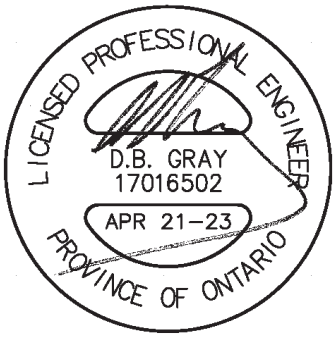
SERVICING BRIEF &
STORMWATER MANAGEMENT REPORT

765 Green Creek Drive
Ottawa, Ontario

Report No. 20014

March 26, 2021
Revised June 21, 2022
Revised April 21, 2023



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SIGNED & DATED

D.B. Gray Engineering Inc.

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

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765 Green Creek Drive
Ottawa, Ontario

This report describes the services and addresses the stormwater management requirements of 8225 sq.m. property at 765 Green Creek in Ottawa. Currently a 1290 sq.m. building used by SMART union as the Local 47 Training Center occupies the property. A 1,180 sq.m. addition to the training center is proposed.

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

WATER SUPPLY FOR FIREFIGHTING:

There is an existing 150mm private watermain and fire hydrant on the property. The private hydrant is 23 m unobstructed distance to the fire department connection (FDC); less than the required maximum of 45 m. There are also two existing municipal fire hydrants adjacent to the property; about 67 m and 94 m unobstructed distances to the building.

The existing building and proposed addition are non-combustible construction with a sprinkler system throughout. Based on this construction, a fire flow of 83.3 L/s (5,000 L/min) is required, as calculated as per the Fire Underwriter Survey "Water Supply For Fire Protection". The calculations were submitted to the City and boundary conditions were requested. (The calculations submitted were based on a previous design requiring a fire flow of 133.33 L/s.)

The boundary conditions for the 133.3 L/s fire flow (based on the city's computer model of the municipal water distribution system) were received from the City. They include a HGL (hydraulic grade line) of 96.8 m during the above flow rate in the municipal watermains at the subject location which calculates to be 367 kPa (62 psi). (At 83.3 L/s fire flow the pressure would be higher.) Since the pressure is above 138 kPa (20 psi) there is an adequate water supply for firefighting from the existing municipal water distribution system.

As per City of Ottawa Tech Bulletin ISTB-2018-02, the aggregate fire flow of all contributing fire hydrants within 150 m of the building can used to supply the required fire flow. The two municipal hydrants are Class AA; one is within 75 m and can contribute 5,700 L/min (95 L/s); and the other is within 150 m and can tribute 3,800 L/min (63.3 L/s) (as per Table 1 of ISTB-2018-02). There is also the flow from the private on-site hydrant, therefore, the aggregate flow from all three hydrants is in excess of 9,500 L/min (158.3 L/s), which is greater than the required fire flow of 83.3 L/s.

WATER SERVICE:

The existing 150 mm private watermain and water service supplying the sprinkler system is adequate for the domestic demand.

As per the City of Ottawa Design Guidelines the daily average consumption rate for a commercial development is 35,000 litres per day per hectare; and the maximum daily demand for the subject property is calculated to be 0.3 L/s. Based on a maximum daily peaking factor of 1.5 times the daily average demand and a maximum hourly peaking factor of 1.8 times the maximum daily demand, the maximum daily demand is 0.5 L/s and maximum hourly demand is 0.9 L/s.

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. Based on the boundary conditions received from the City, the minimum HGL (hydraulic grade line) is 110.5 m and the maximum is 116.1 m. With these HGLs the water pressure at the water meter is calculated to vary from 551 kPa to 606 kPa (80 psi to 88 psi). This is an acceptable range of water pressures for the proposed development. However, since it is calculated that the water pressure may be above 80 psi an on-site pressure check is recommended to determine if a pressure reducing valve (PRV) is required.

SANITARY SERVICE:

The existing 150 mm sanitary sewer connection serving the existing building will remain.

Based on the City of Ottawa Sewer Design Guidelines for an industrial property (35,000 L/ha/day; 7.0 peaking factor (as per Appendix 4-B.1); and a 0.33 L/s/ha infiltration flow) the peak flow is calculated to be 2.60 L/s. This flow will be adequately handled by the existing sanitary sewer connection with each pipe segment being only at about 9 to 16% of its capacity.

The 150 mm sanitary sewer connects to an existing 200 mm municipal sanitary sewer which, with a 0.68% slope, has a capacity of 28.2 L/s. The 2.60 L/s in sanitary flows contributing to the municipal sewer is expected to have an negligible impact, as it only serves the subject property and is only at about 8% of its capacity.

STORMWATER MANAGEMENT:

Water Quality:

For the original 2008 design the City of Ottawa required the removal of 70% of the total suspended solids (TSS) from the site runoff. For the current design the City stated that *"typically, 80% TSS removal is required"*, but requested that the Rideau Valley Conservation Authority (RVCA) be consulted. However, the RVCA has stated: *"Due to changes enacted*

through Bill 23 and Ontario Regulation 596/22, the Conservation Authority can no longer provide comments on water quality requirements on site specific applications. Therefore, the decision whether on-site water quality treatment is required and what would trigger on-site water quality now rests with the City."

