PROPOSED FOUR-STOREY

MIXED-USE BUILDING DEVELOPMENT SITE

PART OF LOTS 203 AND 204

R-PLAN 14

360 BOOTH STREET

CITY OF OTTAWA

STORM DRAINAGE REPORT

REPORT R-818-43

T.L. MAK ENGINEERING CONSULTANTS LTD.

AUGUST 2018

REFERENCE FILE NUMBER 818-43

Introduction

The proposed four-storey mixed-use building site is located on the west side of Booth Street, and situated south of Poplar Street and north of Willow Street. Its legal property description is Part of Lots 203 and 204 Registered Plan 14 City of Ottawa. At this time, the residential lot under consideration is occupied by two residential buildings, both of which are two(2)-storey brick- and metal-sided dwellings. The municipal address of the properties is referenced as 358 and 360 Booth Street.

The lot area under consideration is approximately 698.9 square metres. This property is proposed for the development of a four-storey residential mixed-use building with one level of underground parking. The gross area of the proposed building, excluding the underground parking, is approximately 1809 square metres.

This mixed-use building will house eighteen(18) one(1)-bedroom apartments, with commercial establishments on the ground level only. The storm-water outlet for this site is the existing 300mm diameter combined sewer located within the Booth Street road right of way.

From the City of Ottawa's engineering guidelines, the allowable post-development runoff release rates shall not exceed the two(2)-year pre-development conditions of site storm drainage out-letting into a combined sewer. The allowable pre-development runoff coefficient for this existing residential site is the calculated "C" existing value of 0.53 or C=0.4 maximum and T_c=10.0 minutes. If the uncontrolled storm-water runoff exceeds the specified requirements, then on-site storm-water management (SWM) control measures are necessary. The post-development runoff coefficient for this site is estimated at C=0.87, which exceeds the pre-development allowable C=0.4 (maximum) criteria for the Booth Street combined sewer without on-site SWM control. Therefore, SWM measures are needed. Refer to the attached Drainage Area Plan (Figure 1) as detailed in Appendix A.

This report will address and detail the grading, drainage, and storm-water management control measures required to develop this property. Based on the Proposed Site Grading and Servicing Plan (Dwg. 818-43 G-1) and on the Proposed Rooftop Storm-water Management Plan (Dwg. 818-43 SWM-1), the storm-water management of this proposed development property will be controlled on site only by the building rooftops.

The storm-water management calculations that follow will detail the extent of on-site SWM control to be implemented and the storage volume required on site to attain the appropriate runoff release that will conform to the City of Ottawa's established drainage criteria.

Site Data

1. Development Property Area

Post-Development Site Area Characteristics

Development Lot Area	=698.9m^2
Roof Surface Area	=607.2m^2
Concrete Area	=51.5m^2
Asphalt Area	=12.6m^2
Grass Area	=27.6m^2

$$C_{average} = \frac{(607.2 \times 0.9) + (51.5 \times 0.8) + (27.6 \times 0.2) + (12.6 \times 0.9)}{698.9}$$

$$C_{average} = \frac{604.54}{698.9}$$

$$C_{average} = 0.865$$

Say $C_{average}$=0.87

Therefore, the average post-development "C" for this site is 0.87.

2. Controlled Area Data

Roof Surface Area	=607.2m^2
Total Storm-water Controlled Area	=607.2m^2

$$C = \frac{(607.2 \times 0.9)}{607.2}$$

$$C = \frac{546.48}{607.2}$$

$$C = 0.9$$

Say "C"=0.9

Therefore, the post-development "C" for the controlled storm-water drainage area is 0.9.

3. Uncontrolled Area Data

Grass Area	=27.6m^2
Asphalt Area	=12.6m^2
Concrete Area	=51.5m^2
Total Storm-water Uncontrolled Area	=91.70m^2

$$C = \frac{(51.5 \times 0.8) + (27.6 \times 0.2) + (12.6 \times 0.9)}{91.70}$$

$$C = \frac{58.06}{91.70}$$

$$C = 0.633$$

Say "C"=0.63

Therefore, the post-development "C" for the uncontrolled storm-water drainage area of the site is 0.63.

