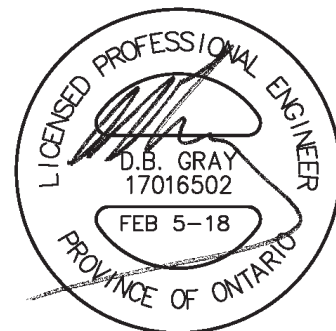


# SERVICING BRIEF & STORMWATER MANAGEMENT REPORT

515-511-509 Gladstone Avenue  
Ottawa, Ontario

Report No. 17039

July 4, 2017  
Revised November 1, 2017  
Revised February 5, 2018



NOT VALID UNLESS  
SIGNED & DATED

## D. B. GRAY ENGINEERING INC.

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# SERVICING BRIEF & STORMWATER MANAGEMENT REPORT

515-511-509 Gladstone Avenue  
Ottawa, Ontario

This report describes the services and addresses the stormwater management requirements of a 1,002 sq.m. property at 515-511-509 (formerly 517) Gladstone Avenue in Ottawa. A three-storey 18-Unit stacked apartment building is proposed. The property is currently vacant.

This report forms part of the stormwater management design for the proposed development. Refer to drawing C-1 to C-4 also prepared by D. B. Gray Engineering Inc.

## WATER SUPPLY FOR FIREFIGHTING:

There is an existing fire hydrant in the Gladstone Avenue right-of-way on the opposite side of the street from the subject property, located approximately 32m unobstructed distance from the furthest front entrance. Since it less than the required 90m an on-site fire hydrant is not required.

A fire flow of 333.3 l/s (20,000 L/min) is required, as calculated as per the Fire Underwriter Survey "Water Supply For Fire Protection".

The boundary conditions received from the city (based on the city's computer model of the municipal water distribution system) includes the HGL of 105.0m during the 333 l/s fire flow conditions at the subject location which calculates to be 340 kPa (49 psi). Since the pressure is above 138 kPa (20 psi) there is an adequate water supply for firefighting.

## WATER SERVICE:

A 50mm water service is proposed to connect to an existing 300mm municipal watermain in Gladstone Avenue.

Based on the AWWA water flow demand curve, an estimated water pressure at the meter of 414 kPa (60 psi), the peak demand is expected to be 3.7 l/s (58 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 1.9 m/s in the proposed 50mm water service connection, therefore it will be adequate for the domestic demand.

Based on the City of Ottawa Water Distribution Design Guidelines for residential properties (18 two-bedroom apartment units / 2.1 persons per unit – 350 l/person/day) and Ministry of the Environment Design Guidelines for peaking factors the daily average flow is 0.2 l/s with a maximum daily and maximum hourly demand of 1.4 and 2.1 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, we required the boundary conditions for the subject area based on the following:

- Average Daily Demand: 0.2 l/s.
- Maximum Daily Demand: 1.4 l/s.
- Maximum Hourly Demand: 2.1 l/s
- Fire Flow Demand: 333.3 l/s
- Maximum Daily + Fire Flow Demand: 334.7 l/s

Based on the boundary conditions received from the city, the minimum HGL (hydraulic grade line) is 106.4 m and the maximum is 118.2 m. With these HGLs the water pressure at the water meter is calculated to vary from 364 kPa to 479 kPa (53 to 70 psi). This is an acceptable range of pressures for the proposed development.

#### SANITARY SERVICE:

Based on the City of Ottawa Sewer Design Guidelines for a residential property (18 two-bedroom apartment units / 2.1 persons per unit – 350 l/person/day – 4.0 peaking factor) and a 0.28 l/s/ha infiltration flow) the post development flow is calculated to be 0.64 l/s.

This flow will be adequately handled by the proposed sanitary sewer service connection (150mm at 1% - 15.9 l/s capacity). The 0.64 l/s in sanitary flows contributing to the existing 250mm municipal sanitary sewer is expected to have an acceptable impact given its capacity of 43.4 l/s (250mm at 0.49%).

#### STORMWATER MANAGEMENT:

##### Water Quality:

Comments and recommendations concerning the stormwater quality criteria for this site are required from the RVCA to determine if permanent on-site quality control measures required.

An erosion and sediment control plan has been developed to be implemented during construction, (see notes 2.1 to 2.5 on drawing C-3). In summary: to filter out construction sediment; sediment capture filter sock inserts will be installed in all existing

catch basins adjacent to the site; and geotextile fabric mud mats will be install at all points of egress to public roads

#### 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 peak flows during the 5-year storm event using a pre-development runoff coefficient or runoff coefficient of 0.50, whichever is less; and the calculated time of concentration, but not less than 10 minutes. It is calculated that the pre-development conditions reflect a 5-year runoff coefficient of 0.37. Using the Airport Formula for sheet flow, it is calculated that the existing time of concentration is 10.4 minutes. Therefore based on runoff coefficient of 0.37 and a time of concentration of 10.4 minutes and using the Rational Method; the maximum allowable release rate is 10.55 l/s for all storm events. (The runoff coefficients for the 100 year event are increased by 25% to maximum 1.00.)

However, there is a 1,401 sq.m. area immediately to the north that drains onto the subject property. As required by the city, this external drainage area is required to be defined and, although it does not need to be controlled, it needs to be included in the stormwater management calculations.

First, to determine the maximum release rate and maximum storage volume required for the subject property, the property to the north was assumed to have been re-developed and its drainage is self-contained and no longer flows onto the subject property.

#### Drainage Area II

(Uncontrolled Flow Off Site – 135 sq.m.):

The runoff from part of 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
The maximum flow rate:	3.65 l/s	1.86 l/s

#### Drainage Area III (Roof – 671 sq.m.):

The three roof drains will be a flow control type which will restrict the flow and cause the storm water to pond on the roof. All roof drains will drain to the cistern. All flow control type roof drains 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) Watts roof drain with a Watts Accutrol Weir RD-100-A1 or equal. The roof drains shall be installed at the low points of the roof which shall be 150mm lower than the perimeter of the roof. As per the Ontario Building Code scuppers shall be installed so that the maximum depth of water on the roof cannot exceed 150mm.

	100-year	5-year
The maximum release rate:	5.19 l/s	3.94 l/s
The maximum ponding depth:	140 mm	106 mm
The maximum stored volume:	21.50 cu.m.	9.42 cu.m.

Drainage Area IV (Assuming no external drainage - 196 sq.m.):

An inlet control device (ICD) located at the outlet pipe of the cistern will control the release of stormwater from the site. The ICD will restrict the flow and force the stormwater to back up into the cistern having a capacity of 4.11 cu.m. Stormwater released through the ICD will be conveyed off the site via a 300mm storm sewer into a proposed 600mm municipal storm sewer in Gladstone Avenue. The ICD shall be a Hydrovex "VHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 10.67 l/s at 1.65 m head. It is calculated that an orifice area of 7,854 sq.mm. (100 mm diameter) and a discharge coefficient of 0.203 will restrict the outflow rate to 6.90 l/s at a head of 0.96 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 4.90 l/s at 0.48 m.

	100-year	5-year
The maximum release rate:	6.90 l/s	4.90 l/s
The maximum stored volume:	4.11 cu.m.	2.07 cu.m.

Entire Site:

Assuming the property to the north has been re-developed and there is no external drainage, the post-development flow off the site is less than or equal to the maximum allowable release rate.

	100-year	5-year
Pre-development (5-year) flow rate:	10.55 l/s	10.55 l/s
The maximum allowable release rate	10.55 l/s	10.55 l/s
The maximum release rate	10.55 l/s	6.76 l/s
Cistern water elevation:	67.64 m	67.16 m
The maximum stored volume (roof):	21.50 cu.m.	9.42 cu.m.
The maximum stored volume (cistern):	<u>4.11</u> cu.m.	<u>2.07</u> cu.m.
Total maximum stored volume:	25.61 cu.m.	11.49 cu.m.

Now, assuming existing conditions and the external drainage from the north to the north is included (but not required to be controlled). The required storage volume and size of the ICD remains the same and excess water will be allowed to flow uncontrolled through the cistern overflow pipe. The invert of the overflow pipe will be located at the 100-year water elevation in the cistern.

