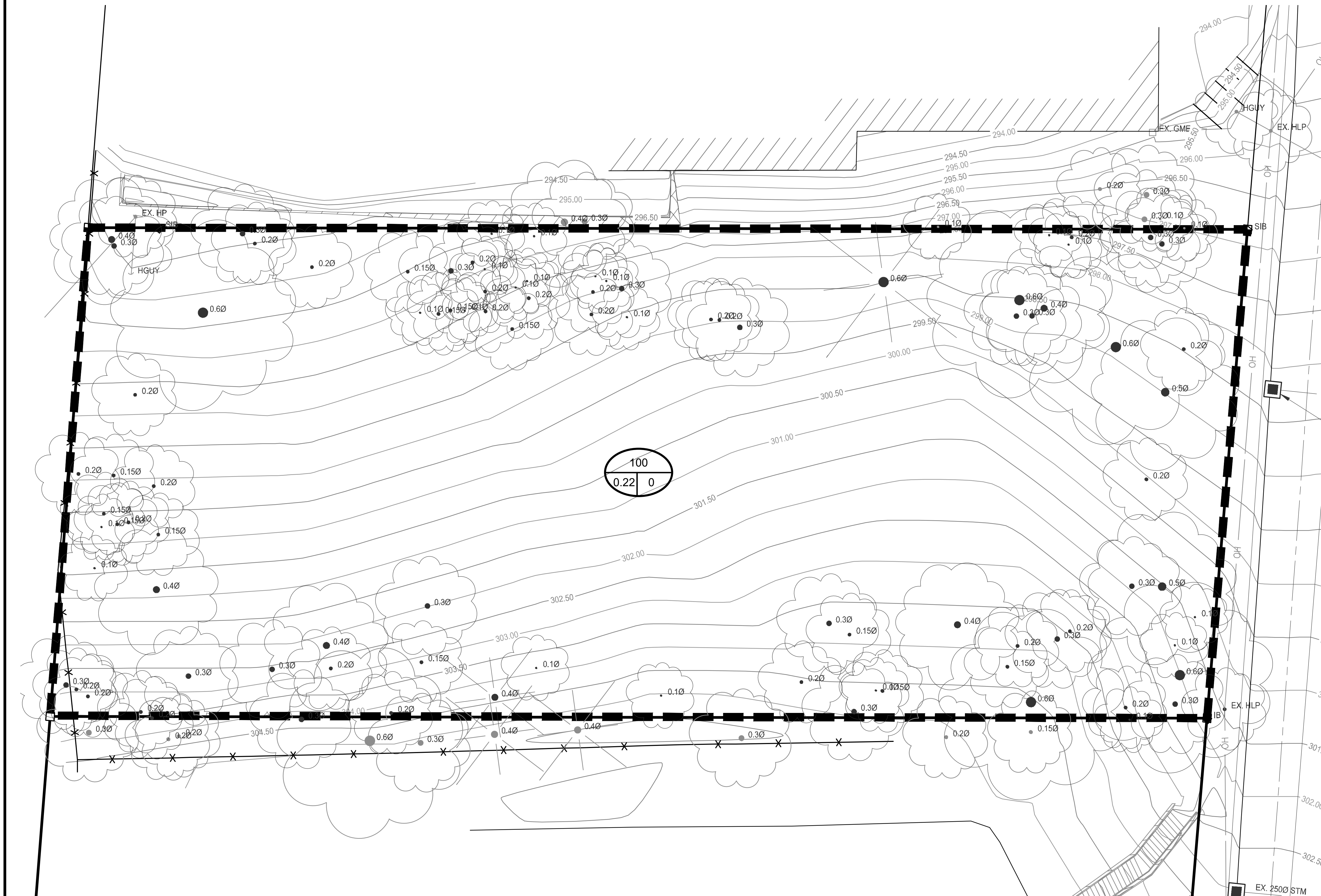
LICENSED PROFESSIONAL ENGINEER
May 10, 2024
S.J. PRIMMER
100141776
PROVINCE OF ONTARIO

Sarah Primmer, P.Eng.

Encl.

