355 Plains Road
City of Burlington

Storm Water Management Report

May 2022

Lamarre Consulting Group Inc.
25 Brookside Terrace, Smithville, ON L0R 2A0
(905) 818-5205 j.lamarre@cogeco.ca

1.0 INTRODUCTION

Lamarre Consulting Group Inc. has been retained by LanHack Consultants Inc. to assess the storm water management requirements relating to the proposed re-development located at 355 Plains Road East in the City of Burlington. The property is approximately 0.7499ha in size and is located on the north side of Plains Road East east of Downsview Drive in the City of Burlington. The site was formerly used as a strip plaza. Under existing conditions the site is covered by approximately 6525m^2 (87.0%) impervious surfaces. It is proposed to re-develop the site with a commercial/residential development such that the impervious coverage would decrease to 6471m^2 (86.3%). Please refer to Figure 1 for the site location.

This report will review the recommended storm water management strategy used to develop the proposed site in accordance with City of Burlington storm water management criteria.

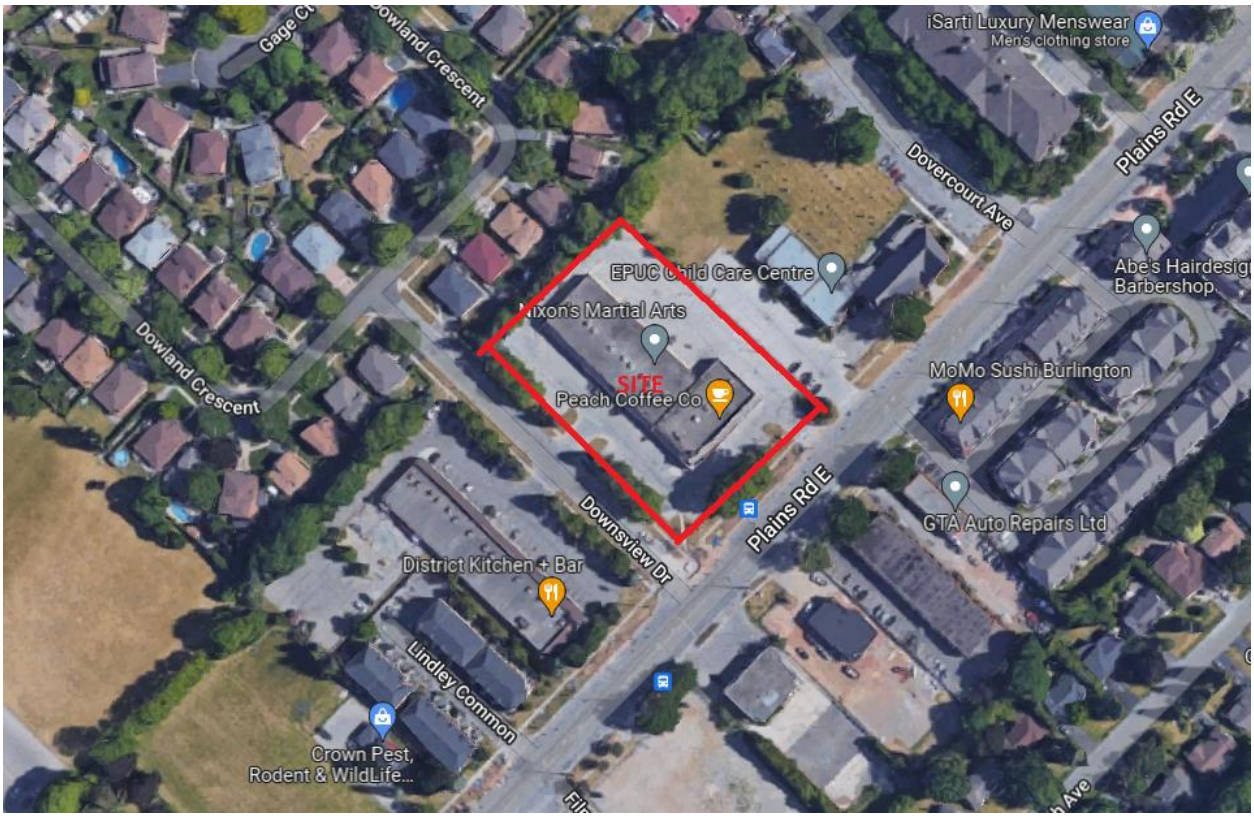


Figure 1: Site Location – 355 Plains Road East, City of Burlington

2.0 STORMWATER MANAGEMENT

The following sections will describe the proposed storm water management (SWM) plan for the existing and proposed development conditions.

2.1 STORMWATER MANAGEMENT CRITERIA

Based on pre-consultation correspondence from the City of Burlington, the following storm water management (SWM) criteria will be applied to the site:

Stormwater Quantity Control

Control post-development peak flows for the 5-year through 100-year storm event to the 5-year pre-development flows. Control to be achieved with orifice tubes. Orifice plates are not permitted.

Stormwater Quality Control

Enhanced level treatment, 80% total suspended solids removal, should be provided for this site. This is to be achieved in a treatment train as feasible.

Erosion Control

25mm storm event to be retained on site and released over a 48-72hr period.

Water Balance

Retain and infiltrate the first 5mm of runoff on site.

2.2 EXISTING CONDITIONS

The site was formerly used as a strip plaza. Under existing conditions the site is covered by approximately 6525m^2 (87.0%) impervious surfaces. The site currently drains to an existing 525mm storm sewer on Downsview Drive along the west side of the site.

City of Burlington staff have advised that the flows from this site to the receiving storm sewer on Downsview Drive shall be controlled to the 5-year pre-development flow rate.

Hydrologic modeling was carried out using the SWMHYMO computer program with IDF parameters taken from the City of Burlington design standards. Based on this modeling the existing 5-year peak flow from this site is estimated at **0.242m^3/s**.

2.3 PROPOSED CONDITIONS

It is proposed to develop the property with a multi-storey residential building with 6471m^2 (86.3%) impervious coverage. It is proposed to capture the runoff from the south building roof and collect this into a cistern. Overflow from the cistern will be combined with the storm runoff from the balance of the site and will pass through into a storm water storage tank prior to outlet to Downsview Avenue. The clean water collected in the cistern will be used for on-site watering and will hold 37.5m^3 (5mm x 7499m^2 site). The stormwater tank will hold a volume of 102m^3 with a footprint of 60.0m^2. The outlet rate from the tank will be controlled with a single 300mm orifice tube set at the tank base (elev. 97.55). In the event of blockage, the tank would surcharge and spill through an overflow pipe to the storm sewer system on Downsview Avenue. The stage-storage-discharge relationship for the proposed tank is provided in Table 1.

