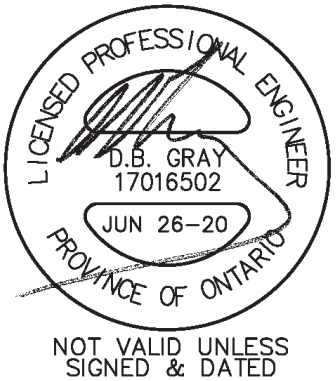
SERVICING BRIEF &
STORMWATER MANAGEMENT REPORT

5353-357 Gardner Street
Ottawa, Ontario

Report No. 20037

June 26, 2020



D.B. Gray Engineering Inc.

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

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SERVICING BRIEF &
STORMWATER MANAGEMENT REPORT

353-357 Gardner Street
Ottawa, Ontario

This report describes the services and addresses the stormwater management requirements of a property 1022 sq.m. in area, located 353-357 Gardner Street in Ottawa. The property also has frontage on McArthur Avenue and the Vanier Parkway. The property currently has two single dwellings that will be demolished. A nine-storey 61-unit apartment building with underground parking is proposed.

This report forms part of the stormwater management design for the proposed development. Refer to drawings C-1 to C-6 also prepared by D. B. Gray Engineering Inc.

WATER SUPPLY FOR FIREFIGHTING:

The proposed building will be installed with a sprinkler system with the fire department connection (FDC) located adjacent to the main entrance of the proposed building. There is an existing municipal fire hydrant (FH-1) on Montgomery Street about 43 m unobstructed distance to the proposed FDC. Since this municipal fire hydrant is located less than the maximum 45 m permitted, an additional fire hydrant is not required. There are also existing municipal fire hydrants about 30 m unobstructed distance of the subject property south on McArthur Avenue (FH-2); about 57 m unobstructed distance west on McArthur Avenue (FH-3); and about 117 m unobstructed distance northwest on Selkirk Street (FH-4).

The proposed building will be built of non-combustible construction and with a sprinkler system. A fire flow of 150.0 L/s (9,000 L/min) is required, as calculated as per the Fire Underwriter Survey (FUS) "Water Supply For Fire Protection".

The City performed a Multi-Hydrant analysis (based on the city's computer model of the municipal water distribution system) assuming three hydrants running simultaneously; FH-1 at 95 L/s, FH-3 at 63 L/s & FH-4 at 63 L/s for a total aggregate flow of 220 L/s. The corresponding HGL (hydraulic grade line) at the proposed service connection when the three hydrants are running simultaneously is 104.0m in the 150mm municipal watermain in Gardner Street at the subject location. This HGL calculates to be 455 kPa (66 psi). Since the pressure is above 138 kPa (20 psi) at 220 L/s (greater than the required fire flow of 150 L/s) there is an adequate water supply for firefighting.

WATER SERVICE:

As previously mentioned the proposed building will have a sprinkler system. To service the sprinkler system, a 150 mm water service (connecting to the 150 mm municipal watermain in Gardner Street) is proposed. The 150 mm service will be adequate for the domestic demand.

Based on the City of Ottawa Water Distribution Design Guidelines for residential properties (29 one-bedroom apartment units / 1.4 person per unit; 32 two-bedroom apartment units / 2.1 persons per unit; and 350 L/person/day); and Ministry of the Environment Design Guidelines for peaking factors; the daily average flow is 0.4 L/s with a maximum daily and maximum hourly demand of 2.8 and 4.3 L/s respectively.

To determine water pressure under these demands, boundary conditions, based on the City of Ottawa computer simulation of the water distribution system, at the subject location, are required. In summary, the water demands for the subject development are as follows:

Average Daily Demand: 0.4 L/s.
Maximum Daily Demand: 2.8 L/s.
Maximum Hourly Demand: 4.3 L/s
Fire Flow Demand: 150.0 L/s
Maximum Daily + Fire Flow Demand: 152.8 L/s

Based on the boundary conditions received from the City, the minimum HGL (hydraulic grade line) is 107.5 m and the maximum is 118.2 m. With these HGLs the water pressure at the water meter is calculated to vary from 518 kPa to 623 kPa (75 to 90 psi). These are acceptable pressures for the proposed development, however, since it is calculated that the water pressure can be above 80 psi at times a pressure reducing valve (PRV) is required to be installed immediately downstream of the water meter

SANITARY SERVICE:

The first pipe segment of the municipal sanitary sewer in Gardner Street downstream of the proposed development is 300mm in diameter, with a pipe slope of 0.43%, which calculates to having a capacity of capacity of 66.15 L/s. This pipe segment is at the most upstream end of a branch of the municipal sanitary sewer; there are no properties upstream.

Based on the City of Ottawa Sewer Design Guidelines for a residential property (29 one-bedroom apartment units / 1.4 person per unit; 32 two-bedroom apartment units / 2.1 persons per unit; 280 l/person/day; and a 3.2 peaking factor); and based on a 0.33 L/s/ha infiltration flow; the post development flow is calculated to be 1.15 L/s. This flow will be adequately handled by the proposed sanitary sewer service connection (200 mm at 1% - 34.22 L/s capacity) since, at the design flow, it will only be about 3% full.

The proposed 200mm sanitary service connection will connect to the 300mm municipal sanitary sewer in Gardner Street. The existing residential building is calculated to have generated 0.10 L/s. The 1.05 L/s increase in sanitary flows contributing to the existing 300 mm sanitary sewer is expected to have an acceptable impact.

STORMWATER MANAGEMENT:

Water Quality:

The RVCA has stated: *"Based on the plans submitted, it appears that majority of the rainwater from this site will be from rooftop and landscaping. Parking is proposed underground. Drainage from rooftops and landscaped areas are considered clean for the purpose of the protection of aquatic and fish habitat. Therefore, the RVCA accepts that no onsite water quality measures are required save and except best management practices."* Therefore, no permanent quality control measures are proposed.

An erosion and sediment control plan has been developed to be implemented during construction, (see drawing C-4 and notes 2.1 to 2.5 on drawing C-3). In summary: to filter out construction sediment capture filter sock inserts will be installed in all existing catch basins adjacent to the site; and any material deposited on a public road shall be removed.

Water Quantity:

The stormwater management criteria for quantity control are to control the post development peak flows for the 5-year and 100-year storm events to the peak flows during the 2-year storm event using the pre-development runoff coefficient or runoff coefficient of 0.50, whichever is less; and a calculated time of concentration (not less than 10 minutes). It is calculated that the pre-development conditions reflect a 5-year runoff coefficient of 0.47 and a time of concentration of 7.8 minutes. Therefore, based on runoff coefficient of 0.47, a 10 minute time of concentration; and using the Rational Method; the maximum allowable release rate is 10.24 L/s for all storm events. The runoff coefficients for the 100 year event are increased by 25% to maximum 1.00.

Stormwater will be stored within the development on the roofs of the proposed building and in a cistern under the ramp to the underground parking.

Drainage Area I
(Uncontrolled Flow Off Site – 261 sq.m.):
The runoff from the perimeter of the site will be allowed to flow uncontrolled off the site. The flow from is calculated at 10 minutes concentration.

	100-year	5-year
Maximum flow rate:	8.49 L/s	4.37 L/s

Drainage Area II (8th Floor Roof – 70 sq.m.):
The two roof drains will be flow control types which will restrict the flow and cause the storm water to pond on the roof. The flow control type roof drain shall be installed with a parabolic shaped slotted weir (1 slot per weir drain at 0.0124 l/s per mm per slot - 5 USgpm per inch per slot); the opening at top of flow control weir shall be a minimum 50 mm in diameter: Watts roof drain with a Watts Accutrol Weir RD-100-A1 or equal. The roof drain will be installed at the low point of the roof which will be 150 mm lower than the perimeter of the roof. One scupper, 300 mm wide and installed 150 mm above the roof drains, is required (refer to architectural for exact locations and details). The roof shall be designed to carry the load of water having a 50 mm depth at scupper and 200 mm depth at roof drain (refer to structural).

	100-year	5-year
The maximum release rate:	2.32 L/s	1.64 L/s
The maximum ponding depth:	94 mm	66 mm
The maximum stored volume:	0.72 cu.m.	0.25 cu.m.

