

Prepared By:



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## Stormwater Management Report

1043-1057 3rd Ave East - Owen Sound, ON  
Residential Development  
Lutheran Social Services

**GMBP File: 221130-3**

**April 2023**

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**1043-1057 3RD AVE EAST - OWEN SOUND, ON**

**STORMWATER MANAGEMENT REPORT  
LUTHERAN SOCIAL SERVICES**

**APRIL 2023**

**GMBP FILE: 221130-3**

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## **1. INTRODUCTION AND BACKGROUND**

Lutheran Social Services proposes a residential development consisting of 40 residential units consisting of thirty-five (35) one-bedroom units and five (5) two-bedroom units. The ground floor of the development consists of approximately 40m<sup>2</sup> commercial space residential common rooms, mechanical and garbage rooms along with associated driving and parking areas on an approximately 0.160 ha property located at the north side of 3rd Ave East in Owen Sound, as shown in Figure 1. The 0.160ha site consists of the historical parcels of 1043 and 1057 3<sup>rd</sup> Avenue East in Owen Sound. The parcels are in the process of being merged into one parcel. For the purposes of this report, they are considered one parcel.

For the purpose of this report, 3<sup>rd</sup> Ave East is assumed to travel in a north-south direction and the subject property is therefore located on the easterly side of 3rd Ave East. The subject property is bound by 3rd Ave to the west, commercial lands to the north and south and residential lands to the east. The subject property is zoned as C1 – Core commercial as per City of Owen Sound Comprehensive Zoning Bylaw.

GM BluePlan (GMBP) has been retained to provide a SWM Report to address drainage requirements of the proposed development.

## **2. EXISTING CONDITIONS AND DRAINAGE**

Under current conditions, the 0.160ha subject property is developed with a two story commercial duplex and associated parking areas. The subject property generally slopes downward from east to west. Runoff from the subject property drains overland to the catch basins located on the parking lot and 3rd Ave East draining ultimately to the Owen Sound storm sewer system.

### **2.1 Stormwater Management Design Criteria**

Based on the existing drainage conditions and following discussions with the City, the stormwater management criteria used to develop the appropriate stormwater management approach for the site development is as follows:

1. Post-development peak flow rates for all storm events up to and including a 100 year discharging from the subject property are to be attenuated to less than, or equal to existing 5-year design storm peak flow rates.
2. Enhanced water quality treatment (80% TSS Removal) is to be provided for runoff draining from the subject property prior to discharging to the Owen Sound storm sewer system.

### 3. POST-DEVELOPMENT CONDITIONS AND DRAINAGE

Under post-development conditions, it is proposed to construct an approximately 784m<sup>2</sup> residential development with a total of 40 residential units consisting of thirty-five (35) one-bedroom units and five (5) two-bedroom units. The ground floor of the development consists of approximately 40m<sup>2</sup> commercial space residential common rooms, mechanical and garbage rooms.

Stormwater Runoff from the proposed development is to be controlled via rooftop temporary ponding to attenuate flows to allowable levels. Rooftop stormwater attenuation will be provided by a maximum of six (6) control flow roof drains installed to attenuate the runoff from the building rooftop and provide temporary rooftop ponding. An emergency overflow scupper is proposed at for rooftop runoff to spill under emergency situations only. Runoff from parking lot and driving areas will drain overland to parking lot catch basins and ultimately to 3<sup>rd</sup> Ave east storm sewer.

### 4. QUANTITY CONTROL CRITERIA, PARAMETERS AND MODELLING

#### 4.1 Design Rainfall Events

The City of Owen Sound Engineering Standards provide rainfall data for design storms in the form of Chicago Storm Parameters. The Chicago storm input parameters used to model the various design rainfall events for the subject property are summarized in the following Table 1.

**Table 1 - Design Rainfall Events – Provided by the City of Owen Sound Engineering Standards**

Coefficient	1:2-Year	1:5-Year	1:25-Year	1:100-Year
A	854.100	1234.576	1750.276	2171.754
B	7.781	8.297	8.303	8.303
C	0.830	0.851	0.862	0.867
R	0.375	0.375	0.375	0.375
Duration (min)	180	180	210	210
Depth (mm)	33.228	42.929	59.007	71.271
Intensity (mm/hr)	101.673	134.692	165.718	202.862

#### 4.2 Site Soil Conditions

The soil type within this part of Owen Sound can be considered to be Saugeen Silty Clay loam, as per the Grey County Soils Map (Ontario Soil Survey Report No. 17) published by the Department of Agriculture. Harkaway loam is known to be of the Hydrological Soil Group C.

With consideration of the site's existing pervious ground cover, which could be defined as a combination of "crop and other improved land" a Group C soil is represented with an SCS Curve Number of 82 as per the MTO Drainage Manual's Design Chart 1.09.

The impervious areas within all catchments are associated with an SCS Curve Number of 98.

### 4.3 Existing Catchment Areas

For existing conditions analysis purposes, the 0.160 ha subject property consisting of an approximately 111m<sup>2</sup> residential/commercial building with associated parking areas and the 0.141 ha external area from the adjacent property which drains into the subject property is modelled as two (2) drainage catchments as described in Table 2 below and as shown on Figure 2. The existing conditions MIDUSS computer modelling is attached in Appendix A.

**Table 2: Existing Conditions Catchment**

Catchment	Description	Area (ha)	Impervious Level (%)
10	Entire Property	0.160	97
11	External Area	0.141	90

The results of the existing conditions routing analysis are summarized in Section 4.5.

### 4.4 Post-Development Catchment Areas

For post-development analysis purposes, the 0.160 ha subject property and 0.141 ha external area were modelled as three (3) drainage catchments described in Table 3 below and as shown on Figure 3. The post-development conditions MIDUSS computer modelling is attached in Appendix B.

**Table 3: Post-Development Conditions Catchments**

Catchment	Description	Area (ha)	Impervious Level (%)
100	Rooftop	0.055	100
101	External Area	0.141	90
102	Parking Lot	0.105	92

The results of the post-development conditions routing analysis are summarized in Section 4.5.

### 4.5 MIDUSS Quantity Control Modelling Results

MIDUSS modelling software was used to model the expected existing 5-year design storm conditions and post-development conditions stormwater runoff from the subject property under the various design storms. Results from the models are summarized in the following Tables, and the modelling is provided for reference in Appendix A and B.

Table 4 below provides the total peak flow rates discharging from the subject property under existing 5-year design storm as well as the total post-development peak flow rates discharging from the subject property during 5, 25 and 100-year design storm events. As per the requirements of the Town, the existing 5-year peak flow rates represents the allowable peak flow rate discharging from the subject property during all storm events.

**Table 4: Summary of Existing 5-Year Design Peak Runoff Flow Results**

Catchments	Return Storm Frequency (yr)		
	5	25	100
Existing Conditions (m <sup>3</sup> /s)	0.077	---	---
Post-Development (m <sup>3</sup> /s)	0.051	0.060	0.061

As shown in Table 4 above, under post-development conditions, the peak flow rates during 5, 25 and 100 year design storms to be drained from the proposed development are expected to be less than the release rate during existing 5-year design storm.

