

11 YORKVILLE PARTNERS INC.

STORMWATER MANAGEMENT REPORT

11-25 YORKVILLE AVE. & 16-18
CUMBERLAND ST.

DECEMBER 14, 2018





STORMWATER MANAGEMENT REPORT 11-25 YORKVILLE AVE. & 16-18 CUMBERLAND ST.

11 YORKVILLE PARTNERS INC.

REZONING & SITE PLAN APPLICATION



PROJECT NO.: 17M-01494-00

DATE: DECEMBER 2018

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1 INTRODUCTION

1.1 SCOPE

WSP has been retained by 11 Yorkville Partnership Inc. to prepare a Stormwater Management Report for the proposed development of 11-25 Yorkville Avenue and 16-18 Cumberland Street in the City of Toronto (herein referred to as Building A and B, respectively, or 'the site'). This report is to support the Rezoning Application and Site Plan Application for Building A and the Rezoning Application for Building B.

This stormwater management report examines the potential water quality, quantity and water balance impacts of the proposed development and summarizes how each will be addressed in accordance with the City of Toronto's Wet Weather Flow Management Guidelines (WWFMG).

1.2 SITE LOCATION

The site is located on the south side of Yorkville Avenue just west of Yonge Street and on the north side of Cumberland Street. The total site area is 0.32 ha. Building A is 0.28 ha and Building B is 0.04 ha. The location of the proposed development is shown in Figure 1.

1.3 STORMWATER MANAGEMENT PLAN OBJECTIVES

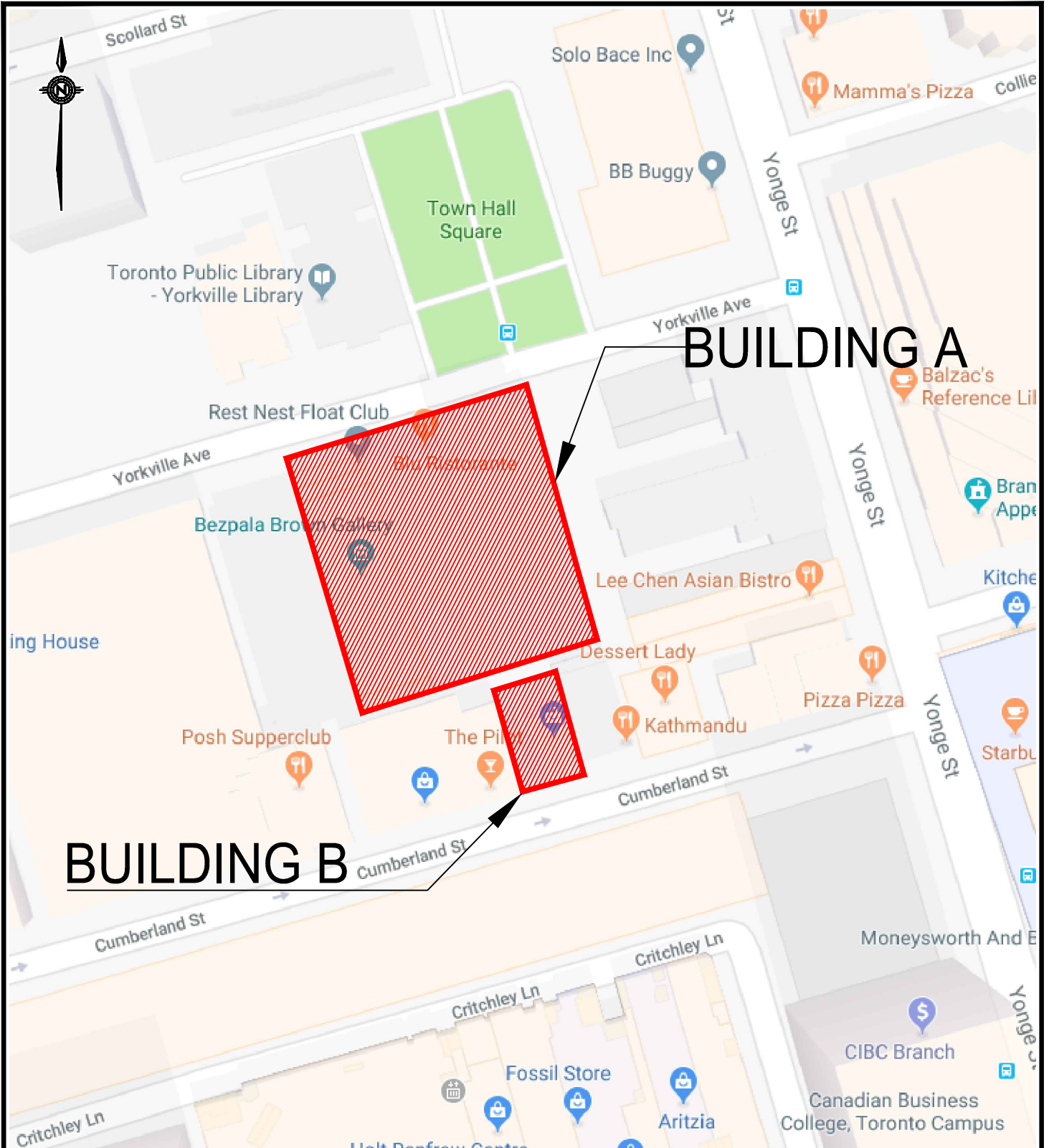
The objectives of the stormwater management plan are as follows:

- Determine site specific stormwater management requirements to ensure that the proposals are in conformance with the City of Toronto WWFMG document;
 - Evaluate various stormwater management practices that meet the requirements of the City and recommend a preferred strategy; and
 - Prepare a stormwater management report documenting the strategy along with the technical information necessary for the justification and sizing of the proposed stormwater management facilities.
-

1.4 DESIGN CRITERIA

The City of Toronto issued the WWFMG document in November 2006 to provide direction on the management of rainfall and runoff inside the City's jurisdiction. A summary of the stormwater management criteria applicable to this project follows:

- **Water Balance** – The WWFMG requires a site to 'retain stormwater on-site, to the extent practicable, to achieve the same level of annual volume of overland runoff allowable from the development site under pre-development conditions'. According to the guidelines, if the allowable annual runoff volume from the development site under post-development conditions is less than the pre-development conditions, then the maximum allowable annual runoff is 50% of the total average annual rainfall depth. Typically, the minimum on-site runoff retention will require the site to retain all runoff from 5 mm storm event through infiltration, evapotranspiration or rainwater reuse.
- **Water Quality** – Under the WWFMG, the site is required to target a long-term removal of 80% of total suspended solids (TSS) on an annual loading basis.




BUILDING A

BUILDING B

©2018 Google - Map data ©2018 Tele Atlas

2018.12.14 FIGURE 1 - Site Location.dwg 11 Yorkville Site Location - J:\1441 Projects by Job Number\2017\17M-01494-00 11 Yorkville Ave\CAD\ Dec 17, 2018 - 10:13am

CLIENT 11 YORKVILLE PARTNERS INC.			
TITLE 11-25 YORKVILLE AVE. & 16-18 CUMBERLAND ST.			
<p>SITE LOCATION</p>		Checked VB	Drawn AutoCAD/B.K.B.
		Date DECEMBER 2018	Proj. No. 17M-00164
		Scale NTS	Figure No. 1 Gr.No.

- **Erosion Control** –As indicated in WWFMG, ‘For small infill/redevelopment sites < 2.0 ha, erosion control in the form of stormwater detention is normally not required, provided the on-site minimum runoff retention from a small design rainfall event (typically 5 mm) is achieved under the Water Balance Criteria.’ During construction, appropriate erosion and sediment controls will be implemented.
- **Water Quantity Control and Discharge to Municipal Infrastructure** – Runoff from the 2-year to 100-year design storms must not exceed the allowable release rate as stated in the WWFMG. The allowable release rate to the municipal storm sewer system from the development site is the 2-year pre-development flow rate based on a runoff coefficient of 0.50 or the capacity of the receiving sewer.

2 PRE-DEVELOPMENT CONDITIONS

2.1 GENERAL

Currently, 11 Yorkville is occupied by a 10-storey commercial building with an underground parking structure at its rear to the south. 17 Yorkville Avenue is occupied by a 3-storey commercial building with a small hardscaped backyard area. 19-25 Yorkville Avenue is occupied by a 4-storey commercial building. These properties total an area of 0.29 ha and drain to the Yorkville Avenue sewer.

16 Cumberland Street is occupied by a 3-storey commercial building and 18 Cumberland Street is occupied by a 2-storey commercial building. These properties total an area of 0.04 ha and are assumed to drain to the Cumberland Street sewer. An investigation into the current drainage patterns will confirm the existing drainage location of the buildings at 16 and 18 Cumberland Street.

The total site area is 0.32 ha, the majority of which consists of roof area and hard paved surfaces. It is assumed that there is currently no stormwater management system on this site. Under existing conditions, due to the high ratio of impervious surfaces, a runoff coefficient of 0.90 is estimated, however the WWFMG specify a maximum runoff coefficient of 0.50 be used when calculating runoff in existing conditions for the purposes of determining the allowable release rate.

Figure 2 illustrates the existing conditions of the subject site.

2.2 RAINFALL INFORMATION

The rainfall intensity for the site was calculated using the following equation: $I = AT^C$

Where;

I = rainfall intensity in mm/hour

T = time of concentration in hours

A and C = constant parameters (see below)

The parameters (A, C) recommended for use by the City of Toronto (per Section 3.1 of the Wet Weather Flow Management Guidelines) are summarized in Table 2.1.

Table 2.1 Rainfall Parameters

RETURN PERIOD (years)	2	5	10	25	50	100
A	21.8	32.0	38.7	45.2	53.5	59.7
C	-0.78	-0.79	-0.80	-0.80	-0.80	-0.80

Source: City of Toronto Wet Weather Flow Management Guidelines (November 2006)

An initial time of concentration, T_c , of 10 minutes (or 0.167 hours) is recommended in the WWFMG document.



LEGEND

	PROPERTY BOUNDARY			
<table border="1"><tr><td>101</td></tr><tr><td>0.287</td></tr><tr><td>0.90</td></tr></table>	101	0.287	0.90	SUBCATCHMENT ID AREA (HA) RUNOFF COEFFICIENT
101				
0.287				
0.90				



CLIENT	11 YORKVILLE PARTNERS INC.		
TITLE	11-25 YORKVILLE AVE. & 16-18 CUMBERLAND ST.		
EXISTING CONDITIONS			

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Date	DECEMBER 2018	Proj. No.	17M-01494
Scale	AS SHOWN	Figure No.	2
		Gr.No.	

2.3 ALLOWABLE FLOW RATES

It is estimated that runoff from the existing building roof and surrounding at-grade at 11-25 Yorkville Avenue are collected by a combined sewer system on Yorkville Street and runoff at 16-18 Cumberland Street are collect by a combined sewer system on Cumberland Street. According to the WWFMG, Section 2.2.3.8, the allowable release rate to the combined sewer on Yorkville Ave. from the existing site is 35.2 L/s from Building A. This is based on the 2-year pre-development flow rate calculated with an area of 0.29 ha and a runoff coefficient value of 0.50.

The allowable release rate to the Cumberland Street sewer from Building B is 4.4 L/s. This is based on the 2-year pre-development flow rate calculated with an area of 0.04 ha and a runoff coefficient value of 0.50.

The calculated pre-development peak flow rates for the existing site for 2-year to 100-year storm events are summarized in Table 2.2. Detailed calculations are provided in Appendix A.

Table 2.2 Pre-Development Peak Flow Rate Calculations & Maximum Allowable Site Discharge Rate

RETURN PERIOD (YEARS)	RAINFALL INTENSITY, I (MM/HR)	EXISTING PEAK RUNOFF RATES, Q (L/s) ¹ YORKVILLE AVENUE C=0.9	EXISTING PEAK RUNOFF RATES, Q (L/s) ² YORKVILLE AVENUE C=0.5	WWFMG MAXIMUM ALLOWABLE RELEASE RATE, Q _A ² (L/s) YORKVILLE AVENUE	EXISTING PEAK RUNOFF RATES, Q (L/s) ³ CUMBERLAND STREET C=0.9	EXISTING PEAK RUNOFF RATES, Q (L/s) ⁴ CUMBERLAND STREET C=0.5	WWFMG MAXIMUM ALLOWABLE RELEASE RATE, Q _A ⁴ (L/s) CUMBERLAND STREET
2	88.2	63.4	35.2	35.2	7.9	4.4	4.4
5	131.8	94.7	52.6		11.8	6.6	
10	162.3	116.6	64.8		14.5	8.1	
25	189.5	136.2	75.6		17.0	9.4	
50	224.3	161.2	89.5		20.1	11.2	
100	250.3	179.8	99.9		22.4	12.4	

¹ C=0.90, pre-development sewer drainage catchment area of 0.29 ha and time of concentration of 10 minutes

² C=0.50, pre-development sewer drainage catchment area of 0.29 ha and time of concentration of 10 minutes

³ C=0.90, pre-development sewer drainage catchment area of 0.04 ha and time of concentration of 10 minutes

⁴ C=0.50, pre-development sewer drainage catchment area of 0.04 ha and time of concentration of 10 minutes

3 POST-DEVELOPMENT CONDITIONS

3.1 GENERAL

The proposed development consists of one 62-storey mixed use tower (Building A) and one 2-storey retail building (Building B). Building A will have four (4) below-grade parking levels, 670 residential units and approximately 2,366 m² of retail space. Building B will have one below-grade concourse level and two above-ground levels.

The storm service connection for Building A will be provided to existing infrastructure on Yorkville Avenue. The storm sewer connection for Building B will be made on Cumberland Avenue. The at-grade impervious area north of Building A (168 m²) will flow uncontrolled to Yorkville Avenue.

Please refer to Figure 3 for the proposed conditions. Tables 3.1 and 3.2 show the land-use breakdown for Building A and Building B, respectively.

Table 3.1 Proposed Land-Use Area Breakdown - Building A

LAND-USE	AREA (m ²)	RUNOFF COEFFICIENT (C)	PERCENT COVERAGE
Impervious Roof Surfaces	1356	0.90	47%
Green Roof Area	475	0.45	17%
Landscape Area	50	0.25	2%
At-Grade Impervious	822	0.90	29%
Uncontrolled Drainage	168	0.90	6%
Total Site Area	2871	0.81	100%

Table 3.2 Proposed Land-Use Area Breakdown - Building B

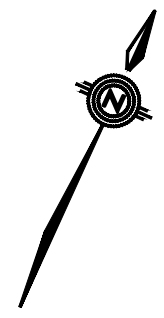
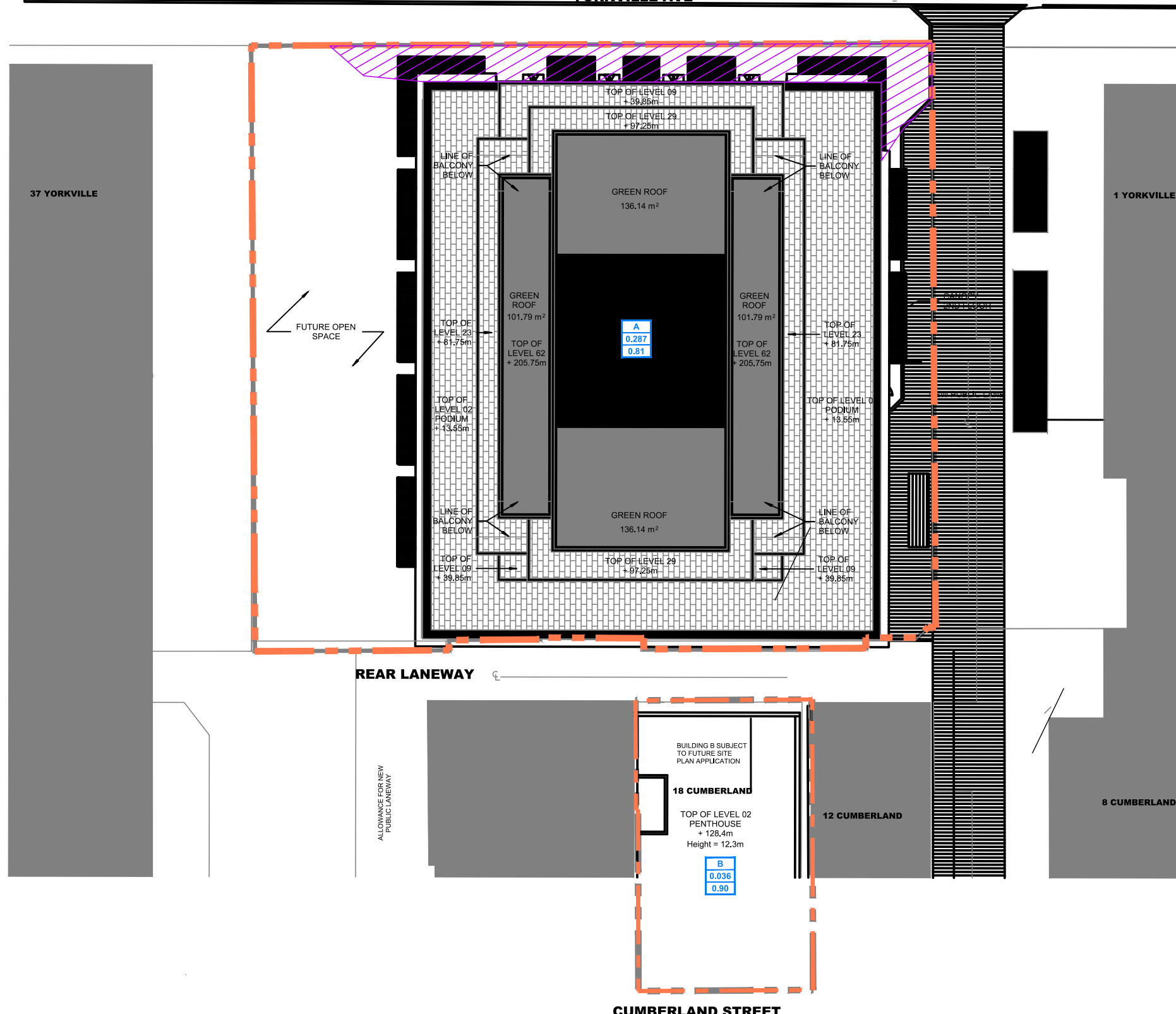
LAND-USE	AREA (m ²)	RUNOFF COEFFICIENT (C)	PERCENT COVERAGE
Impervious Roof Surfaces	308	0.90	86%
At-Grade Impervious	50	0.90	14%
Total Site Area	358	0.90	100%

3.2 WATER BALANCE


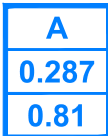

As noted in Section 1.4, the WWFMG states that the proponent should target the retention of 5 mm of stormwater runoff from all surfaces, in order to ensure 50% of the total average annual rainfall volume is retained on site. Due to the underground parking garage occupying the entire site area, infiltration is not feasible for this project. A water reuse sump volume, stored within the stormwater cistern, is the mechanism proposed to achieve water balance requirements. The cistern in Building A will store the full water balance required for the site.

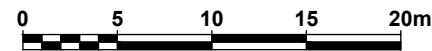
The re-use methods for the captured stormwater at Building A is proposed to be a combination of irrigation supply for the proposed green roof and rooftop misters. The proposed reuse options will only operate from May to September. As such, an annual water balance analysis has been conducted for this site to ensure the re-use options can retain 50% of the total annual average rainfall volume on site.

