

SERVICING BRIEF &
STORMWATER MANAGEMENT REPORT

2510 Walkley Road
Ottawa, Ontario

Report No. 12075

March 8, 2018



NOT VALID UNLESS
SIGNED & DATED

D. B. GRAY ENGINEERING INC.

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

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SERVICING BRIEF & STORMWATER MANAGEMENT REPORT

2510 Walkley Road
Ottawa, Ontario

This report describes the services for, and addresses the stormwater management requirements of, a 9,580 sq.m. property at 2510 Walkley Road in Ottawa. It is located at the southwest corner of the Walkley / Russell Road intersection and backs onto a railway right of way. A two-storey warehouse / office building with underground parking is proposed for Ciot, a company which sells and installs natural stone slabs and ceramic tile. The property is currently vacant. An easement in favour of Enbridge Gas, varying from about 7 m to about 10 m in width, crosses the length of the property. Within this easement are two gas mains, one of which Enbridge considers "Vital". To protect and maintain access to these gas mains Enbridge requires several restrictions including a minimum 1.0 m vertical clearance for any of the site services that cross the gas mains and a maximum 0.5 m grade raise within the easement. To satisfy the latter requirement extensive use of light weight fill (EPS – expanded polystyrene blocks) is proposed.

This report forms part of the stormwater management design for the proposed development. Refer to drawing C-1 to C-8 also prepared by D. B. Gray Engineering Inc.

WATER SUPPLY FOR FIREFIGHTING:

There is an existing fire hydrant in the municipal road right-of-way near the Walkley / Russell Road intersection but it is not sufficiently close to serve the proposed building. An on-site fire hydrant is proposed to connect to a proposed 200 mm private watermain. The hydrant will be located less than the maximum 45 m unobstructed distance to from the proposed fire department connection. The proposed private watermain will connect to an existing 406 mm municipal watermain in Walkley Road.

A fire flow of 150 l/s (9,000 L/min) is required, as calculated as per the Fire Underwriter Survey "Water Supply For Fire Protection".

A model was created using EPANET software to analyze the hydraulics of the proposed 200mm watermain using the boundary conditions provided by the City (Max day + Fire Flow (151.4 l/s) = 124.7 m HGL). Under this fire flow conditions the pressure at the hydrant is 199 kPa (28.9 psi).

Since the pressure is above 138 kPa (20 psi) there will be an adequate water supply for firefighting.

WATER SERVICE:

The proposed building will have a sprinkler system. To service the sprinklers a 150 mm water service connected to the 200 mm private watermain is proposed.

Based on the City of Ottawa Design Guidelines the daily average consumption rate for a commercial development is 28,000 litres per day per hectare. The maximum daily peaking factors is 1.5 of the daily average demand and maximum hourly peaking factor is 1.8 of the maximum daily demand. Based on this rate and peaking factors, and assuming an eight hour day, the maximum daily demand is calculated to be 0.9 l/s (56 L/min). Based on the peaking factors the maximum daily demand is 1.4 l/s (84 L/min) and maximum hourly demand is 2.5 l/s (151 l/min).

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 requested the boundary conditions for the subject area based on the following:

- Average Daily Demand: 0.9 l/s.
- Maximum Daily Demand: 1.4 l/s.
- Maximum Hourly Demand: 2.5 l/s
- Fire Flow Demand: 150.0 l/s
- Maximum Daily + Fire Flow Demand: 151.4 l/s

Based on the boundary conditions received from the city, the minimum HGL (hydraulic grade line) is 123.4 m and the maximum is 131.3 m. With these HGLs the water pressure at the water meter is calculated to vary from 449 kPa to 527 kPa (65 to 76 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 commercial property (50,000 l/ ha / day; 1.5 peaking factor; and a 0.28 l/s/ha infiltration flow) the post development flow is calculated to be 1.10 l/s. This flow will be adequately handled by the proposed sanitary sewer service connection (150mm at 1% - 15.9 l/s capacity).

Other than a 1067 x 686 mm sanitary trunk sewer approximately 9 m deep in Walkley Road sewer there are no storm sewers adjacent to the subject property in either Walkley or Russell Road. There is an existing 250 mm municipal sanitary sewer on the north side of Walkley Road right of way approximately 35 m west of the subject property. A 35.7 m extension of this municipal sanitary sewer is proposed. The 1.10 l/s will be adequately handled by this proposed municipal sanitary sewer (250mm at 0.65% - 50.0 l/s capacity). The 1.10 l/s in sanitary flows contributing to the existing 250mm sanitary sewer is expected to have an acceptable impact given its capacity of 39.2 l/s (250mm at 0.40%).

STORMWATER MANAGEMENT:

Water Quality:

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

An erosion and sediment control plan has been developed to be implemented during construction, (see notes 2.1 to 2.7 on drawing C-5). In summary: to filter out construction sediment a silt fence barrier will be installed adjacent to the north and south property lines; sediment capture filter sock inserts will be installed in all existing catch basins adjacent to the site and all new catch basins as they are installed; geotextile fabric mud mats will be install at all points of egress to public roads; and a straw bale check dam located at the downstream end of an existing swale that is proposed to be modified.

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 0.30. Using the Airport Formula for sheet flow, it is calculated that the existing time of concentration is 12.4 minutes. Therefore based on runoff coefficient of 0.30 and a time of concentration of 12.4 minutes and using the Rational Method; the maximum allowable release rate is 74.19 l/s for all storm events.

Calculations are based on the Rational Method. 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 roof of the proposed building and on the surface of the parking area above catch basins.

Drainage Area I (Uncontrolled Flow Off Site – 1,258 sq.m.):

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
The maximum flow rate:	15.61 l/s	7.29 l/s

Drainage Area II (Roof – 2,854 sq.m.):

All seven roof drains will be a flow control type which will restrict the flow and cause the storm water to pond on the roof. The roof drains will discharge onto the surface and drain into a catch basin in Drainage Area III. (Therefore the flow released from roof drains are added to the runoff in Drainage Area III.). 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:	12.43 l/s	9.58 l/s
The maximum ponding depth:	143 mm	110 mm
The maximum stored volume:	115.09 cu.m.	52.72 cu.m.

Drainage Area III (2,238 sq.m.):

An inlet control device (ICD) located at the outlet pipe of catch basin / manhole CB/MH-11 will control the release of stormwater from Drainage Area III. The ICD will restrict the flow and force the stormwater to back up onto the surface of the parking area above three catch basins (CB/MH-11, CB/MH-12 and CB-13A). The ICD shall be a Hydrovex "VHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 15.20 l/s at 3.06 m head. It is calculated that an orifice area of 7,854 sq.mm. (100 mm in diameter) and a discharge coefficient of 0.250 will restrict the outflow rate to 15.20 l/s at 3.06 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 14.99 l/s at 2.97 m.

	100-year	5-year
The maximum release rate:	15.20 l/s	14.99 l/s
The maximum ponding depth:	300 mm	210 mm
The maximum stored volume:	130.80 cu.m.	47.07 cu.m.

Drainage Area IV (1,604 sq.m.):

An inlet control device (ICD) located at the outlet pipe of catch basin CB-8 will control the release of stormwater from Drainage Area IV. The ICD will restrict the flow and force the stormwater to back up onto the surface of the parking area above catch basin CB-8. The ICD shall be a Hydrovex "VHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 18.04 l/s at 2.38 m head. It is calculated that an orifice area of 12,272 sq.mm. (125 mm in diameter) and a discharge coefficient of 0.215 will restrict the outflow rate to 18.04 l/s at 2.38 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 17.93 l/s at 2.35 m.