B:\Working\RAM CHANDRER HOLDINGS\2401878 - 423127 8 Schofield Street Cambridge\Design Phase\Reports - SWM, FSR, Design Brief, etc\423127 SWM Report_2024-05-10.docx

8 SCHOFIELD STREET
CITY OF CAMBRIDGE



LEGEND

- PROP. STORM SEWER
- DRAINAGE AREA BOUNDARY
- 201 — CATCHMENT NUMBER
- 0.30 — % IMPERVIOUS
- 0.30 — CATCHMENT AREA IN HECTARES

3 0 5 10

1:250 (m)

PRE-DEVELOPMENT STORMWATER DRAINAGE AREA PLAN

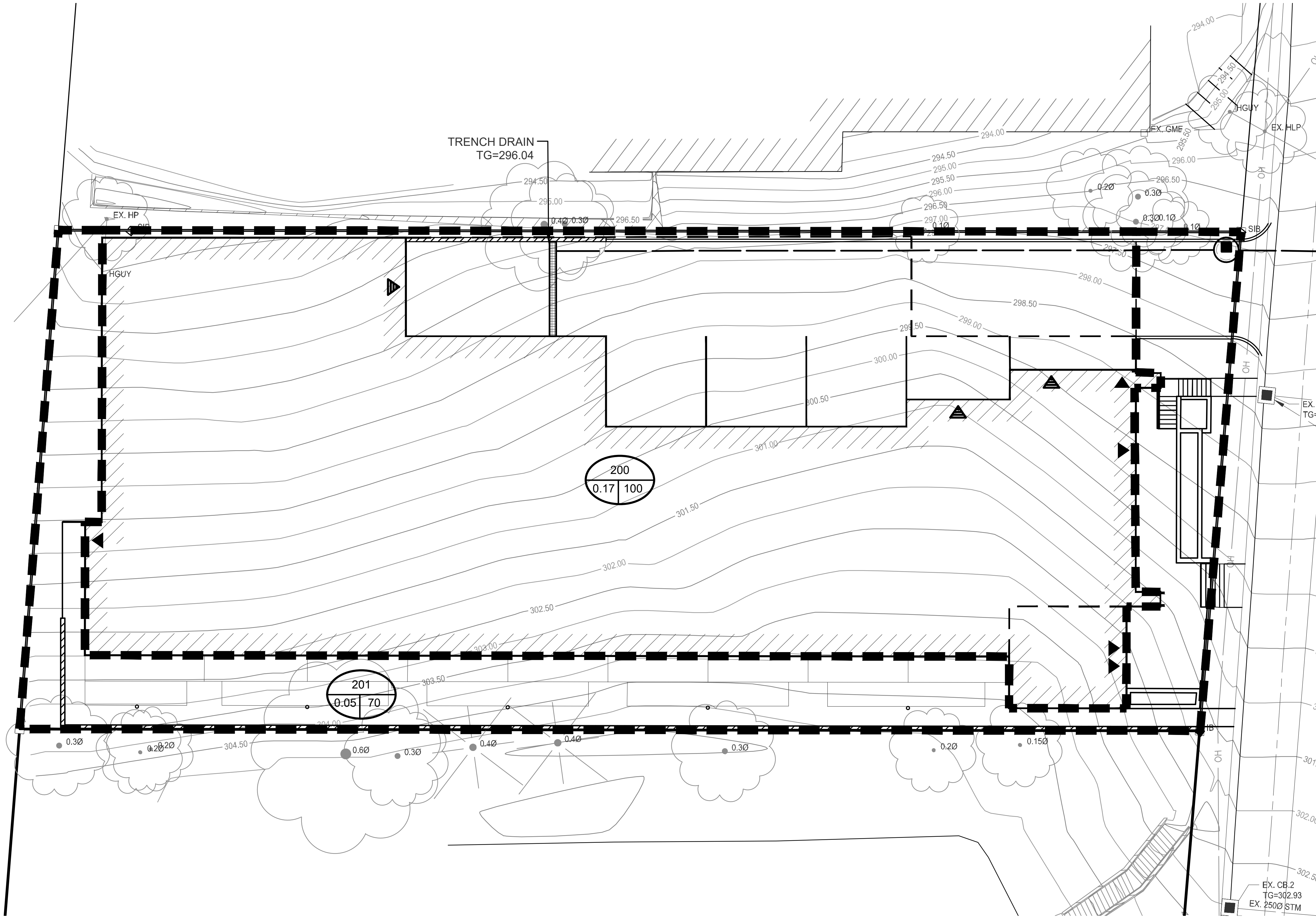
Figure No. A

BluePlan ENGINEERING

423127
APRIL 2024
Scale: 1:250 | NAD 1983 UTM Zone 17N

FILE:W:\Kitchener\423-2023\423127 8 Schofield Street Cambridge\Design Phase\Drawings\423127 PREDEVELOPMENT CATCHMENT Plan.dwg LAYOUT:PRE-DEVELOPMENT
LAST SAVED BY:Sunali3936, 4/25/2024 4:09:59 PM PLOTTED BY:Alif, Sunjar 4/25/2024 4:42:28 PM