YORKVILLE AVE




LEGEND

-  PROPERTY BOUNDARY
-  SUBCATCHMENT ID
AREA (HA)
RUNOFF COEFFICIENT
-  UNCONTROLLED DRAINAGE



CLIENT	11 YORKVILLE PARTNERS INC.		
TITLE	11-25 YORKVILLE AVE. & 16-18 CUMBERLAND ST.		
PROPOSED CONDITIONS			

			
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Date	DECEMBER 2018	Proj. No.	17M-01494
Scale	AS SHOWN	Figure No.	3
		Gr.No.	

The annual total average rainfall within the City of Toronto is 786 mm (Government of Canada, Toronto Rainfall Records from 1981 - 2010). The total annual volume of rainfall over Building A is 2538 m³, and 50% of this volume is 1269 m³.

The monthly irrigation demands for the site for the period from May to September have been estimated by Terraplan Landscape Architects. The annual water demand (153 days) for irrigation is 237 m³. Rooftop misters perform mechanically-driven evapotranspiration, returning water to the atmosphere and counter the heat-island effect of impervious areas. One (1) Koolfog Mojave High-pressure Misting Pump (Model: M20 or approved equivalent) and (1) Koolfog Mojave High-pressure Misting Pump (Model: M88 or approved equivalent) are proposed. The two misters can mist at a combined flow rate of 10.2 L/minute (2.7 GMP) and are proposed to run 8 hours per day between April and October. The annual water demand (153 days) for misting is 1050 m³.

The total annual water demand is 1287 m³, which is more than the stated water balance of 1269 m³. On average, the 72-hour demand will be 10.6 m³, averaged over the entire year. This is the approximate required sump volume. It is the developer's responsibility to ensure the selected mechanisms for irrigation and misting meets the water balance criteria. Detailed water demand calculations can be found in Appendix A. Additional water-reuse information can be found in Appendix C.

The water balance opportunities for Building B will be finalized as part of the building's detailed design. At this stage, it is assumed that sufficient opportunities exist to reuse the 1.43 m³ of water balance for Building B. Detailed calculations can be found in Appendix A.

Table 3.3 Water Balance Calculation - Building B

SURFACE TYPE	AREA (m ²)	INITIAL ABSTRACTION (m)	5 mm VOLUME (m ³)	VOLUME ABSTRACTED (m ³)	WATER BALANCE (m ³)
Impervious Roof Area	308	0.001	1.54	0.31	1.23
At-Grade Impervious	50	0.001	0.25	0.05	0.20
Total Site Area:	358	-	1.79	0.36	1.43

3.3 WATER QUALITY CONTROL

Architectural plans indicate that the majority of the site area will be covered by building rooftop surfaces or landscaping with the exception of an 828 m² area of controlled impervious at-grade land cover. As rooftop areas are free of typical sediment-generating activities (e.g. vehicle traffic) runoff will leave them effectively unchanged, and can be considered clean for the purposes of water quality assessment.

A Jellyfish unit has been sized to treat the runoff prior to entering the cistern. The JF4-2-1 has been sized for 80% TSS removal.

3.4 EROSION CONTROL

As mentioned in Section 1.4, this development is an overall small footprint development. According to the WWFMG, 'For small infill/redevelopment sites <2 ha, erosion control in the form of stormwater detention is normally not required, provided the on-site minimum runoff retention from a small design rainfall event (typically 5 mm) is achieved under the Water Balance Criteria.'

The site area for this application is 0.32 ha, which is well below the 2.0 ha guideline, and the 5 mm water balance requirement has been addressed – therefore additional measures for long-term erosion control are not recommended.

3.5 WATER QUANTITY CONTROL

As noted in Section 2.3, the allowable discharge rate to the municipal sewer system on Yorkville Avenue from the site is estimated to be 35.2 L/sec, which is equivalent to the peak runoff rate under pre-development conditions during a 2-year design storm event with a minimum runoff coefficient of 0.50.

Discharge from Building A will be directed to a SWM control tank located in the underground parking garage. The cistern is designed to have a footprint of approximately 20.72 m² with a height of 12.55 m. The cistern volume is 260 m³, including the sump volume of 10 m³. A pump will be proposed approximately 0.5 m above the base of the cistern to drain runoff from the site for the cistern. The pump will discharge to a discharge chamber, then a control manhole before discharging to the Yorkville Avenue municipal sewer. A 100 mm orifice tube will control the flow from the discharge chamber. Due to insufficient information regarding pump size and associated discharge, a maximum discharge of 19 L/s from the cistern pump is assumed for outlet sizing and cistern storage calculations for Buildings A. This ensures that site meets overall stormwater management criteria. It will be developer's responsibility to ensure that the proposed pump is sized to meet 19 L/s. M.V. Shore have confirmed the pumping rate will not exceed 19 L/s. The letter is attached in Appendix C.

Discharge from Building B will be directed to a SWM control tank located at the concourse level. The cistern is designed to have a footprint of 8 m² with a height of 2 m. This includes the sump volume of 1.4 m³. A 3-inch (76 mm) diameter SXH Hydrobrake valve has been selected to control runoff from the cistern to a maximum flow rate of 3.9 L/s and will be set at 0.18 m above the base of the cistern.

For events greater than the 100-year storm or in the event of an obstruction at the cistern outlet, excess volume from the cistern will be discharged onto the nearby grade, ultimately discharging to the north of the site on Yorkville Street.

The 'HydroCAD' software package has been used to model the behaviour of the proposed SWM system, and determine its response under various storm events. This software utilises the Modified Rational Method to calculate flow rates and related storage values. Detailed output from the model is included in Appendix B. Based on the City's WWFMG criteria – specifically the 'Discharge to Municipal Infrastructure' section – all stormwater runoff from events up to and including the 100-year storm must be contained on site and released at or below the allowable rate. Summaries of the modelled peak offsite discharge rates for the SWM cisterns in Building A and B are provided in Tables 3.4 and 3.5 show the total off site discharge to the municipal sewers on Yorkville Avenue and Cumberland Street, respectively. The proposed discharge from each building are in compliance with the WWFMG discharge rate criteria.

Table 3.4 Summary of Modelling Results - Building A

RETURN PERIOD (YEARS)	UTILIZED CISTERN STORAGE (m ³)	PEAK WATER ELEVATION IN CISTERN (m)	PUMPED FLOW RATE (L/S)	UNCONTROLLED AT-GRADE FLOW RATE (L/S)	ALLOWABLE RELEASE RATE (L/s)	POST-DEVELOPMENT FLOW RATE (L/s)
2	24.9	1.25	19	3.6	35.2	22.6
5	39.5	1.97		5.4		24.4
10	50.3	2.51		6.7		25.7
25	60.5	3.02		7.8		26.8
50	74.1	3.70		9.3		28.3
100	84.6	4.23		10.3		29.3

Table 3.5 Summary of Modelling Results - Building B

RETURN PERIOD (YEARS)	UTILIZED CISTERN STORAGE (m ³)	PEAK WATER ELEVATION IN CISTERN (m)	ALLOWABLE RELEASE RATE (L/S)	CISTERN POST-DEVELOPMENT FLOW RATE (L/s)
2	4.3	0.54	4.4	2.4
5	6.4	0.80		2.7
10	7.9	0.99		3.0
25	9.3	1.16		3.3
50	11.0	1.38		3.6
100	12.4	1.54		3.9

All modelling results assume the respective sump is full at the onset of the storm event. All storage volumes include the sump volume. The modelling results demonstrate that the post-development peak flow rates for all events up to the 100-year storm are lower than the target release rate established in accordance with the WWFMG. The time of duration that results in the peak discharge to Yorkville Avenue from Building A has been iteratively determined to be $t_d = 10$ minutes (for the 100-year event) according to the modified rational method process. For Building B to Cumberland Street, $t_d = 21$ minutes for the 100-year event.

4 CONCLUSIONS

A stormwater management plan has been prepared to support the Rezoning Application and Site Plan Application for Building A and the Rezoning Application for Building B. Building A is proposed at the municipal addresses of 11-25 Yorkville Avenue and 16-18 Cumberland Street in the City of Toronto. The key points are summarized below.

WATER BALANCE

A sump volume of approximately 10.6 m³ is provided at the base of a stormwater cistern in Building A for reuse purposes. This ensures that there is sufficient supply for the irrigation and misting demands during the summer months to reuse 50% of the total annual rainfall. The system demands 1287 m³, and 1128 m³ is required to be reused.

A sump of 1.44 m³ is provided in the cistern of Building B. This ensures that the WWFMG Water Balance volume of at least 1.43 m³ is retained and reused on site for Building B.

WATER QUANTITY

The storage provided by the stormwater cistern in Building A will ensure that the peak offsite discharge rates to the combined sewer on Yorkville Avenue will be below the allowable maximum rate of 35.2 L/s defined in the WWFMG for all storms up to and including the 100-year event. The release rate from cistern A is controlled to 19 L/s through the use of a pump from the proposed 240 m³ cistern. A 100 mm orifice tube on the discharge chamber further ensures the flow is controlled to the allowable release rate. The storage required for the 100-year storm is 84.6 m³, which includes the sump volume of 10.6 m³. The peak discharge rate from Building A is 29.3 L/s.

For Building B, a 3 inch (76 mm) SXH HydroBrake valve is proposed on the outlet of the proposed 16 m³ stormwater cistern. The allowable release rate to the Cumberland Street sewer is 4.4 L/s. The HydroBrake achieved a peak discharge rate of 3.9 L/s. The 100-year storm requires 12.4 m³ of storage.

EROSION CONTROL

The site is below the 2.0 ha erosion control guideline and the on-site minimum retention of the 5 mm rainfall event is achieved under the water balance criteria, therefore no further measures are recommended.

WATER QUALITY

Under the WWFMG, the site is required to target a long-term removal of 80% of total suspended solids (TSS) on an annual loading basis. A Jellyfish unit model JF4-4-1 was sized to achieve 80% TSS removal for this site.

The proposed SWM strategy described in this report addresses all stormwater management related impacts from the project and satisfies the intent of the City of Toronto Wet Weather Flow Management Guidelines.

APPENDIX

A STORMWATER MANAGEMENT CALCULATIONS



Stormwater Management Calculations	Project: 11-25 Yorkville & 16-18 Cumberland	No.:	17M-01494	Page: 1
	Allowable Offsite Discharge Rate - Yorkville Avenue	By: VB Checked: SP	Date: 12/14/2018 Checked: 12/14/2018	

Calculation of existing runoff rate is undertaken using the Rational Method: $Q = 2.78 CIA$

- Where: Q = Peak flow rate (litres/second)
- C = Runoff coefficient
- I = Rainfall intensity (mm/hour)
- A = Catchment area (hectares)

Project Area, A 0.29 hectares
 Runoff Coef, C* 0.50

* Note - actual site runoff coefficient is approximately 0.75, however City of Toronto WWFMG states maximum runoff coefficient to be used in calculation of pre-development peak flow is 0.50 (section 2.2.3.8).

Rainfall intensity calculated in accordance with City of Toronto WWFMG (section 3.1): $I = AT^C$

- Where: A and C = Parameters defined in WWFMG section 3.1.
- I = Rainfall intensity (mm/hour)
- T = Time of concentration (hours)

Return Period (Years)	2	5	10	25	50	100
A	21.8	32.0	38.7	45.2	53.5	59.7
C	-0.78	-0.79	-0.80	-0.80	-0.80	-0.80
T (mins) **	10	10	10	10	10	10
T (hrs)	0.167	0.167	0.167	0.167	0.167	0.167
I (mm/hr)	88.2	131.8	162.3	189.5	224.3	250.3
Q (litres/sec)	35.2	52.6	64.8	75.6	89.5	99.9
Q (m3/sec)	0.035	0.053	0.065	0.076	0.090	0.100

** Note recommended minimum value for time of concentration for small sites (<2.0ha) is 10 minutes.

Allowable release rate to municipal storm sewer system is therefore 35.2 litres/second.
 (As per City of Toronto WWFMG section 2.2.3.7)



Stormwater Management Calculations	Project: 11-25 Yorkville & 16-18 Cumberland	No.:	17M-01494	Page: 2
	Allowable Offsite Discharge Rate - Cumberland Street	By: VB Checked: SP	Date: 12/14/2018 Checked: 12/14/2018	

Calculation of existing runoff rate is undertaken using the Rational Method: $Q = 2.78 \text{ CIA}$

- Where: Q = Peak flow rate (litres/second)
 C = Runoff coefficient
 I = Rainfall intensity (mm/hour)
 A = Catchment area (hectares)

Project Area, A **0.04** hectares
 Runoff Coef, C* 0.50

* Note - actual site runoff coefficient is approximately 0.75, however City of Toronto WWFMG states maximum runoff coefficient to be used in calculation of pre-development peak flow is 0.50 (section 2.2.3.8).

Rainfall intensity calculated in accordance with City of Toronto WWFMG (section 3.1): $I = AT^C$

- Where: A and C = Parameters defined in WWFMG section 3.1.
 I = Rainfall intensity (mm/hour)
 T = Time of concentration (hours)

Return Period (Years)	2	5	10	25	50	100
A	21.8	32.0	38.7	45.2	53.5	59.7
C	-0.78	-0.79	-0.80	-0.80	-0.80	-0.80
T (mins) **	10	10	10	10	10	10
T (hrs)	0.167	0.167	0.167	0.167	0.167	0.167
I (mm/hr)	88.2	131.8	162.3	189.5	224.3	250.3
Q (litres/sec)	4.4	6.6	8.1	9.4	11.2	12.4
Q (m3/sec)	0.004	0.007	0.008	0.009	0.011	0.012

** Note recommended minimum value for time of concentration for small sites (<2.0ha) is 10 minutes.

Allowable release rate to municipal storm sewer system is therefore 4.4 litres/second.
 (As per City of Toronto WWFMG section 2.2.3.7)



Project:	11-25 Yorkville & 16-18 Cumberland	No.:	17M-01494
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Checked:	SP	Page:	3

Subject: Stormwater Management Calculations - Water Balance Building A

Proposed Reuse Methods:

- Irrigation (May - Sept) Refer to Terraplan Irrigation Demand (March 2018)
 - Misting Rate 2.7 USGPM Refer to Koolfog product specification sheet
- Misting Rate 0.61 m³/hour System consists of one M20 mister and one M88 mister.
- Hours of Operation per day 8 hours
- Daily Misting Demand (m³) 4.91 m³/day

Month	Days per Month	Mister Demand (m ³)	Irrigation Demand (m ³)	Total Reuse Demand (m ³)
Jan	31	0.0	0.0	0.0
Feb	28	0.0	0.0	0.0
Mar	31	0.0	0.0	0.0
Apr	30	147.2	0.0	147.2
May	31	152.1	44.5	196.6
Jun	30	147.2	53.0	200.2
Jul	31	152.1	60.6	212.7
Aug	31	152.1	48.4	200.5
Sep	30	147.2	30.4	177.5
Oct	31	152.1	0.0	152.1
Nov	30	0.0	0.0	0.0
Dec	31	0.0	0.0	0.0
Total	365	1050	237	1287

The total yearly reuse demand is: 1287 m³/year
 The average daily demand is: 3.53 m³/day
 Average 72-hour demand is: **10.58** m³

Therefore, the proposed water balance methods require a sump volume of 10.58 cubic meters.

Ensure Adequate Demand for 50% of Yearly Rainfall:

The following rainfall data was obtained from the Environment Canada website, results in mm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
51.8	47.7	49.8	68.5	74.3	71.5	75.7	78.1	74.5	61.1	75.1	57.9	786.0

To achieve the water balance requirement, 50% of the annual rainfall must be reused on site which is equal to a rainfall depth of 393 mm over the entire year

The total volume to be reused is equal to the rainfall depth multiplied by the site area. Given the site area is 0.29 ha, the volume of 50% of the annual rainfall on site is 1128 m³.

Therefore the proposed reuse methods have sufficient demand to reuse 50% of the yearly rainfall since the demand of 1287 m³ exceeds 50% of the rainfall volume (1128 m³).



The City of Toronto Wet Weather Flow Management Guidelines (WWFMG) require a site "to retain water on-site to the extent practicable, to achieve the same level of annual volume of overland runoff allowable from the development site under pre-development conditions".

- Section 2.2.1.1 (a)

In this case, the minimum on-site runoff retention will require the site to retain all runoff from 5 mm storm event through evapotranspiration infiltration, or rainwater reuse. WWFMG Section 2.2.1.1 (d).

The current area measurements and land use types for the site are as follows:

Land Use	Area (m ²)	Runoff C	Impervious	CN
Impervious Roof Area	308	0.90	100%	98
Green Roof Area	-	0.45	0%	81
Landscape	-	0.90	100%	98
At-Grade Impervious	50	0.90	100%	98
Uncontrolled Drainage	-	0.90	100%	98
Total Site Area:	358	0.90	100%	98

Surface Type	Area (m ²)	IA (m)	Volume Abstracted (m ³)	5 mm Volume (m ³)	Water Balance (m ³)
Impervious Roof Area	308	0.001	0.31	1.54	1.23
Green Roof Area	-	0.005	0.00	0.00	0.00
Landscape	-	0.005	0.00	0.00	0.00
At-Grade Impervious	50	0.001	0.05	0.25	0.20
Uncontrolled Drainage	-	0.001	0.00	0.00	0.00
Total Site Area:	358	-	0.36	1.79	1.43

For the purposes of the water balance calculation it is assumed that green roofs can accept 5 mm of rainfall without producing any runoff.

This is supported by EPA analysis of green roof manufacturer data sheets (dry unit weights versus saturated unit weights).

It is assumed that the remaining hard surfaces on the site can abstract 1 mm of rainfall, and that all soft landscaped areas can absorb 5 mm

Therefore, volume of runoff during a 5 mm storm event: **1.43** m³



Stormwater Management Calculations	Project: 11-25 Yorkville & 16-18 Cumberland	No.: 17M-01494	Page: 5
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	Checked: SP	Checked: 12/14/2018	

Orifice Tube Size, D (mm) 100
 Orifice Coefficient, C 0.8
 Orifice Area, A (m²) 0.008
 Orifice invert elevation, h1 0

Orifice Equation: $Q = CA \times \sqrt{2gh}$

Water Elev. in Tank h2 (m)	Head on Outlet* h (m)	Q (m ³ /2)	Q L/s	Tank Min. Active Vol (m ³)
0.00	-	-	-	-
0.05	-	-	-	-
0.10	0.05	0.006	6.2	2
0.15	0.10	0.009	8.8	3
0.20	0.15	0.011	10.8	4
0.25	0.20	0.012	12.4	5
0.30	0.25	0.014	13.9	6
0.35	0.30	0.015	15.2	7
0.40	0.35	0.016	16.5	8
0.45	0.40	0.018	17.6	9
0.50	0.45	0.019	18.7	10
0.55	0.50	0.020	19.7	11
0.60	0.55	0.021	20.6	12
0.65	0.60	0.022	21.6	13
0.70	0.65	0.022	22.4	14
0.75	0.70	0.023	23.3	15
0.80	0.75	0.024	24.1	16
0.85	0.80	0.025	24.9	17
0.90	0.85	0.026	25.7	18
0.95	0.90	0.026	26.4	19
1.00	0.95	0.027	27.1	20
1.05	1.00	0.028	27.8	21
1.10	1.05	0.029	28.5	22
1.15	1.10	0.029	29.2	23
1.20	1.15	0.030	29.8	24
1.25	1.20	0.030	30.5	25
1.30	1.25	0.031	31.1	26
1.35	1.30	0.032	31.7	27
1.40	1.35	0.032	32.3	28
1.45	1.40	0.033	32.9	29
1.50	1.45	0.034	33.5	30
1.55	1.50	0.034	34.1	31
1.60	1.55	0.035	34.6	32

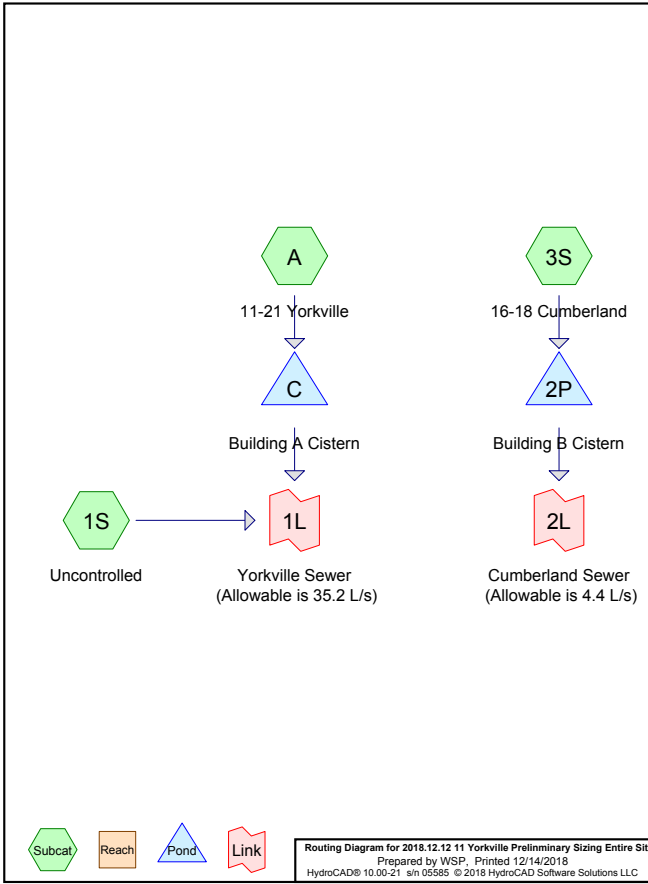
Therefore, if there is a pump malfunction that causes the pumping rate to exceed 19 L/s, the maximum release rate is under the 2-year allowable release rate to the municipal sewer system.