Table 1: Stage-Storage-Discharge Relationship for Storm Water Tank System

Stage Storage Discharge
355 Plains Road East

Input Data:	Orifice Diameter	300	mm				
	Orifice Elevation	97.70	(Center)	97.55	(Invert)		
	Pipe Diameter	250	mm				
	Pipe Elevation	99.13	(Center)	99.00	(invert)		
	C Co-efficient	0.62					

Stage Storage Discharge

Elev. (m)	Incr. Elev. (m)	Ponding Area (m2)	Depth (m)	Total Volume*	Note	Orifice Outlet (m3/s)	Orifice Outlet (m3/s)	Total Outflow (m3/s)
97.55	0.00	60	0	37.5		0.000		0.000
97.80	0.25	60	0.25	52.5		0.061		0.061
97.98	0.18	60	0.43	63.3		0.103		0.103
98.25	0.27	60	0.70	79.5		0.144		0.144
98.50	0.25	60	0.95	94.5		0.174		0.174
98.75	0.25	60	1.20	109.5		0.199		0.199
99.00	0.25	60	1.45	124.5		0.221	0.000	0.221
99.25	0.25	60	1.70	139.5		0.242	0.048	0.289

* Includes cistern volume

Flow Rates based on orifice equation $Q = C \times A (2 \times g \times h)^{0.5}$

Weir Overflow

Q=1.5 C L H^1.5

	H	L=4.0	Q
99.00	0		0
99.25	0.25		0.750

The proposed conditions with this cistern/storage tank were assessed using the SWMHYMO Hydrologic Modeling program developed by J.F. Sabourin & Associates for the 5-year to 100-year City of Burlington Chicago storm distribution. Both the 4-hour and 24-hour duration storms were modeled with the 24-hour storm being adopted for use as it generated slightly higher required storage volumes. Volume comparisons between the 4-hour and 24-hour design storms can be seen in Table 2. Appendix A contains detailed hydrologic modeling parameters and Appendix B contains input and summary output printouts for the proposed conditions.

Table 2: Proposed Conditions Storage Volumes and Controlled Peak Discharge Rates

Storm Event	**Storage Volume (m^3)****	**Total Peak Discharge (m^3/s)**	**Allowable Peak Discharge Rate (m^3/s)**
4hr Chicago			
25mm	55.2	0.072	
2-Yr	67.7	0.116	
5-Yr	79.7	0.147	
10-Yr	88.2	0.165	
25-Yr	100.6	0.189	
50-Yr	109.7	0.204	
100-Yr	119.0	0.219	**0.242**
24hr Chicago			
2-Yr	68.6	0.118	
5-Yr	80.4	0.150	
10-Yr	90.0	0.170	
25-Yr	102.1	0.193	
50-Yr	111.4	0.208	
100-Yr	121.0	**0.223**	

** Discharge rates based off SWMHYMO Hydrologic Modeling*
*** Volume includes 37.5m^3 Cistern*

Table 3 summarizes the storage volume requirements and depths within the storm water storage tank system for the 2-year to 100-year storm events.

Table 3: Proposed Conditions Volume Requirements Summary

Storm Event	**Tank Storage/Depth**		
	Volume in Tank (m^3)	**Storage Depth/(Elevation) (m)**	
2-Yr	31.1	0.52 (98.07)	**Max. Volume Provided (m^3)** 87.0**
5-Yr	42.9	0.72 (98.27)	
10-Yr	52.5	0.88 (98.43)	
25-Yr	64.6	1.08 (98.63)	
50-Yr	73.9	1.23 (98.78)	
100-Yr	**83.5**	1.39 (98.94)	
** Storage Volume Required taken from SWMHYMO Modeling (24-Hour Storm Governs)* *** Depth of storage tank at 1.45m Depth (Overflow Depth)*			

From these results, it can be concluded that for the 5-year through 100-year storm events the peak discharge rate to the Downsview Avenue storm sewer would be controlled to less than the existing 5-year rate. See SWMHYMO analysis in Appendix B.

3.0 STORM WATER RUNOFF QUALITY CONTROL

As per City of Burlington staff comments, storm water runoff should be treated to "enhanced" levels (80% total suspended particle removal). The roof top runoff and the runoff from the landscaped areas is generally considered to be "clean" and will be collected into the cistern prior to outlet to the storm water tank. Runoff from the surface parking and driveway areas is proposed to be collected separate from the balance of the site and to be treated with a Jellyfish® JF4-1-1 stormwater treatment unit prior to outlet into the SWM tank. Sizing calculations are attached in Appendix B for reference.

4.0 EROSION CONTROL

As per City of Burlington staff comments, it is recommended to provide 48hr detention of the runoff from a 25mm storm event. The estimated runoff volume from a 25mm rainfall event is 149.9m^3 (19.99mm runoff volume x 7499m^2 site area). To store this volume of runoff for a 48hr period it would be necessary to achieve an average outflow rate of approximately 0.86l/s. Assuming a driving head of 1.2m it would be necessary to control the flow rate with an orifice approximately 19mm in diameter which is not considered practical. We recommend an alternative solution be discussed at the site plan stage.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is shown that the storm water management measures proposed for this development will satisfy the City of Burlington criteria.

