

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

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Revisions

to the

**Functional Servicing and
Stormwater Management Report
for**

**The Salvation Army Barrhaven Church
102 Bill Leathem Drive
City of Ottawa**

**Prepared by David Shaeffer Engineering Ltd (DSEL),
Project No.: 16-855, July 2017 – Rev 3**

**This revision is prepared by
D. B. Gray Engineering Inc. Report No. 20123**

**January 7, 2022
Revised March 2, 2022**

CONTENTS

REVISIONS TO 1.0 INTRODUCTION

REVISIONS TO 3.2 WATER SUPPLY SERVICING DESIGN

REVISIONS TO 5.3 PROPOSED STORMWATER MANAGEMENT SYSTEM

REVISIONS TO 5.4 STORMWATER SERVICING CONCLUSIONS

REVISIONS TO 8.0 CONCLUSIONS AND RECOMMENDATIONS

LIST OF APPENDICES

REVISIONS TO APPENDIX B – WATER SUPPLY

REVISIONS TO APPENDIX D – STORMWATER MANAGEMENT

REVISIONS TO 1.0 INTRODUCTION

This is a revision to the Functional Servicing and Stormwater Management Report for The Salvation Army Barrhaven Church, 102 Bill Leathem Drive, City of Ottawa, prepared by David Shaeffer Engineering Ltd (DSEL), Project No.: 16-855, July 2017 – Rev 3.

Specifically this is a revision to sections 3.2 Water Supply Servicing Design; 5.3 Proposed Stormwater Management System; 5.4 Stormwater Servicing Conclusions; and 8.0 Conclusions and Recommendations; in the aforementioned report.

This report forms part of the servicing and stormwater management design for the proposed development. Also refer to drawings C-1 to C-5, prepared by D.B. Gray Engineering Inc.

REVISIONS TO 3.2 WATER SUPPLY SERVICING DESIGN

The following replaces Section 3.2 in the DSEL report.

A private on-site fire hydrant is required (discussed below). To service the on-site hydrant it is proposed that the development be serviced via a 150 mm diameter private watermain connecting to the 305 mm diameter watermain within Bill Leathem Drive. It is proposed that the proposed building will be serviced by a 50 mm water service connecting to the 150 mm private watermain.

On November 22, 2021 the following comment was received from the City of Ottawa: *“Water boundary condition was verified in 2016. If the demand has not changed, still a water boundary condition verification will be required at present day condition. Please provide the water boundary condition request to the City PM directly.”*

The DSEL report calculated the water demand for Phase I and Phase II. The project is now proposed to proceed in three phases. Phase IA, Phase IB and Phase II. This addendum calculates the water demand assuming that all phases are complete.

As per the City of Ottawa Design Guidelines Appendix 4-A the daily average consumption rate for Churches with kitchens is 30 L per sanctuary seat; 8-36 L per person (depending upon the facilities provided) for Assembly Halls; and 75 L per person for offices. Based on 426 sanctuary seats; 30 L per person and 40 persons capacity in the Multi-person Room (Assembly Hall); and 6 office employees; and 8 hours per day the average daily demand for the subject development is 30 L/min (0.5 L/s). Based on a maximum daily peaking factor of 1.5 times the daily average demand and a maximum hourly peaking factor of 1.8 times the maximum daily demand, the maximum daily demand is 45 L/min (0.8 L/s) and maximum hourly demand is 81 L/min (1.4 L/s).

Two sets of boundary conditions were received from the City; Existing Conditions and future conditions when the SUC Zone Reconfiguration is completed.

Based on the existing boundary conditions the minimum (peak hour) HGL (hydraulic grade line) is 125.1 m and the maximum is 130.9 m. With these HGLs the water pressure is calculated to vary from 333 kPa to 390 kPa (48 to 57 psi). This is an acceptable range for the proposed development.

Based on the future boundary conditions the minimum (peak hour) HGL is 145.5 m and the maximum is 147.6 m. With these HGLs the water pressure is calculated to vary from 533 kPa to 553 kPa (77 to 80 psi). This is an acceptable range for the proposed development. However, since it is calculated that the water pressure can be close to 80 psi at times, after the SUC Zone Reconfiguration is completed, an on-site pressure check is recommended to determine if a pressure reducing valve (PRV) is required.

Based on the AWWA water flow demand curve, and a water pressure at the meter of 393 kPa (57 psi), the peak demand for the building is expected to be 4.1 L/s (246 L/min / 33 USgpm). The AWWA method calculates the instantaneous demand and is used to size the water service. This peak demand will produce an acceptable velocity of 2.1 m/s in the proposed 50 mm water service connection (up to 2.4 m/s is acceptable).