8 SCHOFIELD STREET
CITY OF CAMBRIDGE



N

LEGEND

PROP. STORM SEWER

DRAINAGE AREA BOUNDARY

201
0.30 | 0.30

CATCHMENT NUMBER

% IMPERVIOUS

CATCHMENT AREA IN HECTARES

3 0 5 10

1:250 (m)

POST-DEVELOPMENT STORMWATER DRAINAGE AREA PLAN

Figure No. A

BluePlan ENGINEERING

423127
APRIL 2024
Scale: 1:250 | NAD 1983 UTM Zone 17N

FILE:B:\Working\RAM CHANDRER HOLDINGS\2401878 - 423127 8 Schofield Street Cambridge\Design Phase\Drawings\423127 - Design.dwg LAYOUT:POST DEVELOPMENT AREA
LAST SAVED BY:Sarpri4102, 4/29/2024 2:21:11 PM PLOTTED BY:Primmer, Sarah 5/10/2024 8:55:44 AM

APPENDIX A:
Stormwater Management Analysis

Existing Condition Modeling Files
Stage-Storage-Discharge Tables
Post-Development Condition Modeling Files
Roof Drain Details
Water Budget Information

```
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"                Licensee name:                                           gmbp"
"                Company                               Hewlett-Packard Company"
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"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1219.800   Coefficient A"
"       10.500   Constant B"
"        0.823   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           127.834    mm/hr"
"             Total depth                  48.647    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 10"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"           10   No description"
"        0.000   % Impervious"
"        0.220   Total Area"
"       30.000   Flow length"
"       26.000   Overland Slope"
"        0.220   Pervious Area"
"       30.000   Pervious length"
"       26.000   Pervious slope"
"        0.000   Impervious Area"
"       30.000   Impervious length"
"       26.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.023     0.000     0.000     0.000 c.m/sec"
"             Catchment 10           Pervious   Impervious Total Area "
"             Surface Area           0.220      0.000      0.220      hectare"
"             Time of concentration  6.941      0.932      6.941      minutes"
```

```
"              Time to Centroid       86.351     0.000      86.351     minutes"
"              Rainfall depth         48.647     48.647     48.647     mm"
"              Rainfall volume        107.02     0.00       107.02     c.m"
"              Rainfall losses        38.366     48.647     38.366     mm"
"              Runoff depth           10.281     0.000      10.281     mm"
"              Runoff volume          22.62      0.00       22.62      c.m"
"              Runoff coefficient     0.211      0.000      0.211      "
"              Maximum flow           0.023      0.000      0.023      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.023     0.023     0.000     0.000"
```

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"        0.870   Exponent C"
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"            2   Horton equation"
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"        0.000   % Impervious"
"        0.220   Total Area"
"       30.000   Flow length"
"       26.000   Overland Slope"
"        0.220   Pervious Area"
"       30.000   Pervious length"
"       26.000   Pervious slope"
"        0.000   Impervious Area"
"       30.000   Impervious length"
"       26.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.015   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.050   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.077     0.000     0.000     0.000 c.m/sec"
"             Catchment 10           Pervious   Impervious Total Area "
"             Surface Area           0.220      0.000      0.220      hectare"
"             Time of concentration  4.638      0.818      4.638      minutes"
```