APPENDIX

B HYDROLOGIC MODEL OUTPUT (HydroCAD)

Area Listing (all nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
822.0	0.90	At-Grade Impervious (A)
50.4	0.90	At-grade Impervious (3S)
475.0	0.45	Green Roof (A)
1,663.3	0.90	Impervious Roof (3S, A)
50.0	0.25	Landscape (A)
168.0	0.90	Uncontrolled (1S)
3,228.7	0.82	TOTAL AREA



Soil Listing (all nodes)

Area (sq-meters)	Soil Group	Subcatchment Numbers
0.0	HSG A	
0.0	HSG B	
0.0	HSG C	
0.0	HSG D	
3,228.7	Other	1S, 3S, A
3,228.7		TOTAL AREA

Ground Covers (all nodes)

HSG-A (sq-meters)	HSG-B (sq-meters)	HSG-C (sq-meters)	HSG-D (sq-meters)	Other (sq-meters)	Total (sq-meters)	Ground Cover	Subc Num
0.0	0.0	0.0	0.0	822.0	822.0	At-Grade Impervious	
0.0	0.0	0.0	0.0	50.4	50.4	At-grade Impervious	
0.0	0.0	0.0	0.0	475.0	475.0	Green Roof Impervious	
0.0	0.0	0.0	0.0	1,663.3	1,663.3	Impervious Roof	
0.0	0.0	0.0	0.0	50.0	50.0	Landscape	
0.0	0.0	0.0	0.0	168.0	168.0	Uncontrolled	
0.0	0.0	0.0	0.0	3,228.7	3,228.7	TOTAL AREA	

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=13 mm Tc=10.0 min C=0.90 Runoff=0.0036 m ³ /s 2.2 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=13 mm Tc=10.0 min C=0.90 Runoff=0.0077 m ³ /s 4.7 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=12 mm Tc=10.0 min C=0.81 Runoff=0.0527 m ³ /s 32.2 m ³
Pond 2P: Building B Cistern	Peak Elev=0.537 m Storage=4.3 m ³ Inflow=0.0077 m ³ /s 4.7 m ³ Outflow=0.0024 m ³ /s 4.7 m ³
Pond C: Building A Cistern	Peak Elev=1.247 m Storage=24.9 m ³ Inflow=0.0527 m ³ /s 32.2 m ³ Outflow=0.0190 m ³ /s 32.2 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0226 m ³ /s 34.4 m ³ Primary=0.0226 m ³ /s 34.4 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0024 m ³ /s 4.7 m ³ Primary=0.0024 m ³ /s 4.7 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 39.1 m³ Average Runoff Depth = 12 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0036 m³/s @ 0.17 hrs, Volume= 2.2 m³, Depth= 13 mm

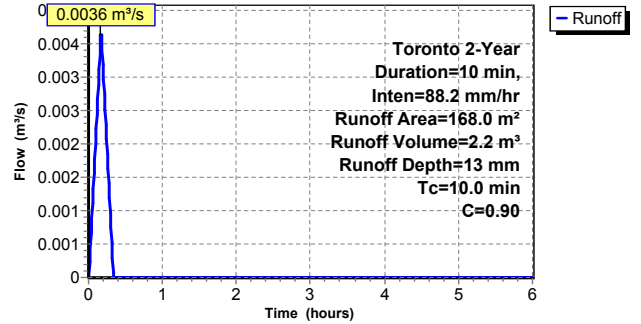
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 2-Year Duration=10 min, Inten=88.2 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0077 m³/s @ 0.17 hrs, Volume= 4.7 m³, Depth= 13 mm

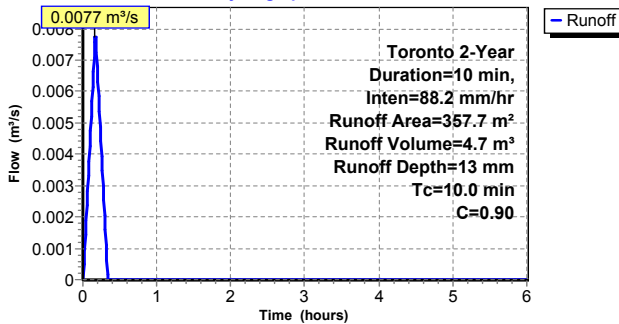
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 2-Year Duration=10 min, Inten=88.2 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.0527 m³/s @ 0.17 hrs, Volume= 32.2 m³, Depth= 12 mm

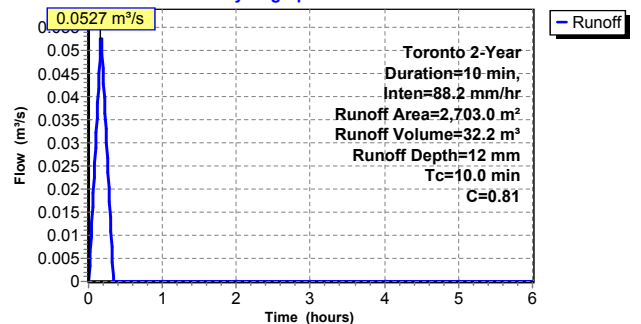
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 2-Year Duration=10 min, Inten=88.2 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 13 mm for 2-Year event
 Inflow = 0.0077 m³/s @ 0.17 hrs, Volume= 4.7 m³
 Outflow = 0.0024 m³/s @ 0.16 hrs, Volume= 4.7 m³, Atten= 69%, Lag= 0.0 min
 Primary = 0.0024 m³/s @ 0.16 hrs, Volume= 4.7 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 0.537 m @ 0.29 hrs Surf.Area= 8.0 m² Storage= 4.3 m³ (2.9 m³ above start)

Plug-Flow detention time= 20.9 min calculated for 3.3 m³ (70% of inflow)
 Center-of-Mass det. time= 12.9 min (22.9 - 10.0)

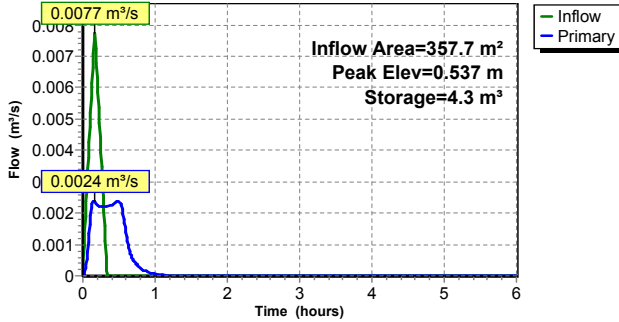
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0024 m³/s @ 0.16 hrs HW=0.358 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0024 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 12 mm for 2-Year event
 Inflow = 0.0527 m³/s @ 0.17 hrs, Volume= 32.2 m³
 Outflow = 0.0190 m³/s @ 0.09 hrs, Volume= 32.2 m³, Atten= 64%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.09 hrs, Volume= 32.2 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 1.247 m @ 0.27 hrs Surf.Area= 20.0 m² Storage= 24.9 m³ (14.9 m³ above start)

Plug-Flow detention time= 14.1 min calculated for 22.2 m³ (69% of inflow)
 Center-of-Mass det. time= 7.3 min (17.3 - 10.0)

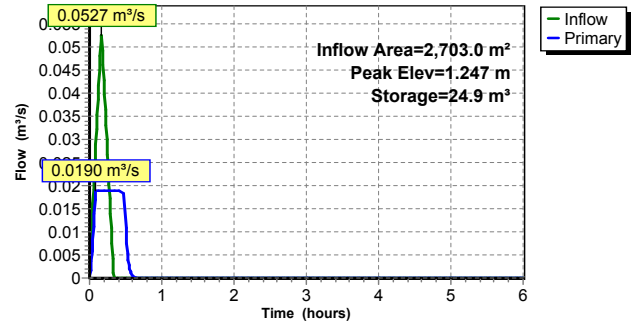
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.09 hrs HW=0.605 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



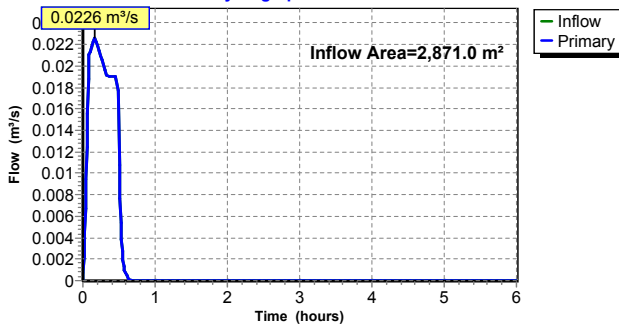
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 12 mm for 2-Year event
 Inflow = 0.0226 m³/s @ 0.17 hrs, Volume= 34.4 m³
 Primary = 0.0226 m³/s @ 0.17 hrs, Volume= 34.4 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



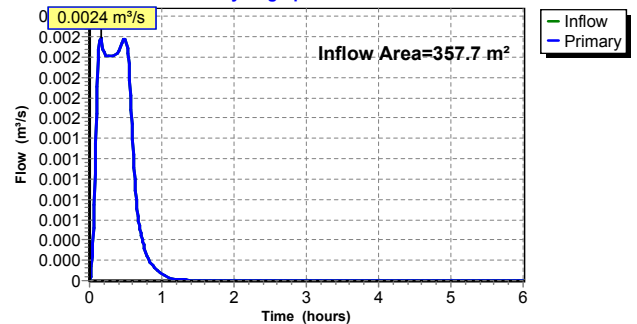
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 13 mm for 2-Year event
 Inflow = 0.0024 m³/s @ 0.16 hrs, Volume= 4.7 m³
 Primary = 0.0024 m³/s @ 0.16 hrs, Volume= 4.7 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=20 mm Tc=10.0 min C=0.90 Runoff=0.0054 m ³ /s 3.3 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=20 mm Tc=10.0 min C=0.90 Runoff=0.0116 m ³ /s 7.1 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=18 mm Tc=10.0 min C=0.81 Runoff=0.0787 m ³ /s 48.1 m ³
Pond 2P: Building B Cistern	Peak Elev=0.793 m Storage=6.3 m ³ Inflow=0.0116 m ³ /s 7.1 m ³ Outflow=0.0026 m ³ /s 7.1 m ³
Pond C: Building A Cistern	Peak Elev=1.968 m Storage=39.4 m ³ Inflow=0.0787 m ³ /s 48.1 m ³ Outflow=0.0190 m ³ /s 48.1 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0244 m ³ /s 51.4 m ³ Primary=0.0244 m ³ /s 51.4 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0026 m ³ /s 7.1 m ³ Primary=0.0026 m ³ /s 7.1 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 58.5 m³ Average Runoff Depth = 18 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0054 m³/s @ 0.17 hrs, Volume= 3.3 m³, Depth= 20 mm

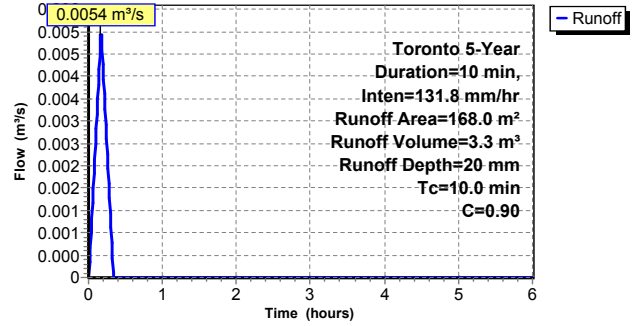
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 5-Year Duration=10 min, Inten=131.8 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0116 m³/s @ 0.17 hrs, Volume= 7.1 m³, Depth= 20 mm

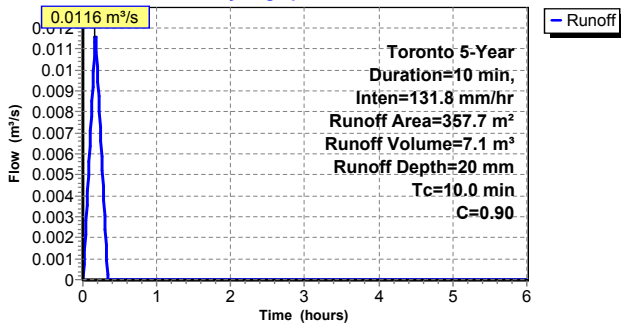
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 5-Year Duration=10 min, Inten=131.8 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.0787 m³/s @ 0.17 hrs, Volume= 48.1 m³, Depth= 18 mm

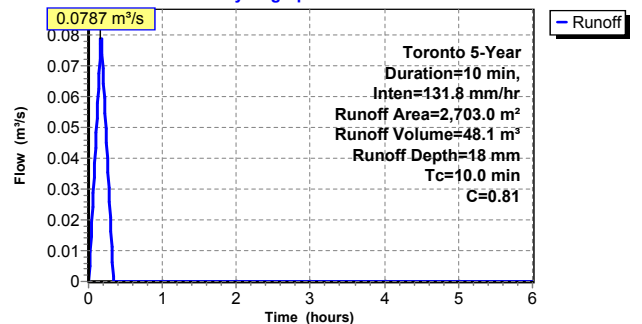
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 5-Year Duration=10 min, Inten=131.8 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 20 mm for 5-Year event
 Inflow = 0.0116 m³/s @ 0.17 hrs, Volume= 7.1 m³
 Outflow = 0.0026 m³/s @ 0.30 hrs, Volume= 7.1 m³, Atten= 78%, Lag= 7.7 min
 Primary = 0.0026 m³/s @ 0.30 hrs, Volume= 7.1 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 0.793 m @ 0.30 hrs Surf.Area= 8.0 m² Storage= 6.3 m³ (4.9 m³ above start)

Plug-Flow detention time= 26.1 min calculated for 5.6 m³ (80% of inflow)
 Center-of-Mass det. time= 19.3 min (29.3 - 10.0)

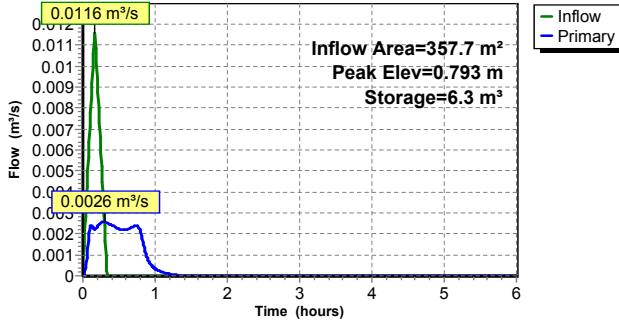
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0026 m³/s @ 0.30 hrs HW=0.793 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0026 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 18 mm for 5-Year event
 Inflow = 0.0787 m³/s @ 0.17 hrs, Volume= 48.1 m³
 Outflow = 0.0190 m³/s @ 0.07 hrs, Volume= 48.1 m³, Atten= 76%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.07 hrs, Volume= 48.1 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 1.968 m @ 0.29 hrs Surf.Area= 20.0 m² Storage= 39.4 m³ (29.4 m³ above start)

Plug-Flow detention time= 19.4 min calculated for 38.0 m³ (79% of inflow)
 Center-of-Mass det. time= 13.5 min (23.5 - 10.0)

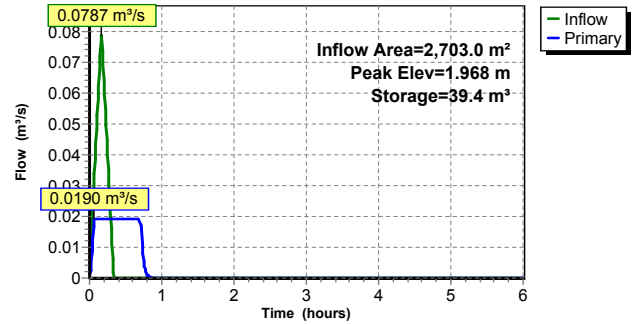
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.07 hrs HW=0.611 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



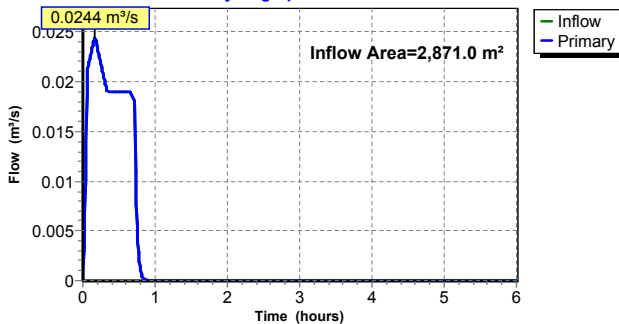
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 18 mm for 5-Year event
 Inflow = 0.0244 m³/s @ 0.17 hrs, Volume= 51.4 m³
 Primary = 0.0244 m³/s @ 0.17 hrs, Volume= 51.4 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