	100-year	5-year
The maximum release rate:	18.04 l/s	17.93 l/s
The maximum ponding depth:	190 mm	160 mm
The maximum stored volume:	23.68 cu.m.	14.33 cu.m.

Drainage Area V (1,152 sq.m.):

An inlet control device (ICD) located at the outlet pipe of catch basin CB-6 will control the release of stormwater from Drainage Area V. The ICD will restrict the flow and force the stormwater to back up onto the surface of the parking area above catch basin CB-6. The ICD shall be a Hydrovex "VHV Vertical Vortex Flow Regulator" and shall be sized

by the manufacturer for a discharge rate of 18.54 l/s at 2.99 m head. It is calculated that an orifice area of 12,272 sq.mm. (125 mm in diameter) and a discharge coefficient of 0.197 will restrict the outflow rate to 18.54 l/s at 2.99 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 18.29 l/s at 2.91 m.

	100-year	5-year
The maximum release rate:	18.54 l/s	18.29 l/s
The maximum ponding depth:	200 mm	120 mm
The maximum stored volume:	12.87 cu.m.	2.91 cu.m.

Drainage Area VI (474 sq.m.):

An inlet control device (ICD) located at the outlet pipe of catch basin CB-2 will control the release of stormwater from Drainage Area VI. The ICD will restrict the flow and force the stormwater to back up onto the surface of the parking area above catch basin CB-2. The ICD shall be a Hydrovex "VHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 6.79 l/s at 2.36 m head. It is calculated that an orifice area of 4,418 sq.mm. (75 mm in diameter) and a discharge coefficient of 0.226 will restrict the outflow rate to 6.79 l/s at 2.36 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 6.72 l/s at 2.31 m.

	100-year	5-year
The maximum release rate:	6.79 l/s	6.72 l/s
The maximum ponding depth:	150 mm	100 mm
The maximum stored volume:	6.25 cu.m.	1.60 cu.m.

Entire Site (9,580 sq.m.):

The maximum post development release rate for the 100-year storm event is equal to the maximum permitted release rate and the maximum post development release rate for the 5-year storm event is less than the maximum permitted release rate.

	100-year	5-year
The maximum allowable release rate:	74.19 l/s	74.19 l/s
The maximum release rate:	74.19 l/s	65.22 l/s
The maximum stored volume:	288.68 cu.m.	118.63 cu.m.

Five Year Storm Event:

It is estimated that 3,214 sq.m. of the lands immediately to the west of the subject property drains onto the subject property. The proposed storm sewer system is sized to include the drainage from these lands.

Stormwater will be conveyed off the site via a 450 mm storm sewer connecting to a 610 mm municipal storm sewer located in Walkley Road. The unrestricted flowrate resulting from one in five-year storm event will produce a peak flow of 166.3 l/s. However the flow control roof drains and an inlet control devices (ICDs) will restrict the flow to a maximum flow of 75.1 l/s during the one in five storm event. The 75.1 l/s in stormwater

flows contributing to the existing 610mm municipal storm sewer is expected to have a negligible impact.

MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE (MOECC)
ENVIRONMENTAL COMPLIANCE APPROVAL (ECA):

The proposed extension of the municipal sanitary sewer will require a MOECC ECA.

The stormwater management facility is located on a property zoned industrial and since part of the proposed building is warehouse it is expected that the MOECC will consider the property "industrial lands. Therefore it is expected that a MOECC ECA will be required. A pre-consultation record is required from the MOECC to confirm.

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 and proposed extension of the municipal sanitary sewer.
5. The sanitary flow contributing to the existing municipal sanitary sewer is expected to have a negligible impact.
6. 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.
7. An erosion and sediment control plan has been developed to be implemented during construction.
8. The maximum post development release rate for the 100-year storm event is equal to the maximum permitted release rate and the maximum post development release rate for the 5-year storm event is less than the maximum permitted 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 stormwater flow contributing to the existing municipal storm sewer is expected to have a negligible impact.
11. The proposed extension of the municipal sanitary sewer will require a MOECC ECA and it is expected that a MOECC ECA will be required for the stormwater management facility.

2510 Walkley Road 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)

= 1.0

A = floor area

Basement Parking Area: 815 sq.m.

Ground Floor Area: 2844 sq.m.

Upper Floor Area: 370 sq.m.

4029 sq.m.

$$F = 13,964 \text{ L/min}$$

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

-15% Change for Limited-combustible Occupancy

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

-40% Reduction for a Sprinkler System

$$= 7,140 \text{ L/min}$$

Added to above for Separation to Exposed Buildings

20% West 3.0 to 10m

0% North > 45m

0% East > 45m

0% South > 45m

20% Total Increase for Exposure (maximum 75%)

$$= 8,568 \text{ L/min}$$

$$F = 9,000 \text{ L/min (rounded off to the nearest 1,000 L/min)}$$

$$= 150.0 \text{ l/s}$$

150.0 l/s

Required fire flow requirement as per Fire Underwriter Survey

1.4 l/s

Maximum Daily Domestic Demand

151.4 l/s

Required Minimum Water Supply Flow Rate
(MAX DAY + FIRE FLOW)

2510 Walkley Road Ottawa, Ontario

Water Demand

DAILY AVERAGE

COMMERCIAL: 28,000 l / gross ha / day (as per Ottawa Design Guidelines)
 0.96 ha (land area)
 26824 l / day
 8 hour day
 55.9 l/min 0.9 l/s 14.8 USgpm

MAXIMUM DAILY DEMAND

1.5 (Peaking Factor as per Ottawa Design Guidelines)
 83.8 l/min 1.4 l/s 22.1 USgpm

MAXIMUM HOURLY DEMAND

1.8 (Peaking Factor as per Ottawa Design Guidelines)
 150.9 l/min 2.5 l/s 39.9 USgpm

Elevation of Water Meter: 77.58 m ASL
 Finish Floor Elevation: 76.68 m ASL

Static Pressure at Water Meter

MINIMUM HGL: 123.4 m ASL 65 psi 449 kPa
 MAXIMUM HGL: 131.3 m ASL 76 psi 527 kPa



Douglas Gray <d.gray@dbgrayengineering.com>

RE: 2510 Walkley Rd

1 message

Shillington, Jeffrey <jeff.shillington@ottawa.ca>
To: Douglas Gray <d.gray@dbgrayengineering.com>
Cc: Lucio Renna <l.renna@dbgrayengineering.com>

Wed, Jan 10, 2018 at 1:27 PM

Doug,

Sorry about that. Please find below the requested boundary conditions.

The following are boundary conditions, HGL, for hydraulic analysis at 2510 Walkley (zone 2C) assumed to be connected to the 406mm on Walkley (see attached PDF for location).

Minimum HGL = 123.4m

Maximum HGL = 131.3m

Max Day + Fire Flow (150 L/s) = 124.7m

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.

Regards,

Jeff Shillington, P.Eng.

Project Manager, Development Review, South Branch

Planning, Infrastructure and Economic Development

City of Ottawa

tel: 580-2424 x 16960

email: jeff.shillington@ottawa.ca

From: Douglas Gray [mailto:d.gray@dbgrayengineering.com]
Sent: Wednesday, January 10, 2018 12:31 PM
To: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Cc: Lucio Renna <l.renna@dbgrayengineering.com>
Subject: Fwd: 2510 Walkley Rd

Hi Jeffery

This is a reminder that we requested boundary conditions for 2510 Walkley Rd on Nov 27-17 (see below).