Table 5 below summarizes the capacity available at the various stages in the rooftop ponding via control flow drains and provides a comparison to the capacity that is expected to be used during the various design storm event. The stage-storage-discharge calculations for the rooftop ponding are included as Appendix C.

**Table 5: Conceptual Stage-Storage-Discharge Capacities for Rooftop Ponding**

	Available Capacity in SWM Facility Design			Capacity Used During Various Design Storm Events		
	Peak Flow (m <sup>3</sup> /s)	Storage Volume (m <sup>3</sup> )	Storage Elevation (m)	Peak Flow (m <sup>3</sup> /s)	Storage Volume (m <sup>3</sup> )	Storage Elevation (m)
<b>Roof Surface</b>	0	0	0.000	---	---	---
<b>5-year Design Storm</b>	---	---	---	0.001	15.52	0.028
<b>25-year Design Storm</b>	---	---	---	0.001	21.74	0.039
<b>100-year Design Storm</b>	---	---	---	0.002	26.67	0.048
<b>Overflow Scupper</b>	---	55.00	0.100			

As shown in Table 5 above, during the 5-, 25- and 100-year design storms runoff will discharge via the Control drains without spilling via the overflow scupper.

Table 6 below summarizes the capacity available at the various stages in the 600mm Diameter super pipe with 100mm orifice and provides a comparison to the capacity that is expected to be used during the various design storm event. The stage-storage-discharge calculations are included as Appendix C.

**Table 6: Conceptual Stage-Storage-Discharge Capacities for 600mm diameter Super Pipe Storage**

	Available Capacity in SWM Facility Design			Capacity Used During Various Design Storm Events		
	Peak Flow (m <sup>3</sup> /s)	Storage Volume (m <sup>3</sup> )	Storage Elevation (m)	Peak Flow (m <sup>3</sup> /s)	Storage Volume (m <sup>3</sup> )	Storage Elevation (m)
<b>Bottom of the pipe</b>	0	0	179.45	---	---	---
<b>Top of the pipe</b>	0.036	11.6	180.05	---	---	---
<b>5-year Design Storm</b>	---	---	---	0.051	13.6	180.63
<b>Top of Grate</b>	0.060	19.6	181.10	---	---	---
<b>25-year Design Storm</b>	---	---	---	0.060	20.5	181.11
<b>100-year Design Storm</b>	---	---	---	0.061	31.2	181.16
<b>Overflow Spillway</b>	0.062	47.8	181.20	---	---	---

As shown in Table 6 above, the 5- year design storm will discharge completely via the 150mm orifice. During the 25-year and 100-year design storms, minor parking lot ponding to a depth of 1cm and 6cm respectively would be expected, with all runoff draining via the 150mm orifice. For storms in excess of a 100-year storm, runoff would spill via the emergency overflow weir.



## 5. STORMWATER QUALITY TREATMENT

Based on the requirements from the City of Owen Sound, the on-site quality control for the stormwater flow is to achieve an 80% long term total suspended solids (TSS) removal rate while treating 90% of the annual runoff, prior to release to the off-site receiving drainage system.

Stormwater quality treatment for the runoff discharging from the proposed development is proposed to be provided by First Defence FD-4HC Treatment Unit designed to help prevent oil, debris, and trash from draining to the 3<sup>rd</sup> Ave East storm sewer.

## 6. SUMMARY

Lutheran Social Services proposes a residential development consisting of 40 residential units consisting of thirty-five (35) one-bedroom units and five (5) two-bedroom units. The ground floor of the development consists of approximately 40m<sup>2</sup> commercial space residential common rooms, mechanical and garbage rooms along with associated driving and parking areas on an approximately 0.160 ha property located at the north side of 3<sup>rd</sup> Ave East in Owen Sound.

Upon completion of the proposed development.

1. The post development peak flow rates during 5, 25 and 100-year design storms to be drained from the proposed development are expected to be less than the release rate during an existing 5-year design storm.
2. Enhanced water quality treatment (80% TSS Removal) is expected to be provided for runoff draining from the subject property prior to discharging to the 3<sup>rd</sup> avenue east storm sewer system.

All of which is respectfully submitted.

### GM BLUEPLAN ENGINEERING LIMITED

Prepared by:



Rasvinder Singh, M.Eng., E.I.T.

Reviewed by:



Ian E. Eriksen, P.Eng.

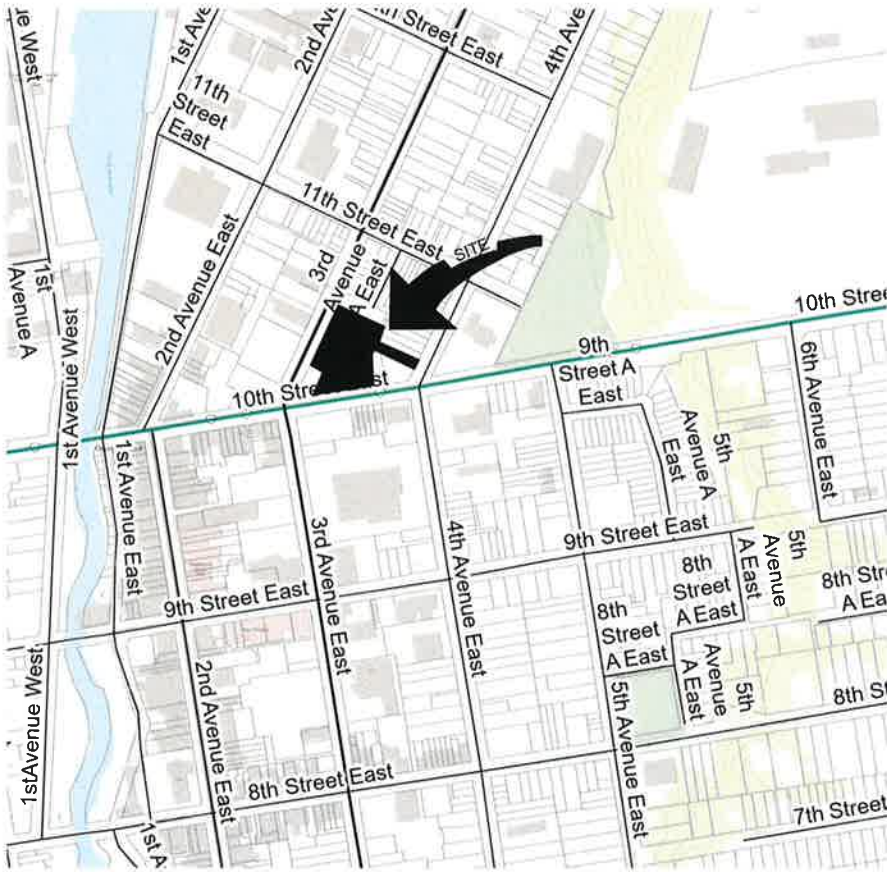


**FIGURES:**



221130-2

City of Owen Sound



N.T.S.  
APR 2023

## SITE LOCATION PLAN

### COMMERCIAL DEVELOPMENT

Figure No. 1

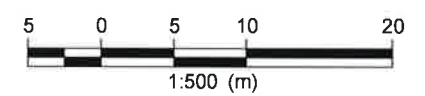


221130  
 1043-1057  
 3rd Avenue East  
 City of Owen Sound



**LEGEND**

- DRAINAGE BOUNDARY
- 10 • DRAINAGE AREA No.
- 0.275 ha 40% IMPERVIOUS PERCENTAGE
- DRAINAGE AREA SIZE (Hectares)