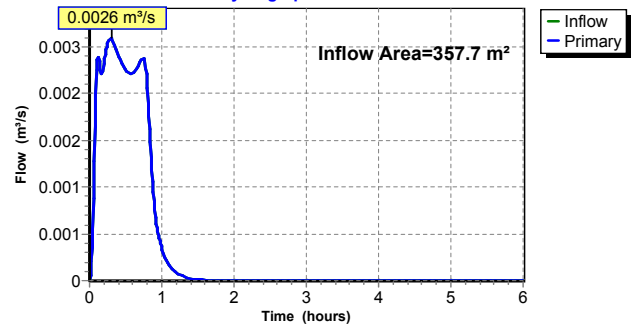
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 20 mm for 5-Year event
 Inflow = 0.0026 m³/s @ 0.30 hrs, Volume= 7.1 m³
 Primary = 0.0026 m³/s @ 0.30 hrs, Volume= 7.1 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=24 mm Tc=10.0 min C=0.90 Runoff=0.0067 m ³ /s 4.1 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=24 mm Tc=10.0 min C=0.90 Runoff=0.0143 m ³ /s 8.7 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=22 mm Tc=10.0 min C=0.81 Runoff=0.0970 m ³ /s 59.2 m ³
Pond 2P: Building B Cistern	Peak Elev=0.970 m Storage=7.8 m ³ Inflow=0.0143 m ³ /s 8.7 m ³ Outflow=0.0029 m ³ /s 8.7 m ³
Pond C: Building A Cistern	Peak Elev=2.494 m Storage=49.9 m ³ Inflow=0.0970 m ³ /s 59.2 m ³ Outflow=0.0190 m ³ /s 59.2 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0257 m ³ /s 63.3 m ³ Primary=0.0257 m ³ /s 63.3 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0029 m ³ /s 8.7 m ³ Primary=0.0029 m ³ /s 8.7 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 72.0 m³ Average Runoff Depth = 22 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0067 m³/s @ 0.17 hrs, Volume= 4.1 m³, Depth= 24 mm

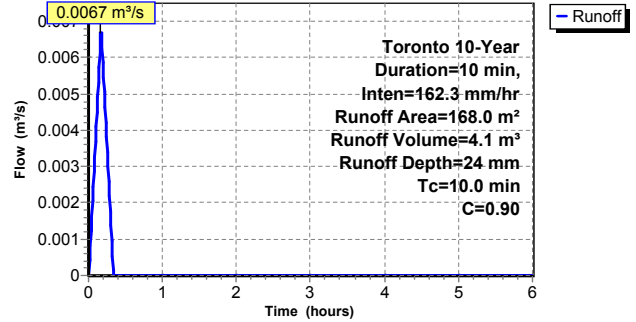
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 10-Year Duration=10 min, Inten=162.3 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0143 m³/s @ 0.17 hrs, Volume= 8.7 m³, Depth= 24 mm

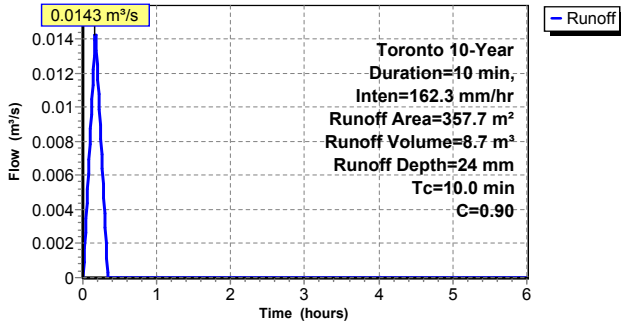
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 10-Year Duration=10 min, Inten=162.3 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.0970 m³/s @ 0.17 hrs, Volume= 59.2 m³, Depth= 22 mm

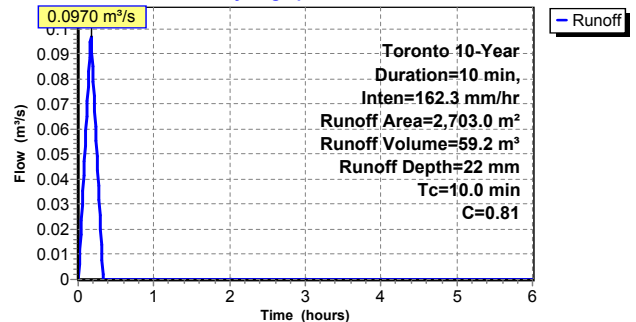
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 10-Year Duration=10 min, Inten=162.3 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 24 mm for 10-Year event
 Inflow = 0.0143 m³/s @ 0.17 hrs, Volume= 8.7 m³
 Outflow = 0.0029 m³/s @ 0.30 hrs, Volume= 8.7 m³, Atten= 79%, Lag= 7.9 min
 Primary = 0.0029 m³/s @ 0.30 hrs, Volume= 8.7 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 0.970 m @ 0.30 hrs Surf.Area= 8.0 m² Storage= 7.8 m³ (6.3 m³ above start)

Plug-Flow detention time= 28.7 min calculated for 7.3 m³ (83% of inflow)
 Center-of-Mass det. time= 22.7 min (32.7 - 10.0)

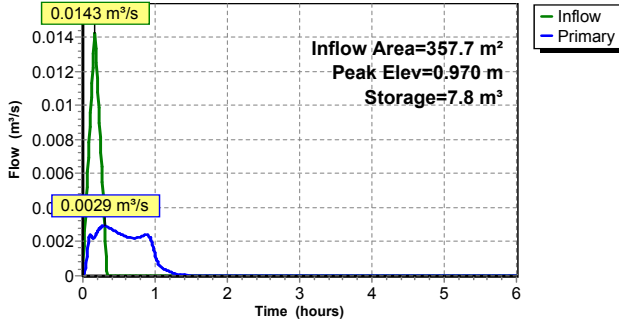
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0029 m³/s @ 0.30 hrs HW=0.970 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0029 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 22 mm for 10-Year event
 Inflow = 0.0970 m³/s @ 0.17 hrs, Volume= 59.2 m³
 Outflow = 0.0190 m³/s @ 0.06 hrs, Volume= 59.2 m³, Atten= 80%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.06 hrs, Volume= 59.2 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 2.494 m @ 0.30 hrs Surf.Area= 20.0 m² Storage= 49.9 m³ (39.9 m³ above start)

Plug-Flow detention time= 23.7 min calculated for 49.1 m³ (83% of inflow)
 Center-of-Mass det. time= 18.1 min (28.1 - 10.0)

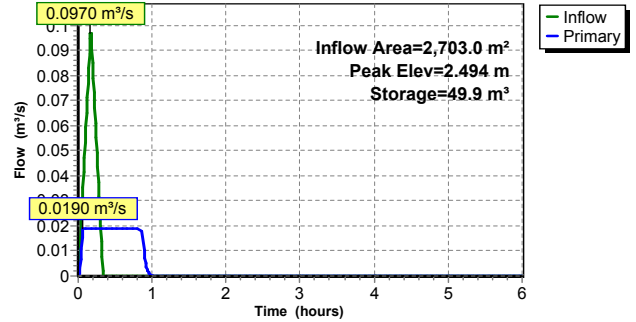
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.06 hrs HW=0.608 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



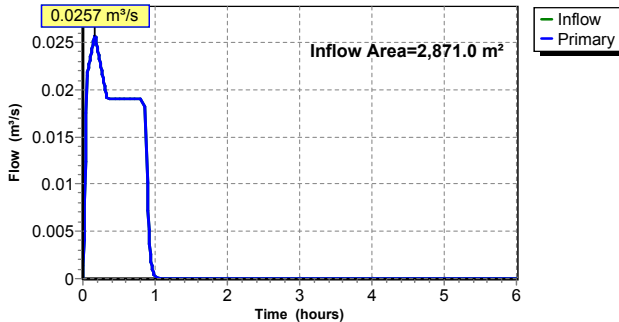
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 22 mm for 10-Year event
 Inflow = 0.0257 m³/s @ 0.17 hrs, Volume= 63.3 m³
 Primary = 0.0257 m³/s @ 0.17 hrs, Volume= 63.3 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



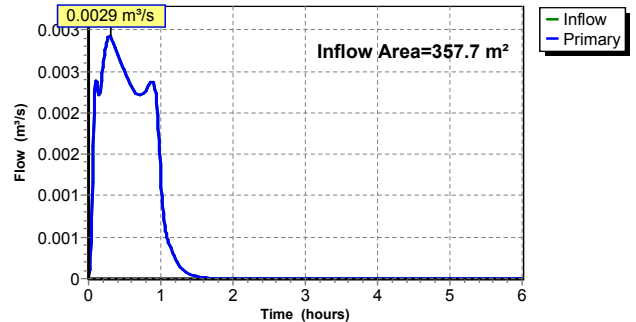
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 24 mm for 10-Year event
 Inflow = 0.0029 m³/s @ 0.30 hrs, Volume= 8.7 m³
 Primary = 0.0029 m³/s @ 0.30 hrs, Volume= 8.7 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=28 mm Tc=10.0 min C=0.90 Runoff=0.0078 m ³ /s 4.8 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=28 mm Tc=10.0 min C=0.90 Runoff=0.0167 m ³ /s 10.2 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=26 mm Tc=10.0 min C=0.81 Runoff=0.1132 m ³ /s 69.1 m ³
Pond 2P: Building B Cistern	Peak Elev=1.130 m Storage=9.0 m ³ Inflow=0.0167 m ³ /s 10.2 m ³ Outflow=0.0032 m ³ /s 10.2 m ³
Pond C: Building A Cistern	Peak Elev=2.973 m Storage=59.5 m ³ Inflow=0.1132 m ³ /s 69.1 m ³ Outflow=0.0190 m ³ /s 69.1 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0268 m ³ /s 73.9 m ³ Primary=0.0268 m ³ /s 73.9 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0032 m ³ /s 10.2 m ³ Primary=0.0032 m ³ /s 10.2 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 84.1 m³ Average Runoff Depth = 26 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0078 m³/s @ 0.17 hrs, Volume= 4.8 m³, Depth= 28 mm

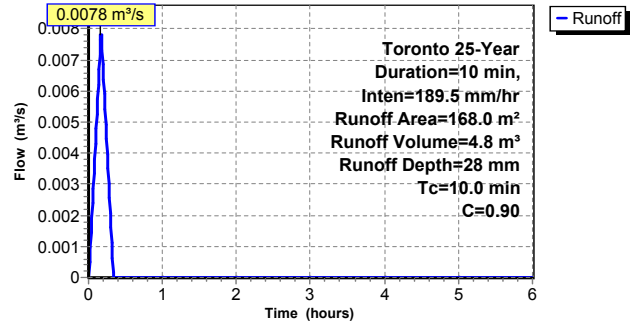
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 25-Year Duration=10 min, Inten=189.5 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0167 m³/s @ 0.17 hrs, Volume= 10.2 m³, Depth= 28 mm

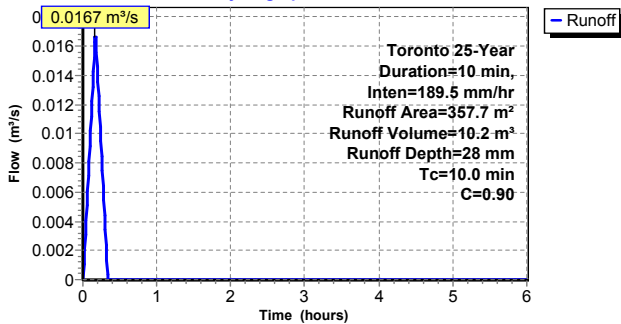
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 25-Year Duration=10 min, Inten=189.5 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.1132 m³/s @ 0.17 hrs, Volume= 69.1 m³, Depth= 26 mm

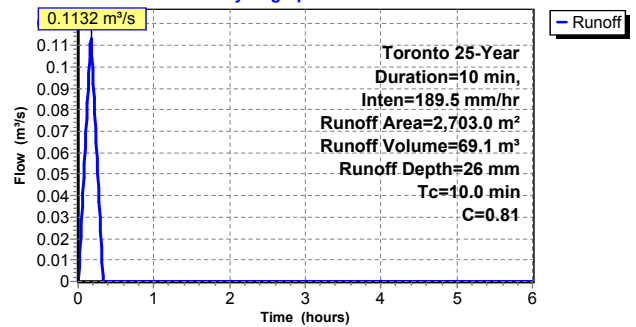
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 25-Year Duration=10 min, Inten=189.5 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 28 mm for 25-Year event
 Inflow = 0.0167 m³/s @ 0.17 hrs, Volume= 10.2 m³
 Outflow = 0.0032 m³/s @ 0.30 hrs, Volume= 10.2 m³, Atten= 81%, Lag= 8.1 min
 Primary = 0.0032 m³/s @ 0.30 hrs, Volume= 10.2 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 1.130 m @ 0.30 hrs Surf.Area= 8.0 m² Storage= 9.0 m³ (7.6 m³ above start)

Plug-Flow detention time= 31.2 min calculated for 8.7 m³ (86% of inflow)
 Center-of-Mass det. time= 25.4 min (35.4 - 10.0)

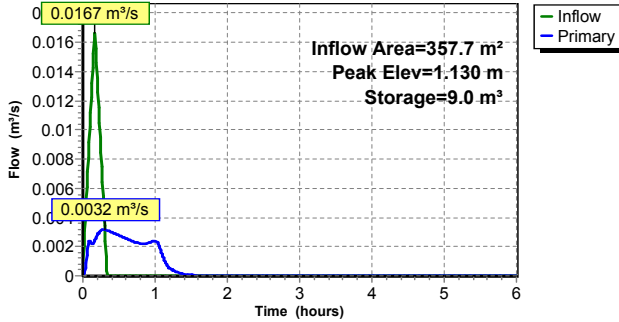
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0032 m³/s @ 0.30 hrs HW=1.129 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0032 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 26 mm for 25-Year event
 Inflow = 0.1132 m³/s @ 0.17 hrs, Volume= 69.1 m³
 Outflow = 0.0190 m³/s @ 0.06 hrs, Volume= 69.1 m³, Atten= 83%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.06 hrs, Volume= 69.1 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 2.973 m @ 0.31 hrs Surf.Area= 20.0 m² Storage= 59.5 m³ (49.5 m³ above start)

Plug-Flow detention time= 27.7 min calculated for 59.0 m³ (85% of inflow)
 Center-of-Mass det. time= 22.3 min (32.3 - 10.0)

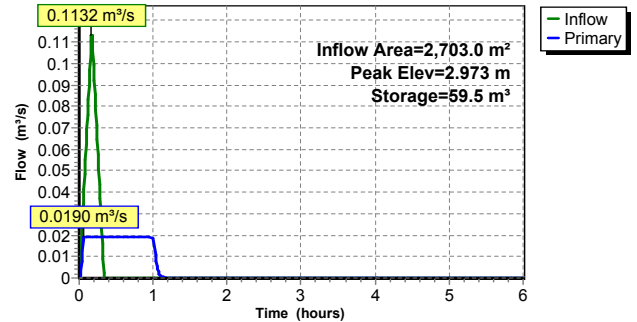
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.06 hrs HW=0.629 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



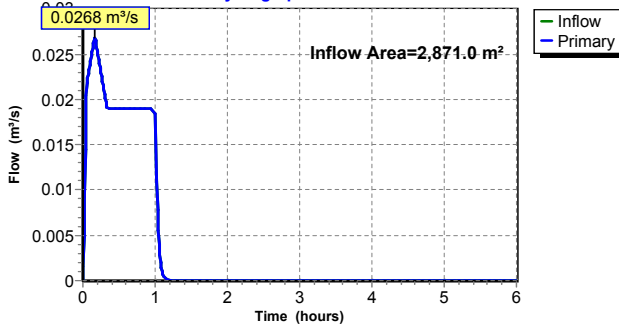
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 26 mm for 25-Year event
 Inflow = 0.0268 m³/s @ 0.17 hrs, Volume= 73.9 m³
 Primary = 0.0268 m³/s @ 0.17 hrs, Volume= 73.9 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



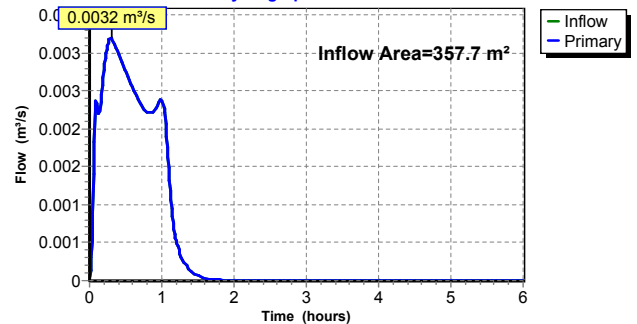
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 28 mm for 25-Year event
 Inflow = 0.0032 m³/s @ 0.30 hrs, Volume= 10.2 m³
 Primary = 0.0032 m³/s @ 0.30 hrs, Volume= 10.2 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=34 mm Tc=10.0 min C=0.90 Runoff=0.0093 m ³ /s 5.7 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=34 mm Tc=10.0 min C=0.90 Runoff=0.0197 m ³ /s 12.0 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=30 mm Tc=10.0 min C=0.81 Runoff=0.1340 m ³ /s 81.8 m ³
Pond 2P: Building B Cistern	Peak Elev=1.335 m Storage=10.7 m ³ Inflow=0.0197 m ³ /s 12.0 m ³ Outflow=0.0035 m ³ /s 12.0 m ³
Pond C: Building A Cistern	Peak Elev=3.589 m Storage=71.8 m ³ Inflow=0.1340 m ³ /s 81.8 m ³ Outflow=0.0190 m ³ /s 81.8 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0283 m ³ /s 87.5 m ³ Primary=0.0283 m ³ /s 87.5 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0035 m ³ /s 12.0 m ³ Primary=0.0035 m ³ /s 12.0 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 99.5 m³ Average Runoff Depth = 31 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0093 m³/s @ 0.17 hrs, Volume= 5.7 m³, Depth= 34 mm

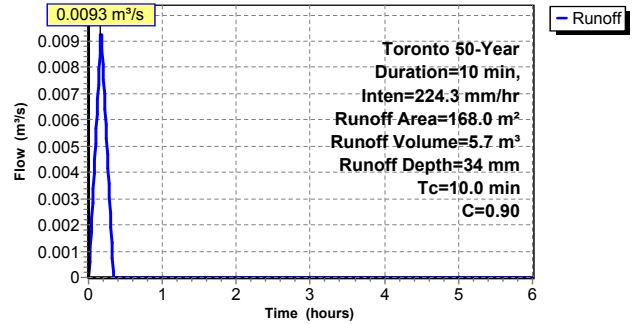
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 50-Year Duration=10 min, Inten=224.3 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0197 m³/s @ 0.17 hrs, Volume= 12.0 m³, Depth= 34 mm

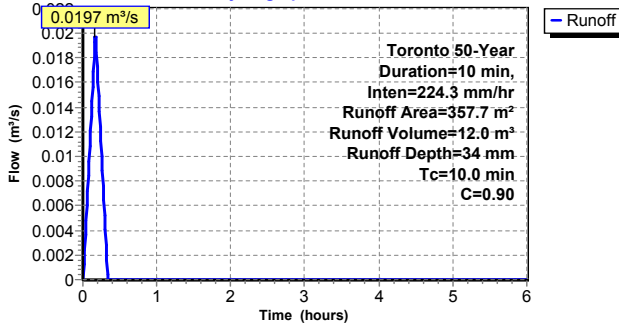
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 50-Year Duration=10 min, Inten=224.3 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.1340 m³/s @ 0.17 hrs, Volume= 81.8 m³, Depth= 30 mm

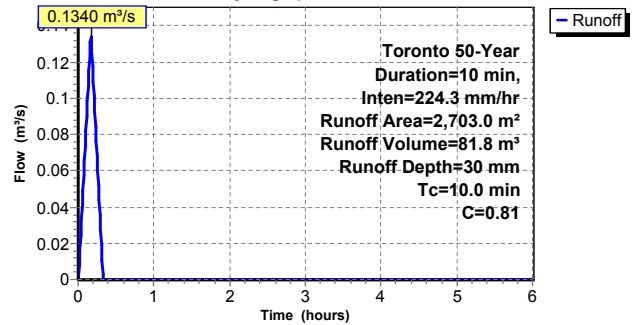
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 50-Year Duration=10 min, Inten=224.3 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 34 mm for 50-Year event
 Inflow = 0.0197 m³/s @ 0.17 hrs, Volume= 12.0 m³
 Outflow = 0.0035 m³/s @ 0.30 hrs, Volume= 12.0 m³, Atten= 82%, Lag= 8.2 min
 Primary = 0.0035 m³/s @ 0.30 hrs, Volume= 12.0 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 1.335 m @ 0.30 hrs Surf.Area= 8.0 m² Storage= 10.7 m³ (9.2 m³ above start)