Thanks, Doug

D. B. GRAY ENGINEERING INC.

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

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d.gray@dbgrayengineering.com

----- Forwarded message -----

From: **Douglas Gray** <d.gray@dbgrayengineering.com>
Date: Mon, Nov 27, 2017 at 12:23 PM
Subject: 2510 Walkley Rd
To: Jeffrey Shillington <Jeffrey.Shillington@ottawa.ca>
Cc: Lucio Renna <l.renna@dbgrayengineering.com>

Hi Jeffery

Please provide the boundary conditions at 2510 Walkley Rd. We have calculated the following expected demands.

Average daily demand: 0.9 l/s.

Maximum daily demand: 1.4 l/s.

Maximum hourly daily demand: 2.5 l/s

Fire Flow demand: 150.0 l/s

Fire Flow + Max Day: 151.4 l/s

Calculations are attached. Also attached is sketch showing the approximately location of the proposed service connection.

Thanks, Doug

D. B. GRAY ENGINEERING INC.

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

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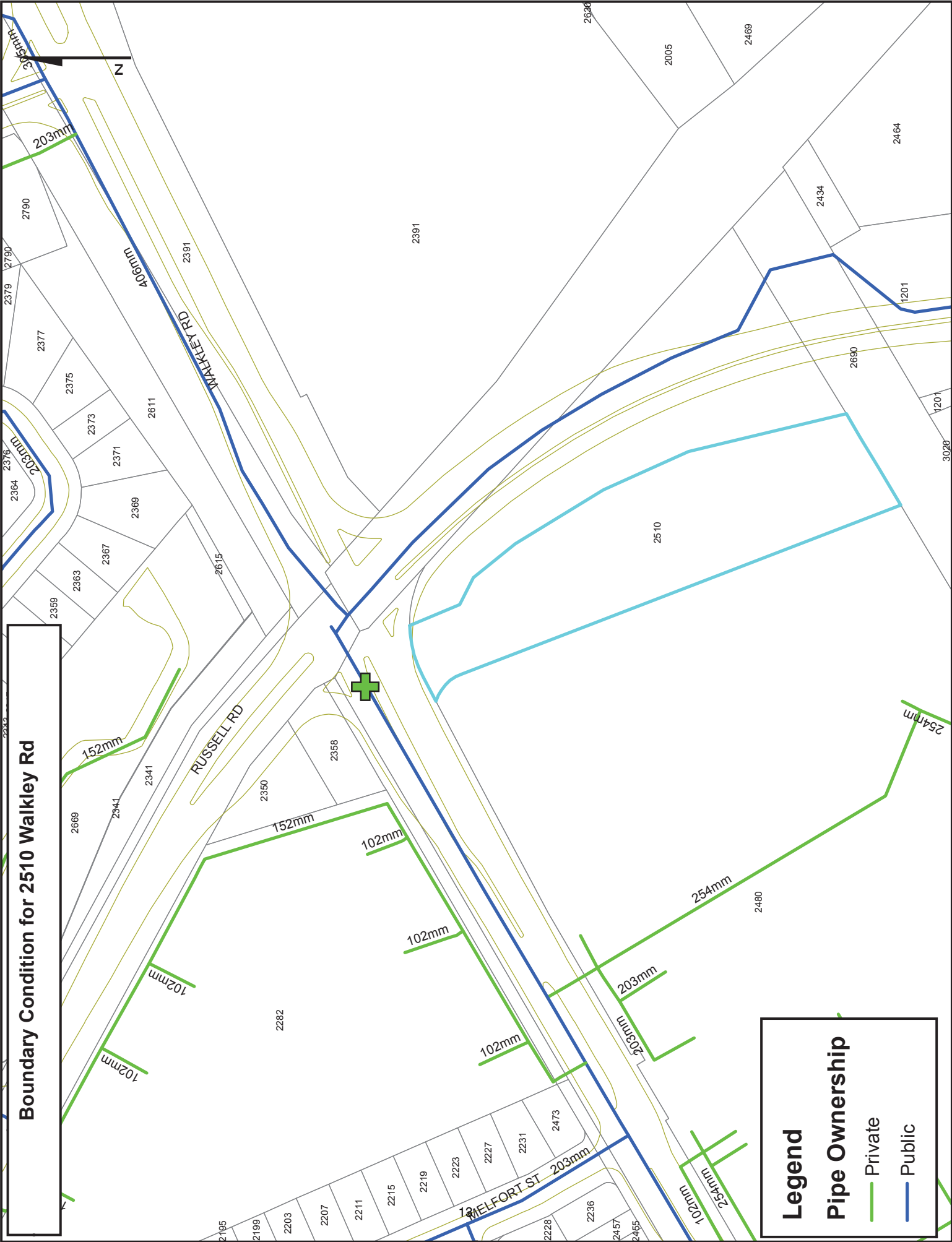
d.gray@dbgrayengineering.com

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 **2510 Walkley Dec 2017.pdf**
116K



Boundary Condition for 2510 Walkley Rd

Legend

Pipe Ownership

- Private
- Public

N

203mm

406mm

152mm

RUSSELL RD

152mm

102mm

102mm

102mm

203mm

254mm

254mm

WELFORT ST 203mm

102mm

254mm

2790

2379

2377

2375

2373

2371

2369

2367

2359

2669

2344

2341

2350

2358

2282

2165

2199

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2473

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2391

2391

2434

2464

1201

2690

3020

2510

1201

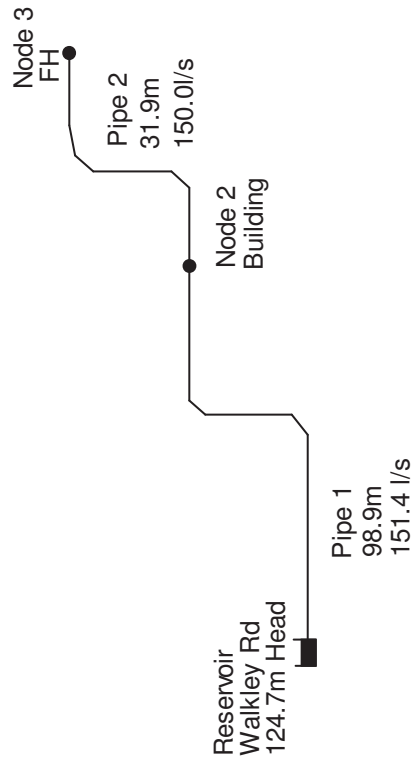
2510 Walkley Rd Ottawa, Ontario

EPANET HYDRAULIC MODELLING RESULTS

MAX DAY + FIRE FLOW: 151.4 l/s

Node ID	Demand	Head	Elevation	Pressure		
	l/s	m	m	m	psi	kPa
1 Reservoir	-151.4	124.70	77.50	47.20	67.1	463
2 Building	1.4	106.99	78.70	28.29	40.2	277
3 FH	150.0	98.32	78.01	20.31	28.9	199

Link ID	Diameter	Length	Roughness	Loss Coeff.	Flow	Velocity
	mm	m			l/s	m/s
Pipe 1	200	98.9	110	3.60	151.4	4.82
Pipe 2	200	31.8	110	3.80	150.0	4.77



Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 2	78.70	1.4	1.40	106.99	28.29
Junc 3	78.01	150	150.00	98.32	20.31
Resvr 1	124.7	#N/A	-151.40	124.70	0.00

Network Table - Links

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Unit Headloss m/km
Pipe 1	98.9	200	110	151.40	4.82	179.10
Pipe 2	31.8	200	110	150.00	4.77	272.48