To achieve the original 70% TSS removal criterion an oil/grit separator manhole was installed. Such a device is designed to remove sediment from the runoff entering the manhole and stores the sediment in a chamber for periodic removal. Specifically a "Stormceptor STC 300i" with a sediment capacity of 1.3 cubic metres and an oil capacity of 325 litres was installed. Based on the proposed site plan the manufacturer (based on the manufacturer's software) calculated that the existing OGS will remove 74% of the TSS. The 2008 site plan developed approximately 75% of the property; while with the current proposed site plan 100% of the property will be developed. Therefore, it can be reasoned that the weighted average of the TSS removal criterion should be about 72.5%; and since the existing OGS exceeds this criterion, it is proposed that the existing OGS shall remain.

An erosion and sediment control plan has been developed to be implemented during construction, (see drawing C-2 and notes 2.1 to 2.7 on drawing C-3). In summary: to filter out construction sediment; a silt fence barrier will be installed adjacent to the east property line; sediment capture filter sock inserts will be installed at existing catch basins adjacent to the site and in the new catch basins as it is installed; a straw bale check dam will be installed at the inlet of a culvert; and any material deposited on a public road will be removed.

Water Quantity:

For the original 2008 design the City of Ottawa required that 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 runoff coefficient of 0.50; and a 20 minute time of concentration. However, to meet the City's current standards, the stormwater management the criteria for quantity control are now 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, whichever is less; and a calculated time of concentration (but not less than 10 minutes). The pre-development (prior to 2008) conditions reflect a 5-year runoff coefficient of 0.30 and, based on the Airport Formula, a time of concentration of 23 minutes. Therefore, using the Rational Method; the maximum allowable release rate is 44.62 L/s for all storm events. The Modified Rational Method is used to calculate the required storage volume. The runoff coefficients for the 100 year event are increased by 25% to maximum 1.00.

Stormwater will be stored within the development in a stormwater detention area (depressed grassed area) and on the asphalt surface above catch basins.

Drainage Area I
(Uncontrolled Flow Off Site – 459 sq.m.):
The runoff from the perimeter of the site will be allowed to flow uncontrolled off the site. The flow from is calculated at 10 minutes concentration.

	100-year	5-year
Maximum flow rate:	5.70 L/s	2.66 L/s

Drainage Area II (7,766 sq.m.):
An inlet control device (ICD) located at the outlet pipe of catch basin / manhole CB/MH-2 will control the release of stormwater from the property. The ICD will restrict the flow and force the stormwater to back up into the stormwater detention area (located at the northwest corner of the property); and, during the 100-year event, onto the asphalt surface above catch basin CB/MH-2 and catch basin CB-3. The ICD shall be a plug style with a round orifice design (with the orifice located at the bottom of the plug) manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 38.92 L/s at 1.39 m head. It is calculated that an orifice area of 12,237 sq.mm. (±125 mm in diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 38.92 L/s at 1.39 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 33.80 L/s at 1.05 m.

	100-year	5-year
Maximum release rate:	38.92 L/s	33.80 L/s
Maximum water elevation:	52.84 m	52.50 m
Maximum stored volume:	226.53 cu.m.	93.97 cu.m.

The Entire Site:

	100-year	5-year
Maximum allowable release rate:	44.62 L/s	44.62 L/s
Maximum release rate:	44.62 L/s	36.46 L/s

Therefore, the maximum post-development release rate for the 100-year storm event is calculated to be equal to the maximum allowable. For the 5-year event the maximum post-development release is calculated to be 18% less than the maximum allowable.

The post development stormwater flows contributing to the private and municipal storm sewer system is expected to have a positive impact given that it is 18% less than the maximum allowable during the 5-year event.

CONCLUSIONS:

1. There is an adequate water supply for firefighting from the municipal watermain.

2. The aggregate flow from all three hydrants in the vicinity of the subject property is greater than the required fire flow.

3. The existing 150 mm water service is adequate for the domestic demand.

4. There is an acceptable range of water pressures for the proposed development, however, since the water pressure may be above 80 psi, an on-site pressure check is recommended to determine if a pressure reducing valve (PRV) is required.

5. The existing 150 mm sanitary sewer connection serving the existing building will remain. The design flow will be adequately handled by the existing sanitary sewer connection with it being only at about 3 to 4% of its capacity.

6. The design sanitary flow contributing to the municipal sewer is expected to have a negligible impact, as it only serves the subject property and is only at about 2% of its capacity.

7. The existing oil/grit separator manhole shall remain and will remove 74% TSS.

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

9. The maximum post-development release rate for the 100-year storm event is calculated to be equal to the maximum allowable. For the 5-year event the maximum post-development release is calculated to be 18% less than the maximum allowable.

10. The post development stormwater flows contributing to the municipal storm sewer system is expected to have a positive impact given that it is 18% less than the maximum allowable during the 5-year event.

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14-Sep-20
REVISED 23-Sep-20
REVISED 04-Dec-20
REVISED 21-Jun-22
REVISED 08-Mar-23

765 Green Creek Drive
Ottawa, Ontario

Fire Flow Requirements

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

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

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

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

2nd Floor	790	
Ground Floor	1719	sq.m.
TOTAL FIRE AREA:	2509	sq.m.