SCALE 1:500  
 FEB 2023

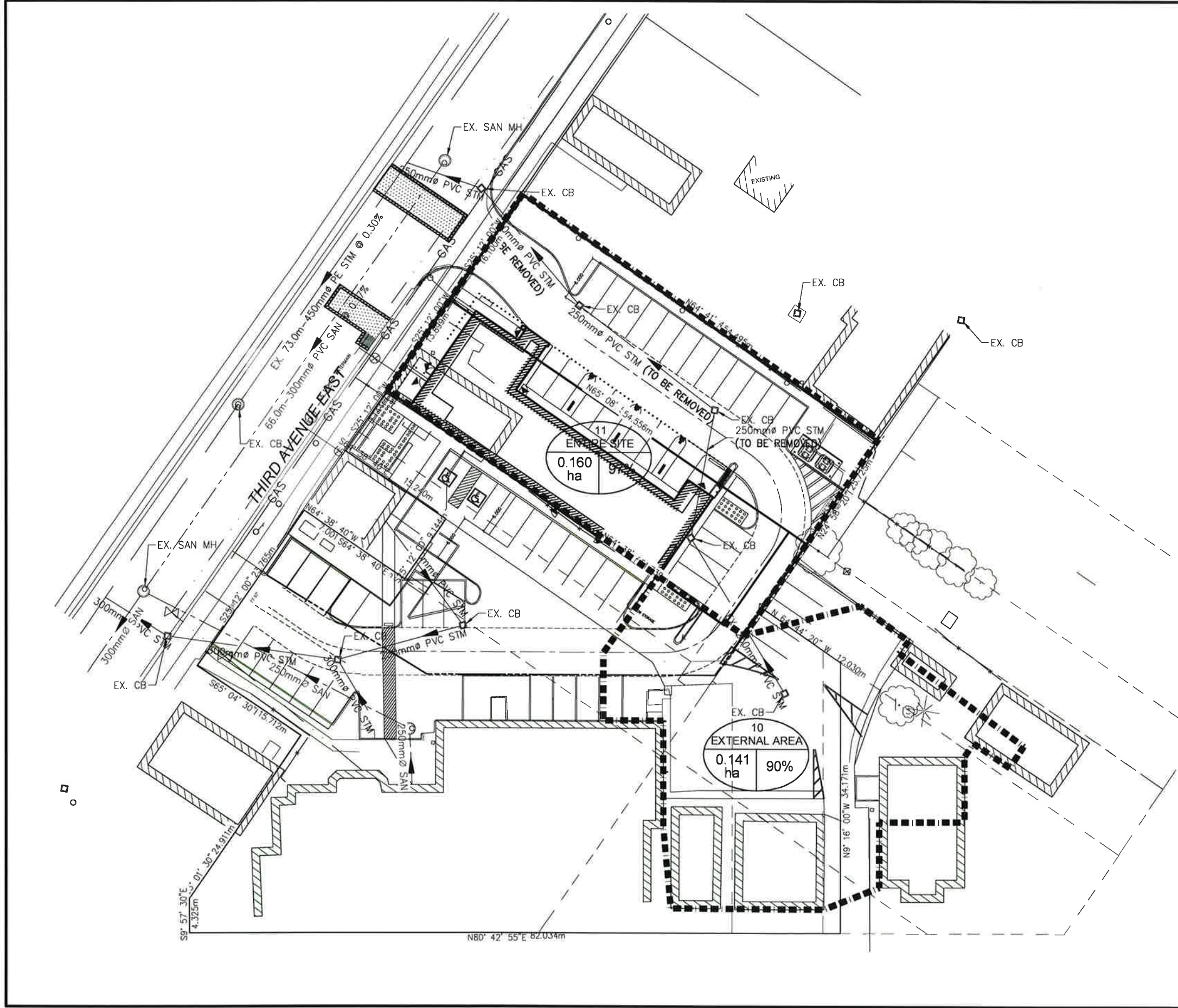
EXISTING CONDITIONS  
 DRAINAGE AREAS

LUTHERAN SOCIAL  
 SERVICES

Figure No. 2

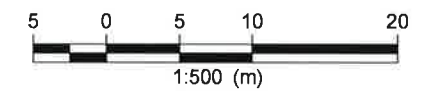
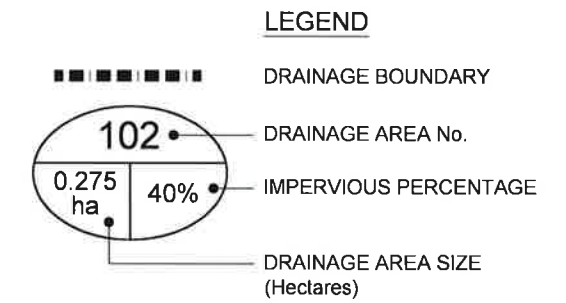


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 LAST SAVED BY: Rwalker, 4/10/2023 4:24:56 AM PLOTTED BY: Rob Walker - GM BluePlan 4/10/2023 4:30:36 AM