Plug-Flow detention time= 33.7 min calculated for 10.6 m³ (88% of inflow)
 Center-of-Mass det. time= 28.5 min (38.5 - 10.0)

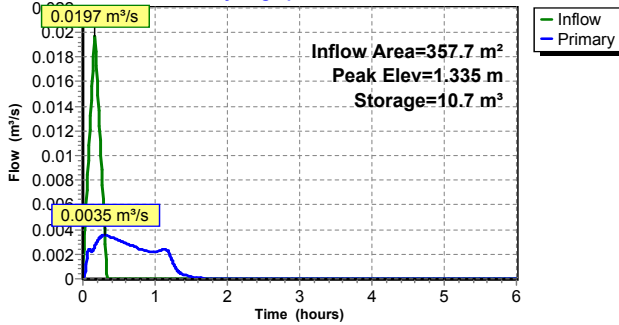
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0035 m³/s @ 0.30 hrs HW=1.334 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0035 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 30 mm for 50-Year event
 Inflow = 0.1340 m³/s @ 0.17 hrs, Volume= 81.8 m³
 Outflow = 0.0190 m³/s @ 0.05 hrs, Volume= 81.8 m³, Atten= 86%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.05 hrs, Volume= 81.8 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 3.589 m @ 0.31 hrs Surf.Area= 20.0 m² Storage= 71.8 m³ (61.8 m³ above start)

Plug-Flow detention time= 33.0 min calculated for 71.8 m³ (88% of inflow)
 Center-of-Mass det. time= 27.7 min (37.7 - 10.0)

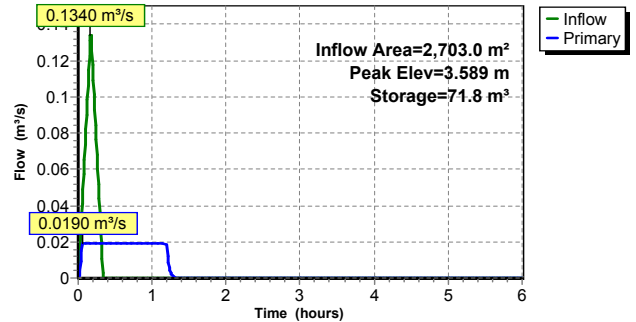
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.05 hrs HW=0.613 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



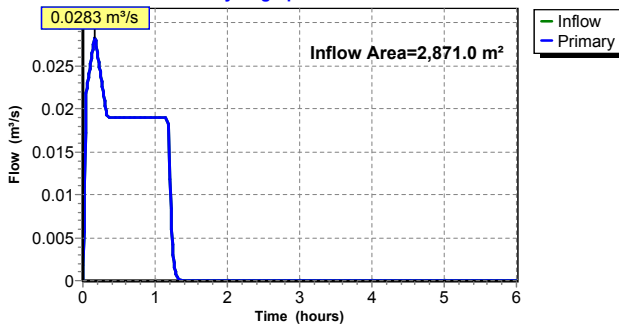
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 30 mm for 50-Year event
 Inflow = 0.0283 m³/s @ 0.17 hrs, Volume= 87.5 m³
 Primary = 0.0283 m³/s @ 0.17 hrs, Volume= 87.5 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



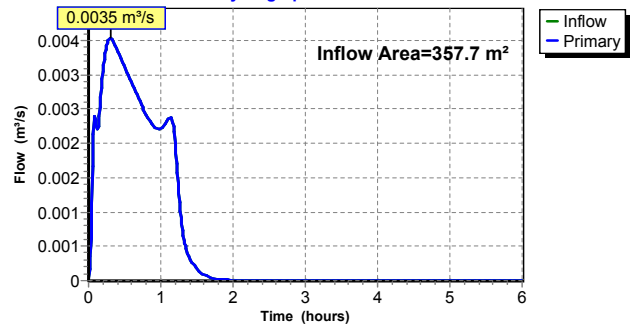
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 34 mm for 50-Year event
 Inflow = 0.0035 m³/s @ 0.30 hrs, Volume= 12.0 m³
 Primary = 0.0035 m³/s @ 0.30 hrs, Volume= 12.0 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=38 mm Tc=10.0 min C=0.90 Runoff=0.0103 m ³ /s 6.3 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=38 mm Tc=10.0 min C=0.90 Runoff=0.0220 m ³ /s 13.4 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=34 mm Tc=10.0 min C=0.81 Runoff=0.1496 m ³ /s 91.3 m ³
Pond 2P: Building B Cistern	Peak Elev=1.489 m Storage=11.9 m ³ Inflow=0.0220 m ³ /s 13.4 m ³ Outflow=0.0038 m ³ /s 13.4 m ³
Pond C: Building A Cistern	Peak Elev=4.053 m Storage=81.1 m ³ Inflow=0.1496 m ³ /s 91.3 m ³ Outflow=0.0190 m ³ /s 91.3 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0293 m ³ /s 97.6 m ³ Primary=0.0293 m ³ /s 97.6 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0038 m ³ /s 13.4 m ³ Primary=0.0038 m ³ /s 13.4 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 111.0 m³ Average Runoff Depth = 34 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0103 m³/s @ 0.17 hrs, Volume= 6.3 m³, Depth= 38 mm

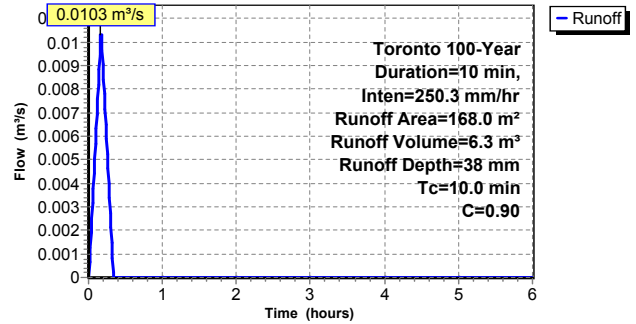
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 100-Year Duration=10 min, Inten=250.3 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0220 m³/s @ 0.17 hrs, Volume= 13.4 m³, Depth= 38 mm

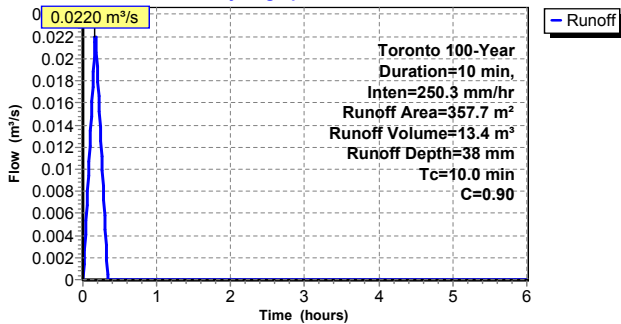
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 100-Year Duration=10 min, Inten=250.3 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.1496 m³/s @ 0.17 hrs, Volume= 91.3 m³, Depth= 34 mm

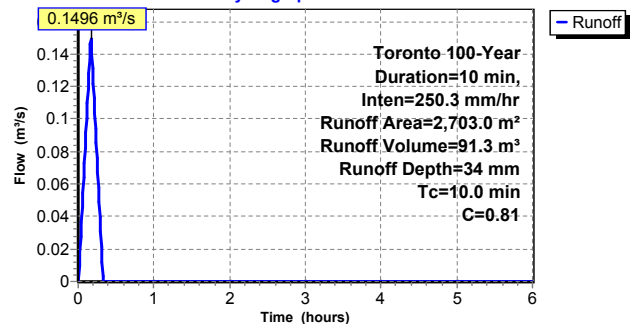
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 100-Year Duration=10 min, Inten=250.3 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 38 mm for 100-Year event
 Inflow = 0.0220 m³/s @ 0.17 hrs, Volume= 13.4 m³
 Outflow = 0.0038 m³/s @ 0.31 hrs, Volume= 13.4 m³, Atten= 83%, Lag= 8.3 min
 Primary = 0.0038 m³/s @ 0.31 hrs, Volume= 13.4 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 1.489 m @ 0.31 hrs Surf.Area= 8.0 m² Storage= 11.9 m³ (10.5 m³ above start)

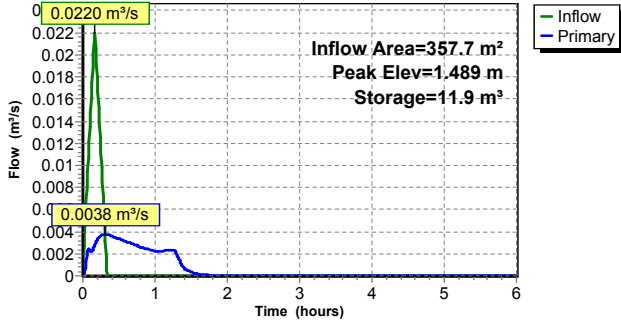
Plug-Flow detention time= 35.2 min calculated for 12.0 m³ (89% of inflow)
 Center-of-Mass det. time= 30.6 min (40.6 - 10.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0038 m³/s @ 0.31 hrs HW=1.489 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0038 m³/s)

Pond 2P: Building B Cistern
 Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 34 mm for 100-Year event
 Inflow = 0.1496 m³/s @ 0.17 hrs, Volume= 91.3 m³
 Outflow = 0.0190 m³/s @ 0.05 hrs, Volume= 91.3 m³, Atten= 87%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.05 hrs, Volume= 91.3 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 4.053 m @ 0.31 hrs Surf.Area= 20.0 m² Storage= 81.1 m³ (71.1 m³ above start)

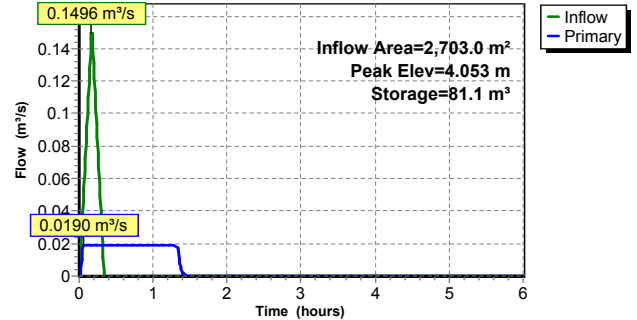
Plug-Flow detention time= 37.0 min calculated for 81.3 m³ (89% of inflow)
 Center-of-Mass det. time= 31.7 min (41.7 - 10.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.05 hrs HW=0.628 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern
 Hydrograph

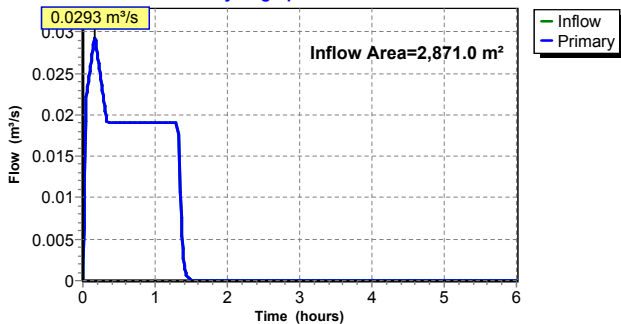


Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 34 mm for 100-Year event
 Inflow = 0.0293 m³/s @ 0.17 hrs, Volume= 97.6 m³
 Primary = 0.0293 m³/s @ 0.17 hrs, Volume= 97.6 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)
 Hydrograph

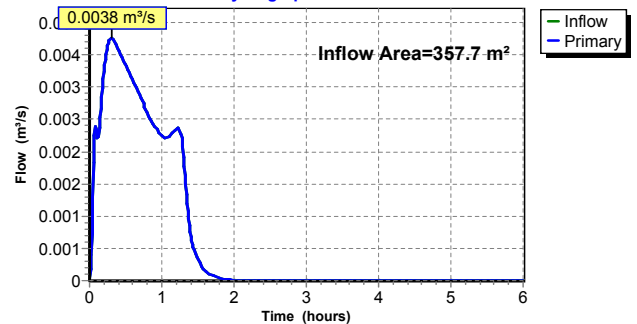


Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 38 mm for 100-Year event
 Inflow = 0.0038 m³/s @ 0.31 hrs, Volume= 13.4 m³
 Primary = 0.0038 m³/s @ 0.31 hrs, Volume= 13.4 m³, Atten= 0%, Lag= 0.0 min

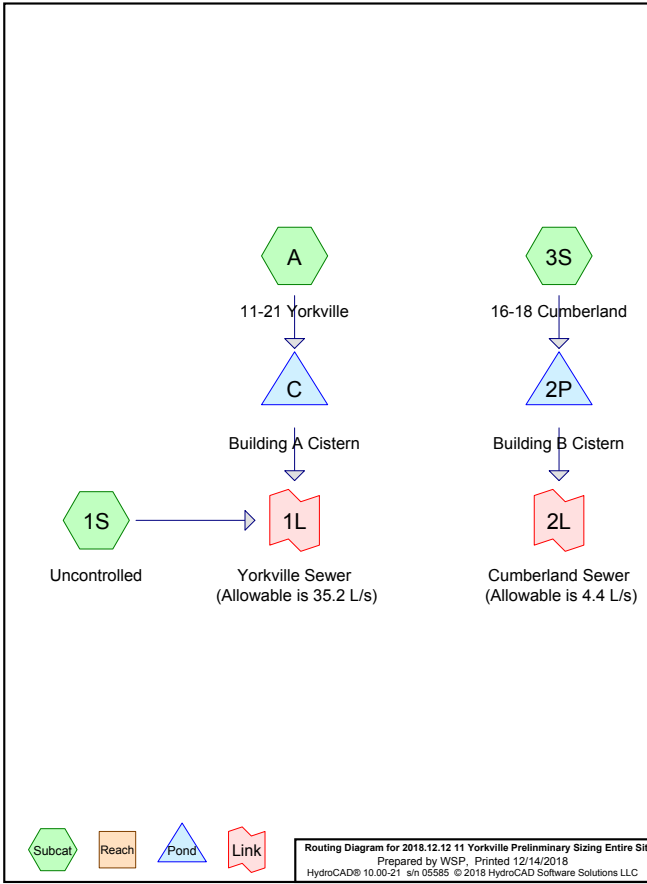
Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)
 Hydrograph



Area Listing (all nodes)

Area (sq-meters)	C	Description (subcatchment-numbers)
822.0	0.90	At-Grade Impervious (A)
50.4	0.90	At-grade Impervious (3S)
475.0	0.45	Green Roof (A)
1,663.3	0.90	Impervious Roof (3S, A)
50.0	0.25	Landscape (A)
168.0	0.90	Uncontrolled (1S)
3,228.7	0.82	TOTAL AREA



Soil Listing (all nodes)

Area (sq-meters)	Soil Group	Subcatchment Numbers
0.0	HSG A	
0.0	HSG B	
0.0	HSG C	
0.0	HSG D	
3,228.7	Other	1S, 3S, A
3,228.7		TOTAL AREA

Ground Covers (all nodes)

HSG-A (sq-meters)	HSG-B (sq-meters)	HSG-C (sq-meters)	HSG-D (sq-meters)	Other (sq-meters)	Total (sq-meters)	Ground Cover	Subc Num
0.0	0.0	0.0	0.0	822.0	822.0	At-Grade Impervious	
0.0	0.0	0.0	0.0	50.4	50.4	At-grade Impervious	
0.0	0.0	0.0	0.0	475.0	475.0	Green Roof Impervious	
0.0	0.0	0.0	0.0	1,663.3	1,663.3	Impervious Roof	
0.0	0.0	0.0	0.0	50.0	50.0	Landscape	
0.0	0.0	0.0	0.0	168.0	168.0	Uncontrolled	
0.0	0.0	0.0	0.0	3,228.7	3,228.7	TOTAL AREA	

Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=16 mm Tc=10.0 min C=0.90 Runoff=0.0021 m ³ /s 2.6 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=16 mm Tc=10.0 min C=0.90 Runoff=0.0044 m ³ /s 5.6 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=14 mm Tc=10.0 min C=0.81 Runoff=0.0301 m ³ /s 37.9 m ³
Pond 2P: Building B Cistern	Peak Elev=0.503 m Storage=4.0 m ³ Inflow=0.0044 m ³ /s 5.6 m ³ Outflow=0.0024 m ³ /s 5.6 m ³
Pond C: Building A Cistern	Peak Elev=1.074 m Storage=21.5 m ³ Inflow=0.0301 m ³ /s 37.9 m ³ Outflow=0.0190 m ³ /s 37.9 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0211 m ³ /s 40.5 m ³ Primary=0.0211 m ³ /s 40.5 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0024 m ³ /s 5.6 m ³ Primary=0.0024 m ³ /s 5.6 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 46.1 m³ Average Runoff Depth = 14 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

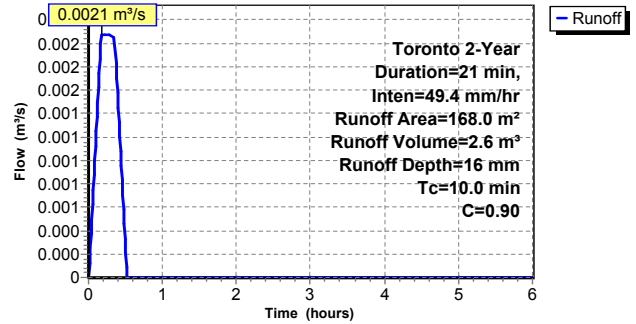
Runoff = 0.0021 m³/s @ 0.17 hrs, Volume= 2.6 m³, Depth= 16 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 2-Year Duration=21 min, Inten=49.4 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

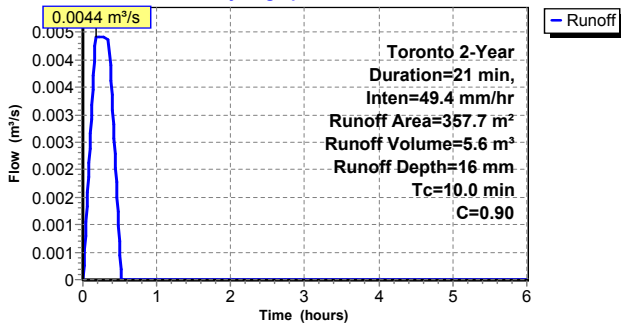
Runoff = 0.0044 m³/s @ 0.17 hrs, Volume= 5.6 m³, Depth= 16 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 2-Year Duration=21 min, Inten=49.4 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

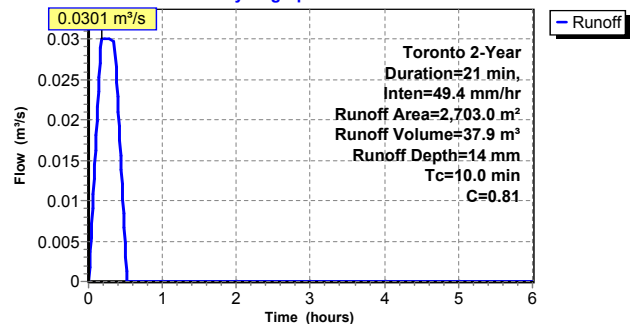
Runoff = 0.0301 m³/s @ 0.17 hrs, Volume= 37.9 m³, Depth= 14 mm

Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 2-Year Duration=21 min, Inten=49.4 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 16 mm for 2-Year event
 Inflow = 0.0044 m³/s @ 0.17 hrs, Volume= 5.6 m³
 Outflow = 0.0024 m³/s @ 0.22 hrs, Volume= 5.6 m³, Atten= 46%, Lag= 3.0 min
 Primary = 0.0024 m³/s @ 0.22 hrs, Volume= 5.6 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 0.503 m @ 0.43 hrs Surf.Area= 8.0 m² Storage= 4.0 m³ (2.6 m³ above start)

Plug-Flow detention time= 20.8 min calculated for 4.1 m³ (74% of inflow)
 Center-of-Mass det. time= 12.1 min (27.6 - 15.5)

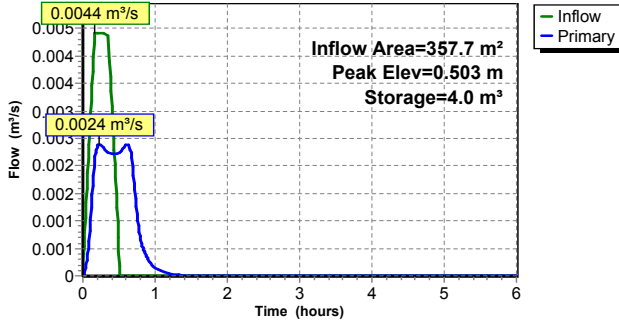
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0024 m³/s @ 0.22 hrs HW=0.340 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0024 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 14 mm for 2-Year event
 Inflow = 0.0301 m³/s @ 0.17 hrs, Volume= 37.9 m³
 Outflow = 0.0190 m³/s @ 0.14 hrs, Volume= 37.9 m³, Atten= 37%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.14 hrs, Volume= 37.9 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 1.074 m @ 0.41 hrs Surf.Area= 20.0 m² Storage= 21.5 m³ (11.5 m³ above start)

Plug-Flow detention time= 13.3 min calculated for 27.8 m³ (73% of inflow)
 Center-of-Mass det. time= 5.8 min (21.3 - 15.5)

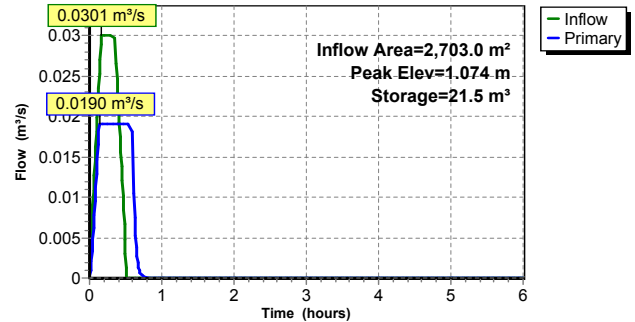
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.14 hrs HW=0.606 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



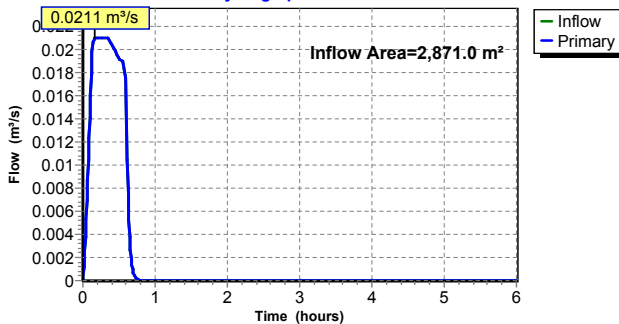
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 14 mm for 2-Year event
 Inflow = 0.0211 m³/s @ 0.17 hrs, Volume= 40.5 m³
 Primary = 0.0211 m³/s @ 0.17 hrs, Volume= 40.5 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



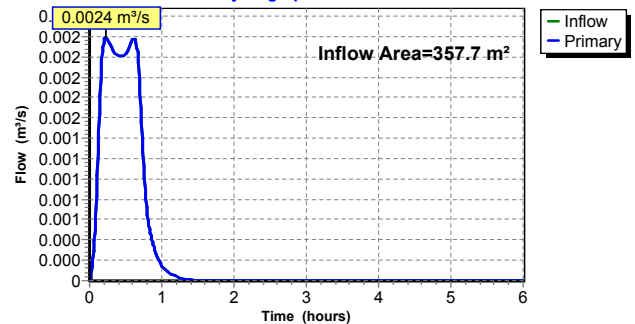
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 16 mm for 2-Year event
 Inflow = 0.0024 m³/s @ 0.22 hrs, Volume= 5.6 m³
 Primary = 0.0024 m³/s @ 0.22 hrs, Volume= 5.6 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=23 mm Tc=10.0 min C=0.90 Runoff=0.0031 m ³ /s 3.9 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=23 mm Tc=10.0 min C=0.90 Runoff=0.0066 m ³ /s 8.3 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=21 mm Tc=10.0 min C=0.81 Runoff=0.0446 m ³ /s 56.2 m ³
Pond 2P: Building B Cistern	Peak Elev.=0.790 m Storage=6.3 m ³ Inflow=0.0066 m ³ /s 8.3 m ³ Outflow=0.0026 m ³ /s 8.3 m ³
Pond C: Building A Cistern	Peak Elev.=1.866 m Storage=37.3 m ³ Inflow=0.0446 m ³ /s 56.2 m ³ Outflow=0.0190 m ³ /s 56.2 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0221 m ³ /s 60.1 m ³ Primary=0.0221 m ³ /s 60.1 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0026 m ³ /s 8.3 m ³ Primary=0.0026 m ³ /s 8.3 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 68.3 m³ Average Runoff Depth = 21 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0031 m³/s @ 0.17 hrs, Volume= 3.9 m³, Depth= 23 mm

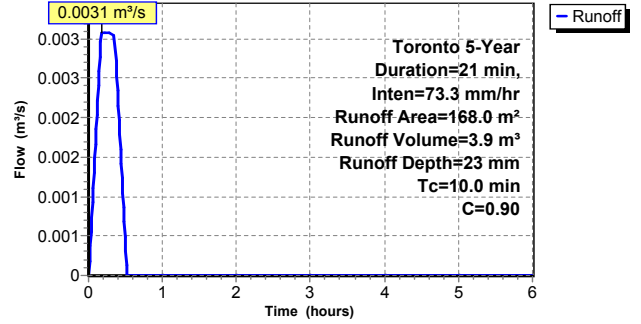
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 5-Year Duration=21 min, Inten=73.3 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0066 m³/s @ 0.17 hrs, Volume= 8.3 m³, Depth= 23 mm

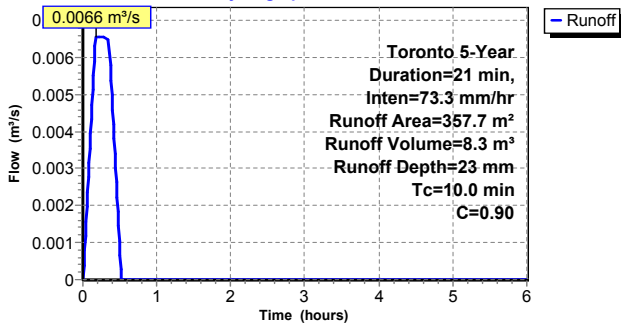
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 5-Year Duration=21 min, Inten=73.3 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.0446 m³/s @ 0.17 hrs, Volume= 56.2 m³, Depth= 21 mm

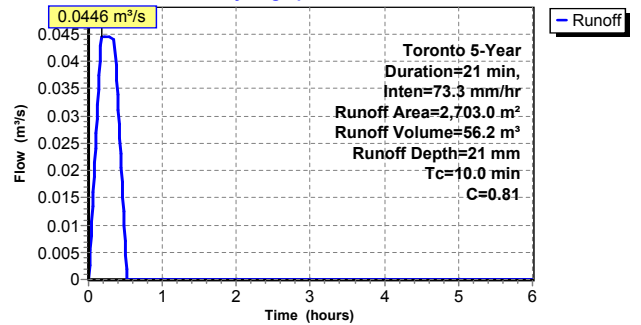
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 5-Year Duration=21 min, Inten=73.3 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 23 mm for 5-Year event
 Inflow = 0.0066 m³/s @ 0.17 hrs, Volume= 8.3 m³
 Outflow = 0.0026 m³/s @ 0.45 hrs, Volume= 8.3 m³, Atten= 60%, Lag= 16.8 min
 Primary = 0.0026 m³/s @ 0.45 hrs, Volume= 8.3 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 0.790 m @ 0.45 hrs Surf.Area= 8.0 m² Storage= 6.3 m³ (4.9 m³ above start)

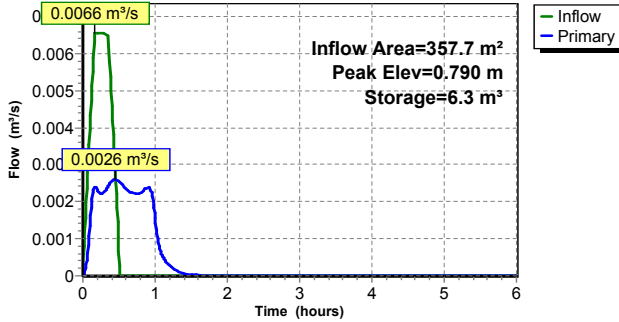
Plug-Flow detention time= 26.9 min calculated for 6.8 m³ (83% of inflow)
 Center-of-Mass det. time= 19.5 min (35.0 - 15.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0026 m³/s @ 0.45 hrs HW=0.790 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0026 m³/s)

Pond 2P: Building B Cistern
 Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 21 mm for 5-Year event
 Inflow = 0.0446 m³/s @ 0.17 hrs, Volume= 56.2 m³
 Outflow = 0.0190 m³/s @ 0.10 hrs, Volume= 56.2 m³, Atten= 57%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.10 hrs, Volume= 56.2 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 1.866 m @ 0.45 hrs Surf.Area= 20.0 m² Storage= 37.3 m³ (27.3 m³ above start)

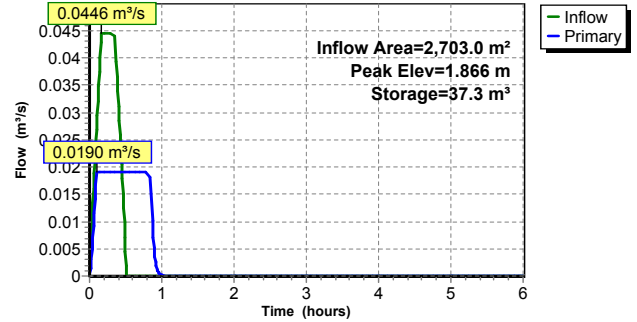
Plug-Flow detention time= 19.2 min calculated for 46.1 m³ (82% of inflow)
 Center-of-Mass det. time= 12.7 min (28.2 - 15.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.10 hrs HW=0.601 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern
 Hydrograph

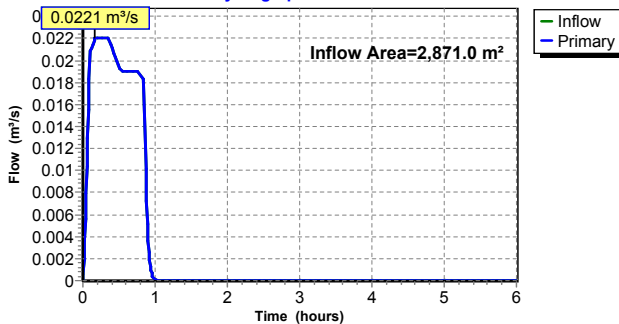


Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 21 mm for 5-Year event
 Inflow = 0.0221 m³/s @ 0.17 hrs, Volume= 60.1 m³
 Primary = 0.0221 m³/s @ 0.17 hrs, Volume= 60.1 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)
 Hydrograph

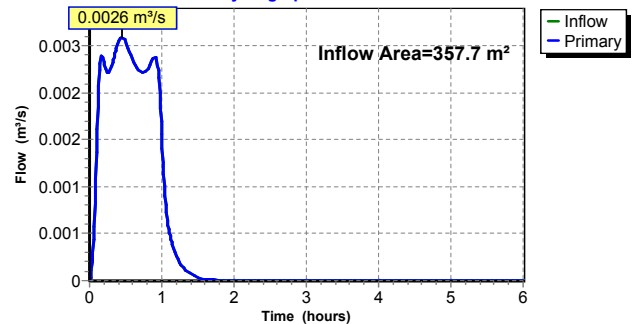


Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 23 mm for 5-Year event
 Inflow = 0.0026 m³/s @ 0.45 hrs, Volume= 8.3 m³
 Primary = 0.0026 m³/s @ 0.45 hrs, Volume= 8.3 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)
 Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=28 mm Tc=10.0 min C=0.90 Runoff=0.0038 m ³ /s 4.7 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=28 mm Tc=10.0 min C=0.90 Runoff=0.0080 m ³ /s 10.1 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=25 mm Tc=10.0 min C=0.81 Runoff=0.0545 m ³ /s 68.7 m ³
Pond 2P: Building B Cistern	Peak Elev=0.978 m Storage=7.8 m ³ Inflow=0.0080 m ³ /s 10.1 m ³ Outflow=0.0029 m ³ /s 10.1 m ³
Pond C: Building A Cistern	Peak Elev=2.443 m Storage=48.9 m ³ Inflow=0.0545 m ³ /s 68.7 m ³ Outflow=0.0190 m ³ /s 68.7 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0228 m ³ /s 73.4 m ³ Primary=0.0228 m ³ /s 73.4 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0029 m ³ /s 10.1 m ³ Primary=0.0029 m ³ /s 10.1 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 83.5 m³ Average Runoff Depth = 26 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0038 m³/s @ 0.17 hrs, Volume= 4.7 m³, Depth= 28 mm

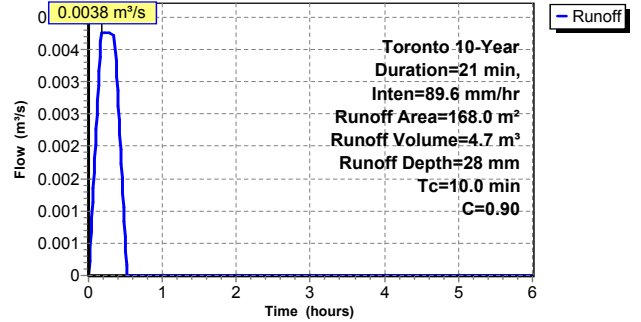
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 10-Year Duration=21 min, Inten=89.6 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0080 m³/s @ 0.17 hrs, Volume= 10.1 m³, Depth= 28 mm

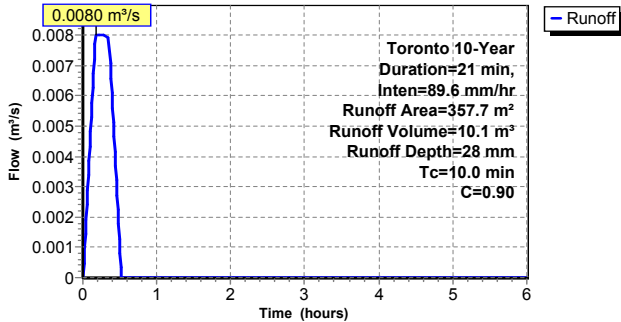
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 10-Year Duration=21 min, Inten=89.6 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.0545 m³/s @ 0.17 hrs, Volume= 68.7 m³, Depth= 25 mm

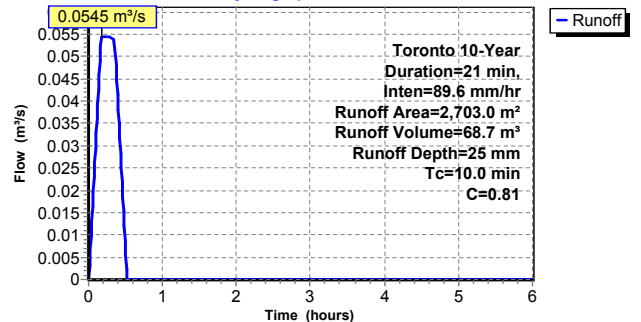
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 10-Year Duration=21 min, Inten=89.6 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 28 mm for 10-Year event
 Inflow = 0.0080 m³/s @ 0.17 hrs, Volume= 10.1 m³
 Outflow = 0.0029 m³/s @ 0.46 hrs, Volume= 10.1 m³, Atten= 63%, Lag= 17.1 min
 Primary = 0.0029 m³/s @ 0.46 hrs, Volume= 10.1 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 0.978 m @ 0.46 hrs Surf.Area= 8.0 m² Storage= 7.8 m³ (6.4 m³ above start)

Plug-Flow detention time= 29.9 min calculated for 8.7 m³ (86% of inflow)
 Center-of-Mass det. time= 23.2 min (38.7 - 15.5)

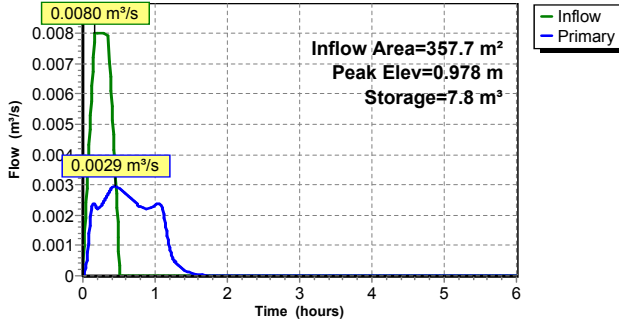
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0029 m³/s @ 0.46 hrs HW=0.978 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0029 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 25 mm for 10-Year event
 Inflow = 0.0545 m³/s @ 0.17 hrs, Volume= 68.7 m³
 Outflow = 0.0190 m³/s @ 0.09 hrs, Volume= 68.7 m³, Atten= 65%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.09 hrs, Volume= 68.7 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 2.443 m @ 0.46 hrs Surf.Area= 20.0 m² Storage= 48.9 m³ (38.9 m³ above start)

Plug-Flow detention time= 23.9 min calculated for 58.6 m³ (85% of inflow)
 Center-of-Mass det. time= 17.7 min (33.2 - 15.5)

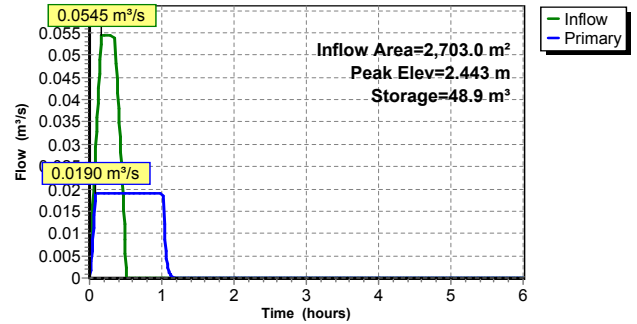
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.09 hrs HW=0.607 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



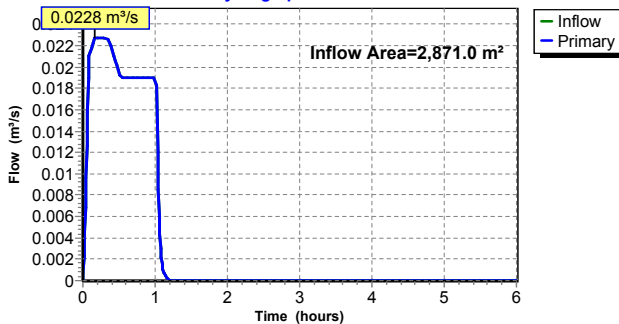
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 26 mm for 10-Year event
 Inflow = 0.0228 m³/s @ 0.17 hrs, Volume= 73.4 m³
 Primary = 0.0228 m³/s @ 0.17 hrs, Volume= 73.4 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