```
"              Time to Centroid       88.665     0.000      88.665     minutes"
"              Rainfall depth         89.669     89.669     89.669     mm"
"              Rainfall volume        197.27     0.00       197.27     c.m"
"              Rainfall losses        47.460     89.669     47.460     mm"
"              Runoff depth           42.209     0.000      42.209     mm"
"              Runoff volume          92.86      0.00       92.86      c.m"
"              Runoff coefficient     0.471      0.000      0.471      "
"              Maximum flow           0.077      0.000      0.077      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.077     0.077     0.000     0.000"
```

8 Schofield Street

City of Cambridge
Our File: 423127
April 25, 2024

Roof (catchment 200)

Rooftop Area = 1,300 m^2

Each noch will allow 10GPM of flow per 1"(25mm): 0.02480 m^3/sec/m

Design Discharge Rate =	0.02480	m^3/sec/m
Max. Average Storage Depth =	100	mm
Design Discharge =	0.0024803	m^3/sec
Min. No. of Drains	2.0	(at least one drain for each 900m^2 per OBC)
Applied No. of Drains =	4	
No. Notches in Weir =	2	
Allowable Release Rate =	0.020	m^3/sec

Rooftop Area = 1,300 m^2 (flat rooftop area that is available for storage)

STAGE-STORAGE-DISCHARGE TABLE

Stage (m)	Storage (m^3)	Storage (ha.m)	Discharge (m^3/s)
0.000	0.0	0.0000	0.000000
0.025	32.5	0.0033	0.004961
0.050	65.0	0.0065	0.009921
0.075	97.5	0.0098	0.014882
0.100	130.0	0.0130	0.019843

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" 32         STORM Chicago storm"
"           1   Chicago storm"
"    1219.800   Coefficient A"
"      10.500   Constant B"
"       0.823   Exponent C"
"       0.400   Fraction R"
"     180.000   Duration"
"       1.000   Time step multiplier"
"            Maximum intensity           127.834    mm/hr"
"            Total depth                  48.647    mm"
"           6   005hyd   Hydrograph extension used in this file"
" 33         CATCHMENT 200"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         200   Catchment 200"
"     100.000   % Impervious"
"       0.130   Total Area"
"      40.000   Flow length"
"       2.000   Overland Slope"
"       0.000   Pervious Area"
"      40.000   Pervious length"
"       2.000   Pervious slope"
"       0.130   Impervious Area"
"      40.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.000   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."
"       0.878   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                    0.035     0.000     0.000     0.000 c.m/sec"
"            Catchment 200          Pervious   Impervious Total Area "
"            Surface Area           0.000      0.130      0.130      hectare"
```

```
"              Time of concentration  23.210     2.433      2.433      minutes"
"              Time to Centroid       129.320    90.760     90.760     minutes"
"              Rainfall depth         48.647     48.647     48.647     mm"
"              Rainfall volume        0.00       63.24      63.24      c.m"
"              Rainfall losses        35.730     5.951      5.951      mm"
"              Runoff depth           12.917     42.696     42.696     mm"
"              Runoff volume          0.00       55.50      55.50      c.m"
"              Runoff coefficient     0.000      0.878      0.878      "
"              Maximum flow           0.000      0.035      0.035      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.035     0.035     0.000     0.000"
" 54           POND DESIGN"
"         0.035   Current peak flow    c.m/sec"
"         0.027   Target outflow    c.m/sec"
"          55.5   Hydrograph volume    c.m"
"            7.   Number of stages"
"         0.000   Minimum water level    metre"
"         0.150   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000     0.000"
"                 0.02500   0.00200    32.500"
"                 0.05000   0.00500    65.000"
"                 0.07500   0.00700    97.500"
"                  0.1000   0.01000   130.000"
"                  0.1250   0.01200   162.500"
"                  0.1500   0.01500   195.000"
"              Peak outflow                 0.003    c.m/sec"
"              Maximum level                0.031    metre"
"              Maximum storage             40.703    c.m"
"              Centroidal lag               5.782   hours"
"                   0.035     0.035     0.003     0.000 c.m/sec"
" 40           HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 Total"
"              Maximum flow                 0.003    c.m/sec"