221130  
 1043-1057  
 3rd Avenue East  
 City of Owen Sound



SCALE 1:500  
 FEB 2023

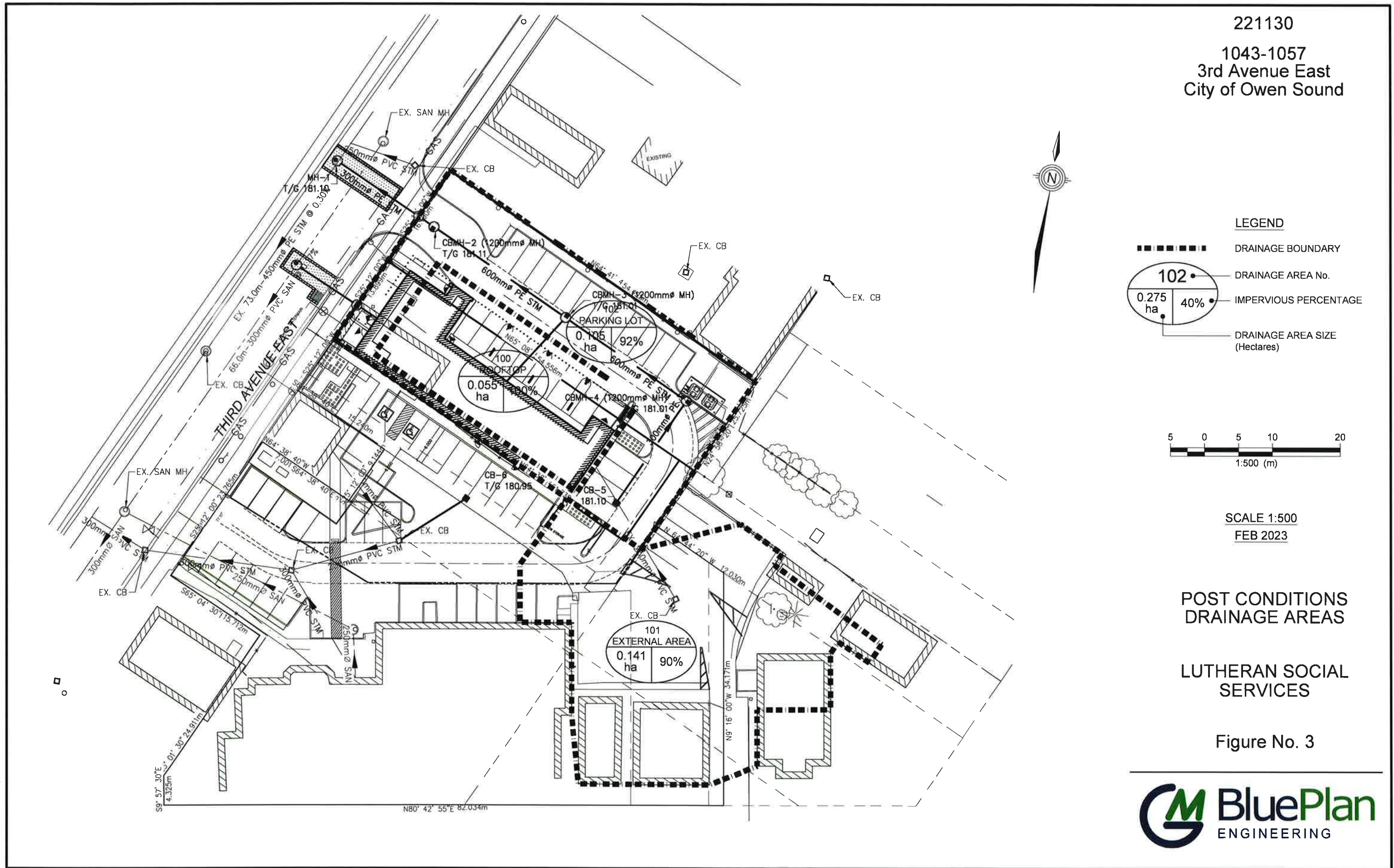
POST CONDITIONS  
 DRAINAGE AREAS

LUTHERAN SOCIAL  
 SERVICES

Figure No. 3



FILE: W:\OwenSound\Owen Sound\221-2021\221130-2 (g) Topo Survey - Lutheran Social Services - 1043 & 1057 - 3rd Ave. E. OS\Drawings\221130-2 MAR 28 2023 R.W.dwg LAYOUT-POST CATCHMENT AREAS  
 LAST SAVED BY: Rwalker, 4/10/2023 4:24:56 AM PLOTTED BY: Rob Walker - CM BluePlan 4/10/2023 4:30:38 AM



**MIDUSS MODELLING – EXISTING AND POST DEVELOPMENT  
APPENDIX A:  
CONDITIONS**

```

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                        5 years Existing 18Jan23.out"
Output filename:        gmbp"
License name:
Company
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180.000 Max. Storm length"
360.000 Max. Hydrograph"
STORM Chicago storm"
32 1 Chicago storm"
1234.576 Coefficient A"
8.297 Constant B"
0.851 Exponent C"
0.375 Fraction R"
180.000 Duration"
1.000 Time step multiplier"
Maximum intensity      134.692 mm/hr"
Total depth            42.929 mm"
6 005hyd Hydrograph extension used in this file"
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1 Equal length"
1 SCS method"
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25.000 Flow length"
2.500 Overland Slope"
0.014 Pervious Area"
25.000 Pervious length"
2.500 Pervious slope"
25.000 Impervious length"
2.500 Impervious slope"
0.250 Pervious Manning 'n'"
82.000 Pervious SCS Curve No."
0.348 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
5.576 Pervious Initial abstraction"
0.015 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.866 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
CATCHMENT 11"
1 Triangular SCS"
1 Equal length"
1 SCS method"
11 5 years existing-Site"
97.000 % Impervious"
0.160 Total Area"
25.000 Flow length"
1.000 Overland Slope"
0.005 Pervious Area"
25.000 Pervious length"
1.000 Pervious slope"
0.155 Impervious Area"
25.000 Impervious length"
1.000 Impervious slope"
0.250 Pervious Manning 'n'"
82.000 Pervious SCS Curve No."
0.348 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
5.576 Pervious Initial abstraction"
0.015 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.866 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
CATCHMENT 10"
10 Surface Area"
10 Time to Centroid"
10 Rainfall depth"
10 Rainfall volume"
10 Runoff depth"
10 Runoff volume"
10 Runoff coefficient"
Maximum flow"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.036 0.000 0.036 0.000 0.000 0.000"
CATCHMENT 11"
33 1 Triangular SCS"
1 Equal length"
1 SCS method"
11 5 years existing-Site"
97.000 % Impervious"
0.160 Total Area"
25.000 Flow length"
1.000 Overland Slope"
0.005 Pervious Area"
25.000 Pervious length"
1.000 Pervious slope"
0.155 Impervious Area"
25.000 Impervious length"
1.000 Impervious slope"
0.250 Pervious Manning 'n'"
82.000 Pervious SCS Curve No."
0.348 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
5.576 Pervious Initial abstraction"
0.015 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.866 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
CATCHMENT 11"
11 Surface Area"
11 Time to Centroid"
11 Rainfall depth"
11 Rainfall volume"
11 Runoff depth"
11 Runoff volume"
11 Runoff coefficient"
Maximum flow"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.041 0.036 0.041 0.036 0.000 0.000"
CATCHMENT 10"
10 Surface Area"
10 Time to Centroid"
10 Rainfall depth"
10 Rainfall volume"
10 Runoff depth"
10 Runoff volume"
10 Runoff coefficient"
Maximum flow"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.036 0.000 0.036 0.000 0.000 0.000"
CATCHMENT 11"
11 Surface Area"
11 Time to Centroid"
11 Rainfall depth"
11 Rainfall volume"
11 Runoff depth"
11 Runoff volume"
11 Runoff coefficient"
Maximum flow"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.041 0.036 0.041 0.036 0.000 0.000"