The tributary area consisting of approximately 91.7 square metres will be out-letting off site uncontrolled from the proposed mixed-use building site.

The SWM area to be controlled is 607.2m^2. Refer to the attached "Drainage Area Plan" in Figure 1 in Appendix A for details.

The rooftop area of the fourth floor (main roof) is ±432.8m^2, and the rooftop area of the lower-level garage is ±174.4m^2. Both areas will be regulated by roof drains. The proposed roof-drain model and details are shown in the Proposed Rooftop Storm-water Management Plan Dwg. 818-43 SWM-1.

Pre-Development Flow Estimation

Maximum allowable off-site flow: two(2)-year storm

Pre-Development Site Area Characteristics

Development Lot Area	=698.9m^2
Roof Area	=154.2m^2
Asphalt Area	=145.0m^2
Concrete Area	=35.0m^2
Grass Area	=364.7m^2

$$C = \frac{(154.2 \times 0.9) + (145.0 \times 0.9) + (35.0 \times 0.8) + (364.7 \times 0.2)}{698.9}$$

$$C = \frac{370.22}{698.9}$$

$$C = 0.53$$

Use C_{allow}=0.4 maximum allowable for redevelopment.

T_c=D/V where D=35.0m, ΔH=0.20m, S=0.57%, and V=0.58 feet/second=0.18m/s

Therefore,

$$T_c = \frac{35.0\text{m}}{0.18\text{m/s}}$$

T_c=3.3 minutes

Use T_c=10 minutes

I_2=77.1mm/hour [City of Ottawa, two(2)-year storm]

Using the Rational Method

Q=2.78 (0.4) (77.1) (0.0699)

Q=5.99L/s

Because 91.7 square metres of the site area are drained uncontrolled off site, the **net** allowable discharge for this site into the existing sewer system is Q={2.78 (0.4) (77.1) (0.0699)−[2.78 (0.63) (179.0) (0.0092)]}=5.99/s−2.88L/s=3.11L/s. Therefore, the maximum allowable flow rate off site is 5.99L/s, and the net allowable controlled flow rate off site is 3.11L/s.

Storm-Water Management Analysis

The net allowable controlled flow rate of 3.11L/s for on-site storm-water management (SWM) detention volume storage will be used for this SWM analysis. Four(4) controlled roof drains are proposed to restrict the flow from the building at a rate of 4×0.63=2.52L/s into the Booth Street combined sewer. This restricted flow rate from the building of 2.52L/s is less than the net allowable release rate, which is calculated at 3.11L/s for this site.

Therefore, the maximum allowable two(2)-year release rate of 5.99L/s will be entering into the existing 300mm Booth Street combined sewer. The runoff that is greater than the allowable release rate will be stored on site at the flat rooftops of the proposed mixed-use building. All the flat rooftops will be used for storm-water detention purposes.

The post-development inflow rate during the five(5)-year and 100-year storms for the parking lot drainage system and rooftop areas can be calculated as follows.

Design Discharge Computation

Flat Rooftop Areas

To Calculate Roof Storage Requirements

The proposed flat roof of the mixed-use building on the property will incorporate four(4) roof drains to control flow off site. The smallest standard roof drain flow rate is each at 0.63L/s (10USgal./min.). Therefore, the minimum storm-water flow that can be controlled from this rooftop and outletted off site is $0.63L/s \times 4 = 2.52L/s < 3.11L/s$, which is the net allowable.

C=0.9 will be used for sizing roof storage volume in this case.