Drainage Area I

(External Drainage Not required to be Controlled – 1,401 sq.m.):

The flow from is calculated at 15 minutes concentration.

	100-year	5-year
The maximum flow rate:	43.32 l/s	22.56 l/s

The above flows are added maximum allowable release rate of 10.55 l/s to determine the maximum allowable release rate.

Entire Site:

Assuming existing conditions and the external drainage from the north to the north is included (but not required to be controlled) the post-development flow off the site is less than or equal to the maximum allowable release rate:

	100-year	5-year
Pre-development (5-year) flow rate:	10.55 l/s	10.55 l/s
External Drainage Not required to be Controlled:	<u>43.32</u> l/s	<u>22.56</u> l/s
Maximum Allowable Release Rate:	53.87 l/s	33.11 l/s
The uncontrolled flow off site:	3.65 l/s	1.86 l/s
The maximum release rate (roof drains):	5.19 l/s	3.94 l/s
The maximum release rate (cistern):	<u>50.26</u> l/s	<u>27.39</u> l/s
The maximum release rate:	53.71 l/s	29.24 l/s
The maximum release rate from the cistern is the release rate through the ICD plus the flow through the overflow pipe:		
The maximum release rate (ICD):	6.90 l/s	4.90 l/s
The maximum release rate (overflow pipe):	<u>43.16</u> l/s	<u>22.49</u> l/s
The maximum release rate:	50.06 l/s	27.39 l/s
Cistern water elevation:	67.64 m	67.16 m
The maximum stored volume (roof):	21.50 cu.m.	9.42 cu.m.
The maximum stored volume (cistern):	<u>4.11</u> cu.m.	<u>2.07</u> cu.m.
Total maximum stored volume:	25.61 cu.m.	11.49 cu.m.

Stormwater will be conveyed off the site via an 300mm storm sewer service connecting to a 600mm municipal storm sewer located in Gladstone Avenue.

Assuming existing conditions and the external drainage from the north to the north is included; the unrestricted flowrate resulting from one in five-year storm event will produce a peak flow of 39.2 l/s. However the inlet control device (ICD) located at the outlet pipe of the cistern will restrict the flow. The restricted flow calculates to a maximum flow of 27.4 l/s during the one in five storm event which will be adequately handled by a proposed storm sewer (300mm at 1.00% - 100.9 l/s capacity)

Assuming the property to the north has been re-developed and there is no external drainage; the unrestricted flowrate resulting from one in five-year storm event will produce a peak flow of 21.1 l/s. However the inlet control device (ICD) located at the outlet pipe of the cistern will restrict the flow. The restricted flow calculates to a maximum flow of 4.9 l/s during the one in five storm event which will be adequately handled by a proposed storm sewer (300mm at 1.00% - 100.9 l/s capacity)

The stormwater flows contributing to the existing 600mm municipal storm sewer (at 0.21% - 293.5 l/s capacity) is expected to have a negligible impact.

## CONCLUSIONS:

1. There is an adequate water supply for firefighting.
2. The existing water pressure is adequate for the proposed development.
3. The proposed water service connection is adequately sized to serve the development.
4. The expected sanitary sewage flow rate will be adequately handled by the proposed sanitary sewer service connection.
5. The sanitary flow contributing to the existing municipal sanitary sewer is expected to have an acceptable impact.
6. Comments are required from the RVCA to determine if permanent on-site quality control measures required.
7. An erosion and sediment control plan has been developed to be implemented during construction.
8. 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 5-year storm event using a pre-development runoff coefficient and the calculated time of concentration. To achieve quantity control stormwater will be stored within the development on the roofs of the proposed building and in a cistern locate below the garage floor. Accounting for an external drainage area, that does not need to be controlled, the maximum post-development release flow off the site is less than the maximum allowable release rate.
9. The restricted flowrate produced by a one in five year storm event will be adequately handled by the proposed storm sewer connection.
10. The restricted stormwater flow contributing to the existing municipal storm sewer is expected to have a negligible impact.

15-Jun-17  
REVISED 20-Jun-17  
REVISED 1-Nov-17

# 517 Gladstone Avenue 18 Unit Apartment Building Ottawa, Ontario

## Fire Flow Requirements

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

$$F = 220 C A^{0.5}$$

F = the required fire flow in litres per minute

C = coefficient related to the type of construction

- = 1.5 for Wood Frame Construction
- = 1.0 for Ordinary Construction (masonry wall, combustible floor and interior)
- = 0.8 for Non-combustible Construction (unprotected structural components)
- = 0.6 for Fire-Resistive Construction (3 hour protected structural components, floor and roof)

= 1.5

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

Ground Floor Area:	636 sq.m.
2nd Floor Area:	630
3rd Floor Area:	630
Total area:	1896 sq.m.

$$F = 14,369 \text{ L/min}$$
$$= 14,000 \text{ L/min (rounded off to the nearest 1,000 L/min)}$$

-15% Change for Limited-combustible Occupancy

$$= 11,900 \text{ L/min}$$

0% Reduction to above for No Sprinkler Protection

$$= 11,900 \text{ L/min}$$

Added to above Contents Fire Hazard for Separation Exposed Buildings

20%	W Side	3.1 to 10m
15%	N Side	10.1 to 20m
25%	E Side	0 to 3m
5%	S Side	20.1 to 30m

65% Total Increase for Exposure (maximum 75%)

$$= 19,635 \text{ L/min}$$

$$F = 20,000 \text{ L/min (rounded off to the nearest 1,000 L/min)}$$

$$= 333.3 \text{ l/s}$$

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Elevation at Fire Hydrant: 70.32 m ASL

Static Pressure at Fire Hydrant

333 l/s FIRE FLOW: 105.0 m ASL      8  
49 psi      340 kPa



# 515-511-509 Gladstone Ave Townhouses Ottawa, Ontario

## Peak Water Demand

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

	No.	F.V.	Total
Bathtub	18	8	144
Toilet - tank	36	6	216
Toilet - flush valve		24	0
Lavs.	36	1.5	54
Bidet		2	0
Urinal - wall flush valve		10	0
Shower	18	2.5	45
K. Sink	18	1.8	32.4
Dishwasher	18	1.3	23.4
Clothes Washer	18	6	108
Commercial Sink		4	0
J. Sink		4	0
Commercial Dishwasher		4	0
Commercial Washer		4	0
Hose 1/2 in		5	0
Hose 3/4 in		12	0

622.8

Peak Demand (fig 4-2 or 4-3 AWWA M22) 52 USgpm

Pressure @ Meter 414 kPa 60 psi

Pressure Factor (table 4-1 AWWA M22) 1.00

Peak Demand 52 USgpm

Irrigation - hose 1/2 in 1 6 Usgpm (includes pressure factor)  
(assumes hose bibs operating in non peak hours)

**TOTAL PEAK DEMAND** 220 l/min 58 USgpm 3.7 l/s

Nominal Size 2.0 in 50 mm  
6.1 ft/s 1.9 m/s

# 517 Gladstone Avenue 18 Unit Apartment Building Ottawa, Ontario Water Demand

	Number of Units	Persons Per Unit	Population
UNIT TYPE:			
Single Family:	0	3.4	0
Semi- detached:	0	2.7	0
Duplex:	0	2.3	0
Townhouse:	0	2.7	0
APARTMENTS:			
Bachelor	0	1.4	0
1 Bedroom:	0	1.4	0
2 Bedroom:	18	2.1	38
3 Bedroom:	0	3.1	0
Average Aptarment:	0	1.8	0
TOTAL:			38

DAILY AVERAGE

	350	litres / person / day			
	9.2	l / min	0.2	l / sec	2.4 USgpm

MAXIMUM DAILY DEMAND

	9.2	(Peaking Factor for a population of 38: Table 3-3 MOE Design Guidelines for Drinking-Water Systems)			
	84.5	l / min	1.4	l / sec	22.3 USgpm

MAXIMUM HOURLY DEMAND

	13.9	(Peaking Factor for a population of 38: Table 3-3 MOE Design Guidelines for Drinking-Water Systems)			
	127.3	l / min	2.1	l / sec	33.6 USgpm

Elevation of Water Meter:	69.30	m ASL
Finish Floor Elevation:	68.40	m ASL

		Static Pressure at Water Meter	
MINIMUM HGL:	106.4	m ASL	53 psi      364 kPa
MAXIMUM HGL:	118.2	m ASL	70 psi      479 kPa



Douglas Gray <d.gray@dbgrayengineering.com>

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## 517 Gladstone Ave

1 message

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**Buchanan, Richard** <Richard.Buchanan@ottawa.ca>  
To: Douglas Gray <d.gray@dbgrayengineering.com>

Tue, Jun 20, 2017 at 10:19 AM

Hi Doug

The following are boundary conditions, HGL, for hydraulic analysis at 517 Gladstone (zone 1W) assumed to be connected to the 305mm on Gladstone (see attached PDF for location).