```

```

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" Surface Area 0.014 0.127 0.141 hectare"
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" Rainfall volume 54.48 54.48 60.53 c.m"
" Rainfall losses 27.979 5.652 7.884 mm"
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" Maximum flow 0.001 0.035 0.036 c.m/sec"
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" 4 Add Runoff "
" 0.036 0.036 0.000 0.000 0.000"
" CATCHMENT 11"
" 33 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 11 5 years existing-Site"
" 97.000 % Impervious"
" 0.160 Total Area"
" 25.000 Flow length"
" 1.000 Overland Slope"
" 0.005 Pervious Area"
" 25.000 Pervious length"
" 1.000 Pervious slope"
" 0.155 Impervious Area"
" 25.000 Impervious length"
" 1.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 82.000 Pervious SCS Curve No."
" 0.348 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 5.576 Pervious Initial abstraction"
" 0.015 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.866 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.041 0.036 0.041 0.036 0.000 0.000 c.m/sec"
" Catchment 11 Pervious Impervious Total Area "
" Surface Area 0.005 0.155 0.160 hectare"
" Time of concentration 19.097 2.232 2.439 minutes"
" Time to Centroid 117.868 86.681 87.064 minutes"
" Rainfall depth 42.929 42.929 42.929 mm"
" Rainfall volume 2.06 66.63 68.69 c.m"
" Rainfall losses 27.968 5.766 6.432 mm"
" Runoff depth 14.960 37.163 36.497 mm"
" Runoff volume 0.72 57.68 58.39 c.m"

```

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"	HYDROGRAPH Combine	100"			
"	6 Combine "				
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    360.000 Max. Hydrograph"
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    1234.576 Coefficient A"
    8.297 Constant B"
    0.851 Exponent C"
    0.375 Fraction R"
    180.000 Duration"
    1.000 Time step multiplier"
    Maximum intensity 134.692 mm/hr"
    Total depth      42.929 mm"
    6 005hyd Hydrograph extension used in this file"
33 CATCHMENT 100"
    1 Triangular SCS"
    1 Equal length"
    1 SCS method"
    100 5 years post- Rooftop"
    100.000 % Impervious"
    0.055 Total Area"
    15.000 Flow length"
    2.000 Overland Slope"
    0.000 Pervious Area"
    0.000 Pervious length"
    2.000 Pervious slope"
    0.055 Impervious Area"
    15.000 Impervious length"
    2.000 Impervious slope"
    0.250 Pervious Manning 'n'"
    82.000 Pervious SCS Curve No."
    0.000 Pervious Runoff coefficient"
    0.100 Pervious Ia/S coefficient"
    5.576 Pervious Initial abstraction"
    0.015 Impervious Manning 'n'"
    98.000 Impervious SCS Curve No."
    0.864 Impervious Runoff coefficient"
    0.100 Impervious Ia/S coefficient"
    0.518 Impervious Initial abstraction"

```

```

" 0.016 0.000 0.000 0.000 c.m/sec"
" Catchment 100 Pervious Impervious Total Area "
" Surface Area 0.000 0.055 0.055 hectare"
" Time of concentration 11.417 1.334 1.334 minutes"
" Time to Centroid 108.072 85.362 85.362 minutes"
" Rainfall depth 42.929 42.929 42.929 mm"
" Rainfall volume 0.00 23.61 23.61 c.m"
" Rainfall losses 27.976 5.827 5.827 mm"
" Runoff depth 14.952 37.102 37.102 mm"
" Runoff volume 0.00 20.41 20.41 c.m"
" Runoff coefficient 0.000 0.864 0.864 "
" Maximum flow 0.000 0.016 0.016 c.m/sec"
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" 4 Add Runoff " 0.016 0.000 0.000 "
" POND DESIGN"
" 54 0.016 Current peak flow c.m/sec"
" 0.016 Target outflow c.m/sec"
" 0.008 Hydrograph volume c.m"
" 20.4 Number of stages"
" 5. 0.000 Minimum water level metre"
" 0.100 Maximum water level metre"
" 0.000 Starting water level metre"
" 0 Keep Design Data: 1 = True; 0 = False"
" Level Discharge Volume"
" 0.02500 0.00080 0.000"
" 0.05000 0.00160 28.000"
" 0.07500 0.00230 41.000"
" 0.10000 0.00310 55.000"
" Peak outflow 0.001 c.m/sec"
" Maximum level 0.028 metre"
" Maximum storage 15.519 c.m"
" Centroidal lag 5.627 hours"
" 0.016 0.016 0.001 0.000 c.m/sec"
" 40 HYDROGRAPH Next link "
" 5 Next link " 0.016 0.001 0.001 0.000"
" CATCHMENT 101"
" 33 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 101 5 years post - external"
" 90.000 % Impervious"
" 0.141 Total Area"
" 25.000 Flow length"
" 2.500 Overland Slope"
" 0.014 Pervious Area"
" 25.000 Pervious length"
" 2.500 Pervious slope"

```





"	Maximum level	180.635	metre"
"	Maximum storage	13.633	c.m"
"	Centroidal lag	1.732	hours"
"	0.027	0.063	0.051 0.000 c.m/sec"
"	HYDROGRAPH	Combine	2000"
"	6	Combine "	
"	2000	Node #"	
"	Total post"		
"	Maximum flow	0.051	c.m/sec"
"	Hydrograph volume	99.438	c.m"
"	0.027	0.063	0.051"
"	38	START/RE-START TOTALS 102"	
"	3	Runoff Totals on EXIT"	
"	Total Catchment area	0.301	hectare"
"	Total Impervious area	0.278	hectare"
"	Total % impervious	92.525"	
"	EXIT"		
"	19		

```

MIDUSS Output ----->
MIDUSS version          Version 2.25 rev. 473
MIDUSS created          Sunday, February 07, 2010
MIDUSS used             ie METRIC
Job folder:             C:\Users\rsingh\Desktop\My Jobs\
                       ie METRIC
Output filename:        C:\Users\rsingh\Desktop\My Jobs\
                       221130-2 1043 & 1057 3rd ave east, OS\MIDUSS\4 april 2023
License name:           25 years post 600 pipe 6april23.out
Company                 gmbp
Date & Time last used:  4/6/2023 at 1:28:44 PM