"              Hydrograph volume           55.210    c.m"
"                      0.035     0.035     0.003     0.003"
" 40           HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                      0.035     0.000     0.003     0.003"
" 33           CATCHMENT 201"
"             1   Triangular SCS"
"             1   Equal length"
"             1   SCS method"
"           201   Catchment 201"
"       100.000   % Impervious"
"         0.077   Total Area"
"        40.000   Flow length"
"         2.000   Overland Slope"
```

```
"        0.000   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.077   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.000   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."
"        0.878   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                      0.021     0.000     0.003     0.003 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.077      0.077      hectare"
"             Time of concentration  23.210     2.433      2.433      minutes"
"             Time to Centroid       129.320    90.760     90.760     minutes"
"             Rainfall depth         48.647     48.647     48.647     mm"
"             Rainfall volume        0.00       37.46      37.46      c.m"
"             Rainfall losses        35.730     5.951      5.951      mm"
"             Runoff depth           12.917     42.696     42.696     mm"
"             Runoff volume          0.00       32.88      32.88      c.m"
"             Runoff coefficient     0.000      0.878      0.878      "
"             Maximum flow           0.000      0.021      0.021      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                      0.021     0.021     0.003     0.003"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                      0.021     0.021     0.021     0.003"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total"
"             Maximum flow                 0.022    c.m/sec"
"             Hydrograph volume           88.086    c.m"
"                      0.021     0.021     0.021     0.022"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                      0.021     0.000     0.021     0.022"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          202   Catchment 202"
"        0.000   % Impervious"
"        0.013   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
```

```
"        0.013   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.266   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."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                      0.000     0.000     0.021     0.022 c.m/sec"
"              Catchment 202          Pervious   Impervious Total Area "
"              Surface Area           0.013      0.000      0.013      hectare"
"              Time of concentration  23.210     2.433      23.210     minutes"
"              Time to Centroid       129.320    90.760     129.320    minutes"
"              Rainfall depth         48.647     48.647     48.647     mm"
"              Rainfall volume        6.32       0.00       6.32       c.m"
"              Rainfall losses        35.730     5.951      35.730     mm"
"              Runoff depth           12.917     42.696     12.917     mm"
"              Runoff volume          1.68       0.00       1.68       c.m"
"              Runoff coefficient     0.266      0.000      0.266      "
"              Maximum flow           0.000      0.000      0.000      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                      0.000     0.000     0.021     0.022"
" 40           HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                      0.000     0.000     0.000     0.022"
" 40           HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 Total"
"              Maximum flow                 0.022    c.m/sec"
"              Hydrograph volume           89.765    c.m"
"                      0.000     0.000     0.000     0.022"
" 40           HYDROGRAPH   Confluence    1"
"             7   Confluence "
"             1   Node #"
"                 Total"
"              Maximum flow                 0.022    c.m/sec"
"              Hydrograph volume           89.765    c.m"
"                      0.000     0.022     0.000     0.000"
" 38           START/RE-START TOTALS 1"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                     0.220    hectare"
"              Total Impervious area                    0.207    hectare"
"              Total % impervious                      94.091"
```

```
" 19          EXIT"
```