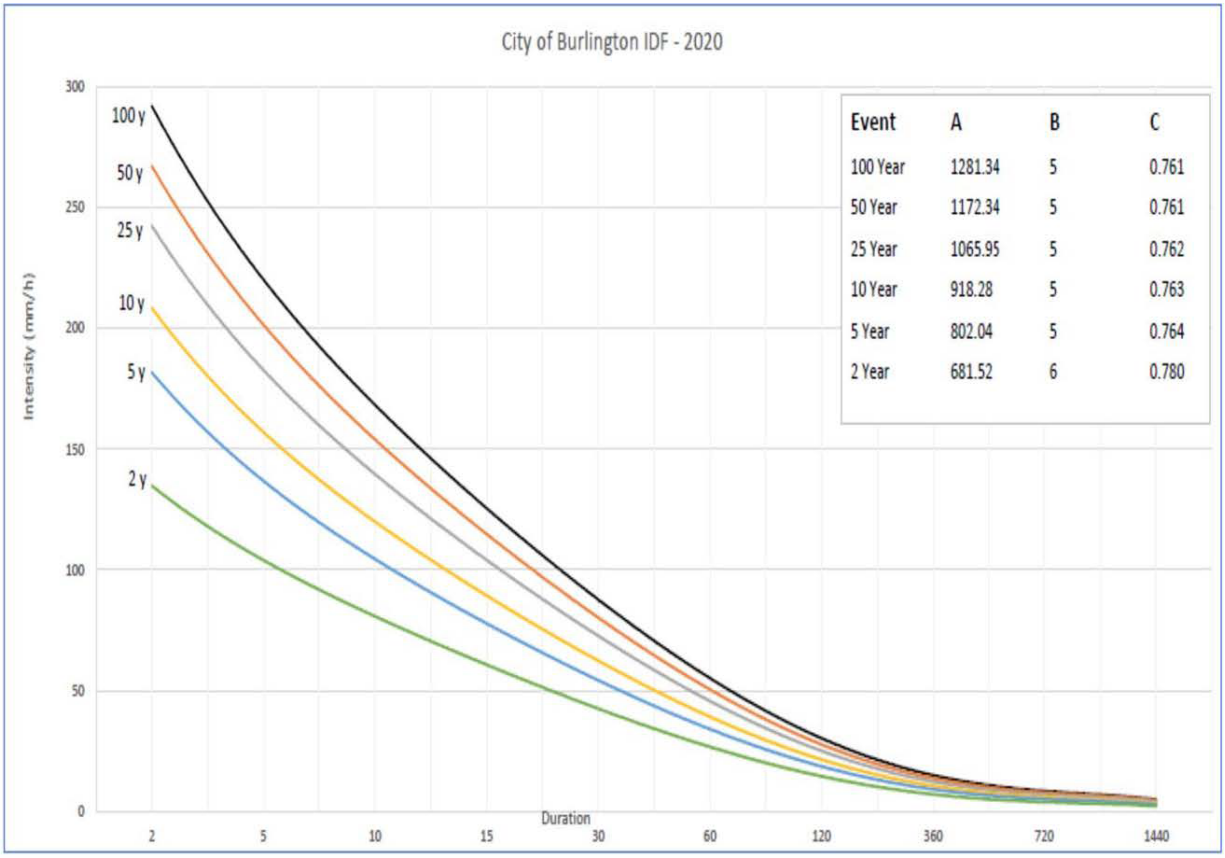
- Collection of clean rooftop and landscaped area runoff into a 37.5m^3 cistern prior to outlet into the proposed SWM tank. This water can be used for on-site irrigation of the landscaped portions of the site.
- The installation of a Jellyfish® JF4-1-1 stormwater treatment unit to treat runoff from the surface parking and driveway portions of the site prior to outlet into the proposed SWM tank.
- Construction of a 60.0m^2 storm water storage tank with a 300mm outlet pipe will control the peak outlet rate from this site during a 100yr storm event to less than the 5yr pre-development rate.

Respectfully submitted,

John Lamarre, P.Eng.
Lamarre Consulting Group Inc.



APPENDIX A: INTENSITY DURATION FREQUENCY IDF



Event	A	B	C
100 Year	1281.34	5	0.761
50 Year	1172.34	5	0.761
25 Year	1065.95	5	0.762
10 Year	918.28	5	0.763
5 Year	802.04	5	0.764
2 Year	681.52	6	0.780

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

- i = rainfall intensity (mm/hour)
- t = time of concentration in minutes (5 minutes)
- A, B and C = constant (see above)