31  TIME PARAMETERS
    5.000  Time Step
    210.000  Max. Storm length"
    360.000  Max. Hydrograph"
32  STORM Chicago storm"
    1  Chicago storm"
    1750.276  Coefficient A"
    8.303  Constant B"
    0.862  Exponent C"
    0.375  Fraction R"
    210.000  Duration"
    1.000  Time step multiplier"
    Maximum intensity 165.717 mm/hr"
    Total depth 59.007 mm"
    6 025hyd Hydrograph extension used in this file"
33  CATCHMENT 100"
    1  Triangular SCS"
    1  Equal length"
    1  SCS method"
    100 25 years post- Rooftop"
    100.000 % Impervious"
    0.055 Total Area"
    15.000 Flow length"
    2.000 Overland Slope"
    0.000 Pervious Area"
    15.000 Pervious length"
    2.000 Pervious slope"
    0.055 Impervious Area"
    15.000 Impervious length"
    2.000 Impervious slope"
    0.250 Pervious Manning 'n'"
    82.000 Pervious SCS Curve No."
    0.000 Pervious Runoff coefficient"
    0.100 Pervious Ia/S coefficient"
    5.576 Pervious Initial abstraction"
    0.015 Impervious Manning 'n'"
    98.000 Impervious SCS Curve No."
    0.890 Impervious Runoff coefficient"
    0.100 Impervious Ia/S coefficient"
    0.518 Impervious Initial abstraction"

```

```

" 0.020 0.000 0.000 0.000 c.m/sec"
" Catchment 100 Impervious Total Area "
" Surface Area 0.000 0.055 0.055 hectare"
" Time of concentration 1.219 1.219 minutes"
" Time to Centroid 117.034 96.867 96.867 minutes"
" Rainfall depth 59.007 59.007 59.007 mm"
" Rainfall volume 32.45 32.45 c.m"
" Rainfall losses 6.515 6.515 mm"
" Runoff depth 52.493 52.493 mm"
" Runoff volume 28.87 28.87 c.m"
" Runoff coefficient 0.890 0.890 "
" Maximum flow 0.020 0.020 c.m/sec"
" HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 0.020 0.020 0.000 0.000"
" POND DESIGN"
" 0.020 Current peak flow c.m/sec"
" 0.008 Target outflow c.m/sec"
" 28.9 Hydrograph volume c.m"
" 5. Number of stages"
" 0.000 Minimum water level metre"
" 0.100 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 0.00080 14.000"
" 0.05000 0.00160 28.000"
" 0.07500 0.00230 41.000"
" 0.10000 0.00310 55.000"
" Peak outflow 0.001 c.m/sec"
" Maximum level 0.039 metre"
" Maximum storage 21.734 c.m"
" Centroidal lag 5.792 hours"
" 0.020 0.020 0.001 0.000 c.m/sec"
" HYDROGRAPH Next link "
" 5 Next link "
" 0.020 0.001 0.001 0.000"
" CATCHMENT 101"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 101 25 years post-External"
" 90.000 % Impervious"
" 0.141 Total Area"
" 25.000 Flow length"
" 2.500 Overland Slope"
" 0.014 Pervious Area"
" 25.000 Pervious length"
" 2.500 Pervious slope"

```



"	Maximum level	181.106	metre"
"	Maximum storage	20.567	c.m"
"	Centroidal lag	1.947	hours"
"	0.035	0.080	0.060 0.000 c.m/sec"
"	HYDROGRAPH	Combine	2000"
"	6	Combine "	
"	2000	Node #"	
"	Total post"		
"	Maximum flow	0.060	c.m/sec"
"	Hydrograph volume	140.748	c.m"
"	0.035	0.080	0.060"
"	START/RE-START TOTALS 102"		
"	3	Runoff Totals on EXIT"	
"	Total Catchment area	0.301	hectare"
"	Total Impervious area	0.278	hectare"
"	Total % impervious	92.525"	
"	EXIT"		
"	19		

```

MIDUSS Output ----->
MIDUSS version          Version 2.25 rev. 473
MIDUSS created          Sunday, February 07, 2010
Units used:             ie METRIC"
Job folders:            C:\Users\rsingh\Desktop\My Jobs\
                        221130-2 1043 & 1057 3rd ave east, OS\MIDUSS\4 april 2023\
Output filename:        100 years post 600 pipe 6april23.out"
License name:           gmbp"
Company:
Date & Time last used:  4/6/2023 at 1:36:30 PM"

31  TIME PARAMETERS"
    5.000  Time Step"
    210.000  Max. Storm length"
    360.000  Max. Hydrograph"
    STORM Chicago storm"
    1  Chicago storm"
    2171.754  Coefficient A"
    8.303    Constant B"
    0.867    Exponent C"
    0.375    Fraction R"
    210.000  Duration"
    1.000    Time step multiplier"
    Maximum intensity  202.862  mm/hr"
    Total depth       71.271  mm"
    6 100hyd Hydrograph extension used in this file"
    CATCHMENT 100"
    1  Triangular SCS"
    1  Equal length"
    1  SCS method"
    100 100 years post- Roofstop"
    100.000  % Impervious"
    0.055  Total Area"
    15.000  Flow length"
    2.000  Overland Slope"
    0.000  Pervious Area"
    0.000  Pervious length"
    2.000  Pervious slope"
    0.055  Impervious Area"
    15.000  Impervious length"
    2.000  Impervious slope"
    0.250  Pervious Manning 'n'"
    82.000  Pervious SCS Curve No."
    0.000  Pervious Runoff coefficient"
    0.100  Pervious Ia/S coefficient"
    5.576  Pervious Initial abstraction"
    0.015  Impervious Manning 'n'"
    98.000  Impervious SCS Curve No."
    0.899  Impervious Runoff coefficient"
    0.100  Impervious Ia/S coefficient"
    0.518  Impervious Initial abstraction"

```