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/s²

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 and parking area 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 Table

ONE HUNDRED YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate	Maximum Release Rate	Maximum Volume Required	Maximum Volume Stored
	l/s	l/s	cu.m.	cu.m.
AREA I (Uncontrolled flow off site)	-	15.61	-	-
AREA II (Roof)	-	12.43	115.09	115.09
AREA III	-	15.20	130.80	130.80
AREA IV	-	18.04	23.68	23.68
AREA V	-	18.54	12.87	12.87
AREA VI	-	6.79	6.25	6.25
TOTAL	74.19	74.19	288.68	288.68

FIVE YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate	Maximum Release Rate	Maximum Volume Required	Maximum Volume Stored
	l/s	l/s	cu.m.	cu.m.
AREA I (Uncontrolled flow off site)	-	7.29	-	-
AREA II (Roof)	-	9.58	52.72	52.72
AREA III	-	14.99	47.07	47.07
AREA IV	-	17.93	14.33	14.33
AREA V	-	18.29	2.91	2.91
AREA VI	-	6.72	1.60	1.60
TOTAL	74.19	65.22	118.63	118.63

2510 Walkley Rd
Ottawa, Ontario

STORM WATER MANAGEMENT CALCULATIONS

Rational Method

ONE HUNDRED YEAR EVENT

Maximum Allowable Release Rate

Pre-development Conditions

Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Landscaped Areas:	9580	sq.m.	0.30
Gravel Areas:	0	sq.m.	0.70

Total Catchment Area 9580 sq.m. 0.30

Area (A):	9580	sq.m.	
Time of Concentration:	12.4	min.	(see below - use not less than 10 min.)
Rainfall Intensity (i):	93	mm/hr	(5 year event)
Runoff Coefficient (C):	0.30		(Table 5.7 -City of Ottawa Sewer Design Guidelines for 0-5% slope pasture in clay and silt loam soil texture)
Flow Rate (2.78AiC):	74.19	l/s	

Time of Concentration: Sheet Flow

$$\text{Airport Formula}$$

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

Runoff Coefficient (C):	0.30	see above
Sheet Flow Distance (L):	48	m
Slope of Land (Sw):	3.1	%
Time of Concentration (Sheet Flow):	12.4	min

DRAINAGE AREA I (Uncontrolled Flow Off Site):

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	0	sq.m.	1.00
Landscaped Areas:	1258	sq.m.	0.25
Gravel Areas:	0	sq.m.	0.88
			<hr/>
Total Catchment Area	1258	sq.m.	0.25
Area (A):	1258	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	179	mm/hr (100 year event)	
Runoff Coefficient (C):	0.25		
Flow Rate (2.78AiC):	15.61	l/s	

DRAINAGE AREA II (Roof):

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	2854	sq.m.	1.00
Paved Area:	0	sq.m.	1.00
Landscaped Areas:	<u>0</u>	sq.m.	<u>0.25</u>

Total Catchment Area 2854 Ave. C 1.00

No. of Roof Drains: 7
Slots per Wier: 1 0.0124 l/s/mm/slot (5 USgpm/in/slot)

Depth at Roof Drain: 143 mm

Maximum Release Rate 12.43 l/s Pond Area: 2411 sq.m.

Achieved Vol: 115.09 cu.m.

Max. Vol. Required: 115.09 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	192.56	12.43	180.13	54.04
10	179	141.67	12.43	129.24	77.54
15	143	113.37	12.43	100.94	90.85
20	120	95.17	12.43	82.74	99.29
25	104	82.39	12.43	69.96	104.94
30	92	72.89	12.43	60.46	108.83
35	83	65.52	12.43	53.09	111.49
40	75	59.62	12.43	47.19	113.26
45	69	54.79	12.43	42.35	114.36
50	64	50.74	12.43	38.31	114.93
55	60	47.31	12.43	34.88	115.09
60	56	44.35	12.43	31.92	114.90
65	53	41.77	12.43	29.34	114.43
70	50	39.50	12.43	27.07	113.71
75	47	37.49	12.43	25.06	112.78
80	45	35.70	12.43	23.27	111.68
85	43	34.08	12.43	21.65	110.41
90	41	32.62	12.43	20.19	109.01
95	39	31.29	12.43	18.86	107.49
100	38	30.07	12.43	17.64	105.85
105	36	28.96	12.43	16.53	104.12
110	35	27.93	12.43	15.50	102.30
115	34	26.98	12.43	14.55	100.39
120	33	26.10	12.43	13.67	98.41
125	32	25.28	12.43	12.85	96.37
130	31	24.51	12.43	12.08	94.26
135	30	23.80	12.43	11.37	92.09
140	29	23.13	12.43	10.70	89.87
145	28	22.50	12.43	10.07	87.60
150	28	21.91	12.43	9.48	85.29
180	24	18.96	12.43	6.53	70.57
210	21	16.78	12.43	4.35	54.76
240	19	15.08	12.43	2.65	38.14
270	17	13.72	12.43	1.29	20.92
300	16	12.61	12.43	0.18	3.20
330	15	11.68	11.68	0.00	0.00
360	14	10.89	10.89	0.00	0.00

DRAINAGE AREA III

(ONE HUNDRED YEAR EVENT)

				C				
	Roof Area:	0	sq.m.		1.00			
	Asphalt/Concrete Area:	1778	sq.m.		1.00			
	Landscaped Areas:	460	sq.m.		1.00			
Total Catchment Area		2238	sq.m.		1.00			
Water Elevation:	79.02	m						
Invert of Outlet Pipe - CB/MH-11 :	75.91	m						
Centroid of ICD Orifice:	75.96	m						
(ICD in Outlet Pipe of CB/MH-11):								
Head:	3.06	m		Surface Storage Above Catch Basin				
				Area	Depth			
Orifice Diameter	100	mm		sq.m.	m			
				CB/MH-11	495	0.30	49.50	cu.m.
Orifice Area:	7854	sq.mm.		CB/MH-12	659	0.30	65.90	cu.m.
				CB-13A	140	0.22	15.40	cu.m.
Coefficient of Discharge:	0.250							
Maximum Release Rate:	15.20	l/s				Achieved Vol:	130.80	cu.m.
						Max. Vol. Required:	130.80	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.
5	243	151.00	12.43	163.43	15.20	148.23	44.47
10	179	111.09	12.43	123.52	15.20	108.32	64.99
15	143	88.90	12.43	101.33	15.20	86.13	77.52
20	120	74.63	12.43	87.06	15.20	71.85	86.23
25	104	64.61	12.43	77.04	15.20	61.84	92.75
30	92	57.16	12.43	69.59	15.20	54.38	97.89
35	83	51.38	12.43	63.81	15.20	48.60	102.07
40	75	46.75	12.43	59.18	15.20	43.98	105.55
45	69	42.96	12.43	55.39	15.20	40.19	108.50
50	64	39.79	12.43	52.22	15.20	37.02	111.05
55	60	37.10	12.43	49.53	15.20	34.32	113.26
60	56	34.78	12.43	47.21	15.20	32.00	115.20
65	53	32.75	12.43	45.19	15.20	29.98	116.92
70	50	30.98	12.43	43.41	15.20	28.20	118.45
75	47	29.40	12.43	41.83	15.20	26.63	119.82
80	45	27.99	12.43	40.42	15.20	25.22	121.04
85	43	26.72	12.43	39.15	15.20	23.95	122.15
90	41	25.58	12.43	38.01	15.20	22.80	123.14
95	39	24.53	12.43	36.97	15.20	21.76	124.04
100	38	23.58	12.43	36.01	15.20	20.81	124.85
105	36	22.71	12.43	35.14	15.20	19.93	125.58
110	35	21.90	12.43	34.33	15.20	19.13	126.24
115	34	21.16	12.43	33.59	15.20	18.38	126.84
120	33	20.47	12.43	32.90	15.20	17.69	127.38
125	32	19.82	12.43	32.25	15.20	17.05	127.87
130	31	19.22	12.43	31.65	15.20	16.45	128.31
135	30	18.66	12.43	31.09	15.20	15.89	128.70
140	29	18.14	12.43	30.57	15.20	15.36	129.05
145	28	17.64	12.43	30.07	15.20	14.87	129.36
150	28	17.18	12.43	29.61	15.20	14.40	129.64
180	24	14.87	12.43	27.30	15.20	12.10	130.65
210	21	13.16	12.43	25.59	15.20	10.38	130.80
240	19	11.82	12.43	24.26	15.20	9.05	130.33
270	17	10.76	12.43	23.19	15.20	7.99	129.37
300	16	9.89	12.43	22.32	15.20	7.11	128.03
330	15	9.16	11.68	20.83	15.20	5.63	111.48
360	14	8.54	10.89	19.42	15.20	4.22	91.13