Drainage Area III (North Side 9th Floor Roof – 269 sq.m.):
The two roof drains will be a flow control types which will restrict the flow and cause the storm water to pond on the roof. The flow control type roof drain shall be installed with a parabolic shaped slotted weir (1 slot per weir drain at 0.0124 l/s per mm per slot - 5 USgpm per inch per slot); the opening at top of flow control weir shall be a minimum 50 mm in diameter: Watts roof drain with a Watts Accutrol Weir RD-100-A1 or equal. The roof drain will be installed at the low point of the roof which will be 150 mm lower than the perimeter of the roof. Two scuppers, 400 mm wide and installed 150 mm above the roof drains, are required (refer to architectural for exact locations and details). The roof shall be designed to carry the load of water having a 50 mm depth at scupper and 200 mm depth at roof drain (refer to structural).

	100-year	5-year
The maximum release rate:	3.09 L/s	2.32 L/s
The maximum ponding depth:	124mm	93 mm
The maximum stored volume:	7.06 cu.m.	2.98 cu.m.

Drainage Area IV (Mechanical Penthouse Roof – 200 sq.m.):
The two roof drains will be a flow control types which will restrict the flow and cause the storm water to pond on the roof. The flow control type roof drain shall be installed with a parabolic shaped slotted weir (1 slot per weir drain at 0.0124 l/s per mm per slot - 5 USgpm per inch per slot); the opening at top of flow control weir shall be a minimum 50 mm in diameter: Watts roof drain with a Watts Accutrol Weir RD-100-A1 or equal. The roof drain will be installed at the low point of the roof which will be 150 mm lower than the perimeter of the roof. Two scuppers, 300 mm wide and installed 150 mm above the roof drains, are required (refer to architectural for exact locations and details). The roof shall be designed to carry the load of water having a 50 mm depth at scupper and 200 mm depth at roof drain (refer to structural).

	100-year	5-year
The maximum release rate:	2.99 L/s	2.21 L/s
The maximum ponding depth:	121mm	89 mm

The maximum stored volume:	4.46 cu.m.	1.80 cu.m.

Drainage Area V (South Side 9th Floor Roof – 89 sq.m.):
The two roof drains will be a flow control types which will restrict the flow and cause the storm water to pond on the roof. The flow control type roof drain shall be installed with a parabolic shaped slotted weir (1 slot per weir drain at 0.0124 l/s per mm per slot - 5 USgpm per inch per slot); the opening at top of flow control weir shall be a minimum 50 mm in diameter: Watts roof drain with a Watts Accutrol Weir RD-100-A1 or equal. The roof drain will be installed at the low point of the roof which will be 150 mm lower than the perimeter of the roof. One scupper, 300 mm wide and installed 150 mm above the roof drains, are required (refer to architectural for exact locations and details). The roof shall be designed to carry the load of water having a 50 mm depth at scupper and 200 mm depth at roof drain (refer to structural).

	100-year	5-year
The maximum release rate:	2.48 L/s	1.76 L/s
The maximum ponding depth:	100mm	71 mm
The maximum stored volume:	1.16 cu.m.	0.42 cu.m.

Drainage Area VI (Includes Cistern – 133 sq.m.):
All drainage areas drain to the cistern located under the ramp to the underground parking. An inlet control device (ICD) located at the outlet pipe of the cistern will control the release of stormwater from the property. The ICD will restrict the flow and force the stormwater to back up into the cistern. To calculate the required storage volume in the cistern ground chambers an average release rate is assumed to be equal to 50% of the maximum release rate. The ICD shall be a Hydrovex "40 SVHV Vertical Vortex Flow Regulator" (or approved equal) and shall be sized by the manufacturer for a discharge rate of 1.75 L/s at 2.01 m head. It is calculated that an orifice area of 1,257 sq.mm. (40 mm in diameter) and a discharge coefficient of 0.22 will restrict the outflow rate to 1.75 L/s at 2.01 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 1.14 L/s at 0.85 m.

	100-year	5-year
Maximum release rate:	1.75 L/s	1.14 L/s
Maximum water elevation:	56.04 m	54.88 m
Maximum stored volume:	42.15 cu.m.	18.00 cu.m.

The Entire Site:

	100-year	5-year
Pre-development flow rate:	27.31 L/s	13.89 L/s
Maximum permitted release rate:	10.24 L/s	10.24 L/s
Maximum release rate:	10.24 L/s	5.51 L/s
Reduction from pre-development conditions:	63 %	60 %
The maximum stored volume:	55.55 cu.m.	23.44 cu.m.

Therefore, the maximum post-development release rate for the 100-year storm event is calculated to be equal to the maximum allowable of 10.24 L/s and to achieve this release rate the maximum required storage capacity is 55.55 cu.m. For the 5-year

event the maximum post-development release is calculated to be less than the maximum allowable at 5.51 L/s and to achieve this release rate the maximum required storage capacity is 23.44 cu.m.

The unrestricted flowrate resulting from one in five-year storm event will produce a peak flow of 18.55 L/s which will be adequately by the proposed 200mm storm sewer connecting the outlet of the cistern to the 450mm dimeter municipal storm sewer in Gardner Street (200mm at 0.58% - 26.1 L/s capacity) being at 71% of its capacity. The restricted flowrate (through the ICD) during a five-year storm event will produce a peak flow of 1.14 L/s; only 4% of the capacity of the storm sewer.

The 60% to 63% reduction in stormwater flows contributing to the municipal storm sewers is expected to have a positive impact.

As required by the City an independent storm sewer connection will be provided for the foundation drains.

CONCLUSIONS:

1. A private on-site fire hydrant is not required.

2. There is an adequate water supply for firefighting.

3. A 150 mm water service is proposed to service a sprinkler system. The 150mm service will be adequate for the domestic demand.

4. There is an acceptable range of water pressures in the municipal watermain for the proposed development, however, since it is calculated that the water pressure can be above 80 psi at times a pressure reducing valve (PRV) is required to be installed immediately downstream of the water meter

5. The expected sanitary sewage flow rate will be adequately handled by the proposed sanitary sewer service connection.

6. The sanitary flow contributing to the existing municipal combined sewer is expected to have an acceptable impact.

7. The proposed development has no surface parking so RVCA does not require onsite water quality treatment. Therefore, no permanent quality control measures are proposed.

8. An erosion and sediment control plan has been developed to be implemented during construction.

9. The stormwater management criteria for quantity control are to control the post development peak flows for the 5-year and 100-year storm events to peak flows during the 2-year storm event using a runoff coefficient of 0.50, whichever is less; and a 10 minute time of concentration. The maximum allowable release rate is 10.24 L/s for all storm events. To achieve quantity control stormwater will be stored within the development on the roof and in a cistern located under the ramp to the underground parking.

10. The maximum post-development release rate for the 100-year storm event is calculated to be equal to the maximum allowable of 10.24 L/s and to achieve this release rate the maximum required storage capacity is 55.55 cu.m. For the 5-year event the maximum post-development release is calculated to be less than the maximum allowable at 5.51 L/s and to achieve this release rate the maximum required storage capacity is 23.44 cu.m.

11. The unrestricted flowrate resulting from one in five-year storm event will be adequately by the proposed storm sewer system.

12. The 60% to 63% reduction in stormwater flows contributing to the municipal storm sewers is expected to have a positive impact.

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09-Apr-20
REVISED 25-Jun-20

353-357 Gardner Street
Ottawa, Ontario

Fire Flow Requirements

Proposed 9-Storey 61-Unit Apartment Building

Fire flow requirement as calculated as per Fire Undewriter 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)

Proposed Apartment Building

9th Floor	558	sq.m.
8th Floor	628	sq.m.
7th Floor	628	sq.m.
6th Floor	628	sq.m.
5th Floor	628	sq.m.
4th Floor	628	sq.m.
3rd Floor	628	sq.m.
2nd Floor	628	sq.m.
1st Floor	628	sq.m.
TOTAL FIRE AREA:	5582	sq.m.