Minimum HGL = 106.4m

Maximum HGL = 118.2m

MaxDay (1.4 L/s) + FireFlow (183 L/s) = 107.6m

MaxDay (1.4 L/s) + FireFlow (333 L/s) = 105.0m

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.*

**From:** Douglas Gray <d.gray@dbgrayengineering.com>  
**Date:** June 15, 2017 at 5:08:10 PM EDT  
**To:** "Deiaco, Simon" <Simon.Deiaco@ottawa.ca>  
**Cc:** Doug Casey <doug@charlesfort.ca>, Lucio Renna <l.renna@dbgrayengineering.com>  
**Subject:** 517 Gladstone Ave

Hi Simon

I am working on a apartment building development at 517 Gladstone Ave.

Who at Infrastructure Approvals should I send the following request for boundary conditions?

I have calculated the following expected demands for the based on a 18- unit apartment building.

Average daily demand: 0.2 l/s.

Maximum daily demand: 1.4 l/s.

Maximum hourly daily demand: 2.1 l/s

Fire Flow demand: 333.3 l/s

Fire Flow + Max Day: 334.7 l/s

We are looking at alternative designs so please also provide the boundary conditions for a fire flow demand of 183.3 l/s.

Average daily demand: 0.2 l/s.

Maximum daily demand: 1.4 l/s.

Maximum hourly daily demand: 2.1 l/s

Fire Flow demand: 183.3 l/s

Fire Flow + Max Day: 184.7 l/s

Our calculations are attached.

Regards, Doug

## D. B. GRAY ENGINEERING INC.

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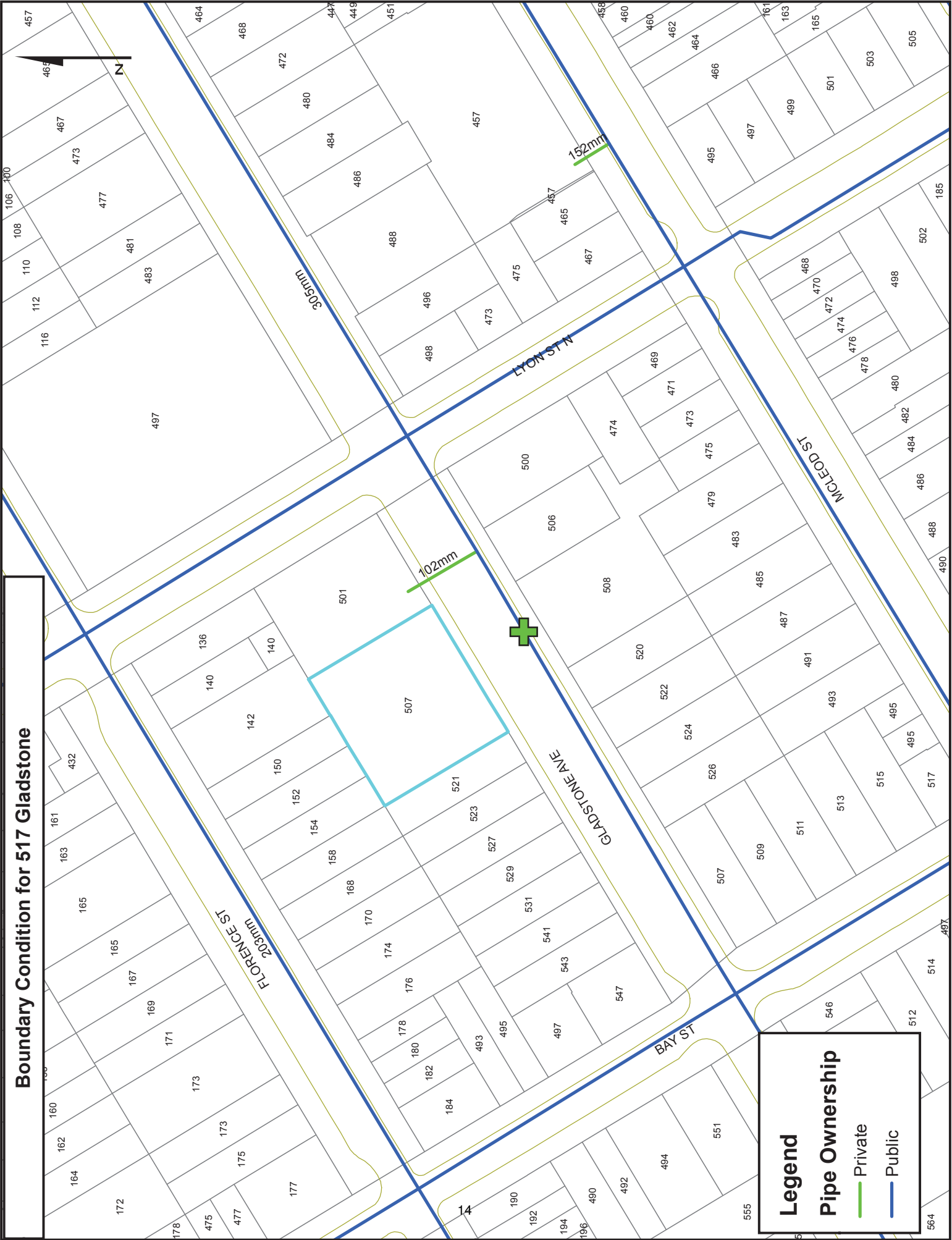
[d.gray@dbgrayengineering.com](mailto:d.gray@dbgrayengineering.com)

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 **517 Gladstone June 2017.pdf**  
118K

# Boundary Condition for 517 Gladstone



**Legend**

Pipe Ownership

- Private
- Public



## STORMWATER MANAGEMENT CALCULATIONS

The orifice calculations are based on the following formula:

$$Q = C_d \times A_o \sqrt{2gh} \times 1000$$

where:

Q = flowrate in litres per second

$C_d$  = coefficient of discharge

$A_o$  = orifice area in sq.m.

g = 9.81 m/s<sup>2</sup>

h = head above orifice in meters

Flow control roof drain calculations are based on the following formula:

$$Q = N \times S \times d \times F$$

where:

Q = flowrate in litres per second

N = number of roof drains

S = slots per weir

d = pond depth at roof drain in mm

F = flowrate through each slot

0.0124 litres per second per mm pond depth (5 USgpm per inch)

Storage calculations on the roof are based on the following formula for volume of a cone:

$$V = (A \times d)/3$$

where:

V = volume in cu.m.