APPENDIX B: Input/Summary Output SWMHYMO Hydrologic Modeling

```
2
START           0.0
*#**********************************************************************
*#          355 PLAINS ROAD EAST - CITY OF BURLINGTON
*#                    LAMARRE CONSULTING GROUP
*#                              May 2022
*#**********************************************************************

*#**********************************************************************
*#
*# 4hr-25mm EVENT
*#
*#**********************************************************************
*#**********************************************************************
*#* PRE DEVELOPMENT - 4hr - 25mm EVENT
*#**********************************************************************
CHICAGO STORM      IUNITS=2  TD=4hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1      A=802.04  B=5.0  C=.764
MODIFY STORM       ICASEms=1 NSHIFT=0.0 XFACT=0.5212677

CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#**********************************************************************
*#* POST DEVELOPMENT - 4hr 25mm EVENT
*#**********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0            0
                       0.00001    0.00375
                       0.061      0.00525
                       0.103      0.00633
                       0.144      0.00795
                       0.174      0.00945
                       0.199      0.01095
                       0.221      0.01245
                       0.992      0.01395   -1
*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
```

```
ADD HYD              ID=10  NHYD=200  ID=6,7

*#*********************************************************************
*#
*# 2yr EVENT
*#
*#*********************************************************************
*#*********************************************************************
*#* PRE DEVELOPMENT - 4hr
*#*********************************************************************
CHICAGO STORM      IUNITS=2  TD=4hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1     A=681.52  B=6.0  C=.780
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#*********************************************************************
*#* POST DEVELOPMENT - 4hr
*#*********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0           0
                        0.00001    0.00375
                        0.061      0.00525
                        0.103      0.00633
                        0.144      0.00795
                        0.174      0.00945
                        0.199      0.01095
                        0.221      0.01245
                        0.992      0.01395   -1
*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD              ID=10  NHYD=200  ID=6,7

*#*********************************************************************
*#* PRE DEVELOPMENT - 24hr
*#*********************************************************************
CHICAGO STORM      IUNITS=2  TD=24hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1     A=681.52  B=6.0  C=.780
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
```

```
                    XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                    DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#*********************************************************************
*#* POST DEVELOPMENT - 24hr
*#*********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                    XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                     OUTFLOW (cms)  STORAGE (ham)
                          0            0
                       0.00001    0.00375
                       0.061       0.00525
                       0.103       0.00633
                       0.144       0.00795
                       0.174       0.00945
                       0.199       0.01095
                       0.221       0.01245
                       0.992       0.01395   -1

*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                    XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD             ID=10  NHYD=200  ID=6,7

*#*********************************************************************
*#
*# 5yr EVENT
*#
*#*********************************************************************
*#*********************************************************************
*#* PRE DEVELOPMENT - 4hr
*#*********************************************************************
CHICAGO STORM      IUNITS=2  TD=4hrs TPRAT=.40  CSDT=5 min
                    ICASEcs=1      A=802.04  B=5.0  C=.764
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                    XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                    DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#*********************************************************************
*#* POST DEVELOPMENT - 4hr
*#*********************************************************************
```

```
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0           0
                       0.00001   0.00375
                       0.061       0.00525
                       0.103       0.00633
                       0.144       0.00795
                       0.174       0.00945
                       0.199       0.01095
                       0.221       0.01245
                       0.992       0.01395   -1

*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD            ID=10  NHYD=200  ID=6,7

*#**********************************************************************
*#* PRE DEVELOPMENT - 24hr
*#**********************************************************************
CHICAGO STORM      IUNITS=2  TD=24hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1     A=802.04  B=5.0  C=.764
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#**********************************************************************
*#* POST DEVELOPMENT - 24hr
*#**********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0           0
                       0.00001   0.00375
                       0.061       0.00525
                       0.103       0.00633
                       0.144       0.00795
                       0.174       0.00945
```

```
                        0.199       0.01095
                        0.221       0.01245
                        0.992       0.01395   -1

*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD            ID=10  NHYD=200  ID=6,7

*#*********************************************************************
*#
*# 10yr EVENT
*#
*#*********************************************************************
*#*********************************************************************
*#* PRE DEVELOPMENT - 4hr
*#*********************************************************************
CHICAGO STORM      IUNITS=2  TD=4hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1     A=918.28  B=5  C=.763
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#*********************************************************************
*#* POST DEVELOPMENT - 4hr
*#*********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0           0
                       0.00001    0.00375
                       0.061       0.00525
                       0.103       0.00633
                       0.144       0.00795
                       0.174       0.00945
                       0.199       0.01095
                       0.221       0.01245
                       0.992       0.01395   -1

*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
```

```
                    Ia =5.0mm      SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD              ID=10  NHYD=200  ID=6,7
*#*********************************************************************
*#* PRE DEVELOPMENT - 24hr
*#*********************************************************************
CHICAGO STORM      IUNITS=2  TD=24hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1      A=918.28  B=5  C=.763
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#*********************************************************************
*#* POST DEVELOPMENT - 24hr
*#*********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0            0
                       0.00001    0.00375
                       0.061      0.00525
                       0.103      0.00633
                       0.144      0.00795
                       0.174      0.00945
                       0.199      0.01095
                       0.221      0.01245
                       0.992      0.01395   -1
*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD              ID=10  NHYD=200  ID=6,7

*#*********************************************************************
*#
*# 25yr EVENT
*#
*#*********************************************************************
*#*********************************************************************
*#* PRE DEVELOPMENT - 4hr
*#*********************************************************************
```

```
CHICAGO STORM      IUNITS=2  TD=4hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1      A=1065.95  B=5  C=.762
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#*********************************************************************
*#* POST DEVELOPMENT - 4hr
*#*********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0           0
                       0.00001    0.00375
                       0.061      0.00525
                       0.103      0.00633
                       0.144      0.00795
                       0.174      0.00945
                       0.199      0.01095
                       0.221      0.01245
                       0.992      0.01395   -1

*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD            ID=10  NHYD=200  ID=6,7

*#*********************************************************************
*#* PRE DEVELOPMENT - 24hr
*#*********************************************************************
CHICAGO STORM      IUNITS=2  TD=24hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1      A=1065.95  B=5  C=.762
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm      SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#*********************************************************************
*#* POST DEVELOPMENT - 24hr
*#*********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
```

```
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0           0
                       0.00001   0.00375
                       0.061     0.00525
                       0.103     0.00633
                       0.144     0.00795
                       0.174     0.00945
                       0.199     0.01095