F = 13,149 L/min
= 13,000 L/min (rounded off to the nearest 1,000 L/min)

-15% Charge for Combustible Occupancy

= 11,050 L/min

Average 40% Reduction for Sprinkler System

= 4,420 L/min

Increase for Separation Exposed Buildings

			Adjacent Building			Length-Height
			Constuction	Length m	Storeys	Factor
17%	North	3.1 to 10m	W.F	13	2	26
0%	East	>45m				0
0%	South	>45m				0
5%	West	30.1 to 45m	W.F	12	2	24
22%	Total Increase for Exposure (maximum 75%)					

= 2,431 L/min Increase

= 9,061 L/min
F = 9,000 L/min (rounded off to the nearest 1,000 L/min)
= 150.0 L/s

Elevation at Subject Property: 57.55 m ASL

			Static Pressure at Fire Hydrant			
150 L/s FIRE FLOW:	104.0	m ASL	66	psi	455	kPa

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09-Apr-20

REVISED 25-Jun-20

353-357 Gardner Street
Ottawa, Ontario

Water Demand

Proposed 9-Storey 61-Unit Apartment Building

	Number of Units	Persons Per Unit	Population
APARTMENTS:			
1 Bedroom:	29	1.4	41
2 Bedroom:	32	2.1	67
3 Bedroom:	0	3.1	0
Average Aptarment:	0	1.8	0
TOTAL:	61		108

DAILY AVERAGE

350 litres / person / day

26.2 L/min | 0.4 L/s | 7 USgpm

MAXIMUM DAILY DEMAND 6.5 (Peaking Factor for a population of 108: Table 3-3 MOE Design Guidelines for Drinking-Water Systems)

170.8 L/min | 2.8 L/s | 45 USgpm

MAXIMUM HOURLY DEMAND 9.8 (Peaking Factor for a population of 108: Table 3-3 MOE Design Guidelines for Drinking-Water Systems)

257.5 L/min | 4.3 L/s | 68 USgpm

	Approximate		Static Pressure at Water Meter			
Elevation of Water Meter:	54.65	m ASL				
Finish Floor Elevation:	53.75	m ASL				
MINIMUM HGL:	107.5	m ASL	75	psi	518	kPa
MAXIMUM HGL:	118.2	m ASL	90	psi	623	kPa

D.B. Gray Engineering Inc.

Douglas Gray <d.gray@dbgrayengineering.com>

RE: 353-357 Gardner St

1 message

Wessel, Shawn <shawn.wessel@ottawa.ca> Fri, Apr 17, 2020 at 9:44 AM
To: Douglas Gray <d.gray@dbgrayengineering.com>
Cc: Florent Filion <f.filion@longwoodbuilders.com>, "Rosaline J. Hill" <rosaline@rjhill.ca>, Alastair Whitewolf <alastair@rjhill.ca>, Caoimhin Kennedy <c.kennedy@dbgrayengineering.com>, "Deiaco, Simon" <Simon.Deiaco@ottawa.ca>

Good morning Mr. Gray.

Please find requested boundary conditions and WD Dept. FH analysis information below:

The following are boundary conditions, HGL, for hydraulic analysis at 353-357 Gardner (zone 1E) assumed to be connected to the 152mm on Gardner (see attached PDF for location).

Minimum HGL =107.5m

Maximum HGL = 118.2m. *The maximum pressure is estimated to be more than 80 psi. A pressure check at completion of construction is recommended to determine if pressure control is required.*

Available Flow @20psi = 120 L/s assuming a ground elevation of 57.2m

A Multi-Hydrant analysis was performed assuming the following three hydrants (located within 150m of the site) running simultaneously (see attached PDF for locations). The total aggregate flow is 220 L/s. The corresponding HGL at the proposed service connection when the three hydrants are running simultaneously is 104.0m.

	Hydrant Flow as per Tech bulletin ISTB-2018-02
H1 (152mm on Montgomery)	95 L/s
H2 (152mm on Selkirk)	63 L/s
H3 (152mm on MacArthur)	63 L/s
Total aggregate flow	**220L/s**

These are for current conditions and are based on computer model simulation.

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 watermains 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.

If you require additional information or clarification, please do not hesitate to contact me anytime.

Thank you

Regards,

Shawn Wessel, A.Sc.T.,rcji

Project Manager - Infrastructure Approvals

Gestionnaire de projet – Approbation des demandes d'infrastructures

Development Review Central Branch | Direction de l'examen des projets d'aménagement, Centrale

Planning, Infrastructure and Economic Development Department | Direction générale de la planification

de l'infrastructure et du développement économique

City of Ottawa | Ville d'Ottawa

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(613) 580 2424 Ext. | Poste 33017

Int. Mail Code | Code de Courrier Interne 01-14

shawn.wessel@ottawa.ca

From: Douglas Gray <d.gray@dbgrayengineering.com>
Sent: April 16, 2020 3:28 PM
To: Wessel, Shawn <shawn.wessel@ottawa.ca>
Cc: Florent Filion <f.filion@longwoodbuilders.com>; Rosaline J. Hill <rosaline@rjhill.ca>; Alastair Whitewolf <alastair@rjhill.ca>; Caoimhin Kennedy <c.kennedy@dbgrayengineering.com>
Subject: Re: 353-357 Gardner St

Thank you Shawn.

The provided boundary conditions indicate that the maximum available flow in the 152mm watermain in Gardner St is 120 L/s @ 20 psi. However, the proposed building requires a fire flow of 166.7 L/s.

Please provide the boundary condition for:

Option #1: A proposed fire hydrant connecting to the 203mm watermain near the intersection of Gardner and Montgomery - see attached sketch.

Option #2: A proposed fire hydrant connecting to the 406mm watermain in McArthur Ave - see attached sketch.

The following are the expected demands (previously sent to you but provided for your convenience).

Average daily demand: 0.5 L/s.

Maximum daily demand: 2.9 L/s.

Maximum hourly daily demand: 4.4 L/s

Fire Flow demand: 166.7 L/s

Fire Flow + Max Day: 169.6 L/s

Regards, Doug

D.B. Gray Engineering Inc.

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

700 Long Point Circle Tel: 613-425-8044

Ottawa, Ontario K1T 4E9 d.gray@dbgrayengineering.com

On Thu, Apr 16, 2020 at 9:36 AM Wessel, Shawn <shawn.wessel@ottawa.ca> wrote:

> Good morning Mr. Gray.
>
> I hope this email finds you, your family, friends and associates well during these trying times.
>
> Please find requested boundary conditions below and attached:
>
> The following are boundary conditions, HGL, for hydraulic analysis at 353-357 Gardner (zone 1E) assumed to be connected to the 152mm on Gardner (see attached PDF for location).
>
> Minimum HGL =107.5m
>
> Maximum HGL = 118.2m. The maximum pressure is estimated to be more than 80 psi. A pressure check at completion of construction is recommended to determine if pressure control is required.
>
> Available Flow @20psi = 120 L/s assuming a ground elevation of 57.2m
>
> These are for current conditions and are based on computer model simulation.
>
> 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 watermains 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.
>
> If you require additional information or clarification, please do not hesitate to contact me anytime.
>
> Thank you

Regards,

Shawn Wessel, A.Sc.T.,rcji

Project Manager - Infrastructure Approvals

Gestionnaire de projet – Approbation des demandes d'infrastructures

Development Review Central Branch | Direction de l'examen des projets d'aménagement, Centrale

Planning, Infrastructure and Economic Development Department | Direction générale de la planification

de l'infrastructure et du développement économique

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Int. Mail Code | Code de Courrier Interne 01-14