```

" 0.025 0.000 0.000 0.000 c.m/sec"
" Catchment 100 Pervious Total Area "
" Surface Area 0.000 0.055 0.055 hectare"
" Time of concentration 8.305 1.119 1.119 minutes"
" Time to Centroid 114.134 96.123 96.123 minutes"
" Rainfall depth 71.271 71.271 71.271 mm"
" Rainfall volume 0.00 39.20 39.20 c.m"
" Rainfall losses 35.803 7.189 7.189 mm"
" Runoff depth 35.469 64.082 64.082 mm"
" Runoff volume 0.00 35.25 35.25 c.m"
" Runoff coefficient 0.000 0.899 0.899 "
" Maximum flow 0.000 0.025 0.025 c.m/sec"
" HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 0.025 0.025 0.000 0.000"
" POND DESIGN"
" 0.025 Current peak flow c.m/sec"
" 0.008 Target outflow c.m/sec"
" 35.2 Hydrograph volume c.m"
" 5. Number of stages"
" 0.000 Minimum water level metre"
" 0.100 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 0.00080 14.000"
" 0.05000 0.00160 28.000"
" 0.07500 0.00230 41.000"
" 0.10000 0.00310 55.000"
" Peak outflow 0.002 c.m/sec"
" Maximum level 0.048 metre"
" Maximum storage 26.661 c.m"
" Centroidal lag 5.781 hours"
" 0.025 0.025 0.002 0.000 c.m/sec"
" HYDROGRAPH Next link "
" 5 Next link "
" 0.025 0.002 0.002 0.000"
" CATCHMENT 101"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 100 100 years post-External"
" 90.000 % Impervious"
" 0.141 Total Area"
" 25.000 Flow length"
" 2.500 Overland Slope"
" 0.014 Pervious Area"
" 25.000 Pervious length"
" 2.500 Pervious slope"

```





"	Maximum level	181.160	metre"
"	Maximum storage	31.286	C.m"
"	Centroidal lag	1.931	hours"
"	0.042	0.099	0.061 0.000 C.m/sec"
"	HYDROGRAPH	Combine	2000"
"	6	Combine "	
"	2000	Node #"	
"	Total post"		
"	Maximum flow	0.061	C.m/sec"
"	Hydrograph volume	173.611	C.m"
"	0.042	0.099	0.061"
"	38	START/RE-START TOTALS 102"	
"	3	Runoff Totals on EXIT"	
"	Total Catchment area	0.301	hectare"
"	Total Impervious area	0.278	hectare"
"	Total % impervious	92.525"	
"	EXIT"		
"	19		

**APPENDIX B:  
OGS UNIT**

# Hydro First Defense® - HC



Rev. 12.5

Project Name: 1043 3rd Avenue East, Owen Sound Report Date: 3/29/2023 Paste  
 Street: 3rd ave East City: Owen Sound  
 Province: ON Country: Canada  
 Designer: Rasvinder Singh email: rasvinder.singh@gmbluep

## Net Annual Removal Model: FD-4HC

Intensity <sup>(1)</sup> (mm/hr)	Fraction of Rainfall <sup>(1)</sup> (%)	FD-4HC Removal Efficiency <sup>(2)</sup> (%)	Weighted Net Annual Efficiency (%)
0.50	10.1%	100.0%	10.1%
1.00	10.7%	100.0%	10.7%
1.50	10.0%	100.0%	10.0%
2.00	8.4%	100.0%	8.4%
2.50	6.6%	98.4%	6.5%
3.00	6.2%	96.7%	6.0%
3.60	4.1%	95.1%	3.9%
4.10	4.2%	93.9%	3.9%
4.60	3.7%	92.9%	3.4%
5.10	3.8%	92.1%	3.5%
6.40	6.4%	90.1%	5.8%
7.60	4.6%	88.7%	4.1%
8.90	3.3%	87.4%	2.9%
10.20	2.4%	86.3%	2.1%
11.40	2.6%	85.4%	2.2%
12.70	1.5%	84.6%	1.3%
15.20	2.1%	83.2%	1.7%
19.10	2.3%	81.4%	1.9%
25.40	3.9%	79.3%	3.1%
38.10	1.4%	76.4%	1.1%
50.80	0.6%	74.3%	0.4%

### Treatment Parameters:

Structure ID: MH-B-4  
 TSS Goal: 80 % Removal  
 TSS Particle Size: Fine  
 Area: 0.301 ha  
 Percent Impervious: 95%  
 Rational C value: 0.87 Calc. Cn  
 Rainfall Station: Owen Sound MAP  
 Peak Storm Flow: 61 L/s

### RESULTS SUMMARY

Model	TSS	Volume
FD-3HC	90.0%	>90%
<b>FD-4HC</b>	<b>93.0%</b>	<b>&gt;90%</b>
FD-5HC	95.0%	>90%
FD-6HC	96.0%	>90%
FD-8HC	98.0%	>90%
FD-10HC	98.0%	>90%

### Model Specification:

Model: FD-4HC  
 Diameter: 1200 mm  
 Peak Flow Capacity: 510.00 L/s  
 Sediment Storage: 0.54 m<sup>3</sup>  
 Oil Storage: 723.00 L

### Installation Configuration:

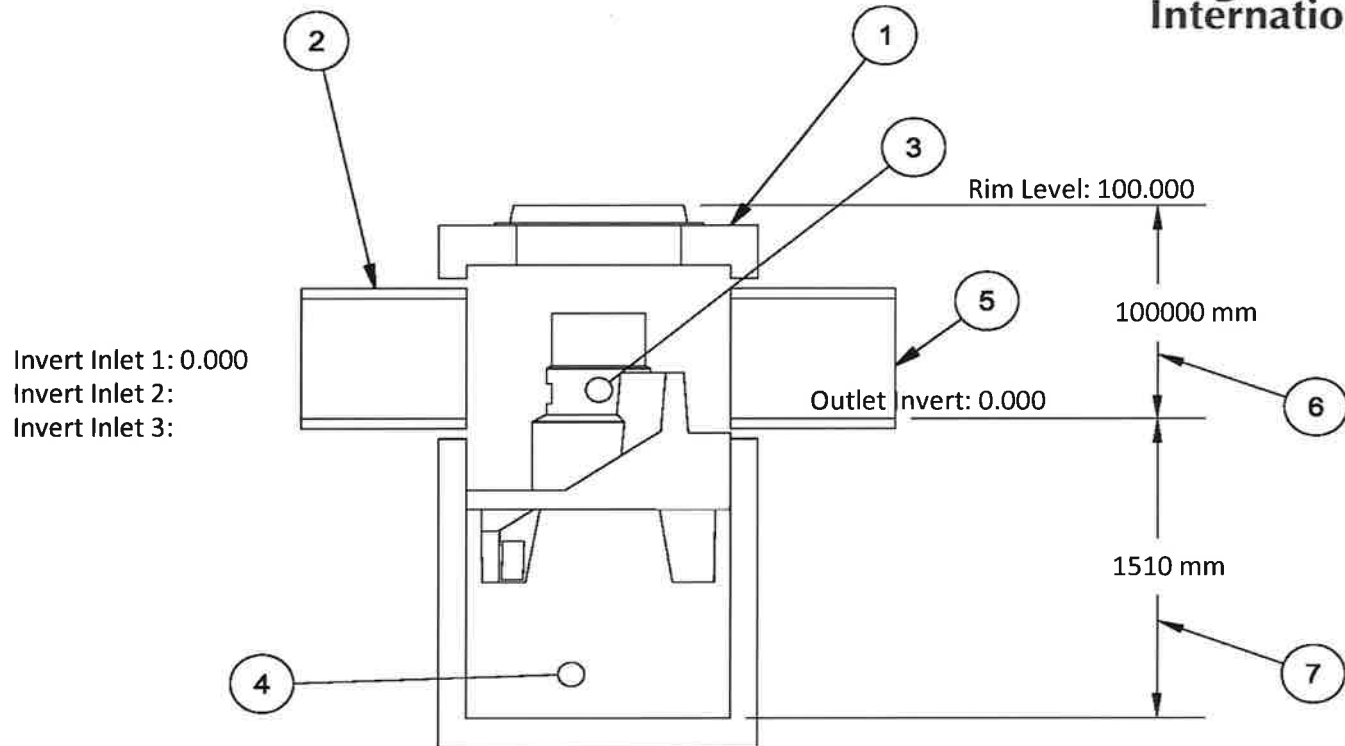
Placement: Online  
 Outlet Pipe Size: 300 mm OK  
 Inlet Pipe 1 Size: 600 mm OK  
 Inlet Pipe 2 Size: \_\_\_\_\_ mm OK  
 Inlet Pipe 3 Size: \_\_\_\_\_ mm OK  
 Rim Level: 100.000 m Calc Invs.  
 Outlet Pipe Invert: \_\_\_\_\_ m OK  
 Invert Pipe 1: \_\_\_\_\_ m OK  
 Invert Pipe 2: \_\_\_\_\_ m  
 Invert Pipe 3: \_\_\_\_\_ m

**Total Net Annual Removal Efficiency: 93.0%**  
**Total Annual Runoff Volume Treated: >90%**

- Rainfall data based on 37 years of rainfall data for Canada Station Owen Sound, Owen Sound, Ontario, Canada.