There is an existing municipal Class AA fire hydrant located in the Bill Leathem Drive right-of-way approximately 112 m from far end of the front façade of the Phase IA / IB building and 120 m from far end of the front façade of the Phase II addition. Since it is greater than the maximum 90 m required by the Ontario Building Code (OBC) a private on-site fire hydrant is required. The private on-site fire hydrant will be located about approximately 50 m from far end of the front façade of the Phase I building and 58 m from far end of the front façade of the Phase II addition. Therefore, the proposed private hydrant will provide adequate coverage for the proposed building and Phase II addition.

As per City of Ottawa Technical Bulletin ISTB-2021-03, where pipe sizing is affected, the flow required for firefighting is to be calculated using the Fire Underwriter Survey (FUS) "Water Supply For Fire Protection" method. The proposed building and additions are non-combustible construction. As per the FUS method the proposed building (Phase IA / IB & II) requires a fire flow of 100.0 L/s (6,000 L/min).

Based on existing conditions, the boundary conditions provided by the City of Ottawa in the 300mm Bill Leathem Drive watermain for the 100 L/s fire flow at the subject property indicate a hydraulic grade line (HGL) of 127.7 m. This HGL calculates to 373 Pa (54 psi). A 150 mm private watermain, connecting to the 300 mm municipal watermain, is proposed to serve the proposed private on-site fire hydrant. A model was created using EPANET software to analyze the hydraulics of the private watermain. Using the provided HGL boundary conditions, and a 95 L/s demand (the maximum flow expected from a Class AA fire hydrant), the pressure at fire hydrant is calculated to be 265 kPa (38.5 psi). Since the pressures are above 138 kPa (20 psi), the private watermain is adequately sized and there is an adequate water supply for firefighting from the existing municipal water distribution system.

Based on future conditions (when the SUC Zone Reconfiguration is completed), the boundary conditions provided by the City of Ottawa in the 300mm Bill Leathem Drive watermain for the 100 L/s fire flow at the subject property indicate a hydraulic grade line (HGL) of 145.2 m. This HGL calculates to 545 Pa (79 psi). A model was created using EPANET software to analyze the hydraulics of the private watermain using the future boundary conditions. Using the provided HGL boundary conditions, and a 95 L/s demand, the pressure at fire hydrant is calculated to be 437 kPa (63.3 psi). Since the pressures are above 138 kPa (20 psi), when the SUC Zone Reconfiguration is completed, the private watermain is adequately sized and there is an adequate water supply for firefighting from the future municipal water distribution system.

As per City of Ottawa Technical Bulletin ISTB-2018-02, the aggregate fire flow of all contributing fire hydrants within 150 m of a building can be used to supply the required fire flow. The existing municipal hydrant in Bill Leathem Drive is a Class AA; is between 75 and 150 m from the building; and can contribute 3,800 L/min (63.3 L/s) (as per Table 1 of ISTB-2018-02). The private on-site hydrant will also be a Class

AA; is within 75 m; and can contribute 5,700 L/min (95.0 L/s) (as per Table 1 of ISTB-2018-02). Therefore, the aggregate flow from both hydrants is 9,500 L/min (158.3 L/s); greater than the required fire flow of 6,000 L/min (100.0 L/s).

REVISIONS TO 5.3 PROPOSED STORMWATER MANAGEMENT SYSTEM

The following replaces Section 5.3 in the DSEL report.

The foundation drains in the previous design connected to the proposed storm sewer system upstream of the inlet control device (ICD). To prevent stormwater from flooding the foundation drains the storm water management design has been redesigned with two ICDs.

The Modified Rational Method was used to calculate the required storage volumes at the post development release rates (the maximum allowable release rate is 70.5 L/s). The runoff coefficients for the 100-year event are increased by 25% to maximum 1.00.

Stormwater is proposed to be stored on the surface in the parking area above catch basins. Roof drainage will discharge to grade and drain to a stormwater detention area (a depressed grassed area to the north of the building) via a grassed swale. To calculate the required surface storage, underground storage in pipes, manholes and catch basins is ignored.

The grassed swales and detention area will promote infiltration.

Temporary grading in the Phase IA and Phase II footprint will direct runoff towards the detention area.

Uncontrolled Flow Off Site (2,820 sq.m):

Stormwater from the perimeter of the property will drain uncontrolled off the site. The flow rates are calculated at a time of concentration of 10 minutes.