shawn.wessel@ottawa.ca

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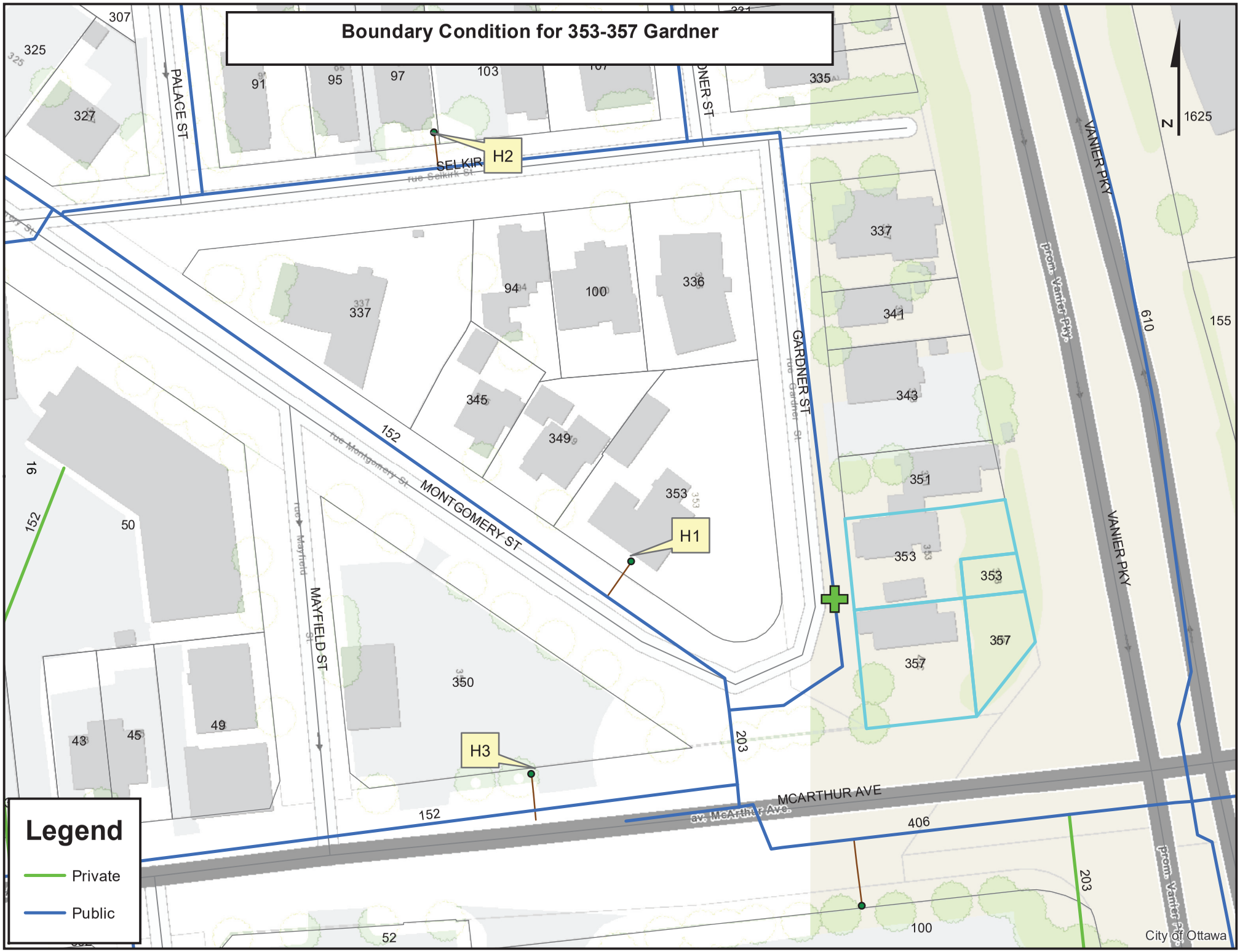
353-357 Gardner Multi-Hydrant April 2020.pdf
1322K


Boundary Condition for 353-357 Gardner
H1
H2
H3
SELKIRK
MONTGOMERY ST
MAYFIELD ST
GARDNER ST
MCARTHUR AVE
PALACE ST
VANIER PKY
Legend
Private
Public
City of Ottawa

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SANITARY SEWER DESIGN FORM

Average Daily Flows
Residential: 280 l / capita / day
Commercial: 28000 l / ha / day
Instituational: 28000 l / ha / day
Light Industrial: 35000 l / ha / day
Heavy Industrial: 55000 l / ha / day

Infiltration Allowance: 0.33 l / s / ha

Peaking Factor:
Residential (Harmon Equation): $1 + \frac{14}{4 + P^{0.5}}$
P = Population / 1000
Harmon Correction Factor: 0.8
Commercial & Institutional: 1.5 If contrinbution > 20%
Commercial & Institutional: 1 If contrinbution < 20%
Industrial: As per Ottawa Guidelines Appendix 4-B

Project: 353-357 Gardner Street
Designed By: D.B.G
22-Jun-20
Page: 1 of 1

Location		Section								Cumulative Residential		Section Non-Residential				Cumulative				Sewer Data n = 0.013							
		Single Family	Semi/Townhouse	Duplex / Triplex	Apartment (average)	Apartment (1 Bed.)	Apartment (2 Bed.)	Apartment (3 Bed.)	Residential Area	Pop.	Peaking Factor	Area	Flow	Peaking Factor	Flow	Area	Sewage Flow	Infiltration Flow	Total Flow	Type of Pipe	Dia. Actual	Dia. Nom.	Slope	Length	Capacity	Velocity	Ratio
		ppu = 3.4	ppu = 2.7	ppu = 2.3	ppu = 1.8	ppu = 1.4	ppu = 2.1	ppu = 3.1																			
FROM	TO	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	ha			ha	l/ha/day		l/s	ha	l/s	l/s	l/s		(mm)	(mm)	(%)	(m)	(l/s)	(m/s)	Q/Qfull
		EXISTING SINGLE FAMILY DWELLINGS TO BE DEMOLISHED																									
		2							0.102	7	3.20					0.102	0.07	0.03	0.10								
		PROPOSED 61 UNIT APARTMENT BUILDING																									
9 Storey	Exist.					29	32		0.102	108	3.20					0.102	1.12	0.03	1.15	PVC	203.2	200	1.00	6.2	34.22	1.06	0.03
Building	300 SAN																										
																					Existing 300 SAN in Gardner Street						
																					304.8	300	0.43		66.15	0.91	

D.B. Gray Engineering Inc.

Douglas Gray <d.gray@dbgrayengineering.com>

RE: RVCA Stormwater Management Comments - 353-357 Gardner Street

1 message

Jamie Batchelor <jamie.batchelor@rvca.ca> Wed, May 20, 2020 at 4:10 PM
To: Ryan Faith <r.faith@dbgrayengineering.com>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>

Good Afternoon Ryan,

Based on the plans submitted, it appears that majority of the rainwater from this site will be from rooftop and landscaping. Parking is proposed underground. Drainage from rooftops and landscaped areas are considered clean for the purpose of the protection of aquatic and fish habitat. Therefore, the RVCA accepts that no onsite water quality measures are required save and except best management practices.

Jamie Batchelor, MCIP, RPP

Planner, ext. 1191

Jamie.batchelor@rvca.ca

Rideau Valley Conservation Authority

3889 Rideau Valley Drive
PO Box 599, Manotick ON K4M 1A5
T 613-692-3571 | 1-800-267-3504 F 613-692-0831 | www.rvca.ca

From: Ryan Faith <r.faith@dbgrayengineering.com>
Sent: Tuesday, May 19, 2020 3:38 PM
To: Jamie Batchelor <jamie.batchelor@rvca.ca>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>
Subject: RVCA Stormwater Management Comments - 353-357 Gardner Street

Hi Jamie,

We are working on a proposed 10 storey apartment building with underground parking on 1,022 sq.m of land at 353-357 Gardner Street in Ottawa.

Please comment on the stormwater management for the site.

I have attached a site plan for your reference.

Thanks,

Ryan Faith

D.B. Gray Engineering Inc.

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

700 Long Point Circle 613-425-8044
Ottawa, Ontario r.faith@dbgrayengineering.com

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)
AREA I (Uncontrolled Flow Off Site)	-	8.49	-	-
AREA II (8th Floor Roof) * Drains to Area VI	-	2.32	0.72	0.72
AREA III (North Side 9th Floor Roof) * Drains to Area VI	-	3.09	7.06	7.06
AREA IV (Mechanical Penthouse Roof) * Drains to Area VI	-	2.99	4.46	4.46
AREA V (South Side 9th Floor Roof) * Drains to Area VI	-	2.48	1.16	1.16
AREA VI	-	1.75	42.15	42.15
TOTAL (Area I + Area VI)	10.24	10.24	55.55	55.55

FIVE YEAR EVENT

Drainage Area	Maximum Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	4.37	-	-
AREA II (8th Floor Roof) * Drains to Area VI	-	1.64	0.25	0.25
AREA III (North Side 9th Floor Roof) * Drains to Area VI	-	2.32	2.98	2.98
AREA IV (Mechanical Penthouse Roof) * Drains to Area VI	-	2.21	1.80	1.80
AREA V (South Side 9th Floor Roof) * Drains to Area VI	-	1.76	0.42	0.42
AREA VI	-	1.14	18.00	18.00
TOTAL (Area I + Area VI)	10.24	5.51	23.44	23.44

353-357 Gardner Street

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS
Rational Method

PRE-DEVELOPMENT CONDITIONS

100-Year Flow Rate

			C
Roof Area:	224	sq.m	1.00
Asphalt/Concrete Area:	169	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	629	sq.m	0.25
Total Catchment Area:	1022	sq.m	0.54

Airport Formula

$$Tc = \frac{3.26 \bullet (1.1 - C) \bullet L^{1/2}}{Sw^{0.33}} \text{ min}$$

Runoff Coefficient (C):	0.54	
Sheet Flow Distance (L):	30.0	m
Slope of Land (Sw):	3	%
Time of Concentration (Sheet Flow):	7.0	min
Area (A):	1022	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.54	
100-Year Pre-Development Flow Rate (2.78AiC):	27.31	L/s

Maximum Allowable Release Rate

			C
Roof Area:	224	sq.m	0.90
Asphalt/Concrete Area:	169	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	629	sq.m	0.20
Total Catchment Area:	1022	sq.m	0.47