F = 8,816 L/min
= 9,000 L/min (rounded off to the nearest 1,000 L/min)

-15% Charge for Combustible Occupancy

= 7,650 L/min

40% Reduction: Sprinkler System

= 3,060 L/min

Increase for Separation Exposed Buildings

			Adjacent Building			Length-Height Factor
			Constuction	Length m	Storeys	
0%	North	>45				0
5%	East	30.1 to 45m				0
0%	South	>45				0
0%	West	>45				0
5%	Total Increase for Exposure (maximum 75%)					

= 383 L/min Increase

= 4,973 L/min
F = 5,000 L/min (rounded off to the nearest 1,000 L/min)
= 83.3 l/s

Elevation at Fire Hydrant	53.07	m ASL				
			Static Pressure at Fire Hydrant			
133 L/s FIRE FLOW:	96.8	m ASL	62	psi	429	kPa

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Water Demand

DAILY AVERAGE

LIGHT INDUSTRIAL:	35,000	L /gross ha / day (as per Ottawa Design Guidelines)				
	0.82	ha (land area)				
	28788	L / day				
	24	hour day				
	20.0	L/min	0.3	L/s	5.3	USgpm

MAXIMUM DAILY DEMAND	1.5	(Peaking Factor as per Ottawa Design Guidelines)				
	30.0	L/min	0.5	L/s	7.9	USgpm

MAXIMUM HOURLY DEMAND	1.8	(Peaking Factor as per Ottawa Design Guidelines)				
	54.0	L/min	0.9	L/s	14.3	USgpm

Elevation of Water Meter:	54.30	m ASL				
Finish Floor Elevation:	53.40	m ASL				
			Static Pressure at Water Meter			
MINIMUM HGL:	110.5	m ASL	80	psi	551	kPa
MAXIMUM HGL:	116.1	m ASL	88	psi	606	kPa

D.B. Gray Engineering Inc.

Douglas Gray <d.gray@dbgrayengineering.com>

RE: 765 Green Creek Dr - Boundary Condition Request

1 message

Mashaie, Sara <sara.mashaie@ottawa.ca> Wed, Sep 23, 2020 at 8:58 AM
To: Douglas Gray <d.gray@dbgrayengineering.com>
Cc: Caoimhin Kennedy <c.kennedy@dbgrayengineering.com>

Hi Doug,

Please find the boundary conditions for the above-noted site, as requested.

The following are boundary conditions, HGL, for hydraulic analysis at 765 Green Creek (zone 1E) assumed to be connected to the 305mm on Green Creek Drive (see attached PDF for location).

Minimum HGL = 110.5m

Maximum HGL = 116.1m. The maximum pressure is estimated to be above 80 psi. A pressure check at completion of construction is recommended to determine if pressure control is required.

MaxDay + Fire Flow (133.3 L/s) = 96.8m

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,

Sara Mashaie, P.Eng., ing.

Project Manager | Gestionnaire de Projet

Development Review, East Branch | Examen des projets d'aménagement, Secteur est

Planning, Infrastructure and Economic Development Department | Services de la planification, de l'infrastructure et du développement économique

City of Ottawa | Ville d'Ottawa

110 Laurier Avenue West. Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1

613.580.2424 ext./poste 27885, sara.mashaie@ottawa.ca

From: Douglas Gray <d.gray@dbgrayengineering.com>
Sent: September 14, 2020 11:28 AM
To: Mashaie, Sara <sara.mashaie@ottawa.ca>
Cc: Caoimhin Kennedy <c.kennedy@dbgrayengineering.com>
Subject: 765 Green Creek Dr - Boundary Condition Request

Hi Sara

We are working on a project that proposes an addition to a Union Training Centre.

Please provide the boundary conditions at 765 Green Creek Dr based on the following expected demands :

Average daily demand: 0.8 L/s.

Maximum daily demand: 1.2 L/s.

Maximum hourly daily demand: 2.2 L/s

Fire Flow demand: 133.3 L/s

Fire Flow + Max Day: 134.5 L/s

Our calculations are attached.