A = ponding area in sq.m.

d = ponding depth in meters



## Summary Tables

### (No External Drainage Property to the North Re-Developed)

ONE HUNDRED YEAR EVENT			
Drainage Area	Maximum Allowable Release Rate	Maximum Release Rate	Maximum Volume Stored
	l/s	l/s	cu.m.
Pre-development Conditions (5-Year Event)	10.55	-	-
AREA II (Uncontrolled flow off site)	-	3.65	-
AREA III (Roof - Drains to AREA IV)	-	5.19	21.50
AREA IV	-	6.90	4.11
TOTAL (Excludes AREA III as it drains to AREA IV)	10.55	10.55	25.61

FIVE YEAR EVENT			
Drainage Area	Maximum Allowable Release Rate	Maximum Release Rate	Maximum Volume Stored
	l/s	l/s	cu.m.
Pre-development Conditions (5-Year Event)	10.55	-	-
AREA II (Uncontrolled flow off site)	-	1.86	-
AREA III (Roof - Drains to AREA IV)	-	3.94	9.42
AREA IV	-	4.90	2.07
TOTAL (Excludes AREA III as it drains to AREA IV)	10.55	6.76	11.49

517 Gladstone Ave.  
 Ottawa, Ontario

STORM WATER MANAGEMENT CALCULATIONS  
 Rational Method  
 ONE HUNDRED YEAR EVENT

Maximum Allowable Release Rate

Pre-development Conditions

			C
Roof Area:	22	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Gravel Area:	146	sq.m.	0.70
Landscaped Areas:	834	sq.m.	0.30
Total Catchment Area	1002	sq.m.	0.37

Time of Concentration: Sheet Flow

Airport Formula  

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

Runoff Coefficient (C):	0.37	see above
Sheet Flow Distance (L):	34.4	m
Slope of Land (Sw):	2	%
Time of Concentration (Sheet Flow):	10.4	min

Area (A):	1002	sq.m.
Time of Concentration:	10.4	min. (see below - use not less than 10 min.)
Rainfall Intensity (i):	102	mm/hr (5 year event)
Runoff Coefficient (C):	0.37	
Flow Rate (2.78AiC):	10.55	l/s

**DRAINAGE AREA II (Uncontrolled Flow Off Site):**  
 (ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	53	sq.m.	1.00
Landscaped Areas:	<u>82</u>	<u>sq.m.</u>	<u>0.25</u>
Total Catchment Area	135	sq.m.	0.54
Area (A):	135	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	179	mm/hr (100 year event)	
Runoff Coefficient (C):	0.54		
Flow Rate (2.78A <sup>0.78</sup> C):	3.65	l/s	

# DRAINAGE AREA III (Roof):

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	671	sq.m.	1.00
Paved Area:	0	sq.m.	1.00
Landscaped Areas:	0	sq.m.	0.25

Total Catchment Area                      671                      Ave. C                      1.00

No. of Roof Drains:                      3  
 Slots per Wier:                      1                      0.0124 l/s/mm/slot (5 USgpm/in/slot)

Depth at Roof Drain:                      140                      mm                      Pond Area:                      462                      sq.m.

Maximum Release Rate                      5.19                      l/s                      Achieved Vol:                      21.50                      cu.m.

Max. Vol. Required:                      21.50                      cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
15	142.9	26.66	5.19	21.46	19.32
20	120.0	22.38	5.19	17.18	20.62
25	103.8	19.37	5.19	14.18	21.27
30	91.9	17.14	5.19	11.95	21.50
35	82.6	15.40	5.19	10.21	21.45
40	75.1	14.02	5.19	8.83	21.18
45	69.1	12.88	5.19	7.69	20.76
50	64.0	11.93	5.19	6.74	20.21
55	59.6	11.12	5.19	5.93	19.57
60	55.9	10.43	5.19	5.23	18.85
65	52.6	9.82	5.19	4.63	18.05
70	49.8	9.29	5.19	4.10	17.20
75	47.3	8.81	5.19	3.62	16.30
80	45.0	8.39	5.19	3.20	15.36
85	43.0	8.01	5.19	2.82	14.39
90	41.1	7.67	5.19	2.48	13.38
95	39.4	7.36	5.19	2.16	12.34
100	37.9	7.07	5.19	1.88	11.27
105	36.5	6.81	5.19	1.62	10.18
110	35.2	6.57	5.19	1.37	9.07
115	34.0	6.34	5.19	1.15	7.95
120	32.9	6.14	5.19	0.94	6.80
125	31.9	5.94	5.19	0.75	5.64
130	30.9	5.76	5.19	0.57	4.46
135	30.0	5.60	5.19	0.40	3.27
140	29.2	5.44	5.19	0.25	2.07
145	28.4	5.29	5.19	0.10	0.85
150	27.6	5.15	5.15	0.00	0.00
165	25.6	4.78	4.78	0.00	0.00
180	23.9	4.46	4.46	0.00	0.00
195	22.4	4.18	4.18	0.00	0.00
210	21.1	3.94	3.94	0.00	0.00
225	20.0	3.73	3.73	0.00	0.00
240	19.0	3.55	3.55	0.00	0.00
255	18.1	3.38	3.38	0.00	0.00
270	17.3	3.23	3.23	0.00	0.00
285	16.6	3.09	3.09	0.00	0.00
300	15.9	2.96	2.96	0.00	0.00
315	15.3	2.85	2.85	0.00	0.00
330	14.7	2.75	2.75	0.00	0.00
345	14.2	2.65	2.65	0.00	0.00
360	13.7	2.56	2.56	0.00	0.00
375	13.3	2.48	2.48	0.00	0.00
390	12.9	2.40	2.40	0.00	0.00

## DRAINAGE AREA IV

(ONE HUNDRED YEAR EVENT)

					C			
	Roof Area:	19	sq.m.		1.00			
	Asphalt/Concrete Area:	121	sq.m.		1.00			
	Landscaped Areas:	56	sq.m.		0.25			
	<b>Total Catchment Area</b>	196	sq.m.		0.79			
	Water Elevation:	67.64	m					
	ICD Invert: (Outlet Pipe of Cistern):	66.68	m					
	Head:	0.96	m					
	Orifice Diameter	100	mm			Cistern		
	Orifice Area:	7854	sq.mm.	Length	Width	Water Depth		
	Coefficient of Discharge:	0.203		2.14	2.00	0.96	4.11	cu.m.
	Maximum Release Rate:	6.90	l/s				Achieved Vol:	4.11 cu.m.
							Max. Vol. Required:	4.11 cu.m.

Time	i	2.78AiC	Roof Release Rate	Total Inflow	Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	l/s	l/s	cu.m.
15	142.9	6.12	5.19	11.31	6.90	4.41	3.97
20	120.0	5.14	5.19	10.33	6.90	3.42	4.11
25	103.8	4.45	5.19	9.64	6.90	2.74	4.10
30	91.9	3.93	5.19	9.12	6.90	2.22	4.00
35	82.6	3.54	5.19	8.73	6.90	1.82	3.83
40	75.1	3.22	5.19	8.41	6.90	1.51	3.62
45	69.1	2.96	5.19	8.15	6.90	1.25	3.36
50	64.0	2.74	5.19	7.93	6.90	1.03	3.08
55	59.6	2.55	5.19	7.74	6.90	0.84	2.78
60	55.9	2.39	5.19	7.58	6.90	0.68	2.46
65	52.6	2.25	5.19	7.45	6.90	0.54	2.12
70	49.8	2.13	5.19	7.32	6.90	0.42	1.77
75	47.3	2.02	5.19	7.21	6.90	0.31	1.41
80	45.0	1.93	5.19	7.12	6.90	0.22	1.03
85	43.0	1.84	5.19	7.03	6.90	0.13	0.65
90	41.1	1.76	5.19	6.95	6.90	0.05	0.27
95	39.4	1.69	5.19	6.88	6.88	0.00	0.00
100	37.9	1.62	5.19	6.81	6.81	0.00	0.00
105	36.5	1.56	5.19	6.75	6.75	0.00	0.00
110	35.2	1.51	5.19	6.70	6.70	0.00	0.00
115	34.0	1.46	5.19	6.65	6.65	0.00	0.00
120	32.9	1.41	5.19	6.60	6.60	0.00	0.00
125	31.9	1.36	5.19	6.56	6.56	0.00	0.00
130	30.9	1.32	5.19	6.51	6.51	0.00	0.00
135	30.0	1.28	5.19	6.48	6.48	0.00	0.00
140	29.2	1.25	5.19	6.44	6.44	0.00	0.00
145	28.4	1.21	5.19	6.41	6.41	0.00	0.00
150	27.6	1.18	5.15	6.33	6.33	0.00	0.00
165	25.6	1.10	4.78	5.87	5.87	0.00	0.00
180	23.9	1.02	4.46	5.48	5.48	0.00	0.00
195	22.4	0.96	4.18	5.14	5.14	0.00	0.00
210	21.1	0.91	3.94	4.85	4.85	0.00	0.00
225	20.0	0.86	3.73	4.59	4.59	0.00	0.00
240	19.0	0.81	3.55	4.36	4.36	0.00	0.00
255	18.1	0.78	3.38	4.15	4.15	0.00	0.00
270	17.3	0.74	3.23	3.97	3.97	0.00	0.00
285	16.6	0.71	3.09	3.80	3.80	0.00	0.00
300	15.9	0.68	2.96	3.64	3.64	0.00	0.00
315	15.3	0.65	2.85	3.50	3.50	0.00	0.00
330	14.7	0.63	2.75	3.38	3.38	0.00	0.00
345	14.2	0.61	2.65	3.26	3.26	0.00	0.00
360	13.7	0.59	2.56	3.15	3.15	0.00	0.00
375	13.3	0.57	2.48	3.05	3.05	0.00	0.00
390	12.9	0.55	2.40	2.95	2.95	0.00	0.00