	100-Year Event	5-Year Event
Maximum Flow Rate	42.33 L/s	20.33 L/s

Drainage Areas A101, A102, A103 & A104 (7,314 sq.m):

An inlet control device (ICD) located at the outlet pipe of manhole MH-3 will control the release of stormwater from Drainage Areas A101, A102, A103 & A104. The ICD will restrict the flow and force the stormwater to back up onto the parking area above catch basins CB-4, CB-5, CB-7 and CB-8. The ICD shall be a plug style with a round orifice (located at the bottom of the plug) and a trash basket design manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 22.16 L/s at 2.55 m head. It is calculated that an orifice area of 5,134 sq.mm. (81 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 22.16 L/s at a head of 2.55 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 12.80 L/s at 1.16 m.

	100-Year Event	5-Year Event
Maximum Release Rate	22.16 L/s	21.87 L/s
Maximum Ponding Elevation	89.30 m	89.24 m
Maximum Volume Stored	188.29 cu.m	74.37 cu.m

Drainage Areas A105 (4,086 sq.m)

An inlet control device (ICD) located at the outlet pipe of catch basin / manhole CB/MH-9 will control the release of stormwater from Drainage Areas A105. The ICD will restrict the flow and force the stormwater to back up onto the stormwater detention area above CB/MH-9 and catch basin CB-10. The ICD shall be a Hydrovex "VHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 6.00 L/s (the minimum flow rate recommended by the City) at 2.62 m head. It is calculated that an orifice area of 4,418 sq.mm. (75 mm diameter) and a discharge coefficient of 0.190 will restrict the outflow rate to 6.00 L/s at a head of 2.62 m. Based on this orifice the maximum outflow rate for the 5-year storm event is calculated to be 5.99 L/s at 2.61 m.

	100-Year Event	5-Year Event
Maximum Release Rate	6.00 L/s	5.99 L/s
Maximum Ponding Elevation	89.30 m	89.39 m
Maximum Volume Stored	114.29 cu.m	47.42 cu.m

Entire Site:

	100-Year Event	5-Year Event
Maximum Allowable Release Rate	70.50 L/s	70.50 L/s
Maximum Release Rate	70.50 L/s	48.19 L/s
Maximum Volume Stored	302.59 cu.m	121.79 cu.m

The maximum post development release rate during the 100-year event is calculated to be 70.50 L/s; equal to the maximum allowable. To achieve the maximum allowable release rate a maximum storage of 302.59 cu.m. is required and provided. During the 5-year event the maximum post development release rate is calculated to be 48.19 L/s; 32% less than the maximum allowable.

REVISIONS TO 5.4 STORMWATER SERVICING CONCLUSIONS

Replace:

"To attenuate flow to the established rate of 70.5 L/s, it is estimated that approximately 321.8 m³ of storage is required."

With:

To attenuate flow to the established rate of 70.5 L/s, it is calculated 302.6 m³ of storage is required.

REVISIONS TO 8.0 CONCLUSIONS AND RECOMMENDATIONS

Replace:

"The FUS method for estimating fire flow indicated a maximum of 9,000 L/min is required for the proposed development, based on boundary conditions provided by the City the existing municipal water infrastructure is capable of providing the proposed development with water within the City's required pressure range."

With:

Based on the FUS method it is calculated that a fire flow of 6,000 L/min is required for the proposed development. Based on existing and future boundary conditions provided by the City the existing municipal water infrastructure is capable of providing the proposed development with water within the City's required pressure range.

Replace:

"Based on the LDH Servicing Study, the contemplated development is required to attenuate post development flows to an equivalent release rate of 48.9 L/s/ha; a max of 321.8 m³ is required to meet the release rate."

With:

Based on the LDH Servicing Study, the contemplated development is required to attenuate post development flows to an equivalent release rate of 48.9 L/s/ha; a maximum storage volume of 302.6 m³ is required to meet the release rate.