Inflow rate (Q_A)=2.78 CIA, where C=0.9, A=surface area of roof, I=mm/hr

For Roof Area 1, Q_{A1}=2.78 CIA
Five(5)-Year Event
C_5=0.90
A=187.0m^2
I=mm/hr

Q_1=2.78 (0.90)(0.0187ha.)I=0.0468I

100-Year Event
C_{100}=1.0
A=187.0m^2
I=mm/hr

Q_1=2.78 (1.0)(0.0187ha.)I=0.052I

For Roof Area 2, Q=2.78 CIA
Five(5)-Year Event
C_5=0.90
A=236.0m^2
I=mm/hr

Q_2=2.78 (0.90)(0.0236ha.)I=0.059I

100-Year Event
C_{100}=1.0
A=236.0m^2
I=mm/hr

Q_2=2.78 (1.0)(0.0236ha.)I=0.0656I

For Roof Area 3, Q=2.78 CIA
Five(5)-Year Event
C_5=0.90
A=94.2m^2
I=mm/hr

Q_3=2.78 (0.90)(0.00942ha.)I=0.0236I

100-Year Event
C_{100}=1.0
A=94.2m^2
I=mm/hr

Q_3=2.78 (1.0)(0.00942ha.)I=0.0262I

For Roof Area 4, Q=2.78 CIA
Five(5)-Year Event
C_5=0.90
A=90.0m^2
I=mm/hr

Q_4=2.78 (0.90)(0.009ha.)I=0.0225I

100-Year Event
C_{100}=1.0
A=90.0m^2
I=mm/hr

Q_4=2.78 (1.0)(0.009ha.)I=0.025I

The summary results of the calculated inflow, and the storage volume of the site and building's flat rooftop to store the five(5)-year and 100-year storm events are shown in Tables 1 to 8 inclusive.

Erosion and Sediment Control

The contractor shall implement Best Management Practices to provide for protection of the receiving storm sewer during construction activities. These practices are required to ensure no sediment and/or associated pollutants are released to the receiving watercourse. These practices include installation of a silt fence barrier (as per OPSD 219.110 and associated specifications) along Booth Street and all other areas that sheet drain off site. Maintenance hole sediment barriers to be AMOCO 4555 non-woven geotextile or approved equivalent.

Conclusion

For development of this mixed-use building site of ±0.07ha., and in controlling the five(5)-year storm-water release rate off site to a net allowable rate of 3.11L/s, a site storage volume of approximately 10.62^3 minimum is required during the five(5)-year event. For this site, four(4) flat rooftop storage areas will be used for storm-water management attenuation.

During the five-year storm event for the flat rooftop storage, the ponding depth of the rooftop at Roof Areas 1, 3, and 4 is estimated at 110mm at the drain and 0mm at the roof perimeter. At Roof Area 2, the ponding depth at the drain is 120mm and 0mm at the roof perimeter. The rooftop storage available at Roof Area 1 is $3.51m^3$, the rooftop storage available at Roof Area 2 is $5.05m^3$, the rooftop storage available at Roof Area 3 is $1.51m^3$, and the rooftop storage available at Roof Area 4 is $1.61m^3$, for a total of $11.68m^3$, which is greater than the required volume of $10.62m^3$.

To control the 100-year storm-water release rate off site to a net allowable controlled flow rate of 3.11L/s, a site storage volume of approximately $25.66m^3$ minimum is required during the 100-year event.

During the 100-year storm event for the flat rooftop storage, the ponding depth of the rooftop at Roof Areas 1, 3, and 4 is estimated at 150mm at the drain and 0mm at the roof perimeter. At Roof Area 2, the ponding depth at the drain is 160mm and 10mm at the roof perimeter. The rooftop storage available at Roof Area 1 is $9.19m^3$, the rooftop storage available at Roof Area 2 is $12.05m^3$, the rooftop storage available at Roof Area 3 is $3.92m^3$, and the rooftop storage available at Roof Area 4 is $4.17m^3$, for a total of $29.33m^3$, which is greater than the required volume of $25.66m^3$.

Therefore, by means of flat building rooftop storage and grading the site to the proposed grades as shown on the Proposed Site Grading and Servicing Plan, and the Proposed Rooftop Storm-water Management Plan, Dwg. 818-43 G-1 and 818-43 SWM-1 respectively, the desirable five(5)-year storm and 100-year storm event detention volumes of $11.68m^3$ and $29.33m^3$ respectively will be available on site.

The controlled release rate from the rooftops is 2.52L/s [from four(4) controlled roof drains], which is less than the calculated net allowable controlled flow rate of 3.11L/s. Therefore, the proposed SWM attenuation design by means of rooftop storage is sufficient to meet the City of Ottawa's drainage criteria as detailed in this report.