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                      Sunday, February 07, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:                            C:\Users\jangsoo.lee\"
"                        OneDrive - GEI Consultants, Inc\00.TEMP\423127\MIduss"
"               Output filename:                        423127_POST_100yr.out"
"               Licensee name:                                           gmbp"
"               Company                                                      "
"               Date & Time last used:                 4/25/2024 at 3:32:40 PM"
" 31         TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32         STORM Chicago storm"
"           1   Chicago storm"
"     3015.100   Coefficient A"
"       21.000   Constant B"
"        0.870   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"            Maximum intensity           177.123    mm/hr"
"            Total depth                  89.669    mm"
"           6   100hyd   Hydrograph extension used in this file"
" 33         CATCHMENT 200"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         200   Catchment 200"
"      100.000   % Impervious"
"        0.130   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.000   Pervious Area"
"       40.000   Pervious length"
"        2.000   Pervious slope"
"        0.130   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.000   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."
"        0.924   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.054     0.000     0.000     0.000 c.m/sec"
"            Catchment 200          Pervious   Impervious Total Area "
"            Surface Area           0.000      0.130      0.130      hectare"
```

```
"              Time of concentration  15.732     2.111      2.111      minutes"
"              Time to Centroid       117.021    89.212     89.212     minutes"
"              Rainfall depth         89.669     89.669     89.669     mm"
"              Rainfall volume        0.00       116.57     116.57     c.m"
"              Rainfall losses        50.013     6.796      6.796      mm"
"              Runoff depth           39.656     82.873     82.873     mm"
"              Runoff volume          0.00       107.73     107.73     c.m"
"              Runoff coefficient     0.000      0.924      0.924      "
"              Maximum flow           0.000      0.054      0.054      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.054     0.054     0.000     0.000"
" 54           POND DESIGN"
"         0.054   Current peak flow    c.m/sec"
"         0.027   Target outflow    c.m/sec"
"         107.7   Hydrograph volume    c.m"
"            5.   Number of stages"
"         0.000   Minimum water level    metre"
"         0.150   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000     0.000"
"                 0.02500   0.02200    32.500"
"                 0.05000   0.04500    65.000"
"                 0.07500   0.06700    97.500"
"                  0.1000   0.08900   130.000"
"              Peak outflow                 0.026    c.m/sec"
"              Maximum level                0.029    metre"
"              Maximum storage             38.325    c.m"
"              Centroidal lag               1.897   hours"
"                   0.054     0.054     0.026     0.000 c.m/sec"
" 40           HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 Total"
"              Maximum flow                 0.026    c.m/sec"
"              Hydrograph volume          107.732    c.m"
"                     0.054     0.054     0.026     0.026"
" 40           HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                     0.054     0.000     0.026     0.026"
" 33           CATCHMENT 201"
"             1   Triangular SCS"
"             1   Equal length"
"             1   SCS method"
"           201   Catchment 201"
"       100.000   % Impervious"
"         0.077   Total Area"
"        40.000   Flow length"
"         2.000   Overland Slope"
"         0.000   Pervious Area"
"        40.000   Pervious length"
```

```
"        2.000   Pervious slope"
"        0.077   Impervious Area"
"       40.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.000   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."
"        0.924   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.032     0.000     0.026     0.026 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.077      0.077      hectare"
"             Time of concentration  15.732     2.111      2.111      minutes"
"             Time to Centroid       117.021    89.212     89.212     minutes"
"             Rainfall depth         89.669     89.669     89.669     mm"
"             Rainfall volume        0.00       69.05      69.05      c.m"
"             Rainfall losses        50.013     6.796      6.796      mm"
"             Runoff depth           39.656     82.873     82.873     mm"
"             Runoff volume          0.00       63.81      63.81      c.m"
"             Runoff coefficient     0.000      0.924      0.924      "
"             Maximum flow           0.000      0.032      0.032      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.032     0.032     0.026     0.026"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                     0.032     0.032     0.032     0.026"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Total"
"             Maximum flow                  0.051    c.m/sec"
"             Hydrograph volume           171.544    c.m"
"                     0.032     0.032     0.032     0.051"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.032     0.000     0.032     0.051"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          202   Catchment 202"
"        0.000   % Impervious"
"        0.013   Total Area"
"       40.000   Flow length"
"        2.000   Overland Slope"
"        0.013   Pervious Area"
"       40.000   Pervious length"
```