Thanks, Doug

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765 Green Creek September 2020.pdf
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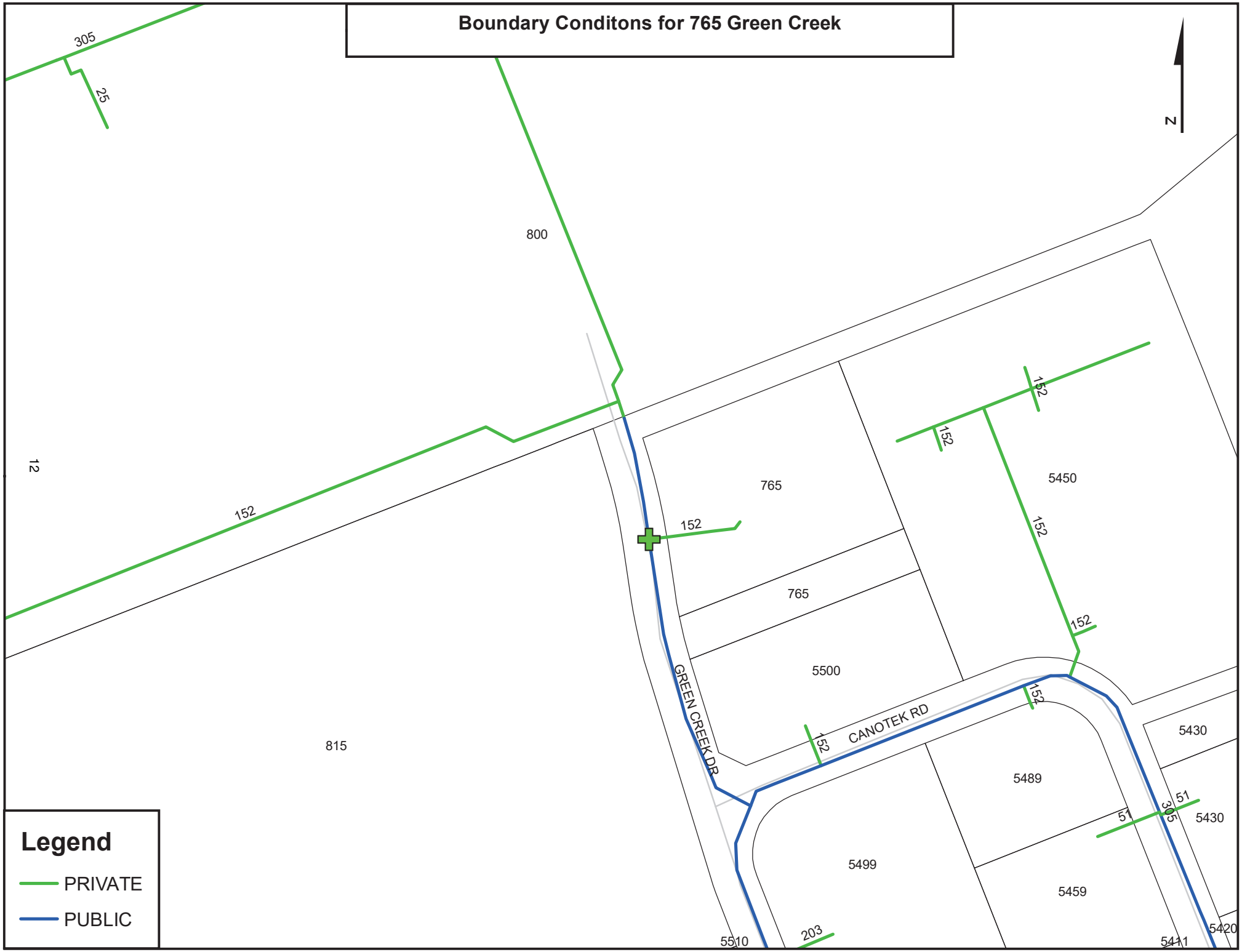
Boundary Conditons for 765 Green Creek
N
305
25
800
12
152
815
765
765
5500
5450
152
152
152
152
152
152
GREEN CREEK DR
CANOTEK RD
5430
5489
5430
51
305
51
5499
5459
5420
5510
203
5411
Legend
PRIVATE
PUBLIC

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SANITARY SEWER DESIGN FORM

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

Infiltration Allowance: 0.33 l / s / ha

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

Project: 765 Green Creek
Designed By: D.B.G.
16-Mar-23
Page: 1 of 1

Location		Section								Cumulative Residential		Section Non-Residential			Cumulative					Sewer Data n = 0.013							Comments
		Single Family	Semi/Town house	Duplex / Triplex	Apartment (average)	Apartment (1 Bed.)	Apartment (2 Bed.)	Apartment (3 Bed.)	Residential Area	Pop.	Peaking Factor	Area	Flow	Peaking Factor	Flow	Area	Sewage Flow	Infiltration Flow	Total Flow	Type of Pipe	Dia. Actual	Dia. Nom.	Slope	Length	Capacity	Velocity	Ratio	
		ppu = 3.4	ppu = 2.7	ppu = 2.3	ppu = 1.8	ppu = 1.4	ppu = 2.1	ppu = 3.1																			
FROM	TO	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	ha			ha	l/ha/day		l/s	ha	l/s	l/s	l/s		(mm)	(mm)	(%)	(m)	(l/s)	(m/s)	Q/Qfull	
		EXISTING SINGLE FAMILY DWELLING																										
EXIST BLDG	MH.SA.1									0.0	3.2	0.823	35000	7	2.332	0.823	2.33	0.27	2.60	PVC	152.4	150	1.60	26.8	20.1	1.10	0.13	
MH.SA.1	MH.SA.A									0.0	3.2					0.823	2.33	0.27	2.60	PVC	152.4	150	1.00	13.8	15.89	0.87	0.16	
										0.0	3.2					0.823	2.33	0.27	2.60	PVC	203.2	200	0.68		28.22	0.87	0.09	