DRAINAGE AREA IV

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	954	sq.m.	1.00
Landscaped Areas:	650	sq.m.	0.25

Total Catchment Area 1604 sq.m. 0.70

Water Elevation: 79.34 m

Invert of Outlet Pipe - CB-8 : 76.90 m

Centroid of ICD Orifice: 76.96 m
(ICD in Outlet Pipe of CB-8):

Head: 2.38 m

Orifice Diameter 125 mm

Orifice Area: 12272 sq.mm.

Coefficient of Discharge: 0.215

Maximum Release Rate: 18.04 l/s

Surface Storage Above Catch Basin

	Area	Depth		
	sq.m.	m		
CB-8	374	0.19	23.68	cu.m.

Achieved Vol: 23.68 cu.m.

Max. Vol. Required: 23.68 cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	l/s	l/s	cu.m.
5	243	75.33	18.04	57.29	17.19
10	179	55.42	18.04	37.38	22.43
15	143	44.35	18.04	26.31	23.68
20	120	37.23	18.04	19.19	23.02
25	104	32.23	18.04	14.19	21.28
30	92	28.51	18.04	10.47	18.85
35	83	25.63	18.04	7.59	15.93
40	75	23.32	18.04	5.28	12.67
45	69	21.43	18.04	3.39	9.15
50	64	19.85	18.04	1.81	5.42
55	60	18.51	18.04	0.46	1.53
60	56	17.35	17.35	0.00	0.00
65	53	16.34	16.34	0.00	0.00
70	50	15.45	15.45	0.00	0.00
75	47	14.67	14.67	0.00	0.00
80	45	13.96	13.96	0.00	0.00
85	43	13.33	13.33	0.00	0.00
90	41	12.76	12.76	0.00	0.00
95	39	12.24	12.24	0.00	0.00
100	38	11.76	11.76	0.00	0.00
105	36	11.33	11.33	0.00	0.00
110	35	10.93	10.93	0.00	0.00
115	34	10.55	10.55	0.00	0.00
120	33	10.21	10.21	0.00	0.00
125	32	9.89	9.89	0.00	0.00
130	31	9.59	9.59	0.00	0.00
135	30	9.31	9.31	0.00	0.00
140	29	9.05	9.05	0.00	0.00
145	28	8.80	8.80	0.00	0.00
150	28	8.57	8.57	0.00	0.00
180	24	7.42	7.42	0.00	0.00
210	21	6.56	6.56	0.00	0.00
240	19	5.90	5.90	0.00	0.00
270	17	5.37	5.37	0.00	0.00
300	16	4.93	4.93	0.00	0.00
330	15	4.57	4.57	0.00	0.00
360	14.5	4.26	4.26	0.00	0.00

DRAINAGE AREA V

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	690	sq.m.	1.00
Landscaped Areas:	462	sq.m.	0.25

Total Catchment Area 1152 sq.m. 0.70

Water Elevation: 77.88 m

Invert of Outlet Pipe - CB-6 : 74.83 m

Centroid of ICD Orifice: 74.89 m
(ICD in Outlet Pipe of CB-6):

Head: 2.99 m

Orifice Diameter 125 mm

Orifice Area: 12272 sq.mm.

Coefficient of Discharge: 0.197

Maximum Release Rate: 18.54 l/s

Surface Storage Above Catch Basin

	Area	Depth		
	sq.m.	m		
CB-6	193	0.20	12.87	cu.m.

Max. Vol. Required: 12.87 cu.m.

Achieved Vol: 12.87 cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	Rate	Rate	Volume
			l/s	l/s	cu.m.
5	243	54.35	18.54	35.81	10.74
10	179	39.98	18.54	21.45	12.87
15	143	32.00	18.54	13.46	12.11
20	120	26.86	18.54	8.32	9.99
25	104	23.25	18.54	4.72	7.08
30	92	20.57	18.54	2.03	3.66
35	83	18.49	18.49	0.00	0.00
40	75	16.83	16.83	0.00	0.00
45	69	15.46	15.46	0.00	0.00
50	64	14.32	14.32	0.00	0.00
55	60	13.35	13.35	0.00	0.00
60	56	12.52	12.52	0.00	0.00
65	53	11.79	11.79	0.00	0.00
70	50	11.15	11.15	0.00	0.00
75	47	10.58	10.58	0.00	0.00
80	45	10.07	10.07	0.00	0.00
85	43	9.62	9.62	0.00	0.00
90	41	9.21	9.21	0.00	0.00
95	39	8.83	8.83	0.00	0.00
100	38	8.49	8.49	0.00	0.00
105	36	8.17	8.17	0.00	0.00
110	35	7.88	7.88	0.00	0.00
115	34	7.61	7.61	0.00	0.00
120	33	7.37	7.37	0.00	0.00
125	32	7.13	7.13	0.00	0.00
130	31	6.92	6.92	0.00	0.00
135	30	6.72	6.72	0.00	0.00
140	29	6.53	6.53	0.00	0.00
145	28	6.35	6.35	0.00	0.00
150	28	6.18	6.18	0.00	0.00
180	24	5.35	5.35	0.00	0.00
210	21	4.73	4.73	0.00	0.00
240	19	4.26	4.26	0.00	0.00
270	17	3.87	3.87	0.00	0.00
300	16	3.56	3.56	0.00	0.00
330	15	3.30	3.30	0.00	0.00
360	14	3.07	3.07	0.00	0.00

DRAINAGE AREA VI

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	303	sq.m.	1.00
Landscaped Areas:	171	sq.m.	0.25

Total Catchment Area 474 sq.m. 0.73

Water Elevation: 76.66 m

Invert of Outlet Pipe - CB-2 : 74.26 m

Centroid of ICD Orifice: 74.30 m
(ICD in Outlet Pipe of CB-2):

Head: 2.36 m

Orifice Diameter 75 mm

Orifice Area: 4418 sq.mm.

Coefficient of Discharge: 0.226

Maximum Release Rate: 6.79 l/s

Surface Storage Above Catch Basin

	Area	Depth		
	sq.m.	m		cu.m.
CB-2	125	0.15	6.25	cu.m.

Achieved Vol: 6.25 cu.m.