The building weeping tile drainage will outlet via a proposed 150mm diameter PVC storm lateral. The roof drains will be outletted via a proposed 125mm PVC storm lateral, where it wyes into the 150mm diameter storm lateral that outlets into the existing Booth Street 300mm diameter combined sewer.

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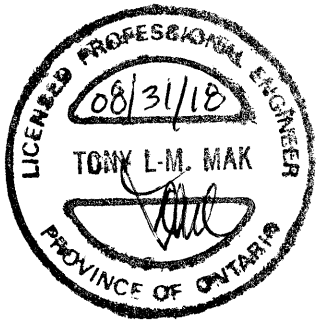


360 BOOTH STREET

PROPOSED FOUR-STOREY MIXED-USE BUILDING SITE

TABLE 1

FIVE(5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 1 STORAGE VOLUME

t_c **TIME** (minutes)	**I FIVE(5)-YEAR** (mm/hr)	**Q ACTUAL** (L/s)	**Q ALLOW** (L/s)	**Q STORED** (L/s)	**VOLUME STORED** (m^3)
5	141.20	6.61	0.63	5.98	1.79
10	104.20	4.88	0.63	4.25	2.55
15	83.50	3.91	0.63	3.28	2.95
20	70.30	3.29	0.63	2.66	3.19
25	60.90	2.85	0.63	2.22	3.33
30	53.93	2.52	0.63	1.89	3.40
35	48.52	2.27	0.63	1.64	3.44
40	44.19	2.07	0.63	1.44	3.46
45	40.63	1.90	0.63	1.27	3.43
50	37.65	1.76	0.63	1.13	3.39

Therefore, the required storage volume is 3.46m^3.

360 BOOTH STREET

PROPOSED FOUR-STOREY MIXED-USE BUILDING SITE

TABLE 2

FIVE(5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 2 STORAGE VOLUME

t_c TIME (minutes)	**I FIVE(5)-YEAR** (mm/hr)	**Q ACTUAL** (L/s)	**Q ALLOW** (L/s)	**Q STORED** (L/s)	**VOLUME STORED** (m^3)
5	141.20	8.33	0.63	7.70	2.31
10	104.20	6.15	0.63	5.52	3.31
15	83.50	4.93	0.63	4.30	3.87
20	70.30	4.15	0.63	3.52	4.22
25	60.90	3.59	0.63	2.96	4.44
30	53.93	3.18	0.63	2.55	4.59
35	48.52	2.86	0.63	2.23	4.68
40	44.19	2.61	0.63	1.98	4.75
45	40.63	2.40	0.63	1.77	4.78
50	37.65	2.22	0.63	1.59	4.77
55	35.12	2.07	0.63	1.44	4.75

Therefore, the required storage volume is 4.78m^3.

360 BOOTH STREET

PROPOSED FOUR-STOREY MIXED-USE BUILDING SITE

TABLE 3

FIVE(5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 3 STORAGE VOLUME

t_c **TIME** (minutes)	**I** **FIVE(5)-YEAR** (mm/hr)	**Q** **ACTUAL** (L/s)	**Q** **ALLOW** (L/s)	**Q** **STORED** (L/s)	**VOLUME** **STORED** (m^3)
5	141.20	3.33	0.63	2.70	0.81
10	104.20	2.46	0.63	1.83	1.10
15	83.50	1.97	0.63	1.34	1.21
20	70.30	1.66	0.63	1.03	1.24
25	60.90	1.44	0.63	0.81	1.22
30	53.93	1.27	0.63	0.64	1.15

Therefore, the required storage volume is 1.24m^3.