Detailed Stormceptor Sizing Report – Existing Unit

Project Information & Location			
Project Name	765 Green Creek Dr.	**Project Number**	07047
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	3/16/2023
Designer Information		**EOR Information (optional)**	
Name	Brandon O'Leary	**Name**	Ryan Faith
Company	Forterra	**Company**	D.B. Gray Engineering Inc.
Phone #	905-630-0359	**Phone #**	
Email	brandon.oleary@forterrabp.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Existing Unit
Recommended Stormceptor Model	STC 750
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	82
PSD	Fine Distribution
Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	74	91
STC 750	82	97
STC 1000	84	97
STC 1500	84	97
STC 2000	87	99
STC 3000	88	99
STC 4000	91	100
STC 5000	91	100
STC 6000	93	100
STC 9000	95	100
STC 10000	95	100
STC 14000	96	100
StormceptorMAX	Custom	Custom

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis
PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station			
State/Province	Ontario	**Total Number of Rainfall Events**	4093
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	**Total Rainfall (mm)**	20978.1
Station ID #	6000	**Average Annual Rainfall (mm)**	567.0
Coordinates	45°19'N, 75°40'W	**Total Evaporation (mm)**	1225.1
Elevation (ft)	370	**Total Infiltration (mm)**	7308.5
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	12444.5

Notes
• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules. • Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed. • For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	0.5280
Imperviousness %	65.04

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	Existing Unit

Site Details

Drainage Area

Total Area (ha)	0.5280
Imperviousness %	65.04

Surface Characteristics

Width (m)	145.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (lps)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	Build Up/ Wash-off

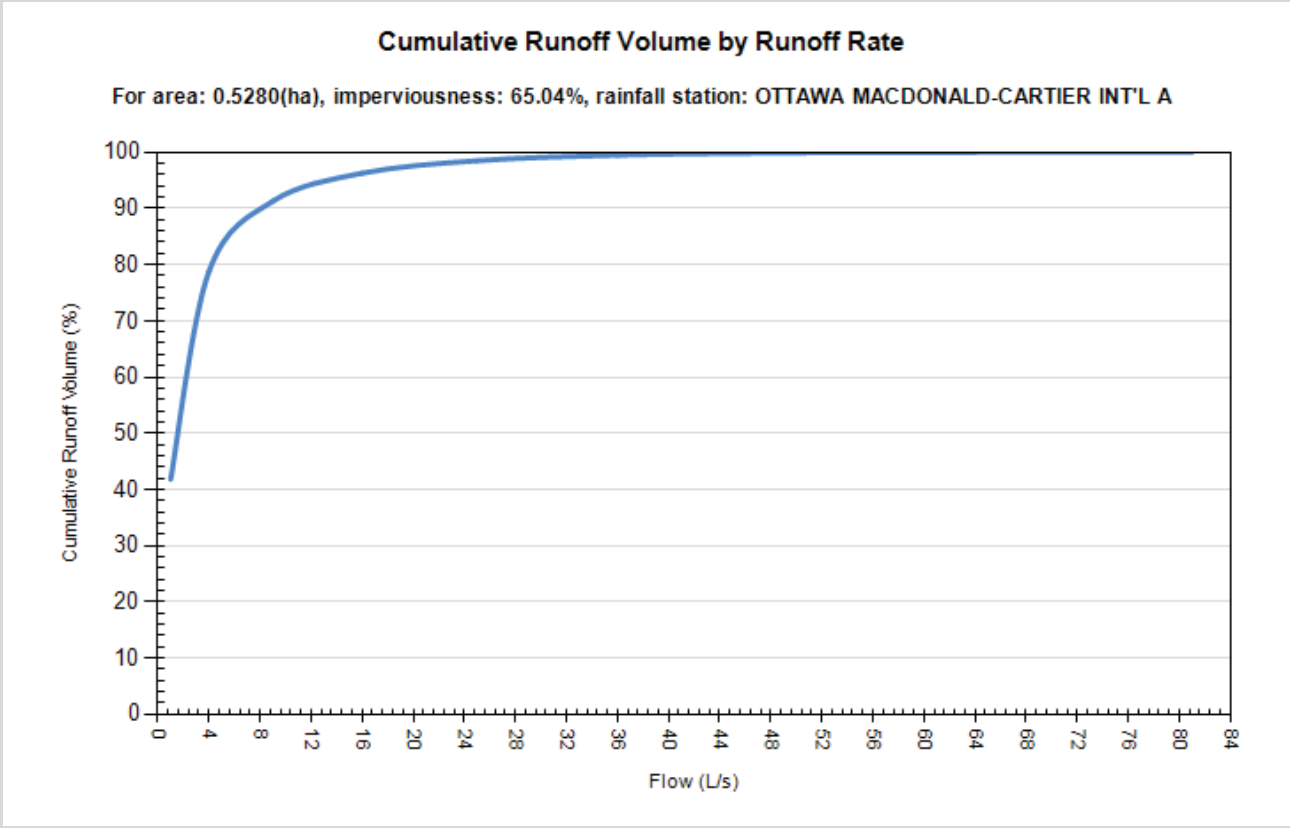
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	125
Exponential Buildup Power	0.40
Exponential Washoff Exponent	0.20

