



# Functional Servicing & Storm Water Management Report

## Proposed Buildings at Existing Self-Storage Development 109-121 Willowlea Road, Carp, Ontario

Prepared for



ACCESS PROPERTY DEVELOPMENT  
ACCESS GROUP OF COMPANIES

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December 6<sup>th</sup>, 2021  
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## EXECUTIVE SUMMARY

- The site is presently operating as a self-storage facility, located at 109-121 Willowlea Road, Carp, Ontario. Offices for the property are located in a separate building on the other side of Willowlea Road.  
Adjacent properties are industrial developments on all sides of the property.
- The proposal combines the existing property and a presently vacant lot.
- The proposed development is for the construction of two new single story self-storage buildings over a presently vacant portion of the site, beside the existing buildings.
- Storm drainage is to be collected and controlled by an on-site pond facility.
- The existing property presently discharges from the site via swales along the property lines, including a swale and easement along the east property line, to an outlet to Willowlea Road at the south east end of the presently vacant lot. Post-development storm runoff from the portion of the site being developed is controlled to pre-development levels or better for all design events from the 5 through 100-year storm and discharging through the same outlet as present.
- Bedrock at the east portion of the site is a shallow 0.6m below existing ground.
- No sanitary drainage is presently provided to the site or planned for the future additional buildings. Services for clients are available in the existing offices across the street.
- Fire protection is provided by an existing 90,000 liter storage tank. Per conversations with City of Ottawa Fire Department, Building B is to be divided into two parts with a fire wall and the new buildings are to be protected by the addition of another 50,000 liter storage tank adjacent and connected to the existing.

## EXISTING CONDITIONS

### BACKGROUND AND SITE DESCRIPTION

The site is comprised of two properties: the portion presently operating as a self-storage facility with one storage building and an area of 8652m<sup>2</sup> and the adjacent vacant property with an area of 7789m<sup>2</sup>. Both properties are owned by the applicant and it is the intent to merge the properties as part of this application.

The proposed facility is serviced by an office located in the main self-storage facility across the street.

A site plan application was previously approved for the construction of two self-storage buildings on the west lot but only one of the two has been constructed to date.

Adjacent properties are commercial and industrial facilities.

### TOPOGRAPHY AND DRAINAGE

The combined area of the overall site area is 16,441.2m<sup>2</sup>. The west portion, the current self-storage area, is mostly well compacted gravel while the east portion is vegetated. Both parcels drain via grassed swales along the property lines which discharge at the south property line to an existing culvert installed at the southeast corner of the site as part of the approved site plan design by others for the current self-storage facility. Note: there is an earth berm inside the property line such that a small portion of the site (the landscaped side of the berm facing Willowlea) drains to the boulevard. This will be maintained in the post-development condition.

### SUB-SURFACE CONDITIONS

A geotechnical investigation for the site was completed by Pinchin Ltd. on May 6<sup>th</sup>, 2021. Six boreholes were sampled throughout the site to refusal at probable bedrock. Borehole locations, with top and bottom elevations corrected to local benchmark, are indicated on the site servicing and grading drawings.

Site stratigraphy is described in the Pinchin report as “a combination of organics, granular fill and glacial till overlying probable bedrock to the maximum borehole refusal depth of approximately 2.1 mbgs”, with the deepest borehole closest to the existing entrance (BH1 – 2.06m), BH6 near the back of the existing storage facility is 0.91m to bedrock and *all other* boreholes having a maximum depth of 0.61m from existing ground to borehole refusal and assumed bedrock. Also, “surficial organics were encountered in Boreholes BH2 to BH5 and were measured to range in thickness from approximately 100 to 600 mm” and that “groundwater was encountered between approximately 0.2 and 2.0 mbgs within Boreholes BH1, BH2, and BH4; however, was not encountered within the remainder of the boreholes at drilling completion. The water encountered is perched above the relatively impermeable probable rock surface. Seasonal variations in the

water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather condition”.

Recommended pavement structure from the Pinchin report is as follows:

Pavement Layer	Compaction	Light Duty Paving	Heavy Duty Paving
<b>Asphalt Layer (OPSS 1150)</b>	92-97% MRD	40mm HL3 50mm HL8	40mm HL3 80mm HL8
<b>OPSS 1010 Granular A</b>	100% SPMDD	150mm	150mm
<b>OPSS 1010 Granular B Sub-Base, Type II</b>	100% SPMDD	300mm	450mm