360 BOOTH STREET

PROPOSED FOUR-STOREY MIXED-USE BUILDING SITE

TABLE 4

FIVE(5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 4 STORAGE VOLUME

t_c **TIME** (minutes)	**I** **FIVE(5)-YEAR** (mm/hr)	**Q** **ACTUAL** (L/s)	**Q** **ALLOW** (L/s)	**Q** **STORED** (L/s)	**VOLUME** **STORED** (m^3)
5	141.20	3.18	0.63	2.55	0.77
10	104.20	2.35	0.63	1.72	1.03
15	83.50	1.88	0.63	1.25	1.13
20	70.30	1.58	0.63	0.95	1.14
25	60.90	1.37	0.63	0.74	1.11
30	53.93	1.21	0.63	0.58	1.04

Therefore, the required storage volume is 1.14m^3.

360 BOOTH STREET

PROPOSED FOUR-STOREY MIXED-USE BUILDING SITE

TABLE 5

100-YEAR EVENT

REQUIRED BUILDING ROOF AREA 1 STORAGE VOLUME

t_c **TIME** (minutes)	**I 100-YEAR** (mm/hr)	**Q ACTUAL** (L/s)	**Q ALLOW*** (L/s)	**Q STORED** (L/s)	**VOLUME STORED** (m^3)
10	178.6	9.29	0.63	8.66	5.20
15	142.9	7.43	0.63	6.80	6.12
20	120.0	6.24	0.63	5.61	6.73
25	103.9	5.40	0.63	4.77	7.16
30	91.9	4.78	0.63	4.15	7.47
35	82.6	4.30	0.63	3.67	7.71
40	75.14	3.91	0.63	3.28	7.87
45	69.05	3.59	0.63	2.96	7.99
50	63.95	3.33	0.63	2.70	8.10
55	59.62	3.10	0.63	2.47	8.15
60	55.90	2.91	0.63	2.28	8.21
70	49.79	2.59	0.63	1.96	8.232
75	47.26	2.46	0.63	1.83	8.24
80	44.99	2.34	0.63	1.71	8.21

Therefore, the required storage volume is 8.24m^3.

360 BOOTH STREET

PROPOSED FOUR-STOREY MIXED-USE BUILDING SITE

TABLE 6

100-YEAR EVENT

REQUIRED BUILDING ROOF AREA 2 STORAGE VOLUME

t_c **TIME** (minutes)	**I 100-YEAR** (mm/hr)	**Q ACTUAL** (L/s)	**Q ALLOW*** (L/s)	**Q STORED** (L/s)	**VOLUME STORED** (m^3)
10	178.6	11.72	0.63	11.09	6.65
15	142.9	9.37	0.63	8.74	7.87
20	120.0	7.87	0.63	7.24	8.69
25	103.9	6.82	0.63	6.19	9.29
30	91.9	6.03	0.63	5.40	9.72
35	82.6	5.42	0.63	4.79	10.06
40	75.14	4.93	0.63	4.30	10.36
45	69.05	4.53	0.63	3.90	10.53
50	63.95	4.20	0.63	3.57	10.71
55	59.62	3.91	0.63	3.28	10.82
60	55.90	3.67	0.63	3.04	10.94
65	52.65	3.45	0.63	2.82	11.00
70	49.79	3.27	0.63	2.64	11.09
75	47.26	3.10	0.63	2.47	11.12
80	44.99	2.95	0.63	2.32	11.14
85	42.95	2.82	0.63	2.19	11.17
90	41.11	2.70	0.63	2.07	11.18
95	39.44	2.59	0.63	1.96	11.17
100	37.90	2.49	0.63	1.86	11.16

Therefore, the required storage volume is 11.18m^3.

360 BOOTH STREET

PROPOSED FOUR-STOREY MIXED-USE BUILDING SITE

TABLE 7

100-YEAR EVENT

REQUIRED BUILDING ROOF AREA 3 STORAGE VOLUME

t_c TIME (minutes)	**I 100-YEAR** (mm/hr)	**Q ACTUAL** (L/s)	**Q ALLOW*** (L/s)	**Q STORED** (L/s)	**VOLUME STORED** (m^3)
10	178.6	4.68	0.63	4.05	2.43
15	142.9	3.74	0.63	3.11	2.80
20	120.0	3.14	0.63	2.51	3.01
25	103.9	2.72	0.63	2.09	3.14
30	91.9	2.41	0.63	1.78	3.20
35	82.6	2.16	0.63	1.53	3.21
40	75.14	1.97	0.63	1.34	3.22
45	69.05	1.81	0.63	1.18	3.19
50	63.95	1.68	0.63	1.05	3.15

Therefore, the required storage volume is 3.22m^3.