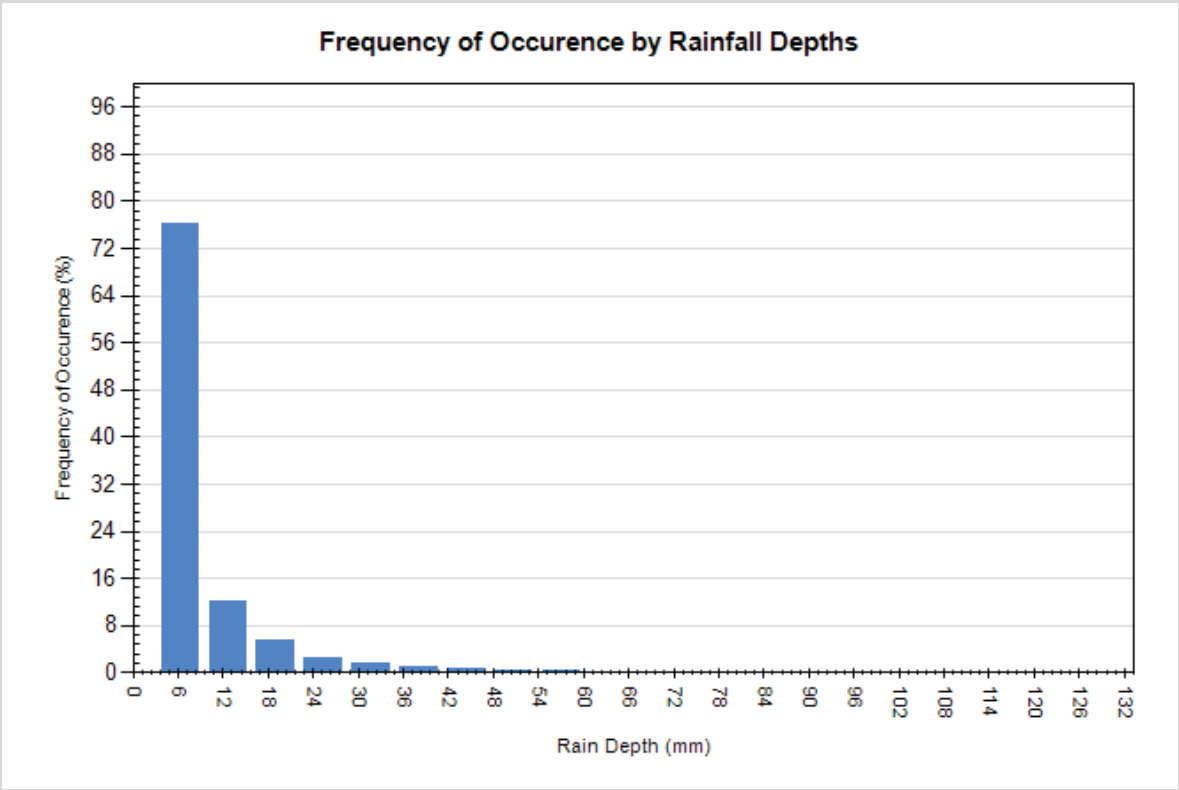
TSS Availability Parameters

Availability Constant A	0.057
Availability Factor B	0.04
Availability Exponent C	1.10
Min. Particle Size Affected by Availability (micron)	400

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m³)	Volume Over (m³)	Cumulative Runoff Volume (%)
1	27630	38521	41.8
4	52159	13999	78.8
9	60374	5786	91.3
16	63707	2453	96.3
25	65162	998	98.5
36	65823	337	99.5
49	66076	84	99.9
64	66150	10	100.0
81	66160	0	100.0



Rainfall Event Analysis				
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	3113	76.1	5230	24.9
12.70	501	12.2	4497	21.4
19.05	225	5.5	3469	16.5
25.40	105	2.6	2317	11.0
31.75	62	1.5	1765	8.4
38.10	35	0.9	1206	5.8
44.45	28	0.7	1163	5.5
50.80	12	0.3	557	2.7
57.15	7	0.2	378	1.8
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

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

Storage calculations for the stormwater detention area are based on the following formula for volume of a prismodal shape (the formula is accurate if both length and width are changing proportionally):

$$V = (A_{top} + A_{bottom} + (A_{top} \times A_{bottom}))^{0.5}) / 3 \times d$$

where:

V = volume in cu.m.
A_{top} = area of pond in sq.m.
A_{bottom} = area of bottom of depressed area
d = ponding depth in meters

Summary Tables

ONE HUNDRED YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	5.70	-	-
AREA II	-	38.92	226.53	226.53
TOTAL	44.62	44.62	226.53	226.53

FIVE YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	2.66	-	-
AREA II	-	33.80	93.97	93.97
TOTAL	44.62	36.46	93.97	93.97

December 4, 2020
REVISED March 16, 2023

765 Green Creek Drive

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS
Rational Method

MAXIMUM ALLOWABLE RELEASE RATE

			C	
Pre-development Conditions (prior to 2008):	8225	sq.m	0.30	(Flat Pasture, Clay and Silt Loam: City of Ottawa Sewer Design Guidelines - Table 5.7)