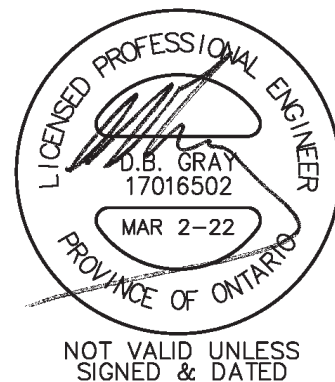
Replace:

"It is proposed that stormwater objectives will be met through storm water retention via surface storage. A 97mm ICD will be installed in STM101 to restrict runoff;"

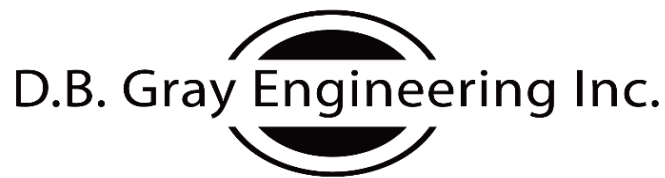
With:

"It is proposed that stormwater objectives will be met through stormwater detention via surface storage. ICDs will be installed in manhole MH-3 and catch basin/manhole CB/MH-9 to restrict runoff;"

Prepared by D. B. Gray Engineering Inc.



**REVISIONS TO APPENDIX B
WATER SUPPLY**



Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains
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26-Nov-21

27-Nov-21

The Salvation Army Barrhaven Church 102 Bill Leathem Drive Ottawa, Ontario

Phase I & II Water Demand

Churches with kitchen facilities:	30 426	L / sanctuary seat (as per Ottawa Design Guidelines) sanctuary seats
Assembly Hall (Multi-purpose Room):	30 40	L / person (as per Ottawa Design Guidelines) persons
Offices:	75 6	L / person (as per Ottawa Design Guidelines) persons

14430 L/day
 8 hour day
 30.1 L/min 0.5 L/s 7.9 USgpm

MAXIMUM DAILY DEMAND: 1.5 (Peaking Factor as per Ottawa Design Guidelines)

45.1 L/min 0.8 L/s 11.9 USgpm

MAXIMUM HOURLY DEMAND: 1.8 (Peaking Factor as per Ottawa Design Guidelines)

81.2 L/min 1.4 L/s 21.4 USgpm

Existing Conditions

Elevation of Water Meter: 91.15 m ASL
 Finish Floor Elevation: 90.25 m ASL
 MINIMUM HGL: 125.1 m ASL Static Pressure at Water Meter: 48 psi 333 kPa
 MAXIMUM HGL: 130.9 m ASL 57 psi 390 kPa

SUC Zone Reconfiguration

Elevation of Water Meter: 91.15 m ASL
 Finish Floor Elevation: 90.25 m ASL
 MINIMUM HGL: 145.5 m ASL Static Pressure at Water Meter: 77 psi 533 kPa
 MAXIMUM HGL: 147.6 m ASL 80 psi 553 kPa

The Salvation Army Barrhaven Church
102 Bill Leathem Drive
Ottawa, Ontario

Peak Water Demand

WATER FIXTURE VALUE
(AWWA Manual M22 - Sizing Water Service Lines and Meters)

	No.	F.V.	Total	
Bathtub	0	8	0	
Toilet - tank	0	6	0	
Toilet - flush valve	8	24	192	
Lavs.	9	1.5	13.5	
Bidet	0	2	0	
Urinal - wall flush valve	3	10	30	
Shower	0	2.5	0	
K. Sink	5	1.8	9	
Dishwasher	0	1.3	0	
Clothes Washer	0	3	0	
Commercial Sink	0	4	0	
J. Sink	1	4	4	
Commercial Dishwasher	2	4	8	
Commercial Washer	0	4	0	
Hose 1/2 in	0	5	0	
Hose 3/4 in	0	12	0	
			256.5	
Peak Demand (fig 4-2 or 4-3 AWWA M22)		67	USgpm	
Pressure @ Meter	393	kPa	57	psi
Pressure Factor (table 4-1 AWWA M22)		0.97		
Peak Demand		65	USgpm	
Irrigation - hose 1/2 in	0	0	USgpm (includes pressure factor)	
(assumes hose bibs operating in non peak hours)				
TOTAL PEAK DEMAND	246	L/min	65	USgpm
			4.1	L/s
Nominal Size	2.0	in	50	mm
	6.9	ft/s	2.1	m/s



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REVISÉ 26-Nov-21
 17-Dec-21

The Salvation Army Barrhaven Church 102 Bill Leathem Drive Ottawa, Ontario

Phase I & II - Fire Flow Requirements

Fire flow requirement as calculated as per Fire Underwriter Survey "Water Supply For Fire Protection".

$F = 220 C A^{0.5}$ = the required fire flow in litres per minute

C = coefficient related to the type of construction
 = 0.8 Non-combustible Construction (unprotected structural components)

A = total floor area (all storeys excluding basements at least 50% below grade)

Phase 1	654 sq.m.
Gym	484 sq.m.
Phase 2	544 sq.m.

TOTAL FIRE AREA: 1682 sq.m.