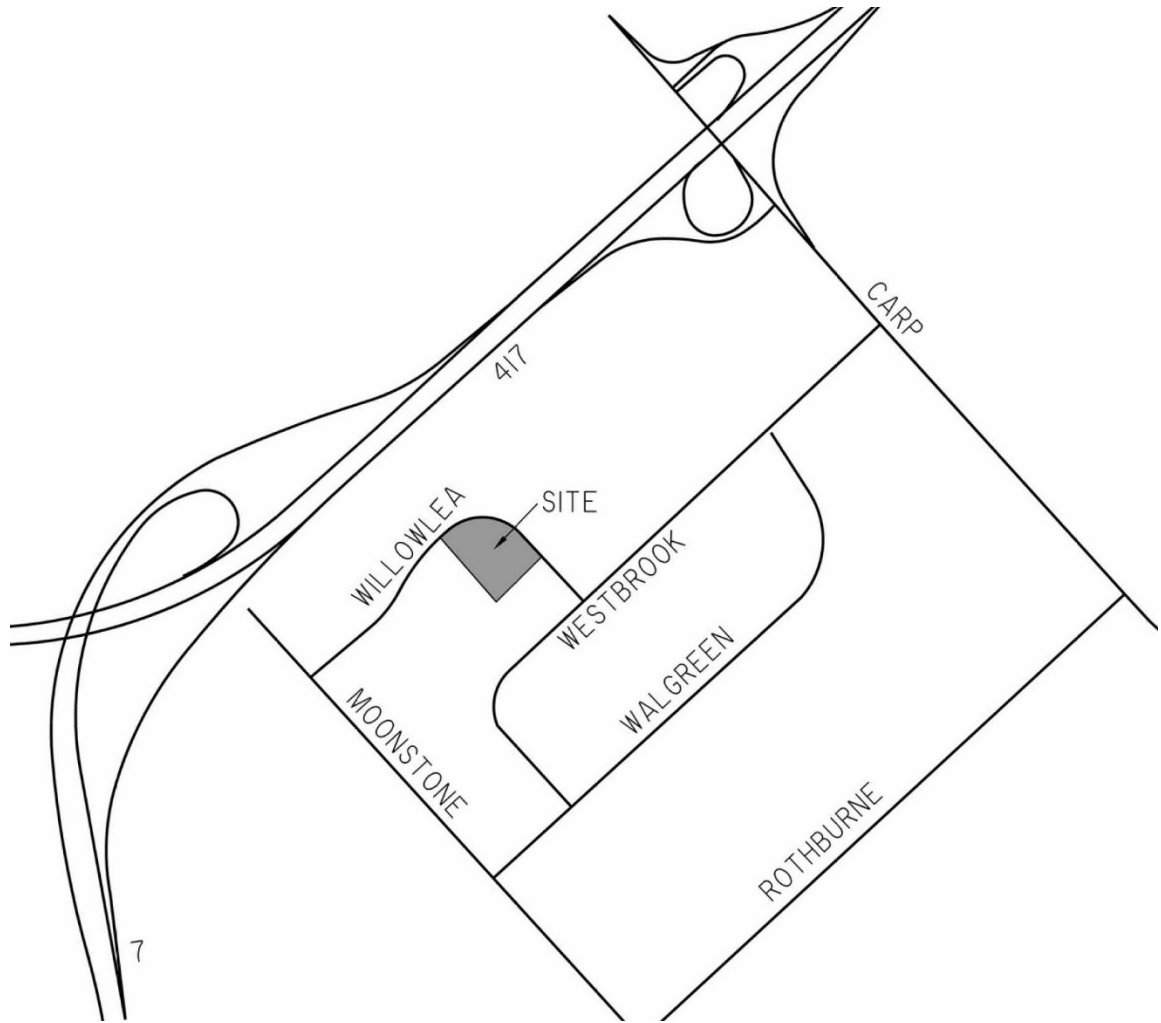


Figure 1: Site Location

## PROPOSED DEVELOPMENT

The proposed development is for the construction of two single-story self-storage buildings adjacent to the existing self-storage building.

### SERVICING AND DRAINAGE

#### *STORM FLOWS*

As noted previously, flows from the site are overland to the southeast corner of the property. Because of the shallow bedrock, the proposal maintains overland drainage in lieu of storm sewers and catchbasins. Site discharge is to the current point, via the existing culvert at the outlet to the existing ditch at the side of Willowlea Road.

#### *STORM WATER MANAGEMENT*

Paved and other impervious areas (such as building roofs, sidewalks, etc.) which no longer allow absorption by native soils of storm water runoff from a development site are the primary factor affecting the quantity and rate of storm runoff from the site after development. To mitigate this, a pond is proposed for the southeast corner of the property to control storm quantity to predevelopment levels for storm events from the 5- to 100-year events.

#### ***Existing Drainage Area and Runoff Coefficients***

The existing site is 42.6% impervious or semi-pervious and has a runoff coefficient C of 0.419.

#### **Existing Conditions**

Existing Buildings	1040.5	
Gravel Area	<u>5736.6</u>	sq.m.
<b>Total Impervious Area:</b>	<b>6777.1</b>	<b>sq.m.</b>
Landscaped Area:	<u>9117.0</u>	sq.m.
<b>Total:</b>	<b>15894.1</b>	
<b>Draining to Willowlea</b>	<u><b>547.1</b></u>	<b>sq.m.</b>
	<b>16441.2</b>	

#### **Existing**

*(excludes area draining to Willowlea)*

			% of Area	Runoff Coefficient	Weighted Coefficient
Buildings	1040.5	sq.m.	6.55%	0.90	0.059
Gravel	5736.6		36.09%	0.60	0.217
Landscaped	<u>9117.0</u>	sq.m.	<u>57.36%</u>	0.25	<u>0.143</u>
<b>Total</b>	<b>15894.1</b>	<b>sq.m.</b>	<b>100.00%</b>		<b>0.419</b>

*Note: notwithstanding the above existing condition and in consideration of the upper*

*stratigraphy in the borehole data, described as “dense”, “moist”, and “wet”, indicating poor absorption, a pre-development (vacant land) runoff coefficient of C=0.25 was used to determine allowable runoff and storage volumes required.*

**Proposed Drainage Area and Runoff Coefficient**

**Proposed Development**

Buildings:	0.0	sq.m.
Paved Area	<u>12268.9</u>	sq.m.
<i>Total Impervious Area:</i>	<i>12268.9</i>	<i>sq.m.</i>
Landscaped Area:	3448.0	sq.m.
	15716.9	
<i>Draining to Willowlea</i>	<u><i>724.3</i></u>	<i>sq.m.</i>
	16441.2	