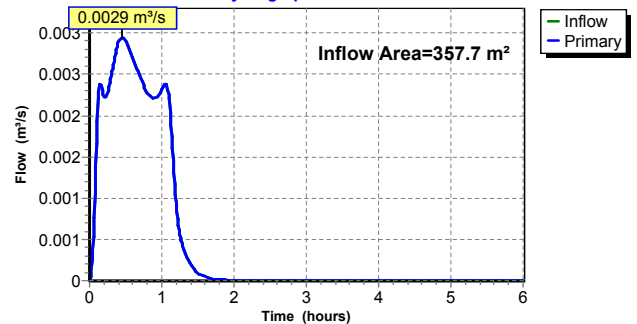
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 28 mm for 10-Year event
 Inflow = 0.0029 m³/s @ 0.46 hrs, Volume= 10.1 m³
 Primary = 0.0029 m³/s @ 0.46 hrs, Volume= 10.1 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=33 mm Tc=10.0 min C=0.90 Runoff=0.0044 m ³ /s 5.5 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=33 mm Tc=10.0 min C=0.90 Runoff=0.0094 m ³ /s 11.8 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=30 mm Tc=10.0 min C=0.81 Runoff=0.0637 m ³ /s 80.2 m ³
Pond 2P: Building B Cistern	Peak Elev=1.152 m Storage=9.2 m ³ Inflow=0.0094 m ³ /s 11.8 m ³ Outflow=0.0032 m ³ /s 11.8 m ³
Pond C: Building A Cistern	Peak Elev=2.988 m Storage=59.8 m ³ Inflow=0.0637 m ³ /s 80.2 m ³ Outflow=0.0190 m ³ /s 80.2 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0234 m ³ /s 85.8 m ³ Primary=0.0234 m ³ /s 85.8 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0032 m ³ /s 11.8 m ³ Primary=0.0032 m ³ /s 11.8 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 97.6 m³ Average Runoff Depth = 30 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0044 m³/s @ 0.17 hrs, Volume= 5.5 m³, Depth= 33 mm

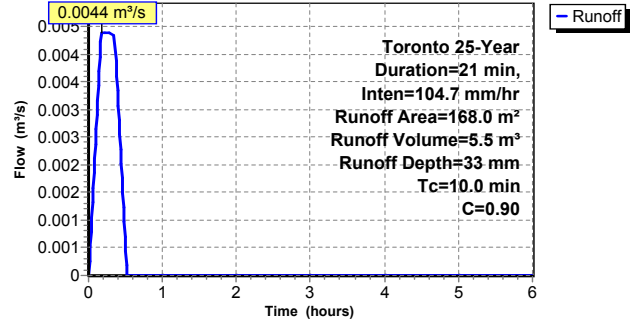
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 25-Year Duration=21 min, Inten=104.7 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0094 m³/s @ 0.17 hrs, Volume= 11.8 m³, Depth= 33 mm

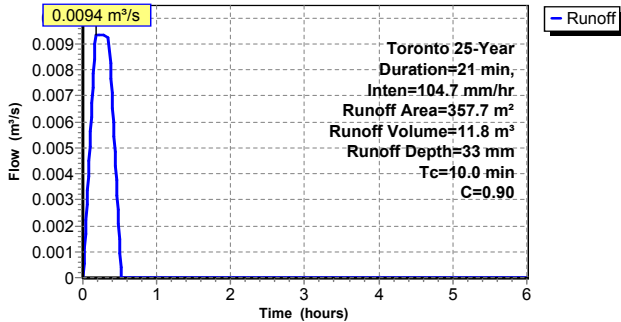
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 25-Year Duration=21 min, Inten=104.7 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.0637 m³/s @ 0.17 hrs, Volume= 80.2 m³, Depth= 30 mm

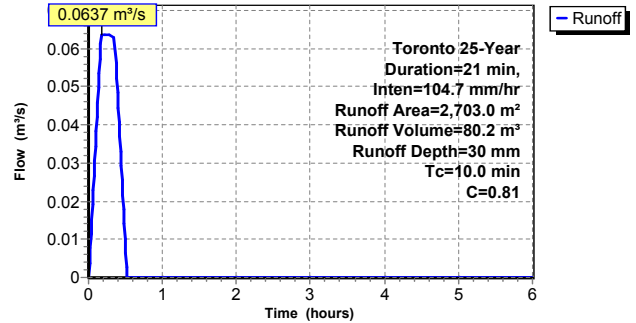
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 25-Year Duration=21 min, Inten=104.7 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 33 mm for 25-Year event
 Inflow = 0.0094 m³/s @ 0.17 hrs, Volume= 11.8 m³
 Outflow = 0.0032 m³/s @ 0.46 hrs, Volume= 11.8 m³, Atten= 65%, Lag= 17.3 min
 Primary = 0.0032 m³/s @ 0.46 hrs, Volume= 11.8 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 1.152 m @ 0.46 hrs Surf.Area= 8.0 m² Storage= 9.2 m³ (7.8 m³ above start)

Plug-Flow detention time= 32.3 min calculated for 10.4 m³ (88% of inflow)
 Center-of-Mass det. time= 26.2 min (41.7 - 15.5)

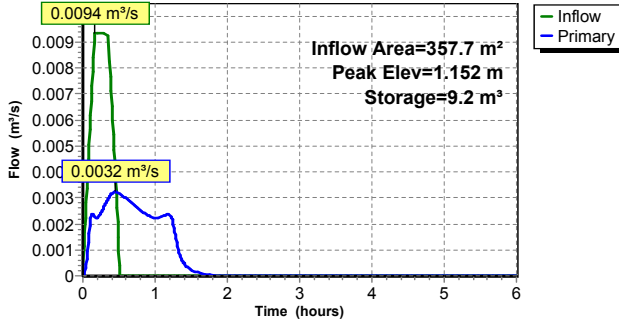
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0032 m³/s @ 0.46 hrs HW=1.152 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0032 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 30 mm for 25-Year event
 Inflow = 0.0637 m³/s @ 0.17 hrs, Volume= 80.2 m³
 Outflow = 0.0190 m³/s @ 0.08 hrs, Volume= 80.2 m³, Atten= 70%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.08 hrs, Volume= 80.2 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 2.988 m @ 0.47 hrs Surf.Area= 20.0 m² Storage= 59.8 m³ (49.8 m³ above start)

Plug-Flow detention time= 28.6 min calculated for 70.2 m³ (88% of inflow)
 Center-of-Mass det. time= 22.5 min (38.0 - 15.5)

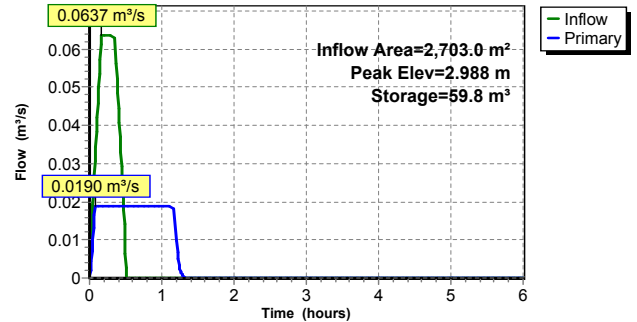
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.08 hrs HW=0.606 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



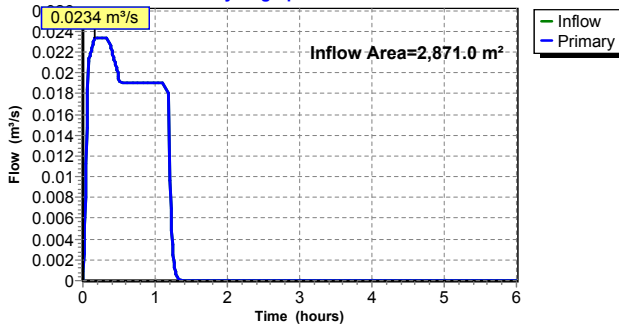
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 30 mm for 25-Year event
 Inflow = 0.0234 m³/s @ 0.17 hrs, Volume= 85.8 m³
 Primary = 0.0234 m³/s @ 0.17 hrs, Volume= 85.8 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



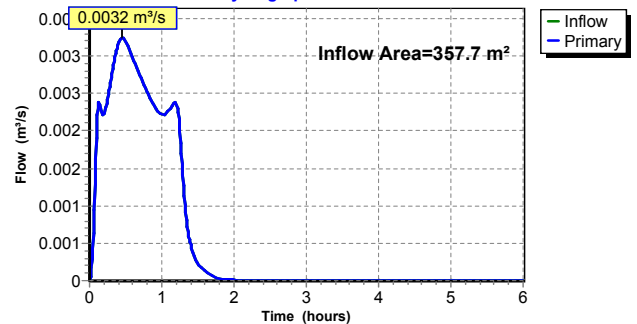
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 33 mm for 25-Year event
 Inflow = 0.0032 m³/s @ 0.46 hrs, Volume= 11.8 m³
 Primary = 0.0032 m³/s @ 0.46 hrs, Volume= 11.8 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=39 mm Tc=10.0 min C=0.90 Runoff=0.0052 m ³ /s 6.6 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=39 mm Tc=10.0 min C=0.90 Runoff=0.0111 m ³ /s 14.0 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=35 mm Tc=10.0 min C=0.81 Runoff=0.0754 m ³ /s 95.0 m ³
Pond 2P: Building B Cistern	Peak Elev=1.376 m Storage=11.0 m ³ Inflow=0.0111 m ³ /s 14.0 m ³ Outflow=0.0036 m ³ /s 14.0 m ³
Pond C: Building A Cistern	Peak Elev=3.695 m Storage=73.9 m ³ Inflow=0.0754 m ³ /s 95.0 m ³ Outflow=0.0190 m ³ /s 95.0 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0242 m ³ /s 101.5 m ³ Primary=0.0242 m ³ /s 101.5 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0036 m ³ /s 14.0 m ³ Primary=0.0036 m ³ /s 14.0 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 115.5 m³ Average Runoff Depth = 36 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0052 m³/s @ 0.17 hrs, Volume= 6.6 m³, Depth= 39 mm

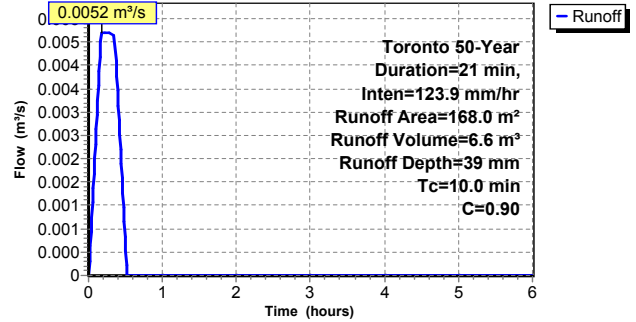
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 50-Year Duration=21 min, Inten=123.9 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0111 m³/s @ 0.17 hrs, Volume= 14.0 m³, Depth= 39 mm

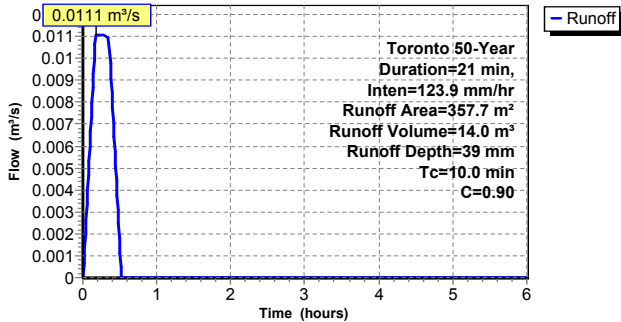
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 50-Year Duration=21 min, Inten=123.9 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.0754 m³/s @ 0.17 hrs, Volume= 95.0 m³, Depth= 35 mm

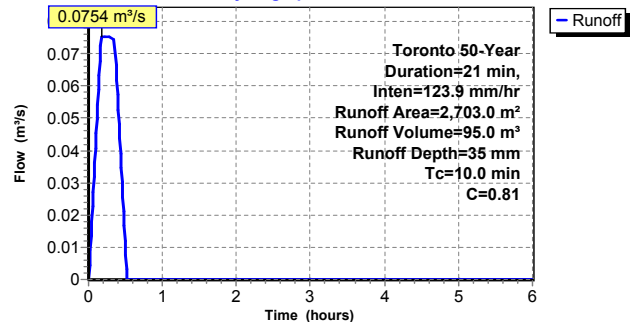
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 50-Year Duration=21 min, Inten=123.9 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 39 mm for 50-Year event
 Inflow = 0.0111 m³/s @ 0.17 hrs, Volume= 14.0 m³
 Outflow = 0.0036 m³/s @ 0.46 hrs, Volume= 14.0 m³, Atten= 67%, Lag= 17.5 min
 Primary = 0.0036 m³/s @ 0.46 hrs, Volume= 14.0 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 1.376 m @ 0.46 hrs Surf.Area= 8.0 m² Storage= 11.0 m³ (9.6 m³ above start)

Plug-Flow detention time= 35.1 min calculated for 12.5 m³ (90% of inflow)
 Center-of-Mass det. time= 29.5 min (45.0 - 15.5)

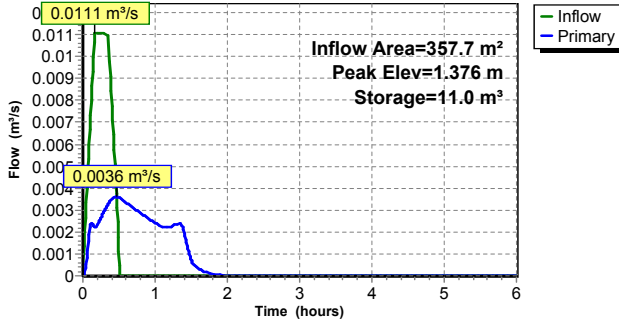
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0036 m³/s @ 0.46 hrs HW=1.376 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0036 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 35 mm for 50-Year event
 Inflow = 0.0754 m³/s @ 0.17 hrs, Volume= 95.0 m³
 Outflow = 0.0190 m³/s @ 0.07 hrs, Volume= 95.0 m³, Atten= 75%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.07 hrs, Volume= 95.0 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 3.695 m @ 0.47 hrs Surf.Area= 20.0 m² Storage= 73.9 m³ (63.9 m³ above start)

Plug-Flow detention time= 34.4 min calculated for 85.0 m³ (89% of inflow)
 Center-of-Mass det. time= 28.7 min (44.2 - 15.5)

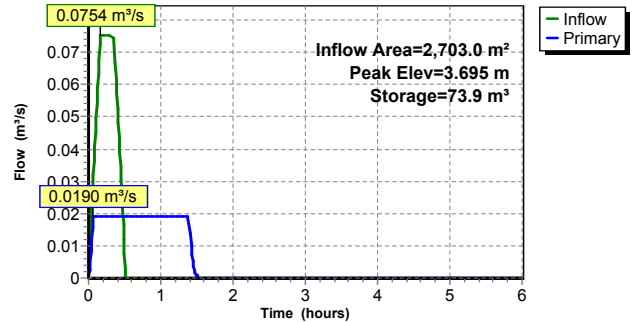
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.07 hrs HW=0.604 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



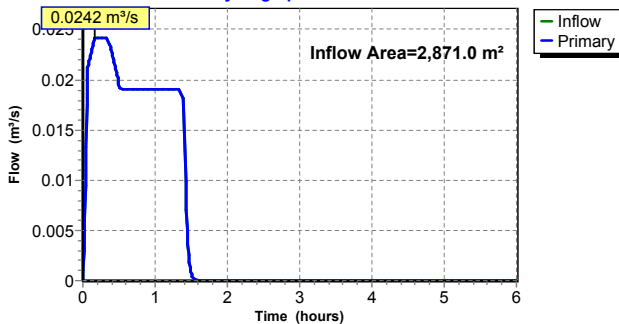
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 35 mm for 50-Year event
 Inflow = 0.0242 m³/s @ 0.17 hrs, Volume= 101.5 m³
 Primary = 0.0242 m³/s @ 0.17 hrs, Volume= 101.5 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



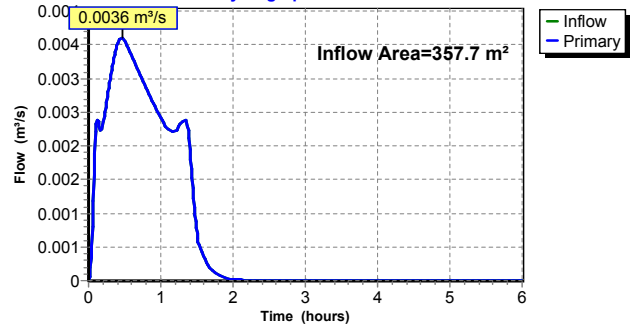
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 39 mm for 50-Year event
 Inflow = 0.0036 m³/s @ 0.46 hrs, Volume= 14.0 m³
 Primary = 0.0036 m³/s @ 0.46 hrs, Volume= 14.0 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



Time span=0.00-6.00 hrs, dt=0.01 hrs, 601 points
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Uncontrolled	Runoff Area=168.0 m ² 0.00% Impervious Runoff Depth=44 mm Tc=10.0 min C=0.90 Runoff=0.0058 m ³ /s 7.3 m ³
Subcatchment 3S: 16-18 Cumberland	Runoff Area=357.7 m ² 0.00% Impervious Runoff Depth=44 mm Tc=10.0 min C=0.90 Runoff=0.0124 m ³ /s 15.6 m ³
Subcatchment A: 11-21 Yorkville	Runoff Area=2,703.0 m ² 0.00% Impervious Runoff Depth=39 mm Tc=10.0 min C=0.81 Runoff=0.0841 m ³ /s 106.0 m ³
Pond 2P: Building B Cistern	Peak Elev=1.545 m Storage=12.4 m ³ Inflow=0.0124 m ³ /s 15.6 m ³ Outflow=0.0039 m ³ /s 15.6 m ³
Pond C: Building A Cistern	Peak Elev=4.228 m Storage=84.6 m ³ Inflow=0.0841 m ³ /s 106.0 m ³ Outflow=0.0190 m ³ /s 106.0 m ³
Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)	Inflow=0.0248 m ³ /s 113.3 m ³ Primary=0.0248 m ³ /s 113.3 m ³
Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)	Inflow=0.0039 m ³ /s 15.6 m ³ Primary=0.0039 m ³ /s 15.6 m ³

Total Runoff Area = 3,228.7 m² Runoff Volume = 128.9 m³ Average Runoff Depth = 40 mm
 100.00% Pervious = 3,228.7 m² 0.00% Impervious = 0.0 m²

Summary for Subcatchment 1S: Uncontrolled

Runoff = 0.0058 m³/s @ 0.17 hrs, Volume= 7.3 m³, Depth= 44 mm

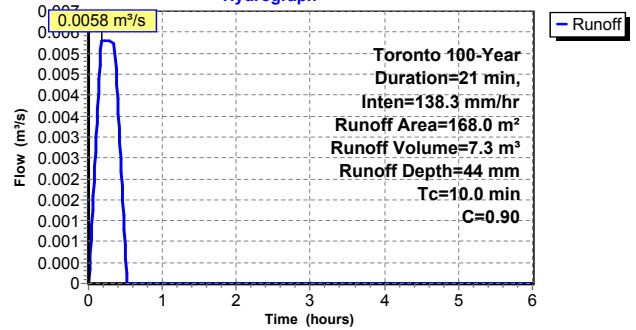
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 100-Year Duration=21 min, Inten=138.3 mm/hr

Area (m ²)	C	Description
168.0	0.90	Uncontrolled
168.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 1S: Uncontrolled