F = 7,218 L/min
 = 7,000 L/min (rounded off to the nearest 1,000 L/min)

-15% Charge for Limited-combustible Occupancy

= 5,950 L/min

0% Reduction: No Sprinkler System

= - L/min

Increase for Separation Exposed Buildings

		Adjacent Building		Length- Height Factor
		Construction	Length m	
0% North	>45m		0	0
0% East	>45m		0	0
0% South	>45m		0	0
0% West	>45m		0	0
0%	Total Increase for Exposure (maximum 75%)			
=	-	L/min Increase		

= 5,950 L/min

F = 6,000 L/min (rounded off to the nearest 1,000 L/min)

= 100.0 l/s

Existing Conditions:

Ground Elevation:	89.62	m ASL		
(at proposed FH)				
100 L/s FIRE FLOW:	127.7	m ASL	54	373
			psi	kPa

SUC Zone Reconfiguration

Ground Elevation:	89.62	m ASL		
(at proposed FH)				
100 L/s FIRE FLOW:	145.2	m ASL	79	545
			psi	kPa



Douglas Gray <d.gray@dbgrayengineering.com>

RE: Boundary Condition Request - Salvation Army Barrhaven 102 Bill Leatham Dr

1 message

Sharif, Golam <sharif.sharif@ottawa.ca>

Tue, Dec 14, 2021 at 11:30 AM

To: Douglas Gray <d.gray@dbgrayengineering.com>

Cc: Ralph Vandenberg <ralph@vwarchitects.ca>, Joe Naufal <joe@vwarchitects.ca>, Daniel Vinals <daniel@vwarchitects.ca>, Laurent Brosseau <l.brosseau@dbgrayengineering.com>

Hi Doug,

Here are the requested BC. If you have any question let me know. Thanks.

Sharif

From: Douglas Gray <d.gray@dbgrayengineering.com>

Sent: November 29, 2021 6:58 AM

To: Sharif, Golam <sharif.sharif@ottawa.ca>

Cc: Ralph Vandenberg <ralph@vwarchitects.ca>; Joe Naufal <joe@vwarchitects.ca>; Daniel Vinals <daniel@vwarchitects.ca>; Laurent Brosseau <l.brosseau@dbgrayengineering.com>

Subject: Boundary Condition Request - Salvation Army Barrhaven 102 Bill Leatham Dr

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Hi Sharif

Please provide the boundary conditions at 102 Bill Leatham Dr. We have calculated the following expected demands based on both Phase I & II of the proposed Church complete.

Average daily demand: 0.5 L/s.

Maximum daily demand: 0.8 L/s.

Maximum hourly daily demand: 1.4 L/s

Fire Flow demand: 100.0 L/s

Fire Flow + Max Day: 100.8 L/s

Calculations are attached. Also attached is DSEL Site Servicing Plan showing the location of the proposed service connection to the City watermain in Bill Leathem Dr.

Thanks, Doug

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle

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102 Bill Leathem Dr_13Dec2021.docx

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Boundary Conditions 102 Bill Leathem Dr

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	30	0.50
Maximum Daily Demand	48	0.80
Peak Hour	84	1.40
Fire Flow Demand #1	6,000	100.00

Location



Results – Existing Conditions

Connection 1 – Bill Leathem Dr.

Demand Scenario	Head (m)	Pressure ¹ (psi)
Maximum HGL	130.9	59.0
Peak Hour	125.1	50.8
Max Day plus Fire 1	127.7	54.5

Ground Elevation = 89.4 m

Results – SUC Zone Reconfiguration

Connection 1 – Bill Leathem Dr.

Demand Scenario	Head (m)	Pressure¹ (psi)
Maximum HGL	147.6	82.8
Peak Hour	145.5	79.8
Max Day plus Fire 1	145.2	79.4

Ground Elevation = 89.4 m

Notes

1. As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:
 - a. If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.
 - b. Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermain deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