360 BOOTH STREET

PROPOSED FOUR-STOREY MIXED-USE BUILDING SITE

TABLE 8

100-YEAR EVENT

REQUIRED BUILDING ROOF AREA 4 STORAGE VOLUME

t_c **TIME** (minutes)	**I 100-YEAR** (mm/hr)	**Q ACTUAL** (L/s)	**Q ALLOW*** (L/s)	**Q STORED** (L/s)	**VOLUME STORED** (m^3)
10	178.6	4.47	0.63	3.84	2.30
15	142.9	3.57	0.63	2.94	2.65
20	120.0	3.00	0.63	2.37	2.84
25	103.9	2.60	0.63	1.97	2.96
30	91.9	2.30	0.63	1.67	3.01
35	82.6	2.07	0.63	1.44	3.02
40	75.14	1.88	0.63	1.25	3.00
45	69.05	1.73	0.63	1.10	2.97

Therefore, the required storage volume is 3.02m^3.

PROPOSED FOUR-STOREY

MIXED-USE BUILDING DEVELOPMENT SITE

PART OF LOTS 203 AND 204

R-PLAN 14

360 BOOTH STREET

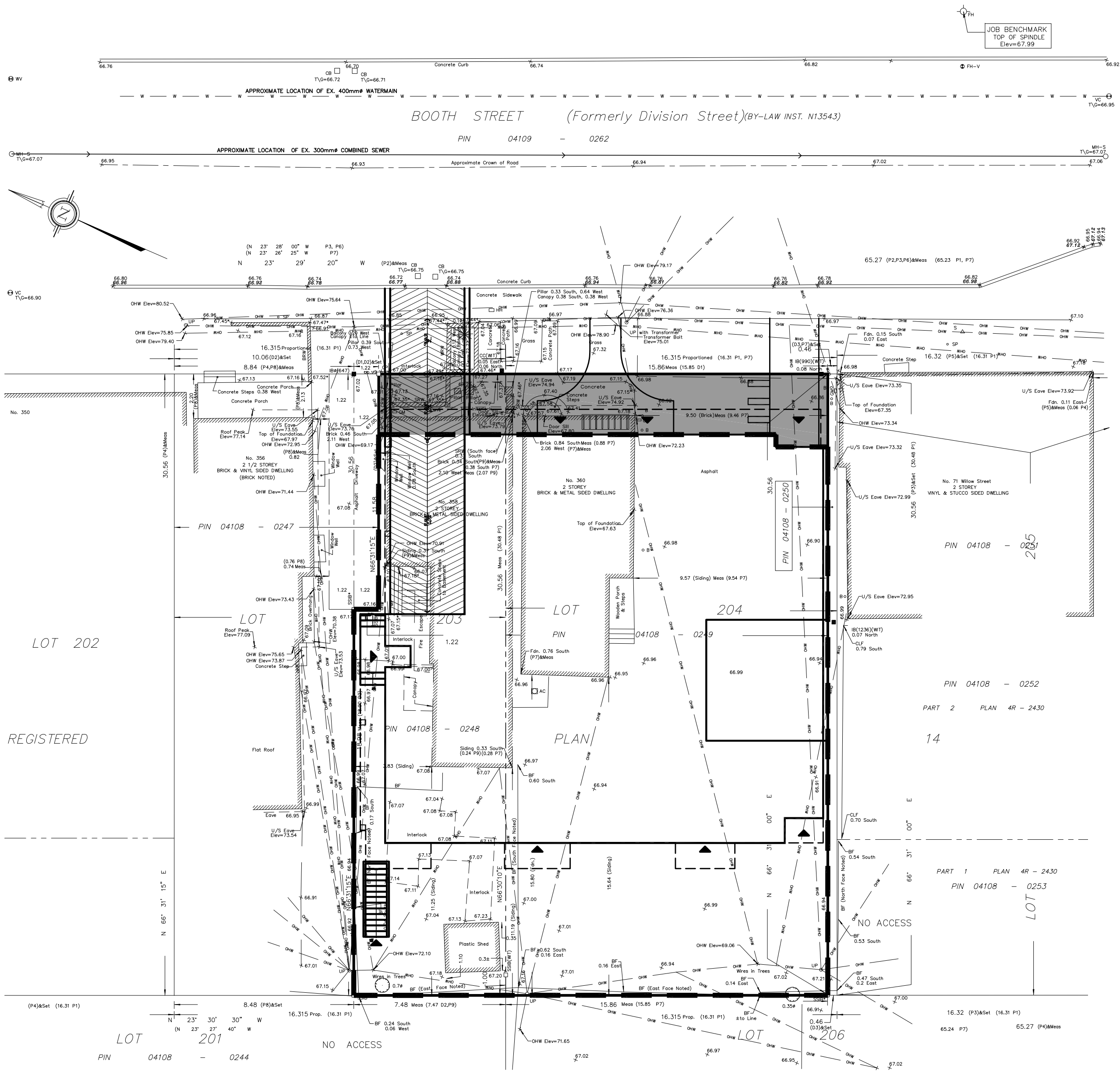
CITY OF OTTAWA

APPENDIX A

STORM DRAINAGE AREA PLAN

FIGURE 1

PROPOSED 360 BOOTH STREET
SITE DEVELOPMENT
DRAINAGE AREA PLAN
NOT TO SCALE



LEGEND

LIMIT OF CONTROLLED STORM DRAINAGE AREA =607.2 SQ. M

UNCONTROLLED STORM DRAINAGE AREA =91.7 SQ. M

TOTAL AREA = 698.90 SQ. M

POST-DEVELOPMENT SITE AVERAGE "C" = 0.87

FIGURE 1

PROPOSED FOUR-STOREY

MIXED-USE BUILDING DEVELOPMENT SITE

PART OF LOTS 203 AND 204

R-PLAN 14

360 BOOTH STREET

CITY OF OTTAWA

APPENDIX B

DETAILED CALCULATIONS

FOR FIVE(5)-YEAR AND 100-YEAR

AVAILABLE STORAGE VOLUME

Available Storage Volume Calculations

Five(5)-Year Event

Roof Storage at Flat Roof Building

The flat Roof Area 1 to Roof Area 4 inclusive will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 10U.S.gal./min. or 0.63L/s.