Hydrograph



Summary for Subcatchment 3S: 16-18 Cumberland

Runoff = 0.0124 m³/s @ 0.17 hrs, Volume= 15.6 m³, Depth= 44 mm

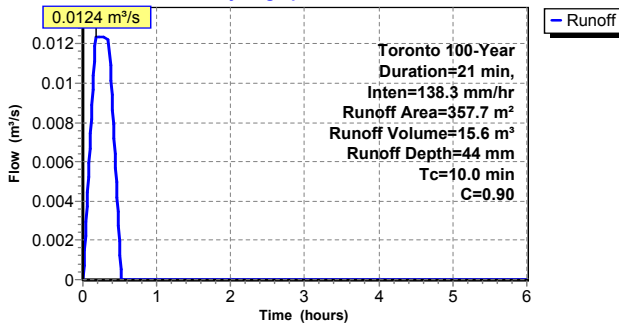
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 100-Year Duration=21 min, Inten=138.3 mm/hr

Area (m ²)	C	Description
307.3	0.90	Impervious Roof
50.4	0.90	At-grade Impervious
357.7	0.90	Weighted Average
357.7		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment 3S: 16-18 Cumberland

Hydrograph



Summary for Subcatchment A: 11-21 Yorkville

Runoff = 0.0841 m³/s @ 0.17 hrs, Volume= 106.0 m³, Depth= 39 mm

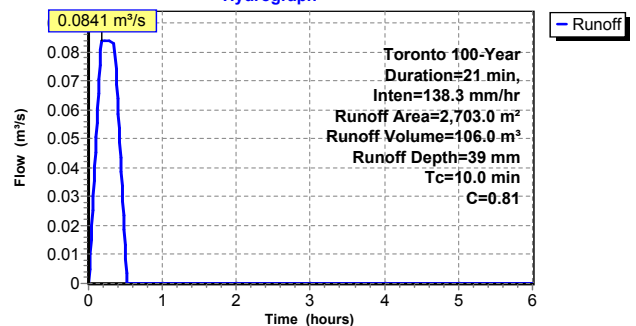
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Toronto 100-Year Duration=21 min, Inten=138.3 mm/hr

Area (m ²)	C	Description
475.0	0.45	Green Roof
1,356.0	0.90	Impervious Roof
822.0	0.90	At-Grade Impervious
50.0	0.25	Landscape
2,703.0	0.81	Weighted Average
2,703.0		100.00% Pervious Area

Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m ³ /s)	Description
10.0					Direct Entry,

Subcatchment A: 11-21 Yorkville

Hydrograph



Summary for Pond 2P: Building B Cistern

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 44 mm for 100-Year event
 Inflow = 0.0124 m³/s @ 0.17 hrs, Volume= 15.6 m³
 Outflow = 0.0039 m³/s @ 0.46 hrs, Volume= 15.6 m³, Atten= 69%, Lag= 17.7 min
 Primary = 0.0039 m³/s @ 0.46 hrs, Volume= 15.6 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs
 Starting Elev= 0.180 m Surf.Area= 8.0 m² Storage= 1.4 m³
 Peak Elev= 1.545 m @ 0.46 hrs Surf.Area= 8.0 m² Storage= 12.4 m³ (10.9 m³ above start)

Plug-Flow detention time= 36.7 min calculated for 14.1 m³ (91% of inflow)
 Center-of-Mass det. time= 31.7 min (47.2 - 15.5)

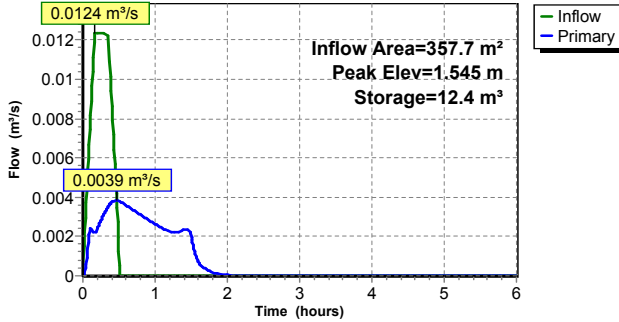
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	16.0 m ³	8.00 mW x 1.00 mL x 2.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.180 m	Reg-U-Flo SXH 3.0-in Metric - Extended

Primary OutFlow Max=0.0039 m³/s @ 0.46 hrs HW=1.545 m (Free Discharge)
 ←1=Reg-U-Flo SXH 3.0-in Metric - Extended (Custom Controls 0.0039 m³/s)

Pond 2P: Building B Cistern

Hydrograph



Summary for Pond C: Building A Cistern

Inflow Area = 2,703.0 m², 0.00% Impervious, Inflow Depth = 39 mm for 100-Year event
 Inflow = 0.0841 m³/s @ 0.17 hrs, Volume= 106.0 m³
 Outflow = 0.0190 m³/s @ 0.07 hrs, Volume= 106.0 m³, Atten= 77%, Lag= 0.0 min
 Primary = 0.0190 m³/s @ 0.07 hrs, Volume= 106.0 m³

Routing by Stor-Ind method, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs / 3
 Starting Elev= 0.500 m Surf.Area= 20.0 m² Storage= 10.0 m³
 Peak Elev= 4.228 m @ 0.48 hrs Surf.Area= 20.0 m² Storage= 84.6 m³ (74.6 m³ above start)

Plug-Flow detention time= 39.0 min calculated for 96.0 m³ (91% of inflow)
 Center-of-Mass det. time= 33.3 min (48.8 - 15.5)

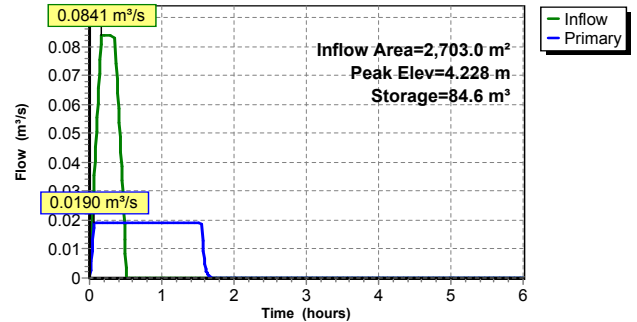
Volume	Invert	Avail.Storage	Storage Description
#1	0.000 m	240.0 m ³	20.00 mW x 1.00 mL x 12.00 mH Prismatoid

Device	Routing	Invert	Outlet Devices
#1	Primary	0.500 m	Pump Discharges@0.000 m Flow (l/min)= 0.0 912.0 1,140.0 Head (meters)= 12.000 6.000 0.000

Primary OutFlow Max=0.0190 m³/s @ 0.07 hrs HW=0.617 m (Free Discharge)
 ←1=Pump (Pump Controls 0.0190 m³/s)

Pond C: Building A Cistern

Hydrograph



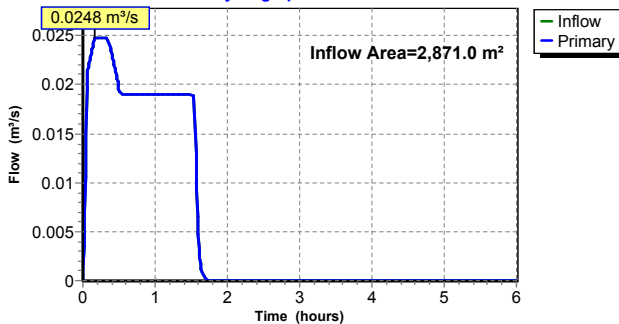
Summary for Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Inflow Area = 2,871.0 m², 0.00% Impervious, Inflow Depth = 39 mm for 100-Year event
 Inflow = 0.0248 m³/s @ 0.17 hrs, Volume= 113.3 m³
 Primary = 0.0248 m³/s @ 0.17 hrs, Volume= 113.3 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 1L: Yorkville Sewer (Allowable is 35.2 L/s)

Hydrograph



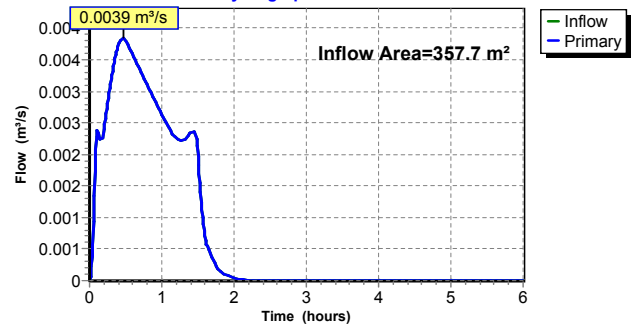
Summary for Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Inflow Area = 357.7 m², 0.00% Impervious, Inflow Depth = 44 mm for 100-Year event
 Inflow = 0.0039 m³/s @ 0.46 hrs, Volume= 15.6 m³
 Primary = 0.0039 m³/s @ 0.46 hrs, Volume= 15.6 m³, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-6.00 hrs, dt= 0.01 hrs

Link 2L: Cumberland Sewer (Allowable is 4.4 L/s)

Hydrograph



APPENDIX

C SUPPORTING STORMWATER MANAGEMENT DOCUMENTS

TERRAPLAN LANDSCAPE ARCHITECTS

PROJECT NUMBER	17-177	PROJECT NAME	11 Yorkville - green roof	TERRAPLAN LANDSCAPE ARCHITECTS
DATE	19-Mar-18	COMPLETED BY	Alex Forbes	

CALCULATIONS FOR WATER COLLECTED vs. WATER NEEDED				
GENERAL INFO	All measures are in Metric Refer to the 'Water Efficiency' section of the LEED Canada-NC 2009 Document Using the chart below please note the below			
Species Factor (Ks)	Species Factor is determined as follows:	Water needs: Low for drought plants, Average and High per plant water needs Shrubs & Grd Cover: Low = .2, Avg=.5, High=.7. Mixed .2, .5, .9. Turfgrass .6, .7, .8		
Density Factor (Kd)	Plant grouping:	Sparsely planted:	'Low' (0.5, shrubs, 0.6 mixed, 0.6 turf, and 0.6 Sedum mats)	
		Densely Planted:	'High' (1.0 shrubs, 1.3 mixed, 1.0 turf, and 1.0 Sedum Plugs)	
Microclimate Factor (Kmc)	Plant grouping exposure to wind, heat, reflected light:	NE / shaded:	'Low', see above	
		SW / hot and gets the summer wind:	'Ave or High'	
$Kl = Ks \times Kd \times Kmc$ $Etl = Kl \times 138.2 \text{ mm/ mth (5.44 ins/ mth) of July, highest ET rate (for Toronto and region)}$ <i>IE</i> can be Drip, Sprinkler (Spray) or Efficient Flow Nozzles $TPWA (L) = \text{area (m}^2) \times (Etl / IE)$				

WATER COLLECTION (if applicable)				
Cistern:	5mm Retention of Storm Water for Irrigation Purposes	3.000	m ³	X 3000.000

DESIGN CASE													
Landscape	Area	Species Factor	Density Factor	Microclimate	Kl	Etl July	IE	TPWA	TPWA	TPWA	TPWA	TPWA	
Type	m ²	Ks	Kd	Kmc			Drip (.9), Low flow (0.75), Spray (.625)	Average (liters)	May	June	July	August	Sept
Trees (Canopy Area)	0.0	0.5	1.0	0.5	0.250	34.550	0.625	0	0	0	0	0	0
Shrubs	0.0	0.4	1.1	1.3	0.572	79.050	0.625	0	0	0	0	0	0
Perennials	0.0	0.3	1.1	1.3	0.429	59.288	0.625	0	0	0	0	0	0
Mixed	0.0	0.2	1.3	0.5	0.130	17.966	0.625	0	0	0	0	0	0
Turfgrass	0.0	0.7	1.0	1.2	0.840	116.088	0.625	0	0	0	0	0	0
Sedum Mats	495.0	0.5	1.0	1.0	0.500	69.100	0.625	43,299	40,234	49,460	54,727	43,718	28,354
Total m²	495.0												
Subtotal (L) per month								43,299	40,234	49,460	54,727	43,718	28,354
Net potable water (L) from Design Case per week								10,825	10,058	12,365	13,682	10,930	7,088
Irrigation water use for 72 hours, (subtotal/7days)*3days								4,639	4,311	5,299	5,864	4,684	3,038
5mm Retention for Irrigation Purposes (see X above)								3000	3,000	3,000	3,000	3,000	3,000
AVERAGE WATER REMAINING IN CISTERN AFTER 72 HR (May-Sept)								0	0	0	0	0	0

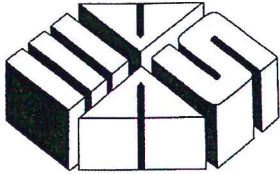
* Trees require 55 L per week or 220 L/ mth less rainfall, 6.4 sq m per tree

APPENDIX D3 – WATER REUSE MISTER DETAILS

Models	M20, M44, M88
Flow Rates	0.5 GPM, 1.1 GPM, 2.2 GPM
Dimensions	Length 35" / 88.9 cm w/ filtration Width 24" / 61 cm Height 15" / 38.1 cm
Weight	109 - 129 lbs 49 - 59 kg
Motor	TEFC .75HP (M20), 2HP (M44 - M88)
Power	110/115 volt standard 50/60Hz
Discharge	1000 psi factory setting 69 bar factory setting
Diagnostics	Inlet and outlet glycerin filled gauges Hour meter showing system usage On/Off/Auto switch
Filtration	Dual filtration, scale inhibiting
Enclosure	Polyethylene enclosure Sound absorption UV protection Superior aesthetics Dual layer protection for electrical control box Integrated oil pan for service



8.0 hours of misting application between hours of 10AM to 6:00PM during April through October.



M.V. SHORE
ASSOCIATES (1993) LIMITED

Consulting Professional Engineers

December 14, 2018

Project no: 17-052

Attention: **Executive Director, Engineering & Construction Services**
16/F, 55 John Street, Toronto, ON M5V 3C6

c/o: **Avi Bachar, P.Eng. PMP**
Manager, Development Engineering
Engineering and Construction Services

cc: **General Manager, Toronto Water**

c/o: **Manager, Environmental Monitoring & Protection Unit**
30 Dee Ave, Toronto ON M9N 1S8

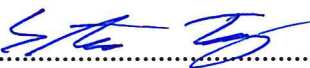
Address: **11 Yorkville Avenue, Toronto**

Dear Sir or Madame;

This letter is to confirm that the designed pumped discharge rate from the storm water cistern to the discharge chamber will be a maximum flow rate no greater than 19.0L/S (301gpm).

For additional information, please contact the undersigned.




.....
Stephen Tsang, P.Eng.

Seal

APPENDIX

D WATER QUALITY DOCUMENTS



STANDARD OFFLINE Jellyfish Filter Sizing Report

Project Information

Date	Thursday, December 13, 2018
Project Name	11 Yorkville Ave.
Project Number	
Location	Toronto

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 JF4-2-1 is recommended to meet the water quality objective by treating a flow of 12.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 142 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)
JF4-2-1	2	1	1.2	12.6	142

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:

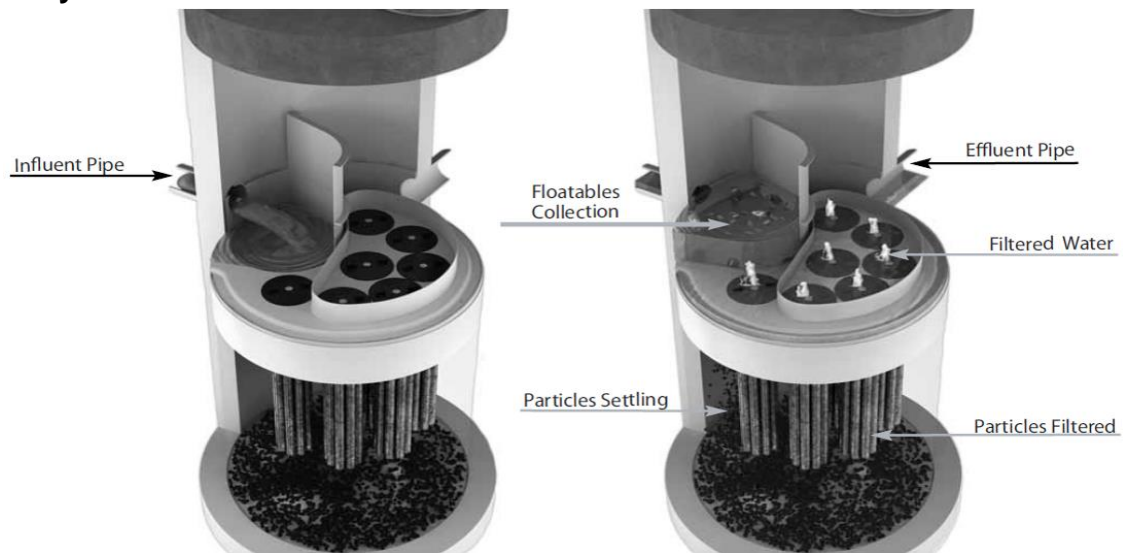
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Performance

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 monitored storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Project Information

Date:	Thursday, December 13, 2018
Project Name:	11 Yorkville Ave.
Project Number:	
Location:	Toronto

Designer Information

Company:	WSP Canada Group Ltd.
Contact:	Victoria Blake
Phone #:	

Notes

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Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	7.7 L/s
Sediment Loading	Treating 90% of the average annual runoff volume, 1488 m ³ , with a suspended sediment concentration of 60 mg/L.	89 kg

Recommendation

The Jellyfish Filter model JF4-2-1 is recommended to meet the water quality objective by treating a flow of 12.6 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 142 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 (m ³)	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

Rainfall

Name:	TORONTO CENTRAL
State:	ON
ID:	100
Record:	1982 to 1999
Co-ords:	45°30'N, 90°30'W

Drainage Area

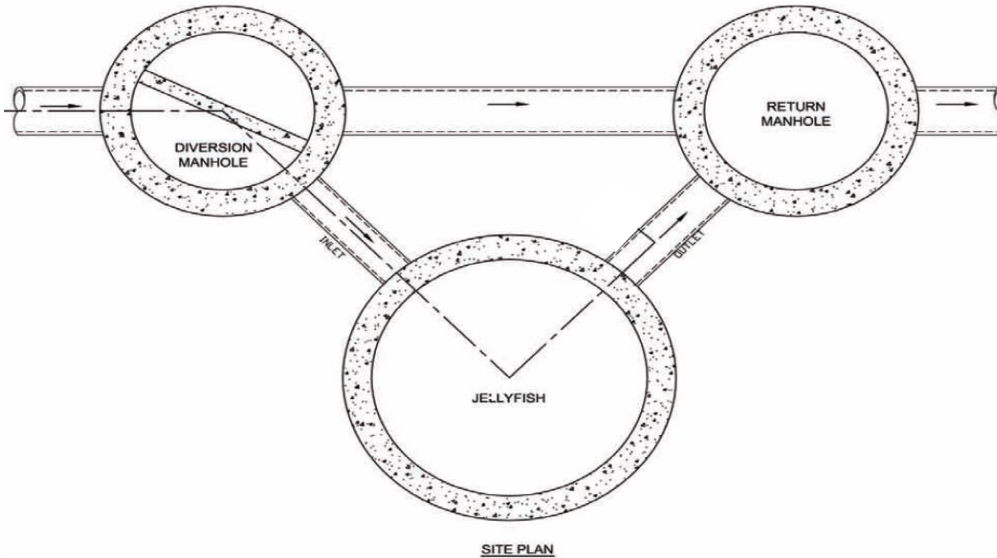
Total Area:	0.3016 ha
Imperviousness:	82%

Upstream Detention

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

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	62°	150	200
1.8	59°	200	250
2.4	52°	250	300
3.0	48°	300	450
3.6	40°	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 calculations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged conditions.
- 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 (ft ² / m ²)	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 Con Seal 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 it 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