Airport Formula

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

Runoff Coefficient (C):	0.30	
Sheet Flow Distance (L):	75	m
Slope of Land (Sw):	1	%
Time of Concentration (Sheet Flow):	23	min
Area (A):	8225	sq.m
Time of Concentration:	23	min
Rainfall Intensity (i):	65	mm/hr (5 year event)
Runoff Coeficient (C):	0.30	
Maximum Allowable Release Rate (2.78AiC):	44.62	L/s

ONE HUNDRED YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	0	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	459	sq.m	0.25
Total Catchment Area:	459	sq.m	0.25

Area (A):	459	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.25	
Release Rate (2.78AiC):	5.70	L/s

DRAINAGE AREA II

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	2486	sq.m	1.00
Asphalt/Concrete Area:	3434	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	1846	sq.m	0.25
Total Catchment Area:	7766	sq.m	0.82

Water Elevation: 52.84 m

Invert of Outlet Pipe - CB/MH-2: 51.39 m

Centroid of ICD Orifice: 51.45 m
(ICD in Outlet Pipe of CB/MH-2)
Head: 1.39 m

Orifice Diameter: 125 mm

Orifice Area: 12237 sq.mm

Coefficient of Discharge: 0.61

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB/MH-2	350	0.23	26.68	cu.m
CB-3B	493	0.19	30.97	cu.m

Stormwater Detention Area

Bottom Area (sq.m)	Top Area (sq.m)	Average Depth (m)	Volume	
97	249	1.01	168.88	cu.m

Maximum Release Rate: 38.92 L/s

Achieved Volume: 226.53 cu.m

Maximum Volume Required: 226.53 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	430.57	38.92	391.65	117.49
10	179	316.77	38.92	277.85	166.71
15	143	253.50	38.92	214.58	193.12
20	120	212.80	38.92	173.87	208.65
25	104	184.23	38.92	145.31	217.96
30	92	162.98	38.92	124.06	223.30
35	83	146.50	38.92	107.57	225.91
40	75	133.31	38.92	94.39	226.53
45	69	122.50	38.92	83.58	225.65
50	64	113.46	38.92	74.53	223.60
55	60	105.78	38.92	66.85	220.61
60	56	99.16	38.92	60.24	216.85
65	53	93.40	38.92	54.47	212.45
70	50	88.33	38.92	49.41	207.50
75	47	83.83	38.92	44.91	202.09
80	45	79.82	38.92	40.89	196.28
85	43	76.20	38.92	37.28	190.12
90	41	72.93	38.92	34.01	183.65
95	39	69.96	38.92	31.04	176.90
100	38	67.24	38.92	28.32	169.91
105	36	64.75	38.92	25.82	162.69
110	35	62.45	38.92	23.53	155.28
115	34	60.33	38.92	21.40	147.68
120	33	58.36	38.92	19.43	139.92
125	32	56.52	38.92	17.60	132.00
130	31	54.82	38.92	15.89	123.95
135	30	53.22	38.92	14.29	115.76
140	29	51.72	38.92	12.79	107.46
145	28	50.31	38.92	11.38	99.05
150	28	48.98	38.92	10.06	90.53
180	24	42.40	38.92	3.48	37.59
210	21	37.51	37.51	0.00	0.00
240	19	33.72	33.72	0.00	0.00
270	17	30.68	30.68	0.00	0.00
300	16	28.19	28.19	0.00	0.00

DRAINAGE AREA II

(ONE HUNDRED YEAR EVENT + 20%)

			C
Roof Area:	2486	sq.m	1.00
Asphalt/Concrete Area:	3434	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	1846	sq.m	0.25
Total Catchment Area:	7766	sq.m	0.82

Water Elevation:	52.89	m
Invert of Outlet Pipe - CB/MH-2:	51.39	m
Centroid of ICD Orifice:	51.45	m
(ICD in Outlet Pipe of CB/MH-2)		
Head:	1.43	m
Orifice Diameter:	125	mm
Orifice Area:	12237	sq.mm
Coefficient of Discharge:	0.61	
Maximum Release Rate:	39.60	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB/MH-2	514	0.28	47.41	cu.m
CB-3B	778	0.24	61.39	cu.m

Stormwater Detention Area

Bottom Area (sq.m)	Top Area (sq.m)	Average Depth (m)	Volume	
97	258	1.06	181.19	cu.m