```
"        2.000   Pervious slope"
"        0.000   Impervious Area"
"       40.000   Impervious length"
"        2.000   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."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.002     0.000     0.032     0.051 c.m/sec"
"              Catchment 202          Pervious   Impervious Total Area "
"              Surface Area           0.013      0.000      0.013      hectare"
"              Time of concentration  15.732     2.111      15.732     minutes"
"              Time to Centroid       117.021    89.212     117.021    minutes"
"              Rainfall depth         89.669     89.669     89.669     mm"
"              Rainfall volume        11.66      0.00       11.66      c.m"
"              Rainfall losses        50.013     6.796      50.013     mm"
"              Runoff depth           39.656     82.873     39.656     mm"
"              Runoff volume          5.16       0.00       5.16       c.m"
"              Runoff coefficient     0.442      0.000      0.442      "
"              Maximum flow           0.002      0.000      0.002      c.m/sec"
" 40           HYDROGRAPH Add Runoff "
"             4   Add Runoff "
"                     0.002     0.002     0.032     0.051"
" 40           HYDROGRAPH Copy to Outflow"
"             8   Copy to Outflow"
"                     0.002     0.002     0.002     0.051"
" 40           HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 Total"
"              Maximum flow                  0.052    c.m/sec"
"              Hydrograph volume           176.699    c.m"
"                     0.002     0.002     0.002     0.052"
" 40           HYDROGRAPH   Confluence    1"
"             7   Confluence "
"             1   Node #"
"                 Total"
"              Maximum flow                  0.052    c.m/sec"
"              Hydrograph volume           176.699    c.m"
"                     0.002     0.052     0.002     0.000"
" 38           START/RE-START TOTALS 1"
"             3   Runoff Totals on EXIT"
"              Total Catchment area                     0.220    hectare"
"              Total Impervious area                    0.207    hectare"
"              Total % impervious                      94.091"
" 19           EXIT"
```

ZURN

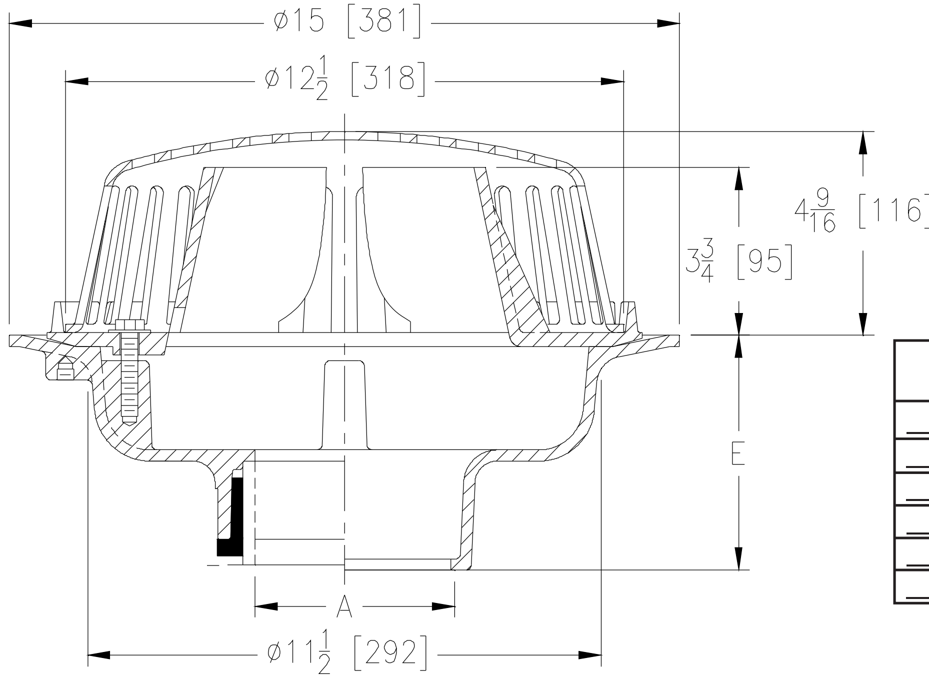
Z105

CONTROL-FLO ROOF DRAIN
W/ PARABOLIC WEIR

SPECIFICATION SHEET

TAG ________

Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice



Specify Number of Notches in Weir	
___-N1	One Notch
___-N2	Two Notches
___-N3	Three Notches
___-N4	Four Notches
___-N5	Five Notches
___-N6	Six Notches

A- Pipe Size In.[mm]	Approx. Wt. Lbs. [kg]	Dome Open Area Sq. In. [cm^2]
2,3,4 [51,76,102]	34 [15]	103 [665]

ENGINEERING SPECIFICATION: ZURN Z105
15" [381mm] Diameter Control-Flo roof drain for dead-level roof construction, Dura-Coated cast iron body, Control-Flo weir shall be linear functioning with integral membrane flashing clamp/gravel guard and Poly-Dome. All data shall be verified proportional to flow rates. Each notch will allow 10 GPM [LPM] of flow per 1" [25mm] of rain water build up above the drain.

OPTIONS (Check/specify appropriate options)

PIPE SIZE	(Specify size/type) OUTLET		E BODY HT. DIM.
3, 4 [76, 102]	_____ IC	Inside Caulk	5-1/4 [133]
2 , 3, 4 [51, 76, 102]	_____ NH	No-Hub	5-1/4 [133]
2 , 3, 4 [51, 76, 102]	_____ NL	Neo-Loc	4-9/16 [116]

PREFIXES

____ Z D.C.C.I. Body with Poly-Dome*
____ ZA D.C.C.I. Body with Aluminum Dome
____ ZC D.C.C.I. Body with Cast Iron Dome

SUFFIXES