Area (A):	1022	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	77	mm/hr	(2 year event)
Runoff Coeficient (C):	0.47		
Maximum Allowable Release Rate (2.78AiC):	10.24	L/s	

ONE HUNDRED-YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	24	sq.m	1.00
Asphalt/Concrete Area:	117	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	120	sq.m	0.25
Total Catchment Area:	261	sq.m	0.66
Area (A):	261	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr	
Runoff Coeficient (C):	0.66		
Release Rate (2.78AiC):	8.49	L/s	

DRAINAGE AREA II (8th Floor Roof)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	70	sq.m	1.00
Asphalt/Concrete Area:	0	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	0	sq.m	0.25
Total Catchment Area:	70	sq.m	1.00

No. of Roof Drains: 2

Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 94 mm

Maximum Release Rate: 2.32 L/s Pond Area: 23 sq.m

Achieved Volume: 0.72 cu.m

Maximum Volume Required: 0.72 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	4.72	2.32	2.40	0.72
10	179	3.47	2.32	1.15	0.69
15	143	2.78	2.32	0.46	0.41
20	120	2.33	2.32	0.01	0.01
25	104	2.02	2.02	0.00	0.00
30	92	1.79	1.79	0.00	0.00
35	83	1.61	1.61	0.00	0.00
40	75	1.46	1.46	0.00	0.00
45	69	1.34	1.34	0.00	0.00
50	64	1.24	1.24	0.00	0.00
55	60	1.16	1.16	0.00	0.00
60	56	1.09	1.09	0.00	0.00
65	53	1.02	1.02	0.00	0.00
70	50	0.97	0.97	0.00	0.00
75	47	0.92	0.92	0.00	0.00
80	45	0.88	0.88	0.00	0.00
85	43	0.84	0.84	0.00	0.00
90	41	0.80	0.80	0.00	0.00
95	39	0.77	0.77	0.00	0.00
100	38	0.74	0.74	0.00	0.00
105	36	0.71	0.71	0.00	0.00
110	35	0.69	0.69	0.00	0.00
115	34	0.66	0.66	0.00	0.00
120	33	0.64	0.64	0.00	0.00
125	32	0.62	0.62	0.00	0.00
130	31	0.60	0.60	0.00	0.00
135	30	0.58	0.58	0.00	0.00
140	29	0.57	0.57	0.00	0.00
145	28	0.55	0.55	0.00	0.00
150	28	0.54	0.54	0.00	0.00
180	24	0.47	0.47	0.00	0.00
210	21	0.41	0.41	0.00	0.00
240	19	0.37	0.37	0.00	0.00
270	17	0.34	0.34	0.00	0.00
300	16	0.31	0.31	0.00	0.00

DRAINAGE AREA III (North Side 9th Floor Roof)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	269	sq.m	1.00
Asphalt/Concrete Area:	0	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	0	sq.m	0.25
Total Catchment Area:	269	sq.m	1.00

No. of Roof Drains: 2

Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 124 mm

Maximum Release Rate: 3.09 L/s

Pond Area: 170 sq.m

Achieved Volume: 7.06 cu.m

Maximum Volume Required: 7.06 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	18.15	3.09	15.06	4.52
10	179	13.35	3.09	10.27	6.16
15	143	10.69	3.09	7.60	6.84
20	120	8.97	3.09	5.88	7.06
25	104	7.77	3.09	4.68	7.02
30	92	6.87	3.09	3.78	6.81
35	83	6.18	3.09	3.09	6.49
40	75	5.62	3.09	2.53	6.08
45	69	5.16	3.09	2.08	5.61
50	64	4.78	3.09	1.70	5.09
55	60	4.46	3.09	1.37	4.53
60	56	4.18	3.09	1.09	3.93
65	53	3.94	3.09	0.85	3.31
70	50	3.72	3.09	0.64	2.67
75	47	3.53	3.09	0.45	2.01
80	45	3.36	3.09	0.28	1.33
85	43	3.21	3.09	0.12	0.64
90	41	3.07	3.07	0.00	0.00
95	39	2.95	2.95	0.00	0.00
100	38	2.83	2.83	0.00	0.00
105	36	2.73	2.73	0.00	0.00
110	35	2.63	2.63	0.00	0.00
115	34	2.54	2.54	0.00	0.00
120	33	2.46	2.46	0.00	0.00
125	32	2.38	2.38	0.00	0.00
130	31	2.31	2.31	0.00	0.00
135	30	2.24	2.24	0.00	0.00
140	29	2.18	2.18	0.00	0.00
145	28	2.12	2.12	0.00	0.00
150	28	2.06	2.06	0.00	0.00
180	24	1.79	1.79	0.00	0.00
210	21	1.58	1.58	0.00	0.00
240	19	1.42	1.42	0.00	0.00
270	17	1.29	1.29	0.00	0.00
300	16	1.19	1.19	0.00	0.00

DRAINAGE AREA IV (Mechanical Penthouse Roof)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	200	sq.m	1.00
Asphalt/Concrete Area:	0	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	0	sq.m	0.25
Total Catchment Area:	200	sq.m	1.00

No. of Roof Drains: 2

Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 121 mm

Maximum Release Rate: 2.99 L/s

Pond Area: 111 sq.m

Achieved Volume: 4.46 cu.m

Maximum Volume Required: 4.46 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	13.49	2.99	10.50	3.15
10	179	9.93	2.99	6.93	4.16
15	143	7.94	2.99	4.95	4.46
20	120	6.67	2.99	3.68	4.41
25	104	5.77	2.99	2.78	4.17
30	92	5.11	2.99	2.11	3.81
35	83	4.59	2.99	1.60	3.36
40	75	4.18	2.99	1.18	2.84
45	69	3.84	2.99	0.85	2.28
50	64	3.56	2.99	0.56	1.69
55	60	3.32	2.99	0.32	1.06
60	56	3.11	2.99	0.11	0.41
65	53	2.93	2.93	0.00	0.00
70	50	2.77	2.77	0.00	0.00
75	47	2.63	2.63	0.00	0.00
80	45	2.50	2.50	0.00	0.00
85	43	2.39	2.39	0.00	0.00
90	41	2.29	2.29	0.00	0.00
95	39	2.19	2.19	0.00	0.00
100	38	2.11	2.11	0.00	0.00
105	36	2.03	2.03	0.00	0.00
110	35	1.96	1.96	0.00	0.00
115	34	1.89	1.89	0.00	0.00
120	33	1.83	1.83	0.00	0.00
125	32	1.77	1.77	0.00	0.00
130	31	1.72	1.72	0.00	0.00
135	30	1.67	1.67	0.00	0.00
140	29	1.62	1.62	0.00	0.00
145	28	1.58	1.58	0.00	0.00
150	28	1.54	1.54	0.00	0.00
180	24	1.33	1.33	0.00	0.00
210	21	1.18	1.18	0.00	0.00
240	19	1.06	1.06	0.00	0.00
270	17	0.96	0.96	0.00	0.00
300	16	0.88	0.88	0.00	0.00

DRAINAGE AREA V (South Side 9th Floor Roof)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	89	sq.m	1.00
Asphalt/Concrete Area:	0	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	0	sq.m	0.25
Total Catchment Area:	89	sq.m	1.00

No. of Roof Drains: 2
Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 100 mm

Maximum Release Rate: 2.48 L/s Pond Area: 35 sq.m

Achieved Volume: 1.16 cu.m

Maximum Volume Required: 1.16 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	6.00	2.48	3.53	1.06
10	179	4.42	2.48	1.94	1.16
15	143	3.54	2.48	1.06	0.95
20	120	2.97	2.48	0.49	0.59
25	104	2.57	2.48	0.09	0.14
30	92	2.27	2.27	0.00	0.00
35	83	2.04	2.04	0.00	0.00
40	75	1.86	1.86	0.00	0.00
45	69	1.71	1.71	0.00	0.00
50	64	1.58	1.58	0.00	0.00
55	60	1.48	1.48	0.00	0.00
60	56	1.38	1.38	0.00	0.00
65	53	1.30	1.30	0.00	0.00
70	50	1.23	1.23	0.00	0.00
75	47	1.17	1.17	0.00	0.00
80	45	1.11	1.11	0.00	0.00
85	43	1.06	1.06	0.00	0.00
90	41	1.02	1.02	0.00	0.00
95	39	0.98	0.98	0.00	0.00
100	38	0.94	0.94	0.00	0.00
105	36	0.90	0.90	0.00	0.00
110	35	0.87	0.87	0.00	0.00
115	34	0.84	0.84	0.00	0.00
120	33	0.81	0.81	0.00	0.00
125	32	0.79	0.79	0.00	0.00
130	31	0.76	0.76	0.00	0.00
135	30	0.74	0.74	0.00	0.00
140	29	0.72	0.72	0.00	0.00
145	28	0.70	0.70	0.00	0.00
150	28	0.68	0.68	0.00	0.00
180	24	0.59	0.59	0.00	0.00
210	21	0.52	0.52	0.00	0.00
240	19	0.47	0.47	0.00	0.00
270	17	0.43	0.43	0.00	0.00
300	16	0.39	0.39	0.00	0.00