                       0.221     0.01245
                       0.992     0.01395   -1
*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD            ID=10  NHYD=200  ID=6,7

*#**********************************************************************
*#
*# 50yr EVENT
*#
*#**********************************************************************
*#**********************************************************************
*#* PRE DEVELOPMENT - 4hr
*#**********************************************************************
CHICAGO STORM      IUNITS=2  TD=4hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1     A=1172.34  B=5 C=.761
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#**********************************************************************
*#* POST DEVELOPMENT - 4hr
*#**********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0           0
                       0.00001   0.00375
                       0.061     0.00525
                       0.103     0.00633
```

```
                    0.144       0.00795
                    0.174       0.00945
                    0.199       0.01095
                    0.221       0.01245
                    0.992       0.01395   -1

*# UNCONTROLLED PERIMETER
CALIB STANDHYD      ID=7  NHYD=200  DT=5min AREA=0.0406ha
                    XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD             ID=10  NHYD=200  ID=6,7

*#**********************************************************************
*#* PRE DEVELOPMENT - 24hr
*#**********************************************************************
CHICAGO STORM       IUNITS=2  TD=24hrs TPRAT=.40  CSDT=5 min
                    ICASEcs=1     A=1172.34  B=5 C=.761
CALIB STANDHYD      ID=1  NHYD=100  DT=5min AREA=0.7499ha
                    XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                    DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#**********************************************************************
*#* POST DEVELOPMENT - 24hr
*#**********************************************************************
CALIB STANDHYD      ID=5  NHYD=200  DT=5min AREA=0.7093ha
                    XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR     ID=6 NHYD=201  IDIN=5  DT=2min
                     OUTFLOW (cms)  STORAGE (ham)
                          0            0
                       0.00001    0.00375
                       0.061       0.00525
                       0.103       0.00633
                       0.144       0.00795
                       0.174       0.00945
                       0.199       0.01095
                       0.221       0.01245
                       0.992       0.01395   -1
*# UNCONTROLLED PERIMETER
CALIB STANDHYD      ID=7  NHYD=200  DT=5min AREA=0.0406ha
                    XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                    Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
```

```
ADD HYD              ID=10  NHYD=200  ID=6,7

*#**********************************************************************
*#
*# 100yr EVENT
*#
*#**********************************************************************
*#**********************************************************************
*#* PRE DEVELOPMENT - 4hr
*#**********************************************************************
CHICAGO STORM      IUNITS=2  TD=4hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1     A=1281.34  B=5  C=.761
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#**********************************************************************
*#* POST DEVELOPMENT - 4hr
*#**********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0           0
                       0.00001   0.00375
                       0.061     0.00525
                       0.103     0.00633
                       0.144     0.00795
                       0.174     0.00945
                       0.199     0.01095
                       0.221     0.01245
                       0.992     0.01395   -1

*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD              ID=10  NHYD=200  ID=6,7

*#**********************************************************************
*#* PRE DEVELOPMENT - 24hr
*#**********************************************************************
CHICAGO STORM      IUNITS=2  TD=24hrs TPRAT=.40  CSDT=5 min
                   ICASEcs=1     A=1281.34  B=5  C=.761
```

```
CALIB STANDHYD     ID=1  NHYD=100  DT=5min AREA=0.7499ha
                   XIMP=0.870  TIMP=0.870 DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=70 MNP=0.25  SCP (hr)=0
                   DPSI =1.0mm  SLPI (%)= 1.5  LGI  (m)=70 MNI=0.015  SCI (hr)=0 -1

*#*********************************************************************
*#* POST DEVELOPMENT - 24hr
*#*********************************************************************
CALIB STANDHYD     ID=5  NHYD=200  DT=5min AREA=0.7093ha
                   XIMP=0.834  TIMP=0.899  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=65 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=65 MNI=0.015  SCI (hr)=0 -1
ROUTE RESERVOIR    ID=6 NHYD=201  IDIN=5  DT=2min
                    OUTFLOW (cms)  STORAGE (ham)
                         0            0
                       0.00001    0.00375
                       0.061      0.00525
                       0.103      0.00633
                       0.144      0.00795
                       0.174      0.00945
                       0.199      0.01095
                       0.221      0.01245
                       0.992      0.01395   -1

*# UNCONTROLLED PERIMETER
CALIB STANDHYD     ID=7  NHYD=200  DT=5min AREA=0.0406ha
                   XIMP=0.120  TIMP=0.234  DWF (cms)=0  LOSS=2   CN=74
                   Ia =5.0mm     SLPP (%)=1.5  LGP (m)=25 MNP=0.25  SCP (hr)=0
                  DPSI =1.0mm   SLPI (%)= 1.5  LGI  (m)=25 MNI=0.015  SCI (hr)=0 -1

*# TOTAL RUNOFF FROM SITE
ADD HYD            ID=10  NHYD=200  ID=6,7
FINISH
```

```
******************************** S U M M A R Y  O U T P U T ********************************
*********************************************************************************************
*            RUN DATE: 2022-05-19    TIME: 09:51:02    RUN COUNTER: 000001            *
*********************************************************************************************
* Input   file: D:\WORK FILES\2022 Projects\2206 - 335 & 355 Plains Road\355Plain.dat        *
* Output  file: D:\WORK FILES\2022 Projects\2206 - 335 & 355 Plains Road\355Plain.out        *
* Summary file: D:\WORK FILES\2022 Projects\2206 - 335 & 355 Plains Road\355Plain.sum        *
* User comments:                                                                            *
* 1:_____________________________________________________________________________________*
* 2:_____________________________________________________________________________________*
* 3:_____________________________________________________________________________________*
*********************************************************************************************


 RUN#:COMMAND#
R0001:C00001-----------------------------------------------------------------------------
   START
    [TZERO =    .00 hrs on       0]
    [METOUT=   2    (1=imperial, 2=metric output)]
    [NSTORM=   0 ]
    [NRUN  = 0001 ]
#*****************************************************************

#         355 PLAINS ROAD EAST - CITY OF BURLINGTON

#                  LAMARRE CONSULTING GROUP

#                             May 2022

#*****************************************************************

#*****************************************************************

#

# 4hr-25mm EVENT

#

#*****************************************************************

#*****************************************************************

#* PRE DEVELOPMENT - 4hr - 25mm EVENT

#*****************************************************************

R0001:C00002-----------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=   4.00:PTOT=  47.96]
```

```
    [A/B/C= 802.040/   5.000/    .764]
R0001:C00003----------------------------------------------------------------------------------
   MODIFY STORM
    [RFACT=   .52:TSHIFT=    .00 min]
    [SDT= 5.00:SDUR=   4.00:PTOT=  25.00]
R0001:C00004------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75     .121 No_date    1:35   21.36 .854     .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#*********************************************************************

#* POST DEVELOPMENT - 4hr 25mm EVENT

#*********************************************************************

R0001:C00005------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71     .111 No_date    1:35   21.07 .843     .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00006------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:      200     .71     .111 No_date    1:35   21.07  n/a     .000
 *           out <=    1.7 06:      201     .71     .071 No_date    1:38   20.75  n/a     .000
   {MxStoUsed=.5523E-02  m3}
# UNCONTROLLED PERIMETER

R0001:C00007------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04     .001 No_date    1:35    6.70 .268     .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00008------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD              1.7 06:      201     .71     .071 No_date    1:38   20.75  n/a     .000
              +     5.0 07:      200     .04     .001 No_date    1:35    6.70  n/a     .000
            SUM=     1.7 10:      200     .75     .072 No_date    1:38   19.99  n/a     .000
#*********************************************************************

#

# 2yr EVENT

#

#*********************************************************************
```

```
#**********************************************************************

#* PRE DEVELOPMENT - 4hr

#**********************************************************************

R0001:C00009----------------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=   4.00:PTOT=  37.20]
    [A/B/C= 681.520/   6.000/    .780]
R0001:C00010------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75     .181 No_date    1:35   32.61 .876     .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#**********************************************************************

#* POST DEVELOPMENT - 4hr

#**********************************************************************

R0001:C00011------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71     .166 No_date    1:35   32.38 .870     .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00012------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:      200     .71     .166 No_date    1:35   32.38  n/a     .000