Roof Storage Area 1

Available flat roof area for storage =187.0m^2 @roof slope of 1.3% minimum or 110mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.11\text{m})[96.38 + 4(23.7) + 0]}{6}$$

$$V = \frac{(0.11)(191.18)}{6}$$

$$V = 3.51\text{m}^3$$

The available Roof Area 1 storage volume of 3.51m^3 >required five(5)-year storage volume of 3.46m^3 from Table 1.

Roof Storage Area 2

Available flat roof area for storage =201.2m^2 @roof slope of 1.1% minimum or 120mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.12\text{m})[125.15 + 4(31.82) + 0]}{6}$$

$$V = \frac{(0.12)(252.43)}{6}$$

$$V = 5.05\text{m}^3$$

The available Roof Area 2 storage volume of 5.05m^3 >required five(5)-year storage volume of 4.78m^3 from Table 2.

Roof Storage Area 3

Available flat roof area for storage =81.32m^2 @roof slope of 1.9% minimum or 110mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.11\text{m})[40.5 + 4(10.43) + 0]}{6}$$

$$V = \frac{(0.11)(82.22)}{6}$$

$$V = 1.51\text{m}^3$$

The available Roof Area 3 storage volume of 1.51m^3 >required five(5)-year storage volume of 1.24m^3 from Table 3.

Roof Storage Area 4

Available flat roof area for storage =86.0m^2 @roof slope of 2.0% minimum or 110mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.11\text{m})[43.46 + 4(11.07) + 0]}{6}$$

$$V = \frac{(0.11)(87.74)}{6}$$

$$V = 1.61\text{m}^3$$

The available Roof Area 4 storage volume of 1.61m^3 >required five(5)-year storage volume of 1.14m^3 from Table 4.