DRAINAGE AREA VI

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	74	sq.m	1.00
Gravel Area:	2	sq.m	0.875
Landscaped Area:	57	sq.m	0.25
Total Catchment Area:	133	sq.m	0.68

Water Elevation:	56.04	m
Invert of Outlet Pipe:	54.01	m
Centroid of ICD Orifice: (ICD in Outlet Pipe)	54.03	m
Head:	2.01	m
Orifice Diameter:	40	mm
Orifice Area:	1257	sq.mm
Coefficient of Discharge:	0.22	
Maximum Release Rate:	1.75	L/s

Cast-In-Place Cistern

Length (m)	Width (m)	Depth (m)	Volume	
7.60	2.74	2.03	42.15	cu.m

Achieved Volume:	42.15	cu.m
Maximum Volume Required:	42.15	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Flow from Area II (L/s)	Flow from Area III (L/s)	Flow from Area IV (L/s)	Flow from Area V (L/s)	50% of Maximum Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	6.07	2.32	3.09	2.99	2.48	0.88	16.08	4.82
10	179	4.47	2.32	3.09	2.99	2.48	0.88	14.47	8.68
15	143	3.58	2.32	3.09	2.99	2.48	0.88	13.58	12.22
20	120	3.00	2.32	3.09	2.99	2.48	0.88	13.01	15.61
25	104	2.60	2.02	3.09	2.99	2.48	0.88	12.30	18.45
30	92	2.30	1.79	3.09	2.99	2.27	0.88	11.56	20.82
35	83	2.07	1.61	3.09	2.99	2.04	0.88	10.92	22.93
40	75	1.88	1.46	3.09	2.99	1.86	0.88	10.41	24.98
45	69	1.73	1.34	3.09	2.99	1.71	0.88	9.98	26.96
50	64	1.60	1.24	3.09	2.99	1.58	0.88	9.63	28.90
55	60	1.49	1.16	3.09	2.99	1.48	0.88	9.33	30.80
60	56	1.40	1.09	3.09	2.99	1.38	0.88	9.07	32.67
65	53	1.32	1.02	3.09	2.93	1.30	0.88	8.78	34.25
70	50	1.25	0.97	3.09	2.77	1.23	0.88	8.43	35.39
75	47	1.18	0.92	3.09	2.63	1.17	0.88	8.11	36.50
80	45	1.13	0.88	3.09	2.50	1.11	0.88	7.83	37.57
85	43	1.07	0.84	3.09	2.39	1.06	0.88	7.57	38.62
90	41	1.03	0.80	3.07	2.29	1.02	0.88	7.33	39.58
95	39	0.99	0.77	2.95	2.19	0.98	0.88	7.00	39.88
100	38	0.95	0.74	2.83	2.11	0.94	0.88	6.69	40.14
105	36	0.91	0.71	2.73	2.03	0.90	0.88	6.41	40.38
110	35	0.88	0.69	2.63	1.96	0.87	0.88	6.15	40.60
115	34	0.85	0.66	2.54	1.89	0.84	0.88	5.91	40.79
120	33	0.82	0.64	2.46	1.83	0.81	0.88	5.69	40.97
125	32	0.80	0.62	2.38	1.77	0.79	0.88	5.48	41.13
130	31	0.77	0.60	2.31	1.72	0.76	0.88	5.29	41.28
135	30	0.75	0.58	2.24	1.67	0.74	0.88	5.11	41.41
140	29	0.73	0.57	2.18	1.62	0.72	0.88	4.94	41.52
145	28	0.71	0.55	2.12	1.58	0.70	0.88	4.78	41.63
150	28	0.69	0.54	2.06	1.54	0.68	0.88	4.64	41.72
180	24	0.60	0.47	1.79	1.33	0.59	0.88	3.90	42.07
210	21	0.53	0.41	1.58	1.18	0.52	0.88	3.35	42.15
240	19	0.48	0.37	1.42	1.06	0.47	0.88	2.92	42.02
270	17	0.43	0.34	1.29	0.96	0.43	0.88	2.58	41.74
300	16	0.40	0.31	1.19	0.88	0.39	0.88	2.30	41.34

PRE-DEVELOPMENT CONDITIONS

5-Year Flow Rate

			C
Roof Area:	224	sq.m	0.90
Asphalt/Concrete Area:	169	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	629	sq.m	0.20
Total Catchment Area:	1022	sq.m	0.47

Airport Formula (Used when C < 0.40)

$$Tc = \frac{3.26 \cdot (1.1 - C) \cdot L^{1/2}}{Sw^{0.33}} \text{ min}$$

Runoff Coefficient (C):	0.47	
Sheet Flow Distance (L):	30.0	m
Slope of Land (Sw):	3	%
Time of Concentration (Sheet Flow):	7.8	min
Area (A):	1022	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	104	mm/hr
Runoff Coeficient (C):	0.47	
5-Year Pre-Development Flow Rate (2.78AiC):	13.89	L/s

Maximum Allowable Release Rate

			C
Roof Area:	224	sq.m	0.90
Asphalt/Concrete Area:	169	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	629	sq.m	0.20
Total Catchment Area:	1022	sq.m	0.47

Area (A):	1022	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	77	mm/hr	(2 year event)
Runoff Coeficient (C):	0.47		
Maximum Allowable Release Rate (2.78AiC):	10.24	L/s	

FIVE-YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(FIVE YEAR EVENT)

			C
Roof Area:	24	sq.m	0.90
Asphalt/Concrete Area:	117	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	120	sq.m	0.20
Total Catchment Area:	261	sq.m	0.58
Area (A):	261	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.58		
Release Rate (2.78 • A • i • C):	4.37	L/s	

DRAINAGE AREA II (8th Floor Roof)

(FIVE YEAR EVENT)

			C
Roof Area:	70	sq.m	0.90
Asphalt/Concrete Area:	0	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	0	sq.m	0.20
Total Catchment Area:	70	sq.m	0.90

No. of Roof Drains: 2
Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 66 mm

Maximum Release Rate: 1.64 L/s

Pond Area: 11 sq.m

Achieved Volume: 0.25 cu.m

Maximum Volume Required: 0.25 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	2.47	1.64	0.84	0.25
10	104	1.82	1.64	0.19	0.11
15	84	1.46	1.46	0.00	0.00
20	70	1.23	1.23	0.00	0.00
25	61	1.07	1.07	0.00	0.00
30	54	0.94	0.94	0.00	0.00
35	49	0.85	0.85	0.00	0.00
40	44	0.77	0.77	0.00	0.00
45	41	0.71	0.71	0.00	0.00
50	38	0.66	0.66	0.00	0.00
55	35	0.62	0.62	0.00	0.00
60	33	0.58	0.58	0.00	0.00
65	31	0.54	0.54	0.00	0.00
70	29	0.51	0.51	0.00	0.00
75	28	0.49	0.49	0.00	0.00
80	27	0.47	0.47	0.00	0.00
85	25	0.44	0.44	0.00	0.00
90	24	0.43	0.43	0.00	0.00
95	23	0.41	0.41	0.00	0.00
100	22	0.39	0.39	0.00	0.00
105	22	0.38	0.38	0.00	0.00
110	21	0.36	0.36	0.00	0.00
115	20	0.35	0.35	0.00	0.00
120	19	0.34	0.34	0.00	0.00
125	19	0.33	0.33	0.00	0.00
130	18	0.32	0.32	0.00	0.00
135	18	0.31	0.31	0.00	0.00
140	17	0.30	0.30	0.00	0.00
145	17	0.29	0.29	0.00	0.00
150	16	0.29	0.29	0.00	0.00
180	14	0.25	0.25	0.00	0.00
210	13	0.22	0.22	0.00	0.00
240	11	0.20	0.20	0.00	0.00
270	10	0.18	0.18	0.00	0.00
300	9	0.17	0.17	0.00	0.00

DRAINAGE AREA III (North Side 9th Floor Roof)

(FIVE YEAR EVENT)