# FIVE YEAR EVENT

## Maximum Allowable Release Rate

### Pre-development Conditions

			C
Roof Area:	22	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Gravel Area:	146	sq.m.	0.70
Landscaped Areas:	834	sq.m.	0.30
<hr/>			
Total Catchment Area	1002	sq.m.	0.37

Time of Concentration: Sheet Flow

Airport Formula  

$$T_c = \frac{3.26 (1.1 - C) (L)^{1/2}}{S_w^{0.33}} \quad \text{min}$$

Runoff Coefficient (C):	0.37	see above
Sheet Flow Distance (L):	34.4	m
Slope of Land (Sw):	2	%
Time of Concentration (Sheet Flow):	10.4	min

Area (A):	1002	sq.m.
Time of Concentration:	10.4	min. (see below - use not less than 10 min.)
Rainfall Intensity (i):	102	mm/hr (5 year event)
Runoff Coefficient (C):	0.37	
Flow Rate (2.78AiC):	10.55	l/s

**DRAINAGE AREA II (Uncontrolled Flow Off Site):**  
(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	53	sq.m.	0.90
Landscaped Areas:	<u>82</u>	<u>sq.m.</u>	<u>0.20</u>
 Total Catchment Area	135	sq.m.	0.47
 Area (A):	135	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	104	mm/hr (100 year event)	
Runoff Coefficient (C):	0.47		
 Flow Rate (2.78A <sup>1.48</sup> C):	1.86	l/s	

# DRAINAGE AREA III (Roof):

(FIVE YEAR EVENT)

			C
Roof Area:	671	sq.m.	0.90
Paved Area:	0	sq.m.	0.90
Landscaped Areas:	<u>0</u>	sq.m.	<u>0.20</u>

Total Catchment Area                      671                      Ave. C                      0.90

No. of Roof Drains:                      3  
 Slots per Wier:                      1                      0.0124 l/s/mm/slot (5 USgpm/in/slot)

Depth at Roof Drain:                      106                      mm                      Pond Area:                      267                      sq.m.

Maximum Release Rate                      3.94                      l/s                      Achieved Vol:                      9.42                      cu.m.

Max. Vol. Required:                      9.42                      cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
15	83.6	14.03	3.94	10.08	9.08
20	70.3	11.79	3.94	7.85	9.42
25	60.9	10.22	3.94	6.28	9.42
30	53.9	9.05	3.94	5.11	9.20
35	48.5	8.15	3.94	4.20	8.82
40	44.2	7.42	3.94	3.47	8.34
45	40.6	6.82	3.94	2.88	7.77
50	37.7	6.32	3.94	2.38	7.13
55	35.1	5.90	3.94	1.95	6.45
60	32.9	5.53	3.94	1.59	5.71
65	31.0	5.21	3.94	1.27	4.95
70	29.4	4.93	3.94	0.99	4.15
75	27.9	4.68	3.94	0.74	3.32
80	26.6	4.46	3.94	0.52	2.48
85	25.4	4.26	3.94	0.32	1.61
90	24.3	4.08	3.94	0.13	0.73
95	23.3	3.91	3.91	0.00	0.00
100	22.4	3.76	3.76	0.00	0.00
105	21.6	3.62	3.62	0.00	0.00
110	20.8	3.50	3.50	0.00	0.00
115	20.1	3.38	3.38	0.00	0.00
120	19.5	3.27	3.27	0.00	0.00
125	18.9	3.17	3.17	0.00	0.00
130	18.3	3.07	3.07	0.00	0.00
135	17.8	2.98	2.98	0.00	0.00
140	17.3	2.90	2.90	0.00	0.00
145	16.8	2.82	2.82	0.00	0.00
150	16.4	2.75	2.75	0.00	0.00
165	15.2	2.55	2.55	0.00	0.00
180	14.2	2.38	2.38	0.00	0.00
195	13.3	2.23	2.23	0.00	0.00
210	12.6	2.11	2.11	0.00	0.00
225	11.9	2.00	2.00	0.00	0.00
240	11.3	1.90	1.90	0.00	0.00
255	10.8	1.81	1.81	0.00	0.00
270	10.3	1.73	1.73	0.00	0.00
285	9.9	1.65	1.65	0.00	0.00
300	9.5	1.59	1.59	0.00	0.00
315	9.1	1.53	1.53	0.00	0.00
330	8.8	1.47	1.47	0.00	0.00
345	8.5	1.42	1.42	0.00	0.00
360	8.2	1.37	1.37	0.00	0.00
375	7.9	1.33	1.33	0.00	0.00
390	7.7	1.29	1.29	0.00	0.00



# DRAINAGE AREA IV

(FIVE YEAR EVENT)

						C			
	Roof Area:	19	sq.m.			0.90			
	Asphalt/Concrete Area:	121	sq.m.			0.90			
	Landscaped Areas:	56	sq.m.			0.20			
	Total Catchment Area	196	sq.m.			0.70			
	Water Elevation:	67.16	m						
	ICD Invert:	66.68	m						
	(Outlet Pipe of Cistern):								
	Head:	0.48	m						
	Orifice Diameter	100	mm						
	Orifice Area:	7854	sq.mm.	Length	Width	Water Depth			
				2.14	2.00	0.48			
	Coefficient of Discharge:	0.203						2.07	cu.m.
	Maximum Release Rate:	4.90	l/s					Achieved Vol:	2.07 cu.m.
								Max. Vol. Required:	2.07 cu.m.

Time	i	2.78AiC	Roof Release Rate	Total Inflow	Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	l/s	l/s	cu.m.
15	83.6	3.19	3.94	7.13	4.90	2.23	2.01
20	70.3	2.68	3.94	6.62	4.90	1.72	2.07
25	60.9	2.32	3.94	6.27	4.90	1.36	2.05
30	53.9	2.06	3.94	6.00	4.90	1.10	1.98
35	48.5	1.85	3.94	5.79	4.90	0.89	1.87
40	44.2	1.69	3.94	5.63	4.90	0.73	1.75
45	40.6	1.55	3.94	5.49	4.90	0.59	1.60
50	37.7	1.44	3.94	5.38	4.90	0.48	1.43
55	35.1	1.34	3.94	5.28	4.90	0.38	1.26
60	32.9	1.26	3.94	5.20	4.90	0.30	1.08
65	31.0	1.18	3.94	5.13	4.90	0.23	0.88
70	29.4	1.12	3.94	5.06	4.90	0.16	0.68
75	27.9	1.06	3.94	5.01	4.90	0.11	0.48
80	26.6	1.01	3.94	4.96	4.90	0.06	0.27
85	25.4	0.97	3.94	4.91	4.90	0.01	0.05
90	24.3	0.93	3.94	4.87	4.87	0.00	0.00
95	23.3	0.89	3.91	4.80	4.80	0.00	0.00
100	22.4	0.85	3.76	4.62	4.62	0.00	0.00
105	21.6	0.82	3.62	4.45	4.45	0.00	0.00
110	20.8	0.79	3.50	4.29	4.29	0.00	0.00
115	20.1	0.77	3.38	4.15	4.15	0.00	0.00
120	19.5	0.74	3.27	4.01	4.01	0.00	0.00
125	18.9	0.72	3.17	3.89	3.89	0.00	0.00
130	18.3	0.70	3.07	3.77	3.77	0.00	0.00
135	17.8	0.68	2.98	3.66	3.66	0.00	0.00
140	17.3	0.66	2.90	3.56	3.56	0.00	0.00
145	16.8	0.64	2.82	3.46	3.46	0.00	0.00
150	16.4	0.62	2.75	3.37	3.37	0.00	0.00
165	15.2	0.58	2.55	3.13	3.13	0.00	0.00
180	14.2	0.54	2.38	2.92	2.92	0.00	0.00
195	13.3	0.51	2.23	2.74	2.74	0.00	0.00
210	12.6	0.48	2.11	2.59	2.59	0.00	0.00
225	11.9	0.45	2.00	2.45	2.45	0.00	0.00
240	11.3	0.43	1.90	2.33	2.33	0.00	0.00
255	10.8	0.41	1.81	2.22	2.22	0.00	0.00
270	10.3	0.39	1.73	2.12	2.12	0.00	0.00
285	9.9	0.38	1.65	2.03	2.03	0.00	0.00
300	9.5	0.36	1.59	1.95	1.95	0.00	0.00
315	9.1	0.35	1.53	1.87	1.87	0.00	0.00
330	8.8	0.33	1.47	1.81	1.81	0.00	0.00
345	8.5	0.32	1.42	1.74	1.74	0.00	0.00
360	8.2	0.31	1.37	1.68	1.68	0.00	0.00
375	7.9	0.30	1.33	1.63	1.63	0.00	0.00
390	7.7	0.29	1.29	1.58	1.58	0.00	0.00