 *           out <=    1.7 06:      201     .71     .114 No_date    1:38   32.06  n/a     .000
   {MxStoUsed=.6772E-02  m3}
# UNCONTROLLED PERIMETER

R0001:C00013------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04     .002 No_date    1:35   12.94 .348     .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00014------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD            1.7 06:      201     .71     .114 No_date    1:38   32.06  n/a     .000
              +     5.0 07:      200     .04     .002 No_date    1:35   12.94  n/a     .000
           SUM=     1.7 10:      200     .75     .116 No_date    1:38   31.03  n/a     .000
#**********************************************************************

#* PRE DEVELOPMENT - 24hr
```

```
#******************************************************************************

R0001:C00015-------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=  24.00:PTOT=  56.07]
    [A/B/C= 681.520/   6.000/    .780]
R0001:C00016------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75    .182 No_date    9:35   50.33 .898    .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#******************************************************************************

#* POST DEVELOPMENT - 24hr

#******************************************************************************

R0001:C00017------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71    .168 No_date    9:35   50.28 .897    .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00018------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:      200     .71    .168 No_date    9:35   50.28  n/a    .000
 *          out <=    1.7 06:      201     .71    .116 No_date    9:38   49.95  n/a    .000
   {MxStoUsed=.6855E-02  m3}
# UNCONTROLLED PERIMETER

R0001:C00019------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04    .002 No_date    9:35   24.80 .442    .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00020------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD              1.7 06:      201     .71    .116 No_date    9:38   49.95  n/a    .000
              +    5.0 07:      200     .04    .002 No_date    9:35   24.80  n/a    .000
            SUM=     1.7 10:      200     .75    .118 No_date    9:38   48.60  n/a    .000
#******************************************************************************

#

# 5yr EVENT

#
```

```
#*******************************************************************************

#*******************************************************************************

#* PRE DEVELOPMENT - 4hr

#*******************************************************************************

R0001:C00021-----------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=   4.00:PTOT=  47.96]
    [A/B/C= 802.040/   5.000/    .764]
R0001:C00022------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75     .241 No_date    1:35   42.67 .890     .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#*******************************************************************************

#* POST DEVELOPMENT - 4hr

#*******************************************************************************

R0001:C00023------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71     .222 No_date    1:35   42.54 .887     .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00024------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:      200     .71     .222 No_date    1:35   42.54  n/a     .000
 *          out <=    1.7 06:      201     .71     .144 No_date    1:38   42.22  n/a     .000
   {MxStoUsed=.7973E-02  m3}
# UNCONTROLLED PERIMETER

R0001:C00025------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04     .003 No_date    1:35   19.43 .405     .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00026------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD              1.7 06:      201     .71     .144 No_date    1:38   42.22  n/a     .000
              +         5.0 07:      200     .04     .003 No_date    1:35   19.43  n/a     .000
            SUM=        1.7 10:      200     .75     .147 No_date    1:38   40.99  n/a     .000
#*******************************************************************************
```

```
#* PRE DEVELOPMENT - 24hr

#**********************************************************************

R0001:C00027-------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=  24.00:PTOT=  74.18]
    [A/B/C= 802.040/   5.000/    .764]
R0001:C00028----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75     .242 No_date    9:35   67.59 .911     .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#**********************************************************************

#* POST DEVELOPMENT - 24hr

#**********************************************************************

R0001:C00029----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71     .224 No_date    9:35   67.73 .913     .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00030----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:      200     .71     .224 No_date    9:35   67.73  n/a     .000
 *          out <=    1.7 06:      201     .71     .146 No_date    9:38   67.41  n/a     .000
   {MxStoUsed=.8035E-02  m3}
# UNCONTROLLED PERIMETER

R0001:C00031----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04     .004 No_date    9:40   37.87 .510     .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00032----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD            1.7 06:      201     .71     .146 No_date    9:38   67.41  n/a     .000
            +    5.0 07:      200     .04     .004 No_date    9:40   37.87  n/a     .000
          SUM=    1.7 10:      200     .75     .150 No_date    9:38   65.81  n/a     .000
#**********************************************************************

#

# 10yr EVENT
```

```
#

#*****************************************************************************

#*****************************************************************************

#* PRE DEVELOPMENT - 4hr

#*****************************************************************************

R0001:C00033-------------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=   4.00:PTOT=  55.21]
    [A/B/C= 918.280/   5.000/    .763]
R0001:C00034------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75     .279 No_date    1:35   49.52 .897     .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#*****************************************************************************

#* POST DEVELOPMENT - 4hr

#*****************************************************************************

R0001:C00035------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71     .257 No_date    1:35   49.46 .896     .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00036------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:      200     .71     .257 No_date    1:35   49.46  n/a     .000
 *           out <=    1.7 06:      201     .71     .161 No_date    1:38   49.14  n/a     .000
   {MxStoUsed=.8815E-02  m3}
# UNCONTROLLED PERIMETER

R0001:C00037------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04     .004 No_date    1:40   24.22 .439     .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00038------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD              1.7 06:      201     .71     .161 No_date    1:38   49.14  n/a     .000
             +    5.0 07:      200     .04     .004 No_date    1:40   24.22  n/a     .000
```

```
          SUM=    1.7 10:     200    .75    .165 No_date   1:38  47.79  n/a    .000
#*************************************************************************

#* PRE DEVELOPMENT - 24hr

#*************************************************************************

R0001:C00039-----------------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=  24.00:PTOT=  85.55]
    [A/B/C= 918.280/   5.000/    .763]
R0001:C00040------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:     100    .75    .281 No_date   9:35   78.52 .918    .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#*************************************************************************

#* POST DEVELOPMENT - 24hr

#*************************************************************************

R0001:C00041------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:     200    .71    .262 No_date   9:35   78.77 .921    .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00042------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:     200    .71    .262 No_date   9:35   78.77  n/a    .000
 *          out <=    1.7 06:     201    .71    .164 No_date   9:38   78.45  n/a    .000
   {MxStoUsed=.9003E-02  m3}
# UNCONTROLLED PERIMETER

R0001:C00043------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:     200    .04    .007 No_date   9:35   46.63 .545    .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00044------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD            1.7 06:     201    .71    .164 No_date   9:38   78.45  n/a    .000
            +    5.0 07:     200    .04    .007 No_date   9:35   46.63  n/a    .000
          SUM=    1.7 10:     200    .75    .170 No_date   9:38   76.73  n/a    .000
#*************************************************************************

#
```

```
# 25yr EVENT

#

#*********************************************************************

#*********************************************************************

#* PRE DEVELOPMENT - 4hr

#*********************************************************************

R0001:C00045----------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=   4.00:PTOT=  64.45]
    [A/B/C=1065.950/   5.000/    .762]
R0001:C00046------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75     .327 No_date    1:35   58.29 .904     .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#*********************************************************************

#* POST DEVELOPMENT - 4hr

#*********************************************************************

R0001:C00047------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71     .304 No_date    1:35   58.32 .905     .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00048------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:      200     .71     .304 No_date    1:35   58.32  n/a     .000
 *          out <=    1.7 06:      201     .71     .183 No_date    1:38   58.01  n/a     .000
   {MxStoUsed=.1006E-01  m3}