			C
Roof Area:	269	sq.m	0.90
Asphalt/Concrete Area:	0	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	0	sq.m	0.20
Total Catchment Area:	269	sq.m	0.90

No. of Roof Drains: 2
Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 93 mm

Maximum Release Rate: 2.32 L/s Pond Area: 96 sq.m

Achieved Volume: 2.98 cu.m

Maximum Volume Required: 2.98 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	9.50	2.32	7.19	2.16
10	104	7.01	2.32	4.70	2.82
15	84	5.62	2.32	3.31	2.98
20	70	4.73	2.32	2.41	2.90
25	61	4.10	2.32	1.78	2.67
30	54	3.63	2.32	1.31	2.37
35	49	3.27	2.32	0.95	2.00
40	44	2.97	2.32	0.66	1.58
45	41	2.73	2.32	0.42	1.13
50	38	2.53	2.32	0.22	0.66
55	35	2.36	2.32	0.05	0.16
60	33	2.22	2.22	0.00	0.00
65	31	2.09	2.09	0.00	0.00
70	29	1.98	1.98	0.00	0.00
75	28	1.88	1.88	0.00	0.00
80	27	1.79	1.79	0.00	0.00
85	25	1.71	1.71	0.00	0.00
90	24	1.63	1.63	0.00	0.00
95	23	1.57	1.57	0.00	0.00
100	22	1.51	1.51	0.00	0.00
105	22	1.45	1.45	0.00	0.00
110	21	1.40	1.40	0.00	0.00
115	20	1.35	1.35	0.00	0.00
120	19	1.31	1.31	0.00	0.00
125	19	1.27	1.27	0.00	0.00
130	18	1.23	1.23	0.00	0.00
135	18	1.20	1.20	0.00	0.00
140	17	1.16	1.16	0.00	0.00
145	17	1.13	1.13	0.00	0.00
150	16	1.10	1.10	0.00	0.00
180	14	0.95	0.95	0.00	0.00
210	13	0.85	0.85	0.00	0.00
240	11	0.76	0.76	0.00	0.00
270	10	0.69	0.69	0.00	0.00
300	9	0.64	0.64	0.00	0.00

DRAINAGE AREA IV (Mechanical Penthouse Roof)

(FIVE YEAR EVENT)

			C
Roof Area:	200	sq.m	0.90
Asphalt/Concrete Area:	0	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	0	sq.m	0.20
Total Catchment Area:	200	sq.m	0.90

No. of Roof Drains: 2
Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 89 mm

Maximum Release Rate: 2.21 L/s Pond Area: 61 sq.m

Achieved Volume: 1.80 cu.m

Maximum Volume Required: 1.80 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	7.06	2.21	4.85	1.46
10	104	5.21	2.21	3.00	1.80
15	84	4.18	2.21	1.97	1.77
20	70	3.52	2.21	1.30	1.56
25	61	3.05	2.21	0.83	1.25
30	54	2.70	2.21	0.49	0.87
35	49	2.43	2.21	0.21	0.45
40	44	2.21	2.21	0.00	0.00
45	41	2.03	2.03	0.00	0.00
50	38	1.88	1.88	0.00	0.00
55	35	1.76	1.76	0.00	0.00
60	33	1.65	1.65	0.00	0.00
65	31	1.55	1.55	0.00	0.00
70	29	1.47	1.47	0.00	0.00
75	28	1.40	1.40	0.00	0.00
80	27	1.33	1.33	0.00	0.00
85	25	1.27	1.27	0.00	0.00
90	24	1.22	1.22	0.00	0.00
95	23	1.17	1.17	0.00	0.00
100	22	1.12	1.12	0.00	0.00
105	22	1.08	1.08	0.00	0.00
110	21	1.04	1.04	0.00	0.00
115	20	1.01	1.01	0.00	0.00
120	19	0.97	0.97	0.00	0.00
125	19	0.94	0.94	0.00	0.00
130	18	0.92	0.92	0.00	0.00
135	18	0.89	0.89	0.00	0.00
140	17	0.86	0.86	0.00	0.00
145	17	0.84	0.84	0.00	0.00
150	16	0.82	0.82	0.00	0.00
180	14	0.71	0.71	0.00	0.00
210	13	0.63	0.63	0.00	0.00
240	11	0.57	0.57	0.00	0.00
270	10	0.51	0.51	0.00	0.00
300	9	0.47	0.47	0.00	0.00

DRAINAGE AREA V (South Side 9th Floor Roof)

(FIVE YEAR EVENT)

			C
Roof Area:	89	sq.m	0.90
Asphalt/Concrete Area:	0	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	0	sq.m	0.20
Total Catchment Area:	89	sq.m	0.90

No. of Roof Drains: 2

Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 71 mm

Maximum Release Rate: 1.76 L/s

Pond Area: 18 sq.m

Achieved Volume: 0.42 cu.m

Maximum Volume Required: 0.42 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	3.14	1.76	1.39	0.42
10	104	2.32	1.76	0.56	0.34
15	84	1.86	1.76	0.10	0.09
20	70	1.56	1.56	0.00	0.00
25	61	1.36	1.36	0.00	0.00
30	54	1.20	1.20	0.00	0.00
35	49	1.08	1.08	0.00	0.00
40	44	0.98	0.98	0.00	0.00
45	41	0.90	0.90	0.00	0.00
50	38	0.84	0.84	0.00	0.00
55	35	0.78	0.78	0.00	0.00
60	33	0.73	0.73	0.00	0.00
65	31	0.69	0.69	0.00	0.00
70	29	0.65	0.65	0.00	0.00
75	28	0.62	0.62	0.00	0.00
80	27	0.59	0.59	0.00	0.00
85	25	0.56	0.56	0.00	0.00
90	24	0.54	0.54	0.00	0.00
95	23	0.52	0.52	0.00	0.00
100	22	0.50	0.50	0.00	0.00
105	22	0.48	0.48	0.00	0.00
110	21	0.46	0.46	0.00	0.00
115	20	0.45	0.45	0.00	0.00
120	19	0.43	0.43	0.00	0.00
125	19	0.42	0.42	0.00	0.00
130	18	0.41	0.41	0.00	0.00
135	18	0.40	0.40	0.00	0.00
140	17	0.38	0.38	0.00	0.00
145	17	0.37	0.37	0.00	0.00
150	16	0.36	0.36	0.00	0.00
180	14	0.32	0.32	0.00	0.00
210	13	0.28	0.28	0.00	0.00
240	11	0.25	0.25	0.00	0.00
270	10	0.23	0.23	0.00	0.00
300	9	0.21	0.21	0.00	0.00

DRAINAGE AREA VI

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	74	sq.m	0.90
Gravel Area:	2	sq.m	0.70
Landscaped Area:	57	sq.m	0.20
Total Catchment Area:	133	sq.m	0.60

Water Elevation:	54.88	m
Invert of Outlet Pipe:	54.01	m
Centroid of ICD Orifice: (ICD in Outlet Pipe)	54.03	m
Head:	0.85	m
Orifice Diameter:	40	mm
Orifice Area:	1257	sq.mm
Coefficient of Discharge:	0.22	
Maximum Release Rate:	1.14	L/s