Therefore, the ponding depth at the drain location is approximately 0.11m (110mm) at Roof Areas 1, 3, and 4; at Roof Area 2, the ponding depth is 0.12m or 120mm; and the five(5)-year level is estimated not to reach the roof perimeters of the building for all four(4) roof areas.

Hence, Roof Area 1, Roof Area 2, Roof Area 3, and Roof Area 4 of the proposed mixed-use building flat rooftop storage are adequate to store the minimum required five(5)-year storm event volume of 10.62m^3 given it can store up to 11.68m^3.

AVAILABLE STORAGE VOLUME CALCULATIONS

100-Year Event

Roof Storage at Flat Roof Building

The flat Roof Area 1 to Roof Area 4 inclusive will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 10U.S.gal./min. or 0.63L/s.

Roof Storage Area 1

Available flat roof area for storage =187.0m^2 @roof slope of 1.3% minimum or 150mm of fall from roof perimeter to roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.15\text{m})[187.0 + 4(45.15) + 0]}{6}$$

$$V = \frac{(0.15)(367.6)}{6}$$

$$V = 9.19\text{m}^3$$

The available Roof Area 1 storage volume of 2.26m^3 >required 100-year storage volume of 8.24m^3 from Table 5.

Roof Storage Area 2

Available flat roof area for storage =201.2m^2 @roof slope of 1.1% minimum or 150mm of fall from roof perimeter to roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.15\text{m})[201.2+4(50.1)+0]}{6} + (0.01\text{m} \times 201.2\text{m}^2)$$

$$V = \frac{(0.15)(401.6)}{6} + 2.01\text{m}^3$$

$$V = 10.04\text{m}^3 + 2.10\text{m}^3$$

$$V = 12.05\text{m}^3$$

The available Roof Area 2 storage volume of 12.05m^3 >required 100-year storage volume of 11.18m^3 from Table 6.

Roof Storage Area 3

Available flat roof area for storage =81.32m^2 @roof slope of 1.9% minimum or 150mm of fall from roof perimeter to roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.15\text{m})[81.32 + 4(18.9) + 0]}{6}$$

$$V = \frac{(0.15)(156.92)}{6}$$

$$V = 3.92\text{m}^3$$

The available Roof Area 3 storage volume of 3.92m^3 >required 100-year storage volume of 3.22m^3 from Table 7.

Roof Storage Area 4

Available flat roof area for storage =86.0m^2 @roof slope of 2.0% minimum or 150mm of fall from roof perimeter to roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.15\text{m})[86.0 + 4(20.16) + 0]}{6}$$

$$V = \frac{(0.15)(166.64)}{6}$$

$$V = 4.17\text{m}^3$$

The available Roof Area 4 storage volume of 4.17m^3 >required 100-year storage volume of 3.02m^3 from Table 8.

Therefore, the ponding depth at the drain location at Roof Area 1, 3, and 4 is approximately 0.15m (150mm), and at the perimeter of the flat roof area is 0mm above the roof perimeter surface. Accordingly, it is recommended that the six(6) roof scuppers as shown on Dwg. 818-43 G-1 and 818-43 SWM-1 and the architect's roof plan be installed at the perimeter height of the rooftop for emergency overflow purposes in case of blockage from debris buildup at the roof drain of Roof Area 1, 3, and 4.

For Roof Area 2, the ponding depth at the drain location is approximately 0.16m (160mm), and at the perimeter of the flat roof area, it is 10mm above the roof perimeter surface. Accordingly, it is recommended that the two(2) roof scuppers shown for Roof Area 2 be installed 10mm above the perimeter height of the roof for emergency overflow purposes in case of blockage from debris buildup at the roof drain of Roof Area 2.

Hence, Roof Area 1, Roof Area 2, Roof Area 3, and Roof Area 4 of the proposed mixed-use building flat rooftop storage are adequate to store the minimum required 100-year storm event volume of 25.66m^3 given it can store up to 29.33m^3.