# UNCONTROLLED PERIMETER

R0001:C00049------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04     .007 No_date    1:35   30.66 .476     .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00050------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
```

```
   ADD HYD           1.7 06:     201     .71    .183 No_date    1:38   58.01  n/a    .000
             +    5.0 07:     200     .04    .007 No_date    1:35   30.66  n/a    .000
           SUM=    1.7 10:     200     .75    .189 No_date    1:38   56.53  n/a    .000
#*************************************************************************

#* PRE DEVELOPMENT - 24hr

#*************************************************************************

R0001:C00051-------------------------------------------------------------------------------
    CHICAGO STORM
     [SDT= 5.00:SDUR=  24.00:PTOT= 100.03]
     [A/B/C=1065.950/   5.000/   .762]
R0001:C00052------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:     100     .75    .329 No_date    9:35   92.53 .925    .000
     [XIMP=.87:TIMP=.87]
     [LOSS= 2 :CN= 74.0]
     [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
     [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#*************************************************************************

#* POST DEVELOPMENT - 24hr

#*************************************************************************

R0001:C00053------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:     200     .71    .308 No_date    9:35   92.91 .929    .000
     [XIMP=.83:TIMP=.90]
     [LOSS= 2 :CN= 74.0]
     [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
     [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00054------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:     200     .71    .308 No_date    9:35   92.91  n/a    .000
 *          out <=    1.7 06:     201     .71    .185 No_date    9:38   92.59  n/a    .000
    {MxStoUsed=.1021E-01  m3}
# UNCONTROLLED PERIMETER

R0001:C00055------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:     200     .04    .009 No_date    9:35   58.31 .583    .000
     [XIMP=.12:TIMP=.23]
     [LOSS= 2 :CN= 74.0]
     [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
     [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00056------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD           1.7 06:     201     .71    .185 No_date    9:38   92.59  n/a    .000
             +    5.0 07:     200     .04    .009 No_date    9:35   58.31  n/a    .000
           SUM=    1.7 10:     200     .75    .193 No_date    9:38   90.74  n/a    .000
#*************************************************************************
```

```
#

# 50yr EVENT

#

#**************************************************************************

#**************************************************************************

#* PRE DEVELOPMENT - 4hr

#**************************************************************************

R0001:C00057-------------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=   4.00:PTOT=  71.27]
    [A/B/C=1172.340/   5.000/    .761]
R0001:C00058------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75     .363 No_date    1:35   64.81 .909     .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#**************************************************************************

#* POST DEVELOPMENT - 4hr

#**************************************************************************

R0001:C00059------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71     .337 No_date    1:35   64.91 .911     .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00060------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:      200     .71     .337 No_date    1:35   64.91  n/a     .000
 *           out <=    1.7 06:      201     .71     .198 No_date    1:38   64.60  n/a     .000
   {MxStoUsed=.1097E-01  m3}
# UNCONTROLLED PERIMETER

R0001:C00061------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04     .008 No_date    1:35   35.67 .500     .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE
```

```
R0001:C00062----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
  ADD HYD           1.7 06:     201     .71    .198 No_date    1:38   64.60  n/a    .000
            +    5.0 07:     200     .04    .008 No_date    1:35   35.67  n/a    .000
         SUM=    1.7 10:     200     .75    .204 No_date    1:38   63.03  n/a    .000
#*********************************************************************

#* PRE DEVELOPMENT - 24hr

#*********************************************************************

R0001:C00063----------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=  24.00:PTOT= 110.82]
    [A/B/C=1172.340/   5.000/    .761]
R0001:C00064----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD      5.0 01:     100     .75    .365 No_date    9:35  103.00 .929    .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#*********************************************************************

#* POST DEVELOPMENT - 24hr

#*********************************************************************

R0001:C00065----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD      5.0 05:     200     .71    .342 No_date    9:35  103.48 .934    .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00066----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
  ROUTE RESERVOIR ->   5.0 05:     200     .71    .342 No_date    9:35  103.48  n/a    .000
 *          out <=    1.7 06:     201     .71    .200 No_date    9:38  103.17  n/a    .000
   {MxStoUsed=.1114E-01  m3}
# UNCONTROLLED PERIMETER

R0001:C00067----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD      5.0 07:     200     .04    .010 No_date    9:35   67.31 .607    .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious  area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00068----------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
  ADD HYD           1.7 06:     201     .71    .200 No_date    9:38  103.17  n/a    .000
            +    5.0 07:     200     .04    .010 No_date    9:35   67.31  n/a    .000
```

```
          SUM=    1.7 10:     200     .75    .208 No_date    9:38  101.22  n/a    .000
#******************************************************************************

#

# 100yr EVENT

#

#******************************************************************************

#******************************************************************************

#* PRE DEVELOPMENT - 4hr

#******************************************************************************

R0001:C00069-----------------------------------------------------------------------------------------
   CHICAGO STORM
    [SDT= 5.00:SDUR=   4.00:PTOT=  77.90]
    [A/B/C=1281.340/   5.000/    .761]
R0001:C00070------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD      5.0 01:     100     .75    .398 No_date    1:35   71.16 .914    .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#******************************************************************************

#* POST DEVELOPMENT - 4hr

#******************************************************************************

R0001:C00071------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD      5.0 05:     200     .71    .370 No_date    1:35   71.33 .916    .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00072------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->   5.0 05:     200     .71    .370 No_date    1:35   71.33  n/a    .000
 *          out <=    1.7 06:     201     .71    .211 No_date    1:38   71.02  n/a    .000
   {MxStoUsed=.1190E-01  m3}
# UNCONTROLLED PERIMETER

R0001:C00073------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD      5.0 07:     200     .04    .009 No_date    1:35   40.68 .522    .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious    area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
```

```
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00074------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ADD HYD            1.7 06:      201     .71    .211 No_date    1:38   71.02  n/a     .000
             +    5.0 07:      200     .04    .009 No_date    1:35   40.68  n/a     .000
           SUM=    1.7 10:      200     .75    .219 No_date    1:38   69.38  n/a     .000
#*********************************************************************

#* PRE DEVELOPMENT - 24hr

#*********************************************************************

R0001:C00075------------------------------------------------------------------------------------
    CHICAGO STORM
    [SDT= 5.00:SDUR=  24.00:PTOT= 121.12]
    [A/B/C=1281.340/   5.000/    .761]
R0001:C00076------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 01:      100     .75    .400 No_date    9:35  113.04 .933     .000
    [XIMP=.87:TIMP=.87]
    [LOSS= 2 :CN= 74.0]
    [Pervious     area: IAper= 5.00:SLPP=1.50:LGP=  70.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  70.:MNI=.015:SCI=   .0]
#*********************************************************************

#* POST DEVELOPMENT - 24hr

#*********************************************************************

R0001:C00077------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 05:      200     .71    .375 No_date    9:35  113.61 .938     .000
    [XIMP=.83:TIMP=.90]
    [LOSS= 2 :CN= 74.0]
    [Pervious     area: IAper= 5.00:SLPP=1.50:LGP=  65.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  65.:MNI=.015:SCI=   .0]
R0001:C00078------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
   ROUTE RESERVOIR ->    5.0 05:      200     .71    .375 No_date    9:35  113.61  n/a     .000
 *           out <=    1.7 06:      201     .71    .214 No_date    9:40  113.28  n/a     .000
   {MxStoUsed=.1210E-01  m3}
# UNCONTROLLED PERIMETER

R0001:C00079------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
 *  CALIB STANDHYD       5.0 07:      200     .04    .012 No_date    9:35   76.10 .628     .000
    [XIMP=.12:TIMP=.23]
    [LOSS= 2 :CN= 74.0]
    [Pervious     area: IAper= 5.00:SLPP=1.50:LGP=  25.:MNP=.250:SCP=   .0]
    [Impervious   area: IAimp= 1.00:SLPI=1.50:LGI=  25.:MNI=.015:SCI=   .0]
# TOTAL RUNOFF FROM SITE

R0001:C00080------------DTmin-ID:NHYD---------AREAha-QPEAKcms-TpeakDate_hh:mm----RVmm-R.C.---DWFcms
```

```
   ADD HYD            1.7 06:      201     .71     .214 No_date    9:40  113.28  n/a     .000
             +     5.0 07:      200     .04     .012 No_date    9:35   76.10  n/a     .000
           SUM=     1.7 10:      200     .75     .223 No_date    9:38  111.27  n/a     .000
R0001:C00081----------------------------------------------------------------------------------------
   FINISH
```