Since the proposed buildings drain directly to the surrounding surfaces, the building roof area was considered as part of the paved area. The resultant runoff coefficient for the area being developed is as follows:

**Proposed:**

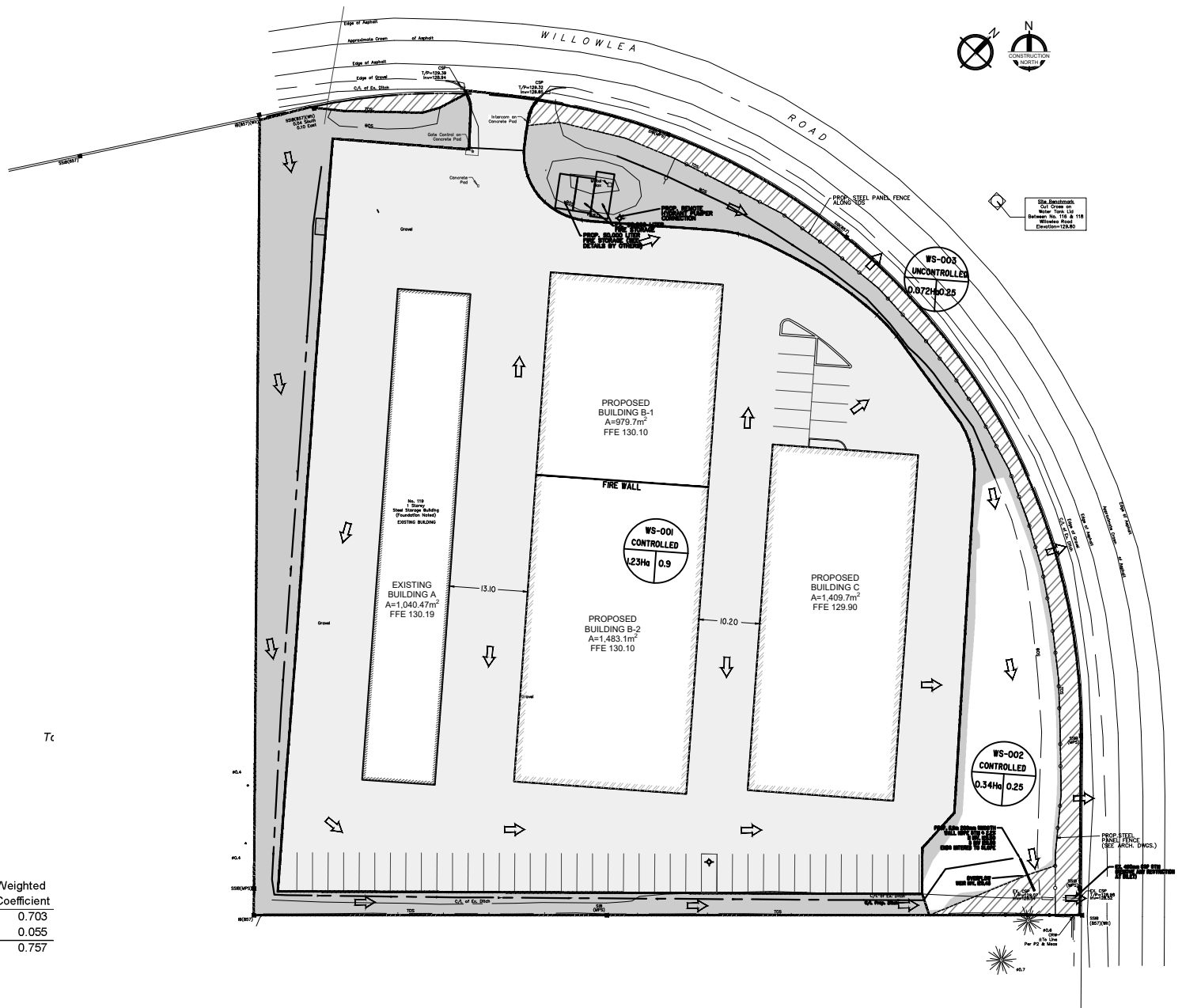
			% of Area	Runoff Coefficient	Weighted Coefficient
Paved and Roof	12268.9	sq.m.	78.06%	0.90	0.703
Landscaped	<u>3448.0</u>	sq.m.	<u>21.94%</u>	0.25	<u>0.055</u>
Total	15716.9	sq.m.	100.00%		0.757
<i>Draining to Willowlea</i>	<u><i>724.3</i></u>	<i>sq.m.</i>			
	16441.2				

The above runoff coefficient was adjusted for low frequency events in accordance with MTO guidelines as follows:

Storm Return Period	Adjustment Factor	Adjusted Coefficient
5	1	0.757
10	1	0.757
25	1.1	0.833
50	1.2	0.909
100	1.25	1.000







**Proposed Development**

Buildings:	4913.0 sq.m.
Paved Area	7355.9 sq.m.
<b>Total Impervious Area:</b>	<b>12268.9 sq.m.</b>
Landscaped Area:	3448.0 sq.m.
	15716.9
Draining to Willowlea	724.3 sq.m.
	16441.2

**Proposed:**

		% of Area	Runoff Coefficient	Weighted Coefficient
Paved and Roof	12268.9 sq.m.	78.06%	0.90	0.703
Landscaped	3448.0 sq.m.	21.94%	0.25	0.055
<b>Total</b>	<b>15716.9 sq.m.</b>	<b>100.00%</b>		<b>0.757</b>
Draining to Willowlea	724.3 sq.m.			
	16441.2			

**NOTE:**

THIS DRAWING TO BE READ IN CONJUNCTION WITH THE STORM WATER MANAGEMENT REPORT FOR THIS SITE.