## Summary Tables

(Includes External Drainage From Property to the  
North Not Required to be Controlled -  
Existing Conditions)

ONE HUNDRED YEAR EVENT			
Drainage Area	Maximum Allowable Release Rate	Maximum Release Rate	Maximum Volume Stored
	l/s	l/s	cu.m.
Pre-development Conditions (5-Year Event)	10.55	-	-
AREA I (External Area Not Required To Be Controlled)	43.32	-	-
AREA II (Uncontrolled flow off site)	-	3.65	-
AREA III (Roof - Drains to AREA IV)	-	5.19	21.50
AREA IV	-	50.06	4.11
TOTAL (Excludes AREA III as it drains to AREA IV)	53.87	53.71	25.61

FIVE YEAR EVENT			
Drainage Area	Maximum Allowable Release Rate	Maximum Release Rate	Maximum Volume Stored
	l/s	l/s	cu.m.
Pre-development Conditions (5-Year Event)	10.55	-	-
AREA I (External Area Not Required To Be Controlled)	22.56	-	-
AREA II (Uncontrolled flow off site)	-	1.86	-
AREA III (Roof - Drains to AREA IV)	-	3.94	9.42
AREA IV	-	27.39	2.07
TOTAL (Excludes AREA III as it drains to AREA IV)	33.11	29.24	11.49

517 Gladstone Ave.  
 Ottawa, Ontario

STORM WATER MANAGEMENT CALCULATIONS  
 Rational Method  
 ONE HUNDRED YEAR EVENT

Maximum Allowable Release Rate

Pre-development Conditions

			C
Roof Area:	22	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Gravel Area:	146	sq.m.	0.70
Landscaped Areas:	<u>834</u>	<u>sq.m.</u>	<u>0.30</u>
Total Catchment Area	1002	sq.m.	0.37

Time of Concentration: Sheet Flow

Airport Formula  

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

Runoff Coefficient (C):	0.37	see above
Sheet Flow Distance (L):	34.4	m
Slope of Land (Sw):	2	%
Time of Concentration (Sheet Flow):	10.4	min

Area (A):	1002	sq.m.
Time of Concentration:	10.4	min. (see below - use not less than 10 min.)
Rainfall Intensity (i):	102	mm/hr (5 year event)
Runoff Coefficient (C):	0.37	
Flow Rate (2.78AiC):	10.55	l/s

## DRAINAGE AREA I

### (External Drainage Not Required to be Controlled)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	686	sq.m.	1.00
Asphalt/Concrete Area:	301	sq.m.	1.00
Landscaped Areas:	<u>414</u>	<u>sq.m.</u>	<u>0.25</u>
Total Catchment Area	1401	sq.m.	0.78
Area (A):	1401	sq.m.	
Time of Concentration:	15	min.	
Rainfall Intensity (i):	143	mm/hr (100 year event)	
Runoff Coefficient (C):	0.78		
Flow Rate (2.78AiC):	43.32	l/s	

## DRAINAGE AREA II (Uncontrolled Flow Off Site):

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	53	sq.m.	1.00
Landscaped Areas:	<u>82</u>	<u>sq.m.</u>	<u>0.25</u>
Total Catchment Area	135	sq.m.	0.54
Area (A):	135	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	179	mm/hr (100 year event)	
Runoff Coefficient (C):	0.54		
Flow Rate (2.78AiC):	3.65	l/s	

## DRAINAGE AREA III (Roof):

(ONE HUNDRED YEAR EVENT)

					C
Roof Area:	671	sq.m.			1.00
Paved Area:	0	sq.m.			1.00
Landscaped Areas:	0	sq.m.			0.25
 Total Catchment Area	 671	 Ave. C			 1.00
 No. of Roof Drains:	 3				
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)			
 Depth at Roof Drain:	 140	 mm		Pond Area:	 462
				sq.m.	
Maximum Release Rate	5.19	l/s		Achieved Vol:	21.50
				cu.m.	
				Max. Vol. Required:	21.50
				cu.m.	

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	l/s	l/s	cu.m.
15	142.9	26.66	5.19	21.46	19.32
20	120.0	22.38	5.19	17.18	20.62
25	103.8	19.37	5.19	14.18	21.27
30	91.9	17.14	5.19	11.95	21.50
35	82.6	15.40	5.19	10.21	21.45
40	75.1	14.02	5.19	8.83	21.18
45	69.1	12.88	5.19	7.69	20.76
50	64.0	11.93	5.19	6.74	20.21
55	59.6	11.12	5.19	5.93	19.57
60	55.9	10.43	5.19	5.23	18.85
65	52.6	9.82	5.19	4.63	18.05
70	49.8	9.29	5.19	4.10	17.20
75	47.3	8.81	5.19	3.62	16.30
80	45.0	8.39	5.19	3.20	15.36
85	43.0	8.01	5.19	2.82	14.39
90	41.1	7.67	5.19	2.48	13.38
95	39.4	7.36	5.19	2.16	12.34
100	37.9	7.07	5.19	1.88	11.27
105	36.5	6.81	5.19	1.62	10.18
110	35.2	6.57	5.19	1.37	9.07
115	34.0	6.34	5.19	1.15	7.95
120	32.9	6.14	5.19	0.94	6.80
125	31.9	5.94	5.19	0.75	5.64
130	30.9	5.76	5.19	0.57	4.46
135	30.0	5.60	5.19	0.40	3.27
140	29.2	5.44	5.19	0.25	2.07
145	28.4	5.29	5.19	0.10	0.85
150	27.6	5.15	5.15	0.00	0.00
165	25.6	4.78	4.78	0.00	0.00
180	23.9	4.46	4.46	0.00	0.00
195	22.4	4.18	4.18	0.00	0.00
210	21.1	3.94	3.94	0.00	0.00
225	20.0	3.73	3.73	0.00	0.00
240	19.0	3.55	3.55	0.00	0.00
255	18.1	3.38	3.38	0.00	0.00
270	17.3	3.23	3.23	0.00	0.00
285	16.6	3.09	3.09	0.00	0.00
300	15.9	2.96	2.96	0.00	0.00
315	15.3	2.85	2.85	0.00	0.00
330	14.7	2.75	2.75	0.00	0.00
345	14.2	2.65	2.65	0.00	0.00
360	13.7	2.56	2.56	0.00	0.00
375	13.3	2.48	2.48	0.00	0.00
390	13	2.40	2.40	0.00	0.00

## DRAINAGE AREA IV

(ONE HUNDRED YEAR EVENT)

				C
Roof Area:	19	sq.m.		1.00
Asphalt/Concrete Area:	121	sq.m.		1.00
Landscaped Areas:	<u>56</u>	sq.m.		<u>0.25</u>
Total Catchment Area	196	sq.m.		0.79

## DRAINAGE AREA IV + DRAINAGE AREA I (External Area)

				C
Roof Area:	705	sq.m.		1.00
Asphalt/Concrete Area:	422	sq.m.		1.00
Landscaped Areas:	<u>470</u>	sq.m.		<u>0.25</u>
Total Catchment Area	1597	sq.m.		0.78

Water Elevation: 67.64 m

ICD Invert: 66.68 m  
(Outlet Pipe of Cistern):

Head: 0.96 m

Orifice Diameter 100

Orifice Area:	7854	sq.mm.	Length	Width	Water Depth		
			2.14	2.00	m	4.11	cu.m.