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Tuesday, April 26, 2022
Project Name	355 Plains Rd. E
Project Number	
Location	Burlington

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 34 years of HAMILTON A rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	7.6	85

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

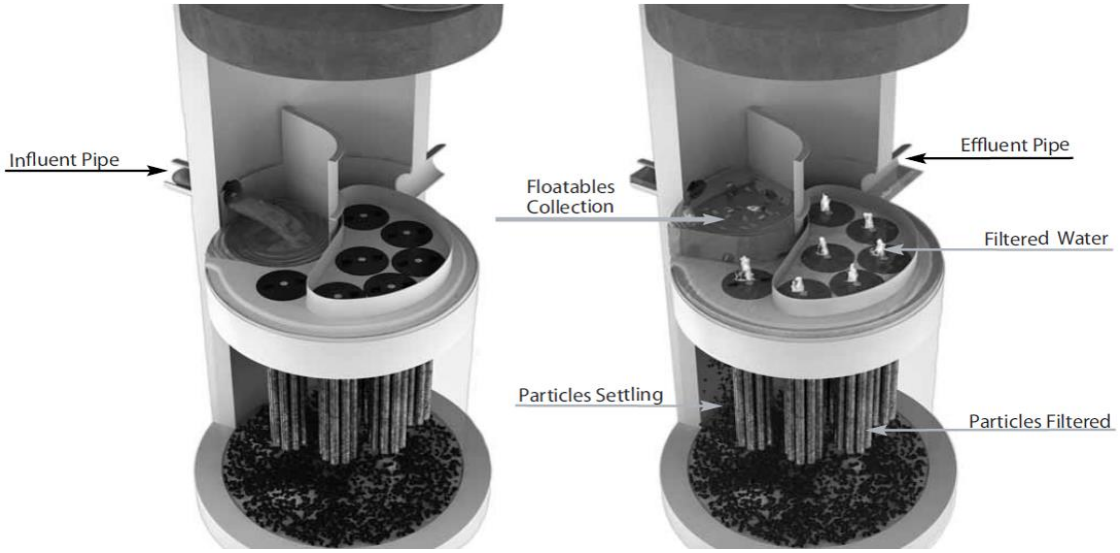
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 77% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 77%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Tuesday, April 26, 2022
Project Name:	355 Plains Rd. E
Project Number:	
Location:	Burlington

Designer Information

Company:	Lamarre Consulting Group Inc.
Contact:	John Lamarre
Phone #:	(905) 818-5205

Notes

Rainfall

Name:	HAMILTON A
State:	ON
ID:	3194
Record:	1970 to 2003
Co-ords:	43°10.N'N, 79°56.W'N

Drainage Area

Total Area:	0.2995 ha
Imperviousness:	73.2%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 34 years of HAMILTON A rainfall data:	**6.2 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 1119 m³, with a suspended sediment concentration of 60 mg/L.	**67 kg**

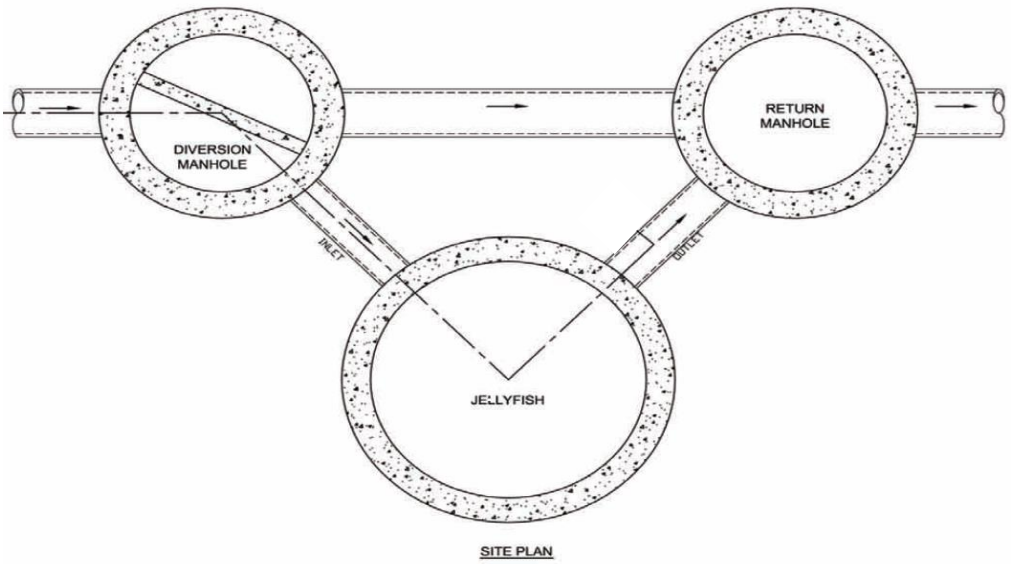
Recommendation

The Jellyfish Filter model JF4-1-1 is recommended to meet the water quality objective by treating a flow of 7.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 34 years of HAMILTON A rainfall data for this site. This model has a sediment capacity of 85 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	**1**	**1**	**1.2**	**2313**	**0.34**	**379**	**7.6**	**85**
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	**62º**	**150**	**200**
1.8	59º	200	250
2.4	52º	250	300
3.0	48º	300	450
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

STANDARD PERFORMANCE SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV)

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: filtration surface area, 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, filtration treatment device 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 GENERAL

2.1.1 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the internal components. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of their installed placement for the entire length of the cartridge.

2.1.2 Pollutant Storage: The Filter device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter treatment device shall have been field tested in accordance with either TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements – Amendments to TARP Tier II Protocol (NJDEP, 2009) or Washington State Technology Assessment Protocol – Ecology (TAPE), 2011 or later version. The field test shall have been verified in accordance with ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV). See Section 3.2 of this specification for field test performance requirements.

3.2 FIELD TEST PERFORMANCE

The field test (as specified in section 3.1.1)shall have monitored a minimum of twenty (20) TARP or TAPE qualifying storm events, and report at **minimum** the following results:

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have ISO 14034 ETV verified load based median TSS removal efficiency of at least 85% and load based median SSC removal efficiency of at least 98%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, and an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce turbidity such that effluent turbidity is 15 NTU or lower.

3.2.5 Nutrients & Metals – The stormwater quality filter treatment device shall have ISO 14034 ETV Verified minimum load based removal efficiencies for the following:

3.2.5.1 Total Phosphorus (TP) Removal - Median TP removal efficiency of at least 49%.

3.2.5.2 Total Nitrogen (TN) Removal - Median TN removal efficiency of at least 39%.

3.2.5.3 Total Zinc (Zn) Removal - Median Zn removal efficiency of at least 69%.

3.2.5.4 Total Copper (Cu) Removal - Median Cu removal efficiency of at least 91%.

END OF SECTION