

**PROPOSED THREE(3)-STOREY APARTMENT BUILDING SITE**

**LOT 6 BLOCK E**

**R-PLAN 146**

**16-20 CHAMPAGNE AVENUE SOUTH**

**CITY OF OTTAWA**

**STORM DRAINAGE REPORT**

**REPORT R-818-54**

**T.L. MAK ENGINEERING CONSULTANTS LTD.**

**SEPTEMBER 2018**

**REFERENCE FILE NUMBER 818-54**

## **Introduction**

The proposed three(3)-storey apartment building site is located on the west side of Champagne Avenue, and situated north of Beech Street and south of Young Street. Its legal property description is Lot 6 Block E Registered Plan 146 City of Ottawa. At this time, the residential property under consideration houses a two(2)-storey stucco building, and a two(2)-storey siding building on the said lot. The municipal address of the existing properties is 16 and 20 Champagne Avenue.

The area of the two(2) amalgamated lots is approximately 659.5 square metres. This property is proposed for the development of a three(3)-storey residential apartment building where the ground floor is approximately 50% below grade, and there are three(3) storeys above the ground-floor level. The total gross floor area of the proposed building [all four(4) floors] is 11,025.0 square feet (1023.7 square metres).

The building will house a total of nineteen(19) units consisting of six(6) two(2)-bedroom, nine(9) one(1)-bedroom, and four(4) bachelor apartments. The storm-water outlet for this site is the existing 1200mm diameter storm sewer located within the Champagne Avenue road right of way.

From storm-drainage criteria set by the staff at the City of Ottawa's Engineering Department, the allowable post-development runoff release rates shall not exceed the five(5)-year pre-development conditions. The allowable pre-development runoff coefficient is the calculated "C" existing value or  $C=0.5$  maximum. 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  $C=0.63$ , which exceeds the calculated pre-development allowable  $C=0.5$  criteria for the Champagne Avenue storm sewer without on-site SWM control. Therefore, SWM measures are required. 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. 818-54 G-1), and on the Proposed Rooftop Storm-water Management Plan (Dwg. 818-54 SWM-1), the storm water of this lot will be controlled on site only by the building's flat rooftop.

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's established drainage criteria.

## Site Data

### 1. Development Property Area

Post-Development Site Area Characteristics

Development Lot Area =659.5m<sup>2</sup>

Roof Surface Area =305.1m<sup>2</sup>

Interlock/Concrete Area =107