Coefficient of Discharge: 0.203

Maximum Release Rate: 6.90 l/s      Achieved Vol: 4.11 cu.m.

Maximum Over Flow Rate: 43.16 l/s

Maximum Release Rate: 50.06 l/s

Max. Vol. Required: 4.11 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Roof Release Rate l/s	Total Inflow l/s	ICD Release Rate l/s	Overflow Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
15	142.9	49.44	5.19	54.63	6.90	43.16	4.57	4.11
20	120.0	41.50	5.19	46.69	6.90	36.36	3.42	4.11
25	103.8	35.93	5.19	41.12	6.90	31.48	2.74	4.11
30	91.9	31.78	5.19	36.98	6.90	27.79	2.28	4.11
35	82.6	28.57	5.19	33.76	6.90	24.90	1.96	4.11
40	75.1	26.00	5.19	31.19	6.90	22.58	1.71	4.11
45	69.1	23.89	5.19	29.08	6.90	20.66	1.52	4.11
50	64.0	22.13	5.19	27.32	6.90	19.05	1.37	4.11
55	59.6	20.63	5.19	25.82	6.90	17.67	1.25	4.11
60	55.9	19.34	5.19	24.53	6.90	16.49	1.14	4.11
65	52.6	18.21	5.19	23.41	6.90	15.45	1.05	4.11
70	49.8	17.23	5.19	22.42	6.90	14.54	0.98	4.11
75	47.3	16.35	5.19	21.54	6.90	13.73	0.91	4.11
80	45.0	15.57	5.19	20.76	6.90	13.00	0.86	4.11
85	43.0	14.86	5.19	20.05	6.90	12.34	0.81	4.11
90	41.1	14.22	5.19	19.41	6.90	11.75	0.76	4.11
95	39.4	13.64	5.19	18.83	6.90	11.21	0.72	4.11
100	37.9	13.11	5.19	18.30	6.90	10.72	0.68	4.11
105	36.5	12.63	5.19	17.82	6.90	10.26	0.65	4.11
110	35.2	12.18	5.19	17.37	6.90	9.85	0.62	4.11
115	34.0	11.76	5.19	16.96	6.90	9.46	0.60	4.11
120	32.9	11.38	5.19	16.57	6.90	9.10	0.57	4.11
125	31.9	11.02	5.19	16.21	6.90	8.76	0.55	4.11
130	30.9	10.69	5.19	15.88	6.90	8.45	0.53	4.11
135	30.0	10.38	5.19	15.57	6.90	8.16	0.51	4.11
140	29.2	10.09	5.19	15.28	6.90	7.89	0.49	4.11
145	28.4	9.81	5.19	15.00	6.90	7.63	0.47	4.11
150	27.6	9.55	5.15	14.70	6.90	7.34	0.46	4.11
165	25.6	8.86	4.78	13.64	6.90	6.32	0.42	4.11
180	23.9	8.27	4.46	12.73	6.90	5.45	0.38	4.11
195	22.4	7.76	4.18	11.94	6.90	4.69	0.35	4.11
210	21.1	7.32	3.94	11.26	6.90	4.03	0.33	4.11
225	20.0	6.92	3.73	10.66	6.90	3.45	0.30	4.11
240	19.0	6.58	3.55	10.12	6.90	2.93	0.29	4.11
255	18.1	6.26	3.38	9.64	6.90	2.47	0.27	4.11
270	17.3	5.98	3.23	9.21	6.90	2.05	0.25	4.11
285	16.6	5.73	3.09	8.82	6.90	1.68	0.24	4.11
300	15.9	5.50	2.96	8.46	6.90	1.33	0.23	4.11
315	15.3	5.29	2.85	8.14	6.90	1.02	0.22	4.11
330	14.7	5.09	2.75	7.84	6.90	0.73	0.21	4.11
345	14.2	4.91	2.65	7.56	6.90	0.46	0.20	4.11
360	13.7	4.75	2.56	7.31	6.90	0.21	0.19	4.11
375	13.3	4.59	2.48	<del>30</del> 7	6.90	0.00	0.17	3.77
390	12.9	0.02	2.40	2.42	2.42	0.00	0.00	0.00

# FIVE YEAR EVENT

## Maximum Allowable Release Rate

### Pre-development Conditions

			C
Roof Area:	22	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Gravel Area:	146	sq.m.	0.70
Landscaped Areas:	<u>834</u>	<u>sq.m.</u>	<u>0.30</u>
Total Catchment Area	1002	sq.m.	0.37

Time of Concentration: Sheet Flow

Airport Formula  

$$T_c = \frac{3.26 (1.1 - C) (L)^{1/2}}{S_w^{0.33}} \quad \text{min}$$

Runoff Coefficient (C):	0.37	see above
Sheet Flow Distance (L):	34.4	m
Slope of Land (Sw):	2	%
Time of Concentration (Sheet Flow):	10.4	min

Area (A):	1002	sq.m.
Time of Concentration:	10.4	min. (see below - use not less than 10 min.)
Rainfall Intensity (i):	102	mm/hr (5 year event)
Runoff Coefficient (C):	0.37	
Flow Rate (2.78AiC):	10.55	l/s

## DRAINAGE AREA I

### (External Drainage Not Required to be Controlled)

(FIVE YEAR EVENT)

			C
Roof Area:	686	sq.m.	0.90
Asphalt/Concrete Area:	301	sq.m.	0.90
Landscaped Areas:	<u>414</u>	<u>sq.m.</u>	<u>0.20</u>
Total Catchment Area	1401	sq.m.	0.69
Area (A):	1401	sq.m.	
Time of Concentration:	15	min.	
Rainfall Intensity (i):	84	mm/hr (100 year event)	
Runoff Coefficient (C):	0.69		
Flow Rate (2.78AiC):	22.56	l/s	

## DRAINAGE AREA II (Uncontrolled Flow Off Site):

(FIV YEAR EVENT)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	53	sq.m.	0.90
Landscaped Areas:	<u>82</u>	<u>sq.m.</u>	<u>0.20</u>
Total Catchment Area	135	sq.m.	0.47
Area (A):	135	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	104	mm/hr (100 year event)	
Runoff Coefficient (C):	0.47		
Flow Rate (2.78AiC):	1.86	l/s	



# DRAINAGE AREA III (Roof):

(FIVE YEAR EVENT)

			C
Roof Area:	671	sq.m.	0.90
Paved Area:	0	sq.m.	0.90
Landscaped Areas:	0	sq.m.	0.20

Total Catchment Area                    671                    Ave. C                    0.90

No. of Roof Drains:                    3  
 Slots per Wier:                    1                    0.0124 l/s/mm/slot (5 USgpm/in/slot)

Depth at Roof Drain:                    106                    mm                    Pond Area:                    267                    sq.m.

Maximum Release Rate                    3.94                    l/s                    Achieved Vol:                    9.42                    cu.m.