Achieved Volume: 289.99 cu.m

Maximum Volume Required: 289.99 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Stress Test (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	430.57	516.68	39.60	477.09	143.13
10	179	316.77	380.13	39.60	340.53	204.32
15	143	253.50	304.20	39.60	264.61	238.15
20	120	212.80	255.36	39.60	215.76	258.91
25	104	184.23	221.08	39.60	181.48	272.22
30	92	162.98	195.58	39.60	155.98	280.76
35	83	146.50	175.80	39.60	136.20	286.03
40	75	133.31	159.97	39.60	120.38	288.91
45	69	122.50	147.00	39.60	107.40	289.99
50	64	113.46	136.15	39.60	96.55	289.66
55	60	105.78	126.93	39.60	87.33	288.21
60	56	99.16	118.99	39.60	79.40	285.83
65	53	93.40	112.08	39.60	72.48	282.68
70	50	88.33	106.00	39.60	66.40	278.88
75	47	83.83	100.60	39.60	61.00	274.52
80	45	79.82	95.78	39.60	56.18	269.68
85	43	76.20	91.44	39.60	51.85	264.42
90	41	72.93	87.52	39.60	47.92	258.79
95	39	69.96	83.95	39.60	44.36	252.82
100	38	67.24	80.69	39.60	41.09	246.57
105	36	64.75	77.70	39.60	38.10	240.04
110	35	62.45	74.94	39.60	35.35	233.28
115	34	60.33	72.39	39.60	32.80	226.30
120	33	58.36	70.03	39.60	30.43	219.11
125	32	56.52	67.83	39.60	28.23	211.75
130	31	54.82	65.78	39.60	26.18	204.22
135	30	53.22	63.86	39.60	24.26	196.53
140	29	51.72	62.06	39.60	22.46	188.70
145	28	50.31	60.37	39.60	20.77	180.74
150	28	48.98	58.78	39.60	19.18	172.65
180	24	42.40	50.89	39.60	11.29	121.92
210	21	37.51	45.01	39.60	5.42	68.26
240	19	33.72	40.46	39.60	0.86	12.45
270	17	30.68	36.82	36.82	0.00	0.00
300	16	28.19	33.83	33.83	0.00	0.00

FIVE YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	0	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	459	sq.m	0.20
Total Catchment Area:	459	sq.m	0.20

Area (A):	459	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	104	mm/hr
Runoff Coeficient (C):	0.20	
Release Rate (2.78 • A • i • C):	2.66	L/s

DRAINAGE AREA II

(FIVE YEAR EVENT)

			C
Roof Area:	2486	sq.m	0.90
Asphalt/Concrete Area:	3434	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	1846	sq.m	0.20
Total Catchment Area:	7766	sq.m	0.73

Water Elevation: 52.50 m

Invert of Outlet Pipe - CB/MH-2: 51.39 m

Centroid of ICD Orifice: 51.45 m
(ICD in Outlet Pipe of CB/MH-2)

Head: 1.05 m

Orifice Diameter: 125 mm

Orifice Area: 12237 sq.mm

Coefficient of Discharge: 0.61

Maximum Release Rate: 33.80 L/s

Stormwater Detention Area

Bottom Area (sq.m)	Top Area (sq.m)	Average Depth (m)	Volume
97	189	0.67	93.97 cu.m

Achieved Volume: 93.97 cu.m

Maximum Volume Required: 93.97 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	223.60	33.80	189.80	56.94
10	104	165.02	33.80	131.22	78.73
15	84	132.34	33.80	98.54	88.69
20	70	111.27	33.80	77.47	92.96
25	61	96.45	33.80	62.65	93.97
30	54	85.41	33.80	51.61	92.90
35	49	76.84	33.80	43.04	90.39
40	44	69.98	33.80	36.18	86.84
45	41	64.35	33.80	30.55	82.48
50	38	59.64	33.80	25.84	77.51
55	35	55.63	33.80	21.83	72.04
60	33	52.18	33.80	18.38	66.16
65	31	49.17	33.80	15.37	59.94
70	29	46.52	33.80	12.72	53.43
75	28	44.17	33.80	10.37	46.67
80	27	42.07	33.80	8.27	39.70
85	25	40.18	33.80	6.38	32.54
90	24	38.47	33.80	4.67	25.22
95	23	36.91	33.80	3.11	17.75
100	22	35.49	33.80	1.69	10.14
105	22	34.18	33.80	0.38	2.42
110	21	32.98	32.98	0.00	0.00
115	20	31.87	31.87	0.00	0.00
120	19	30.83	30.83	0.00	0.00
125	19	29.87	29.87	0.00	0.00
130	18	28.98	28.98	0.00	0.00
135	18	28.14	28.14	0.00	0.00
140	17	27.35	27.35	0.00	0.00
145	17	26.61	26.61	0.00	0.00
150	16	25.91	25.91	0.00	0.00
180	14	22.46	22.46	0.00	0.00
210	13	19.89	19.89	0.00	0.00
240	11	17.89	17.89	0.00	0.00
270	10	16.29	16.29	0.00	0.00
300	9	14.98	14.98	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 and Stormwater Management Report

Location map and plan showing municipal address, boundary, and layout of proposed development: see drawings C-1 to C-3

Plan showing the site and location of all existing services: see drawings C-1 to C-3

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

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

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

Statement of objectives and servicing criteria: see page 1 of Servicing Brief and Stormwater Management Report

Identification of existing and proposed infrastructure available in the immediate area: see drawings C-1 to C-3

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-3

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 & 3 of Servicing Brief

Identification of system constraints: see page 2 of Servicing Brief

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

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

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

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

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

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

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

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

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

Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines: see page 2 & 3 of Servicing Brief

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

Development Servicing Report: Wastewater

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

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

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

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

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

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

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

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

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

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

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

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

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

Development Servicing Report: Stormwater Checklist

Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property): see page 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-1 to C-3

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

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

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

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

Watercourse and hazard lands setbacks: not applicable

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

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

Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period). see drawings C-2 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-5 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 4 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-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 & 6 of Servicing Brief

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

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