DRAWING IS SCHEMATIC ONLY AND NOT FOR CONSTRUCTION.

- PROPOSED DRAINAGE AREAS
- PROPOSED LANDSCAPED AREA (BALANCE OF SITE AREA IMPERVIOUS)
- LANDSCAPED AREA DRAINING TO WILLOWLEA



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**ACCESS PROPERTY DEVELOPMENT**

109-121 WILLOWLEA RD.  
CARP, ONTARIO

**OWNER:**  
ACCESS PROPERTY DEVELOPMENT  
100 CANADIAN ROAD, TORONTO, ONTARIO  
M1R 4Z5 (647)555-2211

**STORM DRAINAGE AREAS POST DEVELOPMENT**

SCALE  
1:1000

DATE  
28-OCT-22

DRAWN  
MS

REF. DWG.  
SWM

CHECKED  
CC

DWG. NO.  
DA-PD

PROJECT NO.  
2152

***Time of Concentration***

The time of concentration for the site was evaluated considering the predevelopment (undeveloped) condition and drainage from the northwest to the southeast. A time of concentration (tc) of 21.9 minutes was used(see appendix A for calculations).

***Peak Flows:***

Outflows were controlled with a 200mm orifice pipe. Summarizing the results:

Storm Event	5 yr	10 yr	25 yr	50 yr	100 yr
<b>Q achieved (m3/s)</b>	0.0475	0.0524	0.0608	0.0670	0.0720
<b>Q allowable (m3/s)</b>	0.0724	0.0724	0.0724	0.0724	0.0724
<b>Δ achieved vs allowable</b>	-0.0249	-0.0200	-0.0116	-0.0054	-0.0004

***Storage:***

Storm Event	5 yr	10 yr	25 yr	50 yr	100 yr
<b>Storage Required:</b>	237.13	283.79	386.24	487.95	577.03
<b>Storage Provided:</b>	237.71	284.33	386.81	488.73	579.21
<b>Δ achieved vs allowable (m3):</b>	0.58	0.54	0.58	0.78	2.18
<b>Water Surface Elevation:</b>	129.138	129.190	129.290	129.374	129.447

The required pre- to post- development flow and storage criteria are met.

Storage volume indicated discounts potential any volume below the groundwater elevation identified on the day of drilling in the area of the pond (i.e, 0 storage below 128.75).

Refer to Appendix A for the supporting calculations.

***OVERLAND FLOW ROUTING***

In the event of clogging or an exceptional storm event, flows in excess of the capacity of the proposed system are conveyed via an overflow spillway at the south side of the pond to the existing outlet on Willowlea Road, in the same manner and to the same location as surface runoff would be in the current pre-development condition.

***WATER QUALITY***

Although the proposed use is not a generator of heavy sediment loading and the site is 30% roof areas, the entire area was considered.

Based on a post-development impervious ratio of 75.4%, per the MOE SWM Planning and Design Manual, 80% long term removal of Total Suspended Solids (TSS) can be achieved with 36.8m<sup>3</sup> of storage per hectare, or 60m<sup>3</sup> for the site. By providing a nominally raised outlet

invert and a 325m<sup>2</sup> bed of 50mm clear stone, 300mm thick over the pond bottom, a total storage volume of 62.9m<sup>3</sup> is provided.

#### *WATER BALANCE*

Although with the existing ground water in the area of the pond near the surface (i.e.: well less than the required minimum 1.0m depth to ground water) infiltration is not ideal, with an outlet invert above the pond invert the proposed gravel sediment basin from the preceding section will act as an area of enhanced evapotranspiration and somewhat limited or delayed infiltration essentially acting as a stormwater wetland. We respectfully submit that the proposed meets or exceeds the extremely limited natural groundwater recharge capabilities of the site.

#### **SANITARY SERVICING**

No sanitary servicing is proposed. Facilities are available for patrons and staff in the existing site offices across the road.

#### **POTABLE AND FIRE WATER SUPPLY**

No potable water supply is proposed.

There is an existing 90,000 liter storage system for fire suppression. Based on OBC requirements and buildings from Group F, Division 2 (from architects for the project, Architecture49), and a K value of 17, the required storage is 83,307 liters.

Reviewing the site, site use, and it's location with City of Ottawa Fire Department staff, it was agreed that for operational reasons an additional 50,000 liters of storage will be provided by adding a new tank to provide additional storage volume (detailed design by others). Furthermore, a dry (remote) hydrant is proposed to service the back of the property. This has been confirmed as the Fire Department's preferred solution and, in their opinion, provides adequate protection for the site, particularly when combined with existing municipal hydrants in relatively close proximity.

Refer to Appendix B.

#### **EROSION AND SEDIMENT CONTROL**

##### *DURING CONSTRUCTION*

Erosion and sediment control measures are to be implemented prior to the start of construction and maintained for the duration of the works.