January 7, 2022

102 Bill Leathem Drive

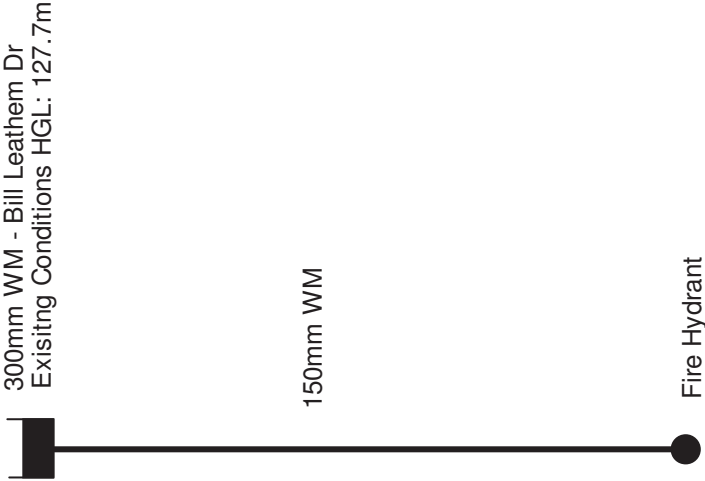
Ottawa, Ontario

EPANET HYDRAULIC MODELLING RESULTS

Existing Conditions

Node ID	Demand	Head	Elevation	Pressure		
	L/s	m	m	m	psi	kPa
1 Reservoir 1 (300 WM - Bill Leathem Dr)	-95.80	127.70	89.22	38.48	54.7	377
2 Proposed FH	95.80	117.75	90.70	27.05	38.5	265

Link ID	Diameter	Length	Roughness	Loss Coeff.	Flow	Velocity
	mm	m			L/s	m/s
Pipe 1	150	15.1	100	3.80	95.80	5.42



Network Table - Nodes

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Jun 2	90.70	95.80	117.75	27.05
Resvr 1	127.7	-95.80	127.70	0.00

Network Table - Links

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s
Pipe 1	15.1	150	100	95.80	5.42

January 7, 2022

102 Bill Leathem Drive

Ottawa, Ontario

EPANET HYDRAULIC MODELLING RESULTS

SUC Zone Reconfiguration

Node ID	Demand	Head	Elevation	Pressure		
	L/s	m	m	m	psi	kPa
1 Reservoir 1 (300 WM - Bill Leathem Dr)	-95.80	145.20	89.22	55.98	79.6	549
2 Proposed FH	95.80	135.25	90.70	44.55	63.3	437

Link ID	Diameter	Length	Roughness	Loss Coeff.	Flow	Velocity
	mm	m			L/s	m/s
Pipe 1	150	15.1	100	3.80	95.80	5.42



Network Table - Nodes

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc 2	90.70	95.80	135.25	44.55
Resvr 1	145.2	-95.80	145.20	0.00

Network Table - Links

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s
Pipe 1	15.1	150	100	95.80	5.42

**REVISIONS TO APPENDIX D
STORMWATER MANAGEMENT**

Summary Tables

ONE HUNDRED-YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
Uncontrolled Flow Off Site	-	42.33	-	-
A101, A102, A103 & A104	-	22.16	188.29	188.29
A105	-	6.00	114.29	114.29
TOTAL	70.50	70.50	302.59	302.59

FIVE-YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
Uncontrolled Flow Off Site	-	20.33	-	-
A101, A102, A103 & A104	-	21.87	74.37	74.37
A105	-	5.99	47.42	47.42
TOTAL	70.50	48.19	121.79	121.79

102 Bill Leathem Drive

Ottawa, Ontario

STORM WATER MANAGEMENT CALCULATIONS

Modified Rational Method

Uncontrolled Flow Off Site (Unattenuated Area as per DSEL report):
(FIVE-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	70	sq.m	0.90
Landscaped Area:	<u>2660</u>	sq.m	<u>0.20</u>
Total Catchment Area:	2730	sq.m	0.22

Uncontrolled Flow Off Site (REVISED)
(FIVE-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	197	sq.m	0.90
Landscaped Area:	<u>2623</u>	sq.m	<u>0.20</u>
Total Catchment Area:	2820	sq.m	0.25

Drainage Area A101 (as per DSEL report):

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	775	sq.m	0.90
Landscaped Area:	<u>655</u>	sq.m	<u>0.20</u>
Total Catchment Area:	1430	sq.m	0.58

Drainage Area A101 (REVISED):

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	722	sq.m	0.90
Landscaped Area:	<u>485</u>	sq.m	<u>0.20</u>
Total Catchment Area:	1207	sq.m	0.62

Drainage Area A102 (as per DSEL report):

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	865	sq.m	0.90
Landscaped Area:	<u>1575</u>	sq.m	<u>0.20</u>
Total Catchment Area:	2440	sq.m	0.45

Drainage Area A102 (REVISED):

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	865	sq.m	0.90
Landscaped Area:	<u>1575</u>	sq.m	<u>0.20</u>
Total Catchment Area:	2440	sq.m	0.45

Drainage Area A103 (as per DSEL report):