- Based on third party verified data and approximating the removal of a PSD similar to the STC Fine distribution
- Rainfall adjusted to 5 min peak intensity based on hourly average.

### Designer Notes:

# Hydro First Defense® - HC



All drawing elevations are metres.

### FD-4HC Specification

1	Vortex Chamber Diameter	1200 mm
2	Inlet Pipe Diameter	600 mm
3	Oil Storage Capacity	723.00 L
4	Min. Provided Sediment Storage Capacity	0.54 m <sup>3</sup>
5	Outlet Pipe Diameter	300 mm
6	Height(Final Grade to Outlet Invert)	100000 mm
7	Sump Depth(Outlet Invert to Sump)	1510 mm
<b>Total Depth</b>		<b>101510 mm</b>

**Notes:**

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**APPENDIX C:  
SWM FACILITY STAGE-STORAGE-DISCHARGE CALCULATIONS**

**Proposed Development**  
**1046-1057 3rd Ave East, Owen Sound**  
**Our File: 221130-2**  
**DEC 2022**

**ROOFTOP STORAGE CALCULATIONS (CATCH. 201)**

Design Discharge Rate = 0.930 L/min/mm/notch = 1.55E-05 m<sup>3</sup>/s/mm/notch  
 Max. Average Storage Depth = 100.000 mm  
 Design Discharge = 93.0 L/min/notch = 0.00155 m<sup>3</sup>/s/notch  
 No. of Drains = 6  
 No. Notches/Drain = 0.33  
 Allowable Release Rate = 186 L/min = 0.00310 m<sup>3</sup>/s  
  
 Rooftop Area = 550 m<sup>2</sup>

**STAGE-STORAGE-DISCHARGE TABLE**

Elevation (m)	Stage (m)	Storage (m <sup>3</sup> )	Discharge (m <sup>3</sup> /s)	
0.0000	0.0000	0	0.000	
0.0250	0.0250	14	0.0008	100yr Depth = 0.048m
0.0500	0.0500	28	0.0016	
0.0750	0.0750	41	0.0023	
0.1000	0.1000	55	0.0031	

1046-1057 3rd Ave East  
 Our File: 221130-2  
 Jan 2023

**SUPERPIPE STORAGE CALCULATIONS**

ELEV	INC DEPTH	PIPE SECTION LENGTH	AREA	INCREMENTAL STORAGE VOL	ACCUM STORAGE VOL	
(m)	(m)	(m)	(sq m)	(cu m)	(cu m)	
179.45	0.00	40	0.000	0.0	0.0	B/ 600mm pipe
179.55	0.10	40	0.031	1.6	1.6	
179.65	0.20	40	0.083	2.1	3.6	
179.75	0.30	40	0.141	2.4	6.0	
179.85	0.40	40	0.200	2.4	8.3	
179.95	0.50	40	0.252	2.1	10.4	
180.05	0.60	40	0.283	1.2	11.6	Top of the pipe
180.15	0.70	---	0.0	0.3	12.0	
180.25	0.80	---	0.0	0.3	12.3	
180.35	0.90	---	0.0	0.3	12.7	
180.45	1.00	---	0.0	0.3	13.0	
180.55	1.10	---	0.0	0.3	13.3	
180.65	1.20	---	0.0	0.3	13.7	
180.75	1.30	---	0.0	0.3	14.0	
180.85	1.40	---	0.0	0.3	14.4	
180.95	1.50	---	0.0	0.3	14.7	
181.00	1.55	---	0.0	0.2	14.9	T/Grate MH 2
181.10	1.65	---	90.0	4.7	19.6	T/Grate MH 1 and 3
181.15	1.70	---	220.0	7.8	27.3	
181.20	1.75	---	600.0	20.5	47.8	Overflow Weir to Road
181.30	1.85	---	1010.0	80.5	128.3	

**Superpipe Dimensions**

L(dw) = 40.00 m  
 D(dw) = 0.60 m  
 Area(dw) = 0.28 m<sup>2</sup>

**Outlet Orifice**

Orifice Dia.: 150 mm  
 Orifice Area: 0.018 m<sup>2</sup>  
 Coefficient: 0.6  
 Invert Elev: 179.40 m

**Storage in structures**

	MH1	MH2	MH3	Total
Elevation	181.1	181	181.1	
Area (m2)	1.13	1.13	1.13	3.39

**Overflow Weir**

Weir Inv. = 181.200 m  
 Weir L = 6.000 m  
 2g = 19.620  
 Max. H = 0.100 m

ELEV	STAGE	STORAGE VOLUME	PRIMARY ORIFICE FLOW	OVERFLOW WEIR	TOTAL DISCHARGE	
(m)	(m)	(cu m)	(cu m/s)	(cu m/s)	(cu m/s)	
179.450	0.00	0.0	0.000	0.000	0.000	B/ Superpipe
179.550	0.10	1.6	0.013	0.000	0.013	
179.650	0.20	3.6	0.020	0.000	0.020	
179.750	0.30	6.0	0.025	0.000	0.025	
179.850	0.40	8.3	0.029	0.000	0.029	
179.950	0.50	10.4	0.032	0.000	0.032	
180.050	0.60	11.6	0.036	0.000	0.036	Top Superpipe
180.150	0.70	12.0	0.039	0.000	0.039	
180.250	0.80	12.3	0.041	0.000	0.041	
180.350	0.90	12.7	0.044	0.000	0.044	
180.450	1.00	13.0	0.046	0.000	0.046	
180.550	1.10	13.3	0.049	0.000	0.049	
180.650	1.20	13.7	0.051	0.000	0.051	
180.750	1.30	14.0	0.053	0.000	0.053	
180.850	1.40	14.4	0.055	0.000	0.055	
180.950	1.50	14.7	0.057	0.000	0.057	
181.000	1.55	14.9	0.058	0.000	0.058	T/Grate MH 2
181.100	1.65	19.6	0.060	0.000	0.060	T/Grate MH 1 and 3
181.150	1.70	27.3	0.061	0.000	0.061	
181.200	1.75	47.8	0.062	0.000	0.062	Overflow Weir to Road
181.300	1.85	128.3	0.063	0.324	0.387	