Max. Vol. Required:                    9.42                    cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
15	83.6	14.03	3.94	10.08	9.08
20	70.3	11.79	3.94	7.85	9.42
25	60.9	10.22	3.94	6.28	9.42
30	53.9	9.05	3.94	5.11	9.20
35	48.5	8.15	3.94	4.20	8.82
40	44.2	7.42	3.94	3.47	8.34
45	40.6	6.82	3.94	2.88	7.77
50	37.7	6.32	3.94	2.38	7.13
55	35.1	5.90	3.94	1.95	6.45
60	32.9	5.53	3.94	1.59	5.71
65	31.0	5.21	3.94	1.27	4.95
70	29.4	4.93	3.94	0.99	4.15
75	27.9	4.68	3.94	0.74	3.32
80	26.6	4.46	3.94	0.52	2.48
85	25.4	4.26	3.94	0.32	1.61
90	24.3	4.08	3.94	0.13	0.73
95	23.3	3.91	3.91	0.00	0.00
100	22.4	3.76	3.76	0.00	0.00
105	21.6	3.62	3.62	0.00	0.00
110	20.8	3.50	3.50	0.00	0.00
115	20.1	3.38	3.38	0.00	0.00
120	19.5	3.27	3.27	0.00	0.00
125	18.9	3.17	3.17	0.00	0.00
130	18.3	3.07	3.07	0.00	0.00
135	17.8	2.98	2.98	0.00	0.00
140	17.3	2.90	2.90	0.00	0.00
145	16.8	2.82	2.82	0.00	0.00
150	16.4	2.75	2.75	0.00	0.00
165	15.2	2.55	2.55	0.00	0.00
180	14.2	2.38	2.38	0.00	0.00
195	13.3	2.23	2.23	0.00	0.00
210	12.6	2.11	2.11	0.00	0.00
225	11.9	2.00	2.00	0.00	0.00
240	11.3	1.90	1.90	0.00	0.00
255	10.8	1.81	1.81	0.00	0.00
270	10.3	1.73	1.73	0.00	0.00
285	9.9	1.65	1.65	0.00	0.00
300	9.5	1.59	1.59	0.00	0.00
315	9.1	1.53	1.53	0.00	0.00
330	8.8	1.47	1.47	0.00	0.00
345	8.5	1.42	1.42	0.00	0.00
360	8.2	1.37	1.37	0.00	0.00
375	7.9	1.33	1.33	0.00	0.00
390	7.7	1.29	1.29	0.00	0.00

## DRAINAGE AREA IV

(FIVE YEAR EVENT)

				C
Roof Area:	19	sq.m.		0.90
Asphalt/Concrete Area:	121	sq.m.		0.90
Landscaped Areas:	<u>56</u>	sq.m.		<u>0.20</u>
Total Catchment Area	196	sq.m.		0.70

## DRAINAGE AREA IV + DRAINAGE AREA I (External Area)

									C
Roof Area:	705	sq.m.							0.90
Asphalt/Concrete Area:	422	sq.m.							0.90
Landscaped Areas:	<u>470</u>	sq.m.							<u>0.20</u>
Total Catchment Area	1597	sq.m.							0.69
Water Elevation:	67.16	m							
ICD Invert:	66.68	m							
(Outlet Pipe of Cistern):									
Head:	0.48	m							
Orifice Diameter	100	mm							Cistern
Orifice Area:	7854	sq.mm.	Length	Width	Water Depth				
			2.14	2.00	0.48			2.07	cu.m.
Coefficient of Discharge:	0.203								
Maximum Release Rate:	4.90	l/s						Achieved Vol:	2.07 cu.m.
Maximum Over Flow Rate:	<u>22.49</u>	l/s							
Maximum Release Rate:	27.39	l/s							
								Max. Vol. Required:	2.07 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Roof Release Rate l/s	Total Inflow l/s	Release Rate l/s	Overflow Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
15	83.6	25.74	3.94	29.69	4.90	22.49	2.30	2.07
20	70.3	21.64	3.94	25.59	4.90	18.96	1.73	2.07
25	60.9	18.76	3.94	22.71	4.90	16.42	1.38	2.07
30	53.9	16.62	3.94	20.56	4.90	14.51	1.15	2.07
35	48.5	14.95	3.94	18.89	4.90	13.00	0.99	2.07
40	44.2	13.61	3.94	17.56	4.90	11.79	0.86	2.07
45	40.6	12.52	3.94	16.46	4.90	10.79	0.77	2.07
50	37.7	11.60	3.94	15.54	4.90	9.95	0.69	2.07
55	35.1	10.82	3.94	14.76	4.90	9.24	0.63	2.07
60	32.9	10.15	3.94	14.09	4.90	8.62	0.58	2.07
65	31.0	9.56	3.94	13.51	4.90	8.08	0.53	2.07
70	29.4	9.05	3.94	12.99	4.90	7.60	0.49	2.07
75	27.9	8.59	3.94	12.54	4.90	7.17	0.46	2.07
80	26.6	8.18	3.94	12.13	4.90	6.79	0.43	2.07
85	25.4	7.82	3.94	11.76	4.90	6.45	0.41	2.07
90	24.3	7.48	3.94	11.43	4.90	6.14	0.38	2.07
95	23.3	7.18	3.91	11.09	4.90	5.83	0.36	2.07
100	22.4	6.90	3.76	10.67	4.90	5.42	0.35	2.07
105	21.6	6.65	3.62	10.27	4.90	5.04	0.33	2.07
110	20.8	6.42	3.50	9.91	4.90	4.70	0.31	2.07
115	20.1	6.20	3.38	9.58	4.90	4.38	0.30	2.07
120	19.5	6.00	3.27	9.27	4.90	4.08	0.29	2.07
125	18.9	5.81	3.17	8.98	4.90	3.80	0.28	2.07
130	18.3	5.64	3.07	8.71	4.90	3.54	0.27	2.07
135	17.8	5.47	2.98	8.46	4.90	3.30	0.26	2.07
140	17.3	5.32	2.90	8.22	4.90	3.07	0.25	2.07
145	16.8	5.18	2.82	8.00	4.90	2.86	0.24	2.07
150	16.4	5.04	2.75	7.79	4.90	2.66	0.23	2.07
165	15.2	4.68	2.55	7.23	4.90	2.12	0.21	2.07
180	14.2	4.37	2.38	6.75	4.90	1.66	0.19	2.07
195	13.3	4.10	2.23	6.34	4.90	1.26	0.18	2.07
210	12.6	3.87	2.11	5.98	4.90	0.91	0.16	2.07
225	11.9	3.66	2.00	5.66	4.90	0.60	0.15	2.07
240	11.3	3.48	1.90	5.38	4.90	0.33	0.14	2.07
255	10.8	3.32	1.81	5.12	4.90	0.09	0.14	2.07
270	10.3	3.17	1.73	4.90	4.90	0.00	0.00	0.00
285	9.9	3.04	1.65	4.69	4.69	0.00	0.00	0.00
300	9.5	2.91	1.59	4.50	4.50	0.00	0.00	0.00
315	9.1	2.80	1.53	4.33	4.33	0.00	0.00	0.00
330	8.8	2.70	1.47	4.17	4.17	0.00	0.00	0.00
345	8.5	2.61	1.42	4.03	4.03	0.00	0.00	0.00
360	8.2	2.52	1.37	3.89	3.89	0.00	0.00	0.00
375	7.9	2.44	1.33	<del>3.77</del>	3.77	0.00	0.00	0.00
390	7.7	2.36	1.29	3.65	3.65	0.00	0.00	0.00



## 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 & Stormwater Management Report

**Location map and plan showing municipal address, boundary, and layout of proposed development:** see drawings C-1 to C-4

**Plan showing the site and location of all existing services:** see drawings C-1 to C-4

**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 defensible 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-4

**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-4

**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 & Stormwater Management Report

**Identification of system constraints:** see page 2 of Servicing Brief & Stormwater Management Report

**Confirmation of adequate domestic supply and pressure:** see page 2 Servicing Brief & Stormwater Management Report

**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 & 6 to 8 of Servicing Brief & Stormwater Management Report

**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 & Stormwater Management Report

**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 feeder mains, 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 Servicing Brief & Stormwater Management Report

**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 & Stormwater Management Report

**(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 & Stormwater Management Report

**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 & Stormwater Management Report

**Description of proposed sewer network including sewers, pumping stations, and forcemains:** see page 3 of Servicing Brief & Stormwater Management Report

**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 3 to 5 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-2

**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 Servicing Brief & 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 & 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-watershed 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-4 and Servicing Brief & 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-4 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 to 5 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-3.

**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: see page 19 of Servicing Brief and Stormwater Management Report**

**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 5 of Servicing Brief & Stormwater Management Report

**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