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	1555	sq.m	0.90
Landscaped Area:	<u>325</u>	sq.m	<u>0.20</u>
Total Catchment Area:	1880	sq.m	0.78

Drainage Area A103 (REVISED):

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	1349	sq.m	0.90
Landscaped Area:	<u>324</u>	sq.m	<u>0.20</u>
Total Catchment Area:	1673	sq.m	0.76

Drainage Area A104 (as per DSEL report):

			C
Roof Area:	565	sq.m	0.90
Asphalt/Concrete Area:	845	sq.m	0.90
Landscaped Area:	<u>940</u>	sq.m	<u>0.20</u>
Total Catchment Area:	2350	sq.m	0.62

Drainage Area A104 (REVISED):

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	995	sq.m	0.90
Landscaped Area:	<u>999</u>	sq.m	<u>0.20</u>
Total Catchment Area:	1994	sq.m	0.55

Drainage Area A105 (as per DSEL report):

			C
Roof Area:	1180	sq.m	0.90
Asphalt/Concrete Area:	80	sq.m	0.90
Landscaped Area:	<u>2130</u>	sq.m	<u>0.20</u>
Total Catchment Area:	3390	sq.m	0.46

Drainage Area A105 (REVISED):

			C
Roof Area:	1745	sq.m	0.90
Asphalt/Concrete Area:	62	sq.m	0.90
Landscaped Area:	<u>2279</u>	sq.m	<u>0.20</u>
Total Catchment Area:	4086	sq.m	0.51

ONE HUNDRED-YEAR EVENT

Maximum Allowable Release Rate

			(as per Longfilelds/Davidson Heights Serviceability Study prepared by Oliver, Mangione, McCalla & Associates dated February 1993)
	48.9	L/s/ha	
Property Area	<u>1.44</u>	ha	
Maximum Allowable Release Rate:	70.50	L/s/ha	

Uncontrolled Flow Off Site (REVISED)

(ONE HUNDRED-YEAR EVENT)

			C	
Roof Area:	0	sq.m		1.00
Asphalt/Concrete Area:	197	sq.m		1.00
Landscaped Area:	2623	sq.m		<u>0.25</u>
Total Catchment Area:	2820	sq.m		0.30
Time of Concentration:	10	min		
Rainfall Intensity (i):	179	mm/hr		
Runoff Coefficient (C):	0.30			
Flow Rate (2.78AiC):	42.33	L/s		

(ONE HUNDRED-YEAR EVENT)

(ONE HUNDRED-YEAR EVENT)

Maximum Volume Required: 114.29 cu.m

Time	i	2.78AiC	Release	Stored	Stored
(min)	(mm/hr)	(L/s)	Rate	Rate	Volume
5	243	160.36	6.00	154.36	46.31
10	179	117.98	6.00	111.98	67.19
15	143	94.42	6.00	88.41	79.57
20	120	79.26	6.00	73.25	87.90
25	104	68.62	6.00	62.61	93.92
30	92	60.70	6.00	54.70	98.45
35	83	54.56	6.00	48.56	101.97
40	75	49.65	6.00	43.65	104.75
45	69	45.62	6.00	39.62	106.97
50	64	42.26	6.00	36.25	108.76
55	60	39.40	6.00	33.39	110.19
60	56	36.93	6.00	30.93	111.34
65	53	34.79	6.00	28.78	112.25
70	50	32.90	6.00	26.89	112.95
75	47	31.22	6.00	25.22	113.49
80	45	29.73	6.00	23.72	113.87
85	43	28.38	6.00	22.38	114.12
90	41	27.16	6.00	21.16	114.26
95	39	26.06	6.00	20.05	114.29
100	38	25.04	6.00	19.04	114.24
105	36	24.12	6.00	18.11	114.10
110	35	23.26	6.00	17.26	113.88
115	34	22.47	6.00	16.46	113.60
120	33	21.73	6.00	15.73	113.26
125	32	21.05	6.00	15.05	112.86
130	31	20.42	6.00	14.41	112.41
135	30	19.82	6.00	13.82	111.91
140	29	19.26	6.00	13.26	111.36
145	28	18.74	6.00	12.73	110.78
150	28	18.24	6.00	12.24	110.15
180	24	15.79	6.00	9.79	105.72
210	21	13.97	6.00	7.97	100.38
240	19	12.56	6.00	6.55	94.37
270	17	11.43	6.00	5.42	87.85
300	16	10.50	6.00	4.50	80.92
330	15	9.72	6.00	3.72	73.67
360	14	9.07	6.00	3.06	66.14
390	13	8.50	6.00	2.49	58.38
420	12	8.01	6.00	2.00	50.42
450	11	7.57	6.00	1.57	42.29
480	11	7.19	6.00	1.18	34.01
510	10	6.84	6.00	0.84	25.60
540	10	6.53	6.00	0.53	17.07
570	9	6.25	6.00	0.25	8.43
600	9	6.00	6.00	0.00	0.00