Cast-In-Place Cistern

Length (m)	Width (m)	Depth (m)	Volume	
7.60	2.74	0.87	18.00	cu.m
		Achieved Volume:	18.00	cu.m
		Maximum Volume Required:	18.00	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Flow from Area II (L/s)	Flow from Area III (L/s)	Flow from Area IV (L/s)	Flow from Area V (L/s)	50% of Maximum Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	3.12	1.64	2.32	2.21	1.76	0.57	8.71	2.61
10	104	2.30	1.64	2.32	2.21	1.76	0.57	7.90	4.74
15	84	1.84	1.46	2.32	2.21	1.76	0.57	7.27	6.54
20	70	1.55	1.23	2.32	2.21	1.56	0.57	6.74	8.09
25	61	1.34	1.07	2.32	2.21	1.36	0.57	6.37	9.56
30	54	1.19	0.94	2.32	2.21	1.20	0.57	6.09	10.97
35	49	1.07	0.85	2.32	2.21	1.08	0.57	5.88	12.35
40	44	0.98	0.77	2.32	2.21	0.98	0.57	5.71	13.70
45	41	0.90	0.71	2.32	2.03	0.90	0.57	5.39	14.55
50	38	0.83	0.66	2.32	1.88	0.84	0.57	5.12	15.37
55	35	0.78	0.62	2.32	1.76	0.78	0.57	4.90	16.15
60	33	0.73	0.58	2.22	1.65	0.73	0.57	4.60	16.57
65	31	0.69	0.54	2.09	1.55	0.69	0.57	4.30	16.78
70	29	0.65	0.51	1.98	1.47	0.65	0.57	4.04	16.97
75	28	0.62	0.49	1.88	1.40	0.62	0.57	3.81	17.14
80	27	0.59	0.47	1.79	1.33	0.59	0.57	3.60	17.28
85	25	0.56	0.44	1.71	1.27	0.56	0.57	3.41	17.41
90	24	0.54	0.43	1.63	1.22	0.54	0.57	3.24	17.51
95	23	0.51	0.41	1.57	1.17	0.52	0.57	3.09	17.61
100	22	0.49	0.39	1.51	1.12	0.50	0.57	2.95	17.69
105	22	0.48	0.38	1.45	1.08	0.48	0.57	2.82	17.76
110	21	0.46	0.36	1.40	1.04	0.46	0.57	2.70	17.82
115	20	0.44	0.35	1.35	1.01	0.45	0.57	2.59	17.87
120	19	0.43	0.34	1.31	0.97	0.43	0.57	2.49	17.91
125	19	0.42	0.33	1.27	0.94	0.42	0.57	2.39	17.94
130	18	0.40	0.32	1.23	0.92	0.41	0.57	2.30	17.96
135	18	0.39	0.31	1.20	0.89	0.40	0.57	2.22	17.98
140	17	0.38	0.30	1.16	0.86	0.38	0.57	2.14	17.99
145	17	0.37	0.29	1.13	0.84	0.37	0.57	2.07	18.00
150	16	0.36	0.29	1.10	0.82	0.36	0.57	2.00	18.00
180	14	0.31	0.25	0.95	0.71	0.32	0.57	1.66	17.90
210	13	0.28	0.22	0.85	0.63	0.28	0.57	1.40	17.67
240	11	0.25	0.20	0.76	0.57	0.25	0.57	1.20	17.34
270	10	0.23	0.18	0.69	0.51	0.23	0.57	1.05	16.94
300	9	0.21	0.17	0.64	0.47	0.21	0.57	0.92	16.48

353-357 Gardner Street

Ottawa, Ontario

STORM SEWER COMPUTATION FORM

Rational Method

FIVE YEAR EVENT

Q = 2.78 A i C

June 23, 2020

n = 0.013

Location			Areas (ha)									Pipe Data									Notes
			Hard	Gravel	Landscape	Roof	Individual	Accum.	Time of Conc.	Rainfall Intensity i	Peak Flow Q	Material	Actual Diameter	Nominal Diameter	Slope	Length	Capacity	Velocity	Time of Flow	Ratio	
Street	From	To	C = 0.9	C = 0.7	C = 0.2	C = 0.9	2.78AC	2.78AC	(min)	(mm/hr)	(L/s)		(mm)	(mm)	(%)	(m)	(L/s)	(m/s)	(min)	Q/Qfull	
	CB-1	SUMP	0.0005		0.0057		0.0044	0.0044	10.00	104	0.46	PVC	254.0	250	0.58	7.1	47.2	0.93	0.13	0.01	
	CISTERN	EXIST.	0.0069	0.0002		0.0628	0.1748	0.1792	10.13	104	18.55	PVC	203.2	200	0.58	7.8	26.1	0.80	0.16	0.71	
		450 ST									1.14	PVC	203.2	200	0.58	7.8	26.1	0.80	0.16	0.04	Flow through ICD
													Existing 450 ST in Gardner Street								
													457.2	450	0.81		267.7	1.63			

City of Ottawa Servicing Study Checklist

General Content

Executive Summary (for large reports only): not applicable

Date and revision number of the report: see page 1 of Servicing Brief and Stormwater Management Report

Location map and plan showing municipal address, boundary, and layout of proposed development: see drawings C-1 to C-6

Plan showing the site and location of all existing services: see drawings C-1 to C-6

Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere: not applicable

Summary of Pre-consultation Meetings with City and other approval agencies: not available

Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria: not applicable

Statement of objectives and servicing criteria: see page 2 of Servicing Brief and Stormwater Management Report

Identification of existing and proposed infrastructure available in the immediate area: see drawings C-1 to C-6

Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available). see drawings C-1 to C-6

Concept level master grading plan to confirm existing and proposed grades in the development and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths: not applicable

Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts: not applicable

Proposed phasing of the development, if applicable: not applicable

Reference to geotechnical studies and recommendations concerning servicing: see note 1.5 on drawing C-3

All preliminary and formal site plan submissions should have the following information:

- **Metric scale:** included
- **North arrow:** included
    - **(including construction North):** not included
- **Key Plan:** included

- **Name and contact information of applicant and property owner:** not available
- **Property limits**: included
    - **including bearings and dimensions:** not included
- **Existing and proposed structures and parking areas:** included
- **Easements, road widening and rights-of-way:** included
- **Adjacent street names:** included

Development Servicing Report: Water

Confirm consistency with Master Servicing Study, if available: not applicable

Availability of public infrastructure to service proposed development: see page 2 of Servicing Brief

Identification of system constraints: see page 2 of Servicing Brief

Confirmation of adequate domestic supply and pressure: see page 2 of Servicing Brief

Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow locations throughout the development: see page 2 & 7 of Servicing Brief

Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves: see page 2 of Servicing Brief

Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design: not applicable

Address reliability requirements such as appropriate location of shut-off valves: not applicable

Check on the necessity of a pressure zone boundary modification:. not applicable

Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range: not applicable

Description of the proposed water distribution network, including locations of proposed connections to the existing systems, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions: not applicable

Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation: not applicable

Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines: see page 2 of Servicing Brief

Provision of a model schematic showing the boundary conditions locations, streets , parcels, and building locations for reference: not applicable

Development Servicing Report: Wastewater

Summary of proposed design criteria: see page 3 of Servicing Brief

(Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure): not applicable

Confirm consistency with Master Servicing Study and /or justification for deviations: not applicable

Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and conditions of sewers: not applicable

Descriptions of existing sanitary sewer available for discharge of wastewater from proposed development: see page 3 of Servicing Brief

Verify available capacity in downstream sanitary sewer and / or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable): not applicable

Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix C) format. see page 9 of Servicing Brief

Description of proposed sewer network including sewers, pumping stations, and forcemains: see page 3 of Servicing Brief

Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality): not applicable

Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development: not applicable

Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity: not applicable

Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding: not applicable

Special considerations such as contamination, corrosive environment etc: not applicable

Development Servicing Report: Stormwater Checklist

Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property): see page 4 of Servicing Brief and Stormwater Management Report

Analysis of available capacity in existing public infrastructure. not applicable

A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern: see drawing C-1 & C-3

Water quality control objective (e/g/ controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking

into account long-term cumulative effects: see Stormwater Management Report Servicing Brief and Stormwater Management Report

Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements: Servicing Brief and Stormwater Management Report

Descriptions of the references and supporting information.
Set-back from private sewage disposal systems. not applicable

Watercourse and hazard lands setbacks: not applicable

Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed: the pre-application consultation record is not yet been issued

Confirm consistency with sub-waterched and Master Servicing Study, if applicable study exists: not applicable

Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period). see drawings C-1 to C-6 and Servicing Brief and Stormwater Management Report

Identification of watercourses within the proposed development and how watercourses will be protected, or , if necessary, altered by the proposed development with applicable approvals. see drawings C-1 to C-6 and Servicing Brief and Stormwater Management Report

Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions: see Servicing Brief and Stormwater Management Report

Any proposed diversion of drainage catchment areas from one outlet to another. : not applicable

Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities. : not applicable

If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event: not applicable

Identification of potential impacts to receiving watercourses: Servicing Brief and Stormwater Management Report

Identification of municipal drains and related approval requirements. : not applicable

Descriptions of how the conveyance and storage capacity will be achieved for the development: see page 3 of Servicing Brief and Stormwater Management Report

100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading:

Inclusion of hydraulic analysis including hydraulic grade line elevations. : not applicable

Description of approach to erosion and sediment control during construction for the protection of receiving watercourses of drainage corridors: see notes 2.1 to 2.5 on drawing C-4

Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplains elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current: not applicable

Identification of fill constraints related to floodplain and geotechnical investigation. : not applicable

Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act: not applicable

Application for Certificate of Approval (CofA) under the Ontario Water Resources Act:

Changes to Municipal Drains. : not applicable

Other permits (National Capital commission, Parks Canada, public Works and Government Services Canada, Ministry of transportation etc.) : not applicable

Conclusion Checklist

Clearly stated conclusions and recommendations: see page 6 of Servicing Brief

Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.

All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario: included