Max. Vol. Required: 6.25 cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	Rate	Rate	Volume
			l/s	l/s	cu.m.
5	243	23.33	6.79	16.53	4.96
10	179	17.16	6.79	10.37	6.22
15	143	13.73	6.79	6.94	6.25
20	120	11.53	6.79	4.73	5.68
25	104	9.98	6.79	3.19	4.78
30	92	8.83	6.79	2.04	3.66
35	83	7.94	6.79	1.14	2.40
40	75	7.22	6.79	0.43	1.03
45	69	6.64	6.64	0.00	0.00
50	64	6.15	6.15	0.00	0.00
55	60	5.73	5.73	0.00	0.00
60	56	5.37	5.37	0.00	0.00
65	53	5.06	5.06	0.00	0.00
70	50	4.79	4.79	0.00	0.00
75	47	4.54	4.54	0.00	0.00
80	45	4.32	4.32	0.00	0.00
85	43	4.13	4.13	0.00	0.00
90	41	3.95	3.95	0.00	0.00
95	39	3.79	3.79	0.00	0.00
100	38	3.64	3.64	0.00	0.00
105	36	3.51	3.51	0.00	0.00
110	35	3.38	3.38	0.00	0.00
115	34	3.27	3.27	0.00	0.00
120	33	3.16	3.16	0.00	0.00
125	32	3.06	3.06	0.00	0.00
130	31	2.97	2.97	0.00	0.00
135	30	2.88	2.88	0.00	0.00
140	29	2.80	2.80	0.00	0.00
145	28	2.73	2.73	0.00	0.00
150	28	2.65	2.65	0.00	0.00
180	24	2.30	2.30	0.00	0.00
210	21	2.03	2.03	0.00	0.00
240	19	1.83	1.83	0.00	0.00
270	17	1.66	1.66	0.00	0.00
300	16	1.53	1.53	0.00	0.00
330	15	1.41	1.41	0.00	0.00
360	14.7	1.32	1.32	0.00	0.00

FIVE YEAR EVENT

Maximum Allowable Release Rate

Pre-development Conditions

Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Landscaped Areas:	9580	sq.m.	0.30
Gravel Areas:	0	sq.m.	0.70

Total Catchment Area 9580 sq.m. 0.30

Area (A):	9580	sq.m.	
Time of Concentration:	12.4	min.	(see below - use not less than 10 min.)
Rainfall Intensity (i):	93	mm/hr	(5 year event)
Runoff Coefficient (C):	0.30		(Table 5.7 -City of Ottawa Sewer Design Guidelines for 0-5% slope pasture in clay and silt loam soil texture)
Flow Rate (2.78AiC):	74.19	l/s	

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):	0.30	see above
Sheet Flow Distance (L):	48	m
Slope of Land (Sw):	3.1	%
Time of Concentration (Sheet Flow):	12.4	min

DRAINAGE AREA I (Uncontrolled Flow Off Site):

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Landscaped Areas:	1258	sq.m.	0.20
Total Catchment Area	1258	sq.m.	0.20
Area (A):	1258	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	104	mm/hr (100 year event)	
Runoff Coefficient (C):	0.20		
Flow Rate (2.78AiC):	7.29	l/s	

DRAINAGE AREA II (Roof):

(FIVE YEAR EVENT)

				C	
	Roof Area:	2854	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		2854	Ave. C	0.90	
No. of Roof Drains:	7				
Slots per Wier:	1	0.0124 l/s/mm/slot	(5 USgpm/in/slot)		
Depth at Roof Drain:	110	mm			
Maximum Release Rate	9.58	l/s		Pond Area:	1433 sq.m.
				Achieved Vol:	52.72 cu.m.
				Max. Vol. Required:	52.72 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	100.81	9.58	91.23	27.37
10	104	74.40	9.58	64.82	38.89
15	84	59.67	9.58	50.08	45.07
20	70	50.16	9.58	40.58	48.70
25	61	43.48	9.58	33.90	50.85
30	54	38.51	9.58	28.93	52.07
35	49	34.64	9.58	25.06	52.63
40	44	31.55	9.58	21.97	52.72
45	41	29.01	9.58	19.43	52.46
50	38	26.89	9.58	17.30	51.91
55	35	25.08	9.58	15.50	51.14
60	33	23.52	9.58	13.94	50.19
65	31	22.17	9.58	12.58	49.08
70	29	20.97	9.58	11.39	47.84
75	28	19.91	9.58	10.33	46.49
80	27	18.97	9.58	9.38	45.05
85	25	18.11	9.58	8.53	43.52
90	24	17.34	9.58	7.76	41.91
95	23	16.64	9.58	7.06	40.24
100	22	16.00	9.58	6.42	38.51
105	22	15.41	9.58	5.83	36.72
110	21	14.87	9.58	5.29	34.89
115	20	14.37	9.58	4.78	33.01
120	19	13.90	9.58	4.32	31.09
125	19	13.47	9.58	3.89	29.14
130	18	13.06	9.58	3.48	27.15
135	18	12.69	9.58	3.10	25.13
140	17	12.33	9.58	2.75	23.09
145	17	12.00	9.58	2.42	21.01
150	16	11.68	9.58	2.10	18.91
180	14	10.13	9.58	0.54	5.87
210	13	8.97	8.97	0.00	0.00
240	11	8.07	8.07	0.00	0.00
270	10	7.34	7.34	0.00	0.00
300	9	6.75	6.75	0.00	0.00
330	9	6.26	6.26	0.00	0.00
360	8	5.84	5.84	0.00	0.00

DRAINAGE AREA III

(FIVE YEAR EVENT)

				C			
	Roof Area:	0	sq.m.	0.90			
	Asphalt/Concrete Area:	1778	sq.m.	0.90			
	Landscaped Areas:	460	sq.m.	0.90			
	Total Catchment Area	2238	sq.m.	0.90			
	Water Elevation:	78.93	m				
	Invert of Outlet Pipe - CB/MH-11 :	75.91	m				
	Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-11):	75.96	m				
	Head:	2.97	m		Surface Storage Above Catch Basin		
	Orifice Diameter	100	mm		Area	Depth	
					sq.m.	m	
	Orifice Area:	7854	sq.mm.		CB/MH-11	250	0.21
					CB/MH-12	333	0.21
					CB-13A	85	0.13
	Coefficient of Discharge:	0.250					
	Maximum Release Rate:	14.99	l/s		Achieved Vol:	47.07	cu.m.
					Max. Vol. Required:	47.07	cu.m.