FIVE YEAR EVENT

Maximum Allowable Release Rate

(as per Longfields/Davidson Heights Serviceability
Study prepared by Oliver, Mangione, McCalla &
Associates dated February 1993)

48.9 L/s/ha

Property Area 1.44 ha

Maximum Allowable Release Rate: 70.50 L/s/ha

Uncontrolled Flow Off Site (REVISED)

(FIVE-YEAR EVENT)

			C	
Roof Area:	0	sq.m		0.90
Asphalt/Concrete Area:	197	sq.m		0.90
Landscaped Area:	<u>2623</u>	sq.m		<u>0.20</u>
Total Catchment Area:	2820	sq.m		0.25
Time of Concentration:	10	min		
Rainfall Intensity (i):	104	mm/hr		
Runoff Coefficient (C):	0.25			
Flow Rate (2.78AiC):	20.33	L/s		

(FIVE-YEAR EVENT)

DRAINAGE AREA A105

(FIVE-YEAR EVENT)

			C
Roof Area:	1745	sq.m	0.90
Asphalt/Concrete Area:	62	sq.m	0.90
Landscaped Area:	2279	sq.m	0.20
Total Catchment Area:	4086	sq.m	0.51
Water Elevation:	89.39	m	
Invert of Outlet Pipe - CB-9:	86.75	m	
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB-9)	86.79	m	
Head:	2.61	m	
Orifice Diameter:	75	mm	
Orifice Area:	4418	sq.mm	
Coefficient of Discharge:	0.190		
Maximum Release Rate:	5.99	L/s	
			Surface Storage Above Catch Basins
			Top Area Depth Volume
			(sq.m) (m)
			448 0.14 47.42 cu.m
			Achieved Volume:
			47.42 cu.m
			Maximum Volume Required:
			47.42 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	81.72	5.99	75.73	22.72
10	104	60.31	5.99	54.32	32.59
15	84	48.36	5.99	42.38	38.14
20	70	40.66	5.99	34.68	41.61
25	61	35.25	5.99	29.26	43.89
30	54	31.21	5.99	25.23	45.41
35	49	28.08	5.99	22.10	46.40
40	44	25.58	5.99	19.59	47.01
45	41	23.52	5.99	17.53	47.33
50	38	21.79	5.99	15.81	47.42
55	35	20.33	5.99	14.34	47.33
60	33	19.07	5.99	13.08	47.09
65	31	17.97	5.99	11.98	46.73
70	29	17.00	5.99	11.01	46.26
75	28	16.14	5.99	10.15	45.70
80	27	15.37	5.99	9.39	45.06
85	25	14.68	5.99	8.70	44.35
90	24	14.06	5.99	8.07	43.58
95	23	13.49	5.99	7.50	42.76
100	22	12.97	5.99	6.98	41.89
105	22	12.49	5.99	6.50	40.98
110	21	12.05	5.99	6.06	40.03
115	20	11.65	5.99	5.66	39.04
120	19	11.27	5.99	5.28	38.02
125	19	10.92	5.99	4.93	36.97
130	18	10.59	5.99	4.60	35.89
135	18	10.28	5.99	4.29	34.79
140	17	10.00	5.99	4.01	33.66
145	17	9.73	5.99	3.74	32.51
150	16	9.47	5.99	3.48	31.35
180	14	8.21	5.99	2.22	23.97
210	13	7.27	5.99	1.28	16.12
240	11	6.54	5.99	0.55	7.91
270	10	5.95	5.95	0.00	0.00
300	9	5.47	5.47	0.00	0.00
330	9	5.07	5.07	0.00	0.00
360	8	4.73	4.73	0.00	0.00
390	8	4.44	4.44	0.00	0.00
420	7	4.18	4.18	0.00	0.00
450	7	3.96	3.96	0.00	0.00
480	6	3.76	3.76	0.00	0.00
510	6	3.58	3.58	0.00	0.00
540	6	3.42	3.42	0.00	0.00
570	6	3.27	3.27	0.00	0.00
600	5	3.14	3.14	0.00	0.00