Since the effectiveness of erosion and sediment controls decreases with sediment loading, regular inspection and repair of damaged controls is essential. As indicated on the drawing under Siltation and Erosion Control, the following control measures or better are to be implemented:

- Silt Fences are to be installed adjacent to all property limits subject to drainage from the development area prior to topsoil stripping and in other locations, such as the base of any topsoil stockpiles.
- Discharge from point source discharges (such as dewatering pumps) to be filtered through a rock check dam (OPSD 219.210 or 219.211) and/or silt fence, as appropriate.
- A mud mat is to be provided at the entrance to ensure that mud is not tracked onto adjacent municipal roads. In the event that mud is tracked onto the adjacent roads, it is to be cleaned daily. In the event that the mud mat is deemed not sufficiently effective, truck washing may be required.
- All disturbed areas and stockpiles are to be seeded and stabilized if they are to remain disturbed for thirty days or longer (see drawing notes).
- Care must be taken when removing silt and siltation controls (particularly at catchbasins) to ensure that any accumulated sediment is not dispersed into the storm sewer network.
- Inspections of all of the erosion and sediment controls on the construction site should be undertaken
  - On a weekly basis
  - After every rainfall event
  - After significant snow melt events
  - Prior to forecasted rainfall events

If damaged control measures are identified during inspection, the damaged or ineffective portion should be repaired and/or replaced within 48 hours.

## CONCLUSION

The impact of the proposed development on the total runoff from the area of the site being developed is mitigated to pre-development levels or better.

Fire protection is being provided for the proposed development. Domestic water and sanitary services are not existing or required.

The proposed development is consistent with the existing and adjacent developments and can be constructed in accordance with City of Ottawa criteria.

Respectfully submitted,

EC²E: Edifesse Consulting Civil Engineers Ltd.



per: *Mauro Savoldelli* P.Eng.

## APPENDIX A: QUANTITY CONTROL CALCULATIONS

Runoff was calculated using City of Ottawa IDF curves for the site.

$$i=A/(t+B)^C$$

IDF PARAMETERS – Ottawa

Parameter	5	10	25	50	100
A	998.071	1174.184	1402.884	1569.58	1735.88
B	6.053	6.014	6.018	6.014	6.014
C	0.814	0.816	0.819	0.820	0.820

As stated in report, flows for all storms were controlled to the 5-year pre-development runoff from the site based on a runoff coefficient of 0.20.

### RESULTS SUMMARY:

Orifice Summary:

	Storm	5	10	25	50	100
Water Level		129.138	129.190	129.290	129.374	129.447
C.L. Orifice El.		128.90	128.90	128.90	128.90	128.90
H (m)		0.24	0.29	0.39	0.47	0.55
Orifice Diameter (mm)		200	200	200	200	200
Radius (mm)		100.0	100.0	100.0	100.0	100.0
A (sq.m.)		0.0314	0.0314	0.0314	0.0314	0.0314
C		0.7	0.7	0.7	0.7	0.7
Q (c.m./s)		0.0475	0.0524	0.0608	0.0670	0.0720
Q allowable (c.m./s.)		0.0724	0.0724	0.0724	0.0724	0.0724
$\Delta$ , m <sup>3</sup> /s (-ve=less than allowable)		-0.0249	-0.0200	-0.0116	-0.0054	-0.0004
Storage Required:		237.13	283.79	386.24	487.95	577.03
Storage Provided:		237.71	284.33	386.81	488.73	579.21
$\Delta$ , m <sup>3</sup> (+ve=surplus)		0.58	0.54	0.58	0.78	2.18

With orifice size calculated using  $Q = CA^2\sqrt{2gH}$  and  $A = \frac{Q}{C^2\sqrt{2gH}}$

### TIME OF CONCENTRATION:

$$t_c = \frac{0.057L}{S_w^{0.2} * A^{0.1}} \text{ for } T_c \text{ in min}$$

Where L=159m, A= 1.644, Slope S=0.0095 (0.95%), Tc = 21.88 minutes

### STORM CALCULATIONS:



**Runoff:**

i) Pre-Development

Storm: **5 yr.**  
Area = 1.571688 Ha.  
i = 66.3 mm/hr (tc=21.9 min.)  
C = 0.25  
Q = 0.0724 c.m./s.

ii) Post-Development

(Roof areas included in paved areas)

Controlled Area:	% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved 12268.9 sq.m.	78.06%	78.06%	0.90	0.7026
Landscaped 3448.0 sq.m.	21.94%	21.94%	0.25	0.0548
Subtotal 15716.9 sq.m.				
Roof 4913.0 sq.m.	31.26%	n/a	n/a	n/a
Total 15716.9 sq.m.	131.26%	100.00%		0.7574
			Frequency Adjustment Factor:	100.00%
			Adjusted Coefficient:	0.7574

iii) Runoff volumes:

**Storm: 5 Yr**  
Area: 15716.88 sq.m.  
1.5717 Ha  
C: 0.7574

Max. Outflow Allowed: 72.41 l/s.  
or: 0.0724 c.m./s

Ottawa IDF					Allowable		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	Predevel. Allowed (c.m./s)	Storage Volume (c.m.)	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	104.193	0.3445	0.0000	0.3445	0.0724	163.28	0.0475	178.21
11	99.192	0.3280	0.0000	0.3280	0.0724	168.69	0.0475	185.12
12	94.696	0.3131	0.0000	0.3131	0.0724	173.32	0.0475	191.24
13	90.630	0.2997	0.0000	0.2997	0.0724	177.28	0.0475	196.69
14	86.934	0.2875	0.0000	0.2875	0.0724	180.65	0.0475	201.56
15	83.557	0.2763	0.0000	0.2763	0.0724	183.50	0.0475	205.91
20	70.251	0.2323	0.0000	0.2323	0.0724	191.87	0.0475	221.74
25	60.896	0.2014	0.0000	0.2014	0.0724	193.44	0.0475	230.78
30	53.928	0.1783	0.0000	0.1783	0.0724	190.65	0.0475	235.46
35	48.518	0.1604	0.0000	0.1604	0.0724	184.85	0.0475	237.13
40	44.184	0.1461	0.0000	0.1461	0.0724	176.87	0.0475	236.62
45	40.629	0.1343	0.0000	0.1343	0.0724	167.24	0.0475	234.45
50	37.653	0.1245	0.0000	0.1245	0.0724	156.30	0.0475	230.99
55	35.123	0.1161	0.0000	0.1161	0.0724	144.33	0.0475	226.48
60	32.943	0.1089	0.0000	0.1089	0.0724	131.50	0.0475	221.12
65	31.044	0.1027	0.0000	0.1027	0.0724	117.96	0.0475	215.04
70	29.372	0.0971	0.0000	0.0971	0.0724	103.81	0.0475	208.37
75	27.888	0.0922	0.0000	0.0922	0.0724	89.15	0.0475	201.18
80	26.562	0.0878	0.0000	0.0878	0.0724	74.05	0.0475	193.54
85	25.369	0.0839	0.0000	0.0839	0.0724	58.55	0.0475	185.51

<b>Max. Vol. (cu.m.):</b>	<b>193.44</b>	<b>237.13</b>
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**Runoff:**

i) Pre-Development

Storm: **5 yr.**  
Area = 1.571688 Ha.  
i = 66.3 mm/hr (tc=21.9 min.)  
C = 0.25  
Q = 0.0724 c.m./s.

ii) Post-Development

(Roof areas included in paved areas)

Controlled Area:	% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved 12268.9 sq.m.	78.06%	78.06%	0.90	0.7026
Landscaped 3448.0 sq.m.	21.94%	21.94%	0.25	0.0548
Subtotal 15716.9 sq.m.				
Roof 4913.0 sq.m.	31.26%	n/a	n/a	n/a
Total 15716.9 sq.m.	131.26%	100.00%		0.7574
			Frequency Adjustment Factor:	100.00%
			Adjusted Coefficient:	0.7574

iii) Runoff volumes:

**Storm: 10 Yr**  
Area: 15716.88 sq.m.  
1.5717 Ha  
C: 0.7574

Max. Outflow Allowed: 72.41 l/s.  
or: 0.0724 c.m./s

Ottawa IDF					Allowable		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	Predevel. Allowed (c.m./s)	Storage Volume (c.m.)	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	122.142	0.4039	0.0000	0.4039	0.0724	198.89	0.0524	210.86
11	116.251	0.3844	0.0000	0.3844	0.0724	205.92	0.0524	219.09
12	110.958	0.3669	0.0000	0.3669	0.0724	212.04	0.0524	226.41
13	106.173	0.3511	0.0000	0.3511	0.0724	217.36	0.0524	232.93
14	101.823	0.3367	0.0000	0.3367	0.0724	222.00	0.0524	238.77
15	97.852	0.3236	0.0000	0.3236	0.0724	226.04	0.0524	244.01
20	82.210	0.2718	0.0000	0.2718	0.0724	239.32	0.0524	263.28
25	71.224	0.2355	0.0000	0.2355	0.0724	244.66	0.0524	274.60
30	63.046	0.2085	0.0000	0.2085	0.0724	244.92	0.0524	280.85
35	56.700	0.1875	0.0000	0.1875	0.0724	241.67	0.0524	283.59
40	51.620	0.1707	0.0000	0.1707	0.0724	235.88	0.0524	283.79
45	47.453	0.1569	0.0000	0.1569	0.0724	228.16	0.0524	282.06
50	43.967	0.1454	0.0000	0.1454	0.0724	218.93	0.0524	278.82
55	41.004	0.1356	0.0000	0.1356	0.0724	208.50	0.0524	274.36
60	38.451	0.1271	0.0000	0.1271	0.0724	197.07	0.0524	268.92
65	36.228	0.1198	0.0000	0.1198	0.0724	184.81	0.0524	262.65
70	34.271	0.1133	0.0000	0.1133	0.0724	171.85	0.0524	255.68
75	32.535	0.1076	0.0000	0.1076	0.0724	158.30	0.0524	248.12
80	30.983	0.1025	0.0000	0.1025	0.0724	144.22	0.0524	240.03
85	29.587	0.0978	0.0000	0.0978	0.0724	129.69	0.0524	231.49

<b>Max. Vol. (cu.m.):</b>	<b>244.92</b>	<b>283.79</b>
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**Runoff:**

i) Pre-Development

Storm: **5 yr.**  
Area = 1.571688 Ha.  
i = 66.3 mm/hr (tc=21.9 min.)  
C = 0.25  
Q = 0.0724 c.m./s.

ii) Post-Development

(Roof areas included in paved areas)

Controlled Area:	% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved 12268.9 sq.m.	78.06%	78.06%	0.90	0.7026
Landscaped 3448.0 sq.m.	21.94%	21.94%	0.25	0.0548
Subtotal 15716.9 sq.m.				
Roof 4913.0 sq.m.	31.26%	n/a	n/a	n/a
Total 15716.9 sq.m.	131.26%	100.00%		0.7574
			Frequency Adjustment Factor:	110.00%
			Adjusted Coefficient:	0.8331

iii) Runoff volumes:

**Storm: 25 Yr**  
Area: 15716.88 sq.m.  
1.5717 Ha  
C: 0.8331

Max. Outflow Allowed: 72.41 l/s.  
or: 0.0724 c.m./s

Ottawa IDF					Allowable		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	Predevel. Allowed (c.m./s)	Storage Volume (c.m.)	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	144.693	0.5263	0.0000	0.5263	0.0724	272.33	0.0608	279.29
11	137.692	0.5008	0.0000	0.5008	0.0724	282.76	0.0608	290.41
12	131.401	0.4779	0.0000	0.4779	0.0724	291.99	0.0608	300.33
13	125.715	0.4573	0.0000	0.4573	0.0724	300.19	0.0608	309.23
14	120.548	0.4385	0.0000	0.4385	0.0724	307.49	0.0608	317.23
15	115.830	0.4213	0.0000	0.4213	0.0724	314.01	0.0608	324.44
20	97.255	0.3537	0.0000	0.3537	0.0724	337.61	0.0608	351.52
25	84.215	0.3063	0.0000	0.3063	0.0724	350.87	0.0608	368.25
30	74.513	0.2710	0.0000	0.2710	0.0724	357.52	0.0608	378.38
35	66.988	0.2437	0.0000	0.2437	0.0724	359.63	0.0608	383.96
40	60.965	0.2218	0.0000	0.2218	0.0724	358.43	0.0608	386.24
45	56.027	0.2038	0.0000	0.2038	0.0724	354.73	0.0608	386.02
50	51.897	0.1888	0.0000	0.1888	0.0724	349.08	0.0608	383.84
55	48.387	0.1760	0.0000	0.1760	0.0724	341.86	0.0608	380.10
60	45.365	0.1650	0.0000	0.1650	0.0724	333.36	0.0608	375.07
65	42.732	0.1554	0.0000	0.1554	0.0724	323.79	0.0608	368.98
70	40.416	0.1470	0.0000	0.1470	0.0724	313.32	0.0608	361.98
75	38.361	0.1395	0.0000	0.1395	0.0724	302.07	0.0608	354.21
80	36.525	0.1329	0.0000	0.1329	0.0724	290.15	0.0608	345.77
85	34.874	0.1268	0.0000	0.1268	0.0724	277.65	0.0608	336.74

<b>Max. Vol. (cu.m.):</b>	<b>359.63</b>	<b>386.24</b>
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**Runoff:**

i) Pre-Development

Storm: **5 yr.**  
Area = 1.571688 Ha.  
i = 66.3 mm/hr (tc=21.9 min.)  
C = 0.25  
Q = 0.0724 c.m./s.

ii) Post-Development

(Roof areas included in paved areas)

Controlled Area:	% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved 12268.9 sq.m.	78.06%	78.06%	0.90	0.7026
Landscaped 3448.0 sq.m.	21.94%	21.94%	0.25	0.0548
Subtotal 15716.9 sq.m.				
Roof 4913.0 sq.m.	31.26%	n/a	n/a	n/a
Total 15716.9 sq.m.	131.26%	100.00%		0.7574
			Frequency Adjustment Factor:	120.00%
			Adjusted Coefficient:	0.9089

iii) Runoff volumes:

**Storm: 50 Yr**  
Area: 15716.88 sq.m.  
1.5717 Ha  
C: 0.9089

Max. Outflow Allowed: 72.41 l/s.  
or: 0.0724 c.m./s

Ottawa IDF					Allowable		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	Predevel. Allowed (c.m./s)	Storage Volume (c.m.)	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	161.471	0.6407	0.0000	0.6407	0.0724	340.99	0.0670	344.20
11	153.646	0.6097	0.0000	0.6097	0.0724	354.59	0.0670	358.13
12	146.617	0.5818	0.0000	0.5818	0.0724	366.75	0.0670	370.60
13	140.263	0.5566	0.0000	0.5566	0.0724	377.64	0.0670	381.82
14	134.490	0.5337	0.0000	0.5337	0.0724	387.45	0.0670	391.95
15	129.219	0.5127	0.0000	0.5127	0.0724	396.30	0.0670	401.12
20	108.471	0.4304	0.0000	0.4304	0.0724	429.61	0.0670	436.03
25	93.909	0.3726	0.0000	0.3726	0.0724	450.34	0.0670	458.37
30	83.076	0.3296	0.0000	0.3296	0.0724	463.03	0.0670	472.67
35	74.676	0.2963	0.0000	0.2963	0.0724	470.20	0.0670	481.45
40	67.954	0.2696	0.0000	0.2696	0.0724	473.36	0.0670	486.22
45	62.442	0.2478	0.0000	0.2478	0.0724	473.48	0.0670	487.95
50	57.834	0.2295	0.0000	0.2295	0.0724	471.23	0.0670	487.30
55	53.918	0.2139	0.0000	0.2139	0.0724	467.08	0.0670	484.75
60	50.545	0.2006	0.0000	0.2006	0.0724	461.37	0.0670	480.65
65	47.608	0.1889	0.0000	0.1889	0.0724	454.36	0.0670	475.25
70	45.025	0.1787	0.0000	0.1787	0.0724	446.26	0.0670	468.75
75	42.733	0.1696	0.0000	0.1696	0.0724	437.22	0.0670	461.32
80	40.685	0.1614	0.0000	0.1614	0.0724	427.36	0.0670	453.07
85	38.843	0.1541	0.0000	0.1541	0.0724	416.79	0.0670	444.11