____ -C Underdeck Clamp
____ -DP Top-Set® Deck Plate (Replaces both -C & -R)
____ -E Static Extension 1 [25] thru 4 [102] (Specify Ht.)
____ -EA Adjustable Extension Assembly 2-1/8 [54] thru 3-1/2 [89]
____ -G Galvanized Cast Iron
____ -R Roof Sump Receiver
____ -TC Neo-Loc Test Cap Gasket (2,3,4 [51,76,102] NL Bottom Outlet Only)
____ -VP Vandal Proof Secured Top
____ -10 6 [152] High Parabolic Weir for Sloped Roof (ZC or ZA)

* Regularly furnished unless otherwise specified.

Zurn Industries, LLC | Specification Drainage Operation
1801 Pittsburgh Avenue, Erie, PA U.S.A. 16502 · Ph. 855-663-9876, Fax 814-454-7929

In Canada | **Zurn Industries Limited**
3544 Nashua Drive, Mississauga, Ontario L4V 1L2 · Ph. 905-405-8272, Fax 905-405-1292

www.zurn.com

Rev. K
Date: 09/25/17
C.N. No. 137793
Prod. | Dwg. No. Z105

summary of

Table 3.1 identifies the approximate relationship between soil types, ground cover, and hydrologic components.

The table utilizes a base precipitation of 940mm. The ratios have been retained for a base of 916.3mm of precipitation to match the Waterloo Wellington Airport station historical data set average annual precipitation (1981 to 2010).

Values Calculated using Table 3.1

Soil Type	Urban Lawn - Clay				
Soil Group	Water Holding Capacity (mm)	Precipitation (mm)	Evapotranspiration (mm)	Runoff (mm)	Infiltration* (mm)
Fine Sandy Loam Type B	75	916	534	115	267

* Infiltration factor has been determined using the following values from Table 3.1

Topography	0.1	Hilly Land, average slope 28 m to 47 m/km
Soils	0.4	Open Sandy loam
Cover	0.2	Woodland
Total Infiltration Factor:	0.7	

	Existing Conditions			Post-Development Conditions					ANNUAL SITE SUMMARY			
	Catchment 100		EXISTING CONDITIONS SUMMARY	Catchment 200	Building Roofs	Catchment 201	Paved Surfaces	POST-DEVELOPMENT SUMMARY		Existing Total	Post-Dev Total	% Diff.
	Impervious	Pervious	Total	Impervious	Pervious	Impervious	Pervious	Total				
Total Area (ha)	0.220		**0.220**	0.170		0.050		**0.220**	**Area (ha)**	**0.22**	**0.22**	
Imperviousness	0%		**0%**	100%		70%		**93%**				
Area (ha)	0.0000	0.220		0.1700	0.000	0.0350	0.015					
Area (m^2)	0	2,200	2,200	1,700	0	350	150	2,200				
Annual Precipitation (mm)	*916*			*916*		*916*						
Precipitation (m^3)	0	2,016		1,558	0	321	137					
Total Precipitation (m^3/year)	2,016		**2,016**	1,558		458		**2,016**	**Precipitation (m^3/year)**	**2,016**	**2,016**	0%
Annual Evapotranspiration (mm)	*183.26*	*534*		*183.26*	*534*	*183.26*	*534*					
Evapotranspiration (m^3)	0	1,175		312	0	64	80					
Total Evapotranspiration (m^3/year)	1,175		**1,175**	312		144		**456**	**Evapotranspiration (m^3/year)**	**1,175**	**456**	-61%
Available for Recharge & Runoff (mm)	*733.04*	*382*		*733.04*	*382*	*733.04*	*382*					
Recharge & Runoff (m^3)	0	841		1,246	0	257	57					
Total Recharge & Runoff (m^3/year)	841		**841**	1,246		314		**1,560**	**Recharge & Runoff (m^3/year)**	**841**	**1,560**	86%
Annual Natural Recharge (mm) (Fine Sandy Loam):	*0*	*187*		*0*	*187*	*0*	*187*					
Pervious @187 mm/year		411	411		0		28	0				
Impervious @0 mm/year	0		0	0		0		0				
Total Annual Natural Recharge (m^3/year)	411		**411**	0		28		**28**	**Natural Recharge (m^3/year)**	**411**	**28**	-93%
Annual Runoff (mm) (Fine Sandy Loam):	*733*	*195*		*733*	*195*	*733*	*195*					
Pervious @195.2 mm/year		429	429		0		29	0				
Impervious @733.1 mm/year	0		0	1,246		257		1,246				
Total Annual Runoff (m^3/year)	429		**429**	1,246		286		**1,532**	**Total Annual Runoff (m^3/year)**	**429**	**1,532**	257%
Total Annual Recharge (m^3/year)	411		411	0		28		28	**Annual Recharge (m^3/year)**	**411**	**28**	-93%
Total Annual Runoff (m^3/year)	429		429	1,246		286		1,532	**Total Annual Runoff (m^3/year)**	**429**	**1,532**	257%