Time min.	i mm/hr	2.78AiC l/s	Roof Release Rate l/s	Total Inflow l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	79.05	9.58	88.64	14.99	73.65	22.09
10	104	58.34	9.58	67.93	14.99	52.94	31.76
15	84	46.79	9.58	56.37	14.99	41.38	37.24
20	70	39.34	9.58	48.92	14.99	33.93	40.72
25	61	34.10	9.58	43.68	14.99	28.69	43.04
30	54	30.20	9.58	39.78	14.99	24.79	44.62
35	49	27.17	9.58	36.75	14.99	21.76	45.70
40	44	24.74	9.58	34.32	14.99	19.34	46.41
45	41	22.75	9.58	32.33	14.99	17.34	46.83
50	38	21.08	9.58	30.67	14.99	15.68	47.04
55	35	19.67	9.58	29.25	14.99	14.26	47.07
60	33	18.45	9.58	28.03	14.99	13.04	46.95
65	31	17.38	9.58	26.97	14.99	11.98	46.71
70	29	16.45	9.58	26.03	14.99	11.04	46.37
75	28	15.62	9.58	25.20	14.99	10.21	45.95
80	27	14.87	9.58	24.46	14.99	9.47	45.45
85	25	14.21	9.58	23.79	14.99	8.80	44.88
90	24	13.60	9.58	23.18	14.99	8.20	44.25
95	23	13.05	9.58	22.63	14.99	7.64	43.58
100	22	12.55	9.58	22.13	14.99	7.14	42.85
105	22	12.09	9.58	21.67	14.99	6.68	42.08
110	21	11.66	9.58	21.24	14.99	6.25	41.28
115	20	11.27	9.58	20.85	14.99	5.86	40.44
120	19	10.90	9.58	20.48	14.99	5.50	39.57
125	19	10.56	9.58	20.14	14.99	5.16	38.67
130	18	10.24	9.58	19.83	14.99	4.84	37.74
135	18	9.95	9.58	19.53	14.99	4.54	36.79
140	17	9.67	9.58	19.25	14.99	4.26	35.82
145	17	9.41	9.58	18.99	14.99	4.00	34.83
150	16	9.16	9.58	18.74	14.99	3.76	33.81
180	14	7.94	9.58	17.52	14.99	2.53	27.38
210	13	7.03	8.97	16.00	14.99	1.01	12.70
240	11	6.32	8.07	14.39	14.39	0.00	0.00
270	10	5.76	7.34	13.10	13.10	0.00	0.00
300	9	5.30	6.75	12.05	12.05	0.00	0.00
330	9	4.91	6.26	11.16	11.16	0.00	0.00
360	8	4.58	5.84	10.41	10.41	0.00	0.00

DRAINAGE AREA IV

(FIVE YEAR EVENT)

				C		
Roof Area:	0	sq.m.		0.90		
Asphalt/Concrete Area:	954	sq.m.		0.90		
Landscaped Areas:	650	sq.m.		0.90		
Total Catchment Area				1604	sq.m.	0.90
Water Elevation:	79.31	m				
Invert of Outlet Pipe - CB-8 :	76.90	m				
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB-8):	76.96	m				
Head:	2.35	m				
Orifice Diameter	125	mm	Surface Storage Above Catch Basin			
			Area	Depth		
Orifice Area:	12272	sq.mm.	sq.m.	m		
			CB-8	268	0.16	14.33 cu.m.
Coefficient of Discharge:	0.215					
Maximum Release Rate:	17.93	l/s			Achieved Vol:	14.33 cu.m.
					Max. Vol. Required:	14.33 cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	Rate	Rate	Volume
			l/s	l/s	cu.m.
5	141	56.66	17.93	38.72	11.62
10	104	41.81	17.93	23.88	14.33
15	84	33.53	17.93	15.60	14.04
20	70	28.19	17.93	10.26	12.31
25	61	24.44	17.93	6.51	9.76
30	54	21.64	17.93	3.71	6.68
35	49	19.47	17.93	1.54	3.23
40	44	17.73	17.73	0.00	0.00
45	41	16.31	16.31	0.00	0.00
50	38	15.11	15.11	0.00	0.00
55	35	14.10	14.10	0.00	0.00
60	33	13.22	13.22	0.00	0.00
65	31	12.46	12.46	0.00	0.00
70	29	11.79	11.79	0.00	0.00
75	28	11.19	11.19	0.00	0.00
80	27	10.66	10.66	0.00	0.00
85	25	10.18	10.18	0.00	0.00
90	24	9.75	9.75	0.00	0.00
95	23	9.35	9.35	0.00	0.00
100	22	8.99	8.99	0.00	0.00
105	22	8.66	8.66	0.00	0.00
110	21	8.36	8.36	0.00	0.00
115	20	8.07	8.07	0.00	0.00
120	19	7.81	7.81	0.00	0.00
125	19	7.57	7.57	0.00	0.00
130	18	7.34	7.34	0.00	0.00
135	18	7.13	7.13	0.00	0.00
140	17	6.93	6.93	0.00	0.00
145	17	6.74	6.74	0.00	0.00
150	16	6.57	6.57	0.00	0.00
180	14	5.69	5.69	0.00	0.00
210	13	5.04	5.04	0.00	0.00
240	11	4.53	4.53	0.00	0.00
270	10	4.13	4.13	0.00	0.00
300	9	3.80	3.80	0.00	0.00
330	9	3.52	3.52	0.00	0.00
360	8 ₃₂	3.28	3.28	0.00	0.00

DRAINAGE AREA V

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	690	sq.m.	0.90
Landscaped Areas:	<u>462</u>	<u>sq.m.</u>	<u>0.20</u>

Total Catchment Area 1152 sq.m. 0.62

Water Elevation:	77.80	m
Invert of Outlet Pipe - CB-6 :	74.83	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB-6):	74.89	m

Head: 2.91 m

Orifice Diameter	125	mm	Surface Storage Above Catch Basin			
Orifice Area:	12272	sq.mm.	Area	Depth		
			sq.m.	m		
			CB-6	72	0.12	2.91 cu.m.

Coefficient of Discharge: 0.197

Maximum Release Rate: 18.29 l/s Achieved Vol: 2.91 cu.m.

Max. Vol. Required: 2.91 cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	Rate	Rate	Volume
			l/s	l/s	cu.m.
5	141	28.00	18.29	9.71	2.91
10	104	20.66	18.29	2.37	1.42
15	84	16.57	16.57	0.00	0.00
20	70	13.93	13.93	0.00	0.00
25	61	12.08	12.08	0.00	0.00
30	54	10.70	10.70	0.00	0.00
35	49	9.62	9.62	0.00	0.00
40	44	8.76	8.76	0.00	0.00
45	41	8.06	8.06	0.00	0.00
50	38	7.47	7.47	0.00	0.00
55	35	6.97	6.97	0.00	0.00
60	33	6.53	6.53	0.00	0.00
65	31	6.16	6.16	0.00	0.00
70	29	5.83	5.83	0.00	0.00
75	28	5.53	5.53	0.00	0.00
80	27	5.27	5.27	0.00	0.00
85	25	5.03	5.03	0.00	0.00
90	24	4.82	4.82	0.00	0.00
95	23	4.62	4.62	0.00	0.00
100	22	4.44	4.44	0.00	0.00
105	22	4.28	4.28	0.00	0.00
110	21	4.13	4.13	0.00	0.00
115	20	3.99	3.99	0.00	0.00
120	19	3.86	3.86	0.00	0.00
125	19	3.74	3.74	0.00	0.00
130	18	3.63	3.63	0.00	0.00
135	18	3.52	3.52	0.00	0.00
140	17	3.42	3.42	0.00	0.00
145	17	3.33	3.33	0.00	0.00
150	16	3.25	3.25	0.00	0.00
180	14	2.81	2.81	0.00	0.00
210	13	2.49	2.49	0.00	0.00
240	11	2.24	2.24	0.00	0.00
270	10	2.04	2.04	0.00	0.00
300	9	1.88	1.88	0.00	0.00
330	9	1.74	1.74	0.00	0.00
360	8.33	1.62	1.62	0.00	0.00

DRAINAGE AREA VI

(FIVE YEAR EVENT)

			C				
Roof Area:	0	sq.m.	0.90				
Asphalt/Concrete Area:	303	sq.m.	0.90				
Landscaped Areas:	171	sq.m.	0.20				
Total Catchment Area		474 sq.m.	0.65				
Water Elevation:	76.61	m					
Invert of Outlet Pipe - CB-2 :	74.26	m					
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB-2):	74.30	m					
Head:	2.31	m					
Orifice Diameter	75	mm	Surface Storage Above Catch Basin				
Orifice Area:	4418	sq.mm.	Area	Depth			
Coefficient of Discharge:	0.226		sq.m.	m			
Maximum Release Rate:	6.72	l/s	CB-2	50	0.10	1.60	cu.m.
			Achieved Vol:		1.60	cu.m.	
			Max. Vol. Required:		1.60	cu.m.	

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	Rate	Rate	Volume
			l/s	l/s	cu.m.
5	141	12.05	6.72	5.33	1.60
10	104	8.89	6.72	2.17	1.30
15	84	7.13	6.72	0.41	0.37
20	70	5.99	5.99	0.00	0.00
25	61	5.20	5.20	0.00	0.00
30	54	4.60	4.60	0.00	0.00
35	49	4.14	4.14	0.00	0.00
40	44	3.77	3.77	0.00	0.00
45	41	3.47	3.47	0.00	0.00
50	38	3.21	3.21	0.00	0.00
55	35	3.00	3.00	0.00	0.00
60	33	2.81	2.81	0.00	0.00
65	31	2.65	2.65	0.00	0.00
70	29	2.51	2.51	0.00	0.00
75	28	2.38	2.38	0.00	0.00
80	27	2.27	2.27	0.00	0.00
85	25	2.16	2.16	0.00	0.00
90	24	2.07	2.07	0.00	0.00
95	23	1.99	1.99	0.00	0.00
100	22	1.91	1.91	0.00	0.00
105	22	1.84	1.84	0.00	0.00
110	21	1.78	1.78	0.00	0.00
115	20	1.72	1.72	0.00	0.00
120	19	1.66	1.66	0.00	0.00
125	19	1.61	1.61	0.00	0.00
130	18	1.56	1.56	0.00	0.00
135	18	1.52	1.52	0.00	0.00
140	17	1.47	1.47	0.00	0.00
145	17	1.43	1.43	0.00	0.00
150	16	1.40	1.40	0.00	0.00
180	14	1.21	1.21	0.00	0.00
210	13	1.07	1.07	0.00	0.00
240	11	0.96	0.96	0.00	0.00
270	10	0.88	0.88	0.00	0.00
300	9	0.81	0.81	0.00	0.00
330	9	0.75	0.75	0.00	0.00
360	8.34	0.70	0.70	0.00	0.00

D.B. GRAY ENGINEERING INC.

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

700 Long Point Circle
Ottawa, Ontario K1T 4E9
613-425-8044
dbgray@rogers.com

STORM SEWER COMPUTATION FORM

RATIONAL METHOD Q = 2.78 A I R FIVE YEAR EVENT

n = 0.013

PROJECT: 2510 Walkley Rd

Designed By: DBG

Date: #####

DRAINAGE AREAS	LOCATION		Hard Surface	Gravel	Landscape	Roof	Individual 2.78 A R	Accum. 2.78 A R	Time of Conc. (min)	Rainfall Intensity I (mm/hr)	Peak Flow Q (l/s)	SEWER DATA				Ratio Q/Ofull	COMMENTS				
	FROM	TO										AREA (ha)	R = 0.90	R = 0.70	R = 0.20			R = 0.90	Type of Pipe	Dia. Actual (mm)	Dia. Nom. (mm)
II + III	CB-13A	MH-13	0.0159			0.2854	0.754	0.754	10.00	104.2	78.5	PVC SDR 35	254.0	250	0.43	28.9	40.7	0.80	0.60	1.93	
III	MH-13	CB/MH-12					0.000	0.754	10.60	101.1	76.2	PVC SDR 36	254.0	250	0.43	9.8	40.7	0.80	0.20	1.87	
III	CB/MH-12	CB/MH-11	0.1018				0.255	1.009	10.80	100.1	101.0	PVC SDR 35	304.8	300	0.34	27.2	58.8	0.81	0.56	1.72	
III	CB/MH-11	MH-9	0.0801		0.0460		0.176	1.185	11.37	97.5	115.5	PVC SDR 35	304.8	300	1.00	53.5	100.9	1.38	0.64	1.14	FLOW THROUGH ICD + FLOW CONTROL ROOF DRAINS
IV	CB-8	MH-9	0.0954		0.0650		0.275	0.275	10.00	104.2	28.6	PVC SDR 35	254.0	250	14.10	8.1	233.0	4.60	0.03	0.12	FLOW THROUGH ICD
											18.3	PVC SDR 35	254.0	250	14.10	8.1	233.0	4.60	0.03	0.08	
							0.000	1.459	12.01	94.7	138.1	CONCRETE	457.2	450	1.00	68.8	297.4	1.81	0.63	0.46	
V	CB-6	MH-7	0.0690		0.0462		0.198	0.198	10.00	104.2	20.7	PVC SDR 35	254.0	250	1.00	1.7	62.0	1.22	0.02	0.33	
											18.3	PVC SDR 35	254.0	250	1.00	1.7	62.0	1.22	0.02	0.29	FLOW THROUGH ICD
	CB/MH-7	CB/MH-4					0.000	1.658	12.64	92.0	152.6	CONCRETE	457.2	450	0.20	46.7	133.0	0.81	0.96	1.15	
	CB/MH-4	CB/MH-3					0.000	1.658	13.60	88.4	146.5	CONCRETE	457.2	450	0.20	6.8	133.0	0.81	0.14	1.10	
											51.6	CONCRETE	457.2	450	0.20	6.8	133.0	0.81	0.14	0.39	FLOW THROUGH ICD
VI	CB-2	CB/MH-3	0.0303		0.0171		0.085	0.085	10.00	104.2	8.9	PVC SDR 35	254.0	250	1.00	1.7	62.0	1.22	0.02	0.14	
											6.7	PVC SDR 35	254.0	250	1.00	1.7	62.0	1.22	0.02	0.11	FLOW THROUGH ICD
							0.000	1.743	13.74	87.8	153.1	CONCRETE	609.6	600	0.14	17.8	239.7	0.82	0.36	0.64	
											58.3	CONCRETE	609.6	600	0.14	17.8	239.7	0.82	0.36	0.24	FLOW THROUGH ICD
VII	CB/MH-15	CB/MH-14			0.0668		0.037	0.037	10.00	104.19	3.9	CONCRETE	457.2	450	1.00	101.6	297.4	1.81	0.93	0.01	
VII	CB/MH-14	CB/MH-1			0.1100		0.061	0.098	10.93	100	9.8	CONCRETE	457.2	450	1.00	46.6	297.4	1.81	0.4	0.03	
VII	CB/MH-1	Existing			0.1446		0.08	1.922	14.1	87	166.3	CONCRETE	609.6	600	0.14	40.5	239.7	0.82	0.82	0.69	FLOW THROUGH ICD
											75.1	CONCRETE	609.6	600	0.14	40.5	239.7	0.82	0.82	0.31	

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-8

Plan showing the site and location of all existing services: see drawings C-1 to C-8

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-8

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-8

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-5

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 and Stormwater Management Report

Identification of system constraints: see page 2 and 3 of Servicing Brief

Confirmation of adequate domestic supply and pressure: see page 2 and 3 of Servicing Brief and 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, & 8 to 15 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 3 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 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 3 of Servicing Brief and 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 of Servicing Brief and 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 and 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 16 of Servicing Brief and Stormwater Management Report

Description of proposed sewer network including sewers, pumping stations, and forcemains: see page 3 of Servicing Brief and 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 pages 4 to 6 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 and C-7.

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 pages 4 to 6 of 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-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-8 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-8 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 pages 4 to 6 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 pages 4 to 6 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 2.7 on drawing C-5

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 7 of Servicing Brief and 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