<b>Max. Vol. (cu.m.):</b>	<b>473.48</b>	<b>487.95</b>
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**Runoff:**

i) Pre-Development

Storm: **5 yr.**  
Area = 1.571688 Ha.  
i = 66.3 mm/hr (tc=21.9 min.)  
C = 0.25  
Q = 0.0724 c.m./s.

ii) Post-Development

(Roof areas included in paved areas)

Controlled Area:	% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved 12268.9 sq.m.	78.06%	78.06%	0.90	0.7026
Landscaped 3448.0 sq.m.	21.94%	21.94%	0.25	0.0548
Subtotal 15716.9 sq.m.				
Roof 4913.0 sq.m.	31.26%	n/a	n/a	n/a
Total 15716.9 sq.m.	131.26%	100.00%		0.7574
		Frequency Adjustment Factor:		125.00%
		Adjusted Coefficient:		0.9468

iii) Runoff volumes:

Storm: **100 Yr**  
Area: 15716.88 sq.m.  
1.5717 Ha  
C: 0.9468

Max. Outflow Allowed: 72.41 l/s.  
or: 0.0724 c.m./s

Ottawa IDF					Allowable		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	Predevel. Allowed (c.m./s)	Storage Volume (c.m.)	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	178.579	0.7381	0.0000	0.7381	0.0724	399.43	0.0720	399.66
11	169.925	0.7024	0.0000	0.7024	0.0724	415.77	0.0720	416.02
12	162.151	0.6702	0.0000	0.6702	0.0724	430.43	0.0720	430.70
13	155.124	0.6412	0.0000	0.6412	0.0724	443.64	0.0720	443.94
14	148.739	0.6148	0.0000	0.6148	0.0724	455.60	0.0720	455.92
15	142.910	0.5907	0.0000	0.5907	0.0724	466.46	0.0720	466.80
20	119.964	0.4958	0.0000	0.4958	0.0724	508.13	0.0720	508.59
25	103.859	0.4293	0.0000	0.4293	0.0724	535.31	0.0720	535.88
30	91.878	0.3798	0.0000	0.3798	0.0724	553.24	0.0720	553.92
35	82.588	0.3414	0.0000	0.3414	0.0724	564.81	0.0720	565.60
40	75.154	0.3106	0.0000	0.3106	0.0724	571.75	0.0720	572.66
45	69.058	0.2854	0.0000	0.2854	0.0724	575.19	0.0720	576.21
50	63.961	0.2644	0.0000	0.2644	0.0724	575.90	0.0720	577.03
55	59.630	0.2465	0.0000	0.2465	0.0724	574.42	0.0720	575.66
60	55.901	0.2311	0.0000	0.2311	0.0724	571.14	0.0720	572.50
65	52.652	0.2176	0.0000	0.2176	0.0724	566.37	0.0720	567.84
70	49.795	0.2058	0.0000	0.2058	0.0724	560.34	0.0720	561.92
75	47.261	0.1953	0.0000	0.1953	0.0724	553.22	0.0720	554.92
80	44.996	0.1860	0.0000	0.1860	0.0724	545.17	0.0720	546.98
85	42.959	0.1776	0.0000	0.1776	0.0724	536.30	0.0720	538.22

<b>Max. Vol. (cu.m.):</b>	<b>575.90</b>	<b>577.03</b>
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*STORAGE CALCULATIONS:*

Pond Elevation	Area (m <sup>2</sup> )	Depth (m)	Δ Volume (m <sup>3</sup> )	Storage (m <sup>3</sup> )	Discharge (m <sup>3</sup> /s)
128.630	0.00			0.00	
128.750	0.00	0.120	0.00	0.00	
128.800	370.12	0.050	9.25	9.25	0.0000
128.900	613.61	0.100	49.19	58.44	0.0226
129.000	729.87	0.100	67.17	125.61	0.0308
129.100	830.66	0.100	78.03	203.64	0.0436
129.200	962.35	0.100	89.65	293.29	0.0533
129.300	1,115.97	0.100	103.92	397.21	0.0616
129.400	1,357.60	0.100	123.68	520.89	0.0689
129.430	1,433.60	0.030	35.94	556.82	0.0709
129.450	1,517.49	0.020	26.33	583.16	0.7200
129.500	1,868.54	0.050	80.65	663.81	

For TSS removal:

From MOE Table 3.2, for 80% long term TSS removal by infiltration:

- for 70% impervious, require 35m<sup>3</sup> per hectare
- for 85% impervious, require 40m<sup>3</sup> per hectare

Therefore, for site (78.1% impervious and 1.572ha), require **57.84m<sup>3</sup>** of storage.

Provided:

- Surface storage below outlet elevation of 128.80 to groundwater elevation of 128.75, from above: 9.25m<sup>3</sup>
- From enhanced swale, 220m long with a minimum depth of 0.3m, minimum width of 0.75m, and 40% void ratio 9.25m<sup>3</sup>
- From 325m<sup>2</sup> of clear stone, 0.30m deep, and based on a 40% void ratio, 325\*0.3\*0.4: 39.00m<sup>3</sup>
- Total provided: 68.05m<sup>3</sup>



## APPENDIX C: SITE SERVICING AND GRADING PLANS

Provided for convenience and not for construction. Refer to full set of engineering drawings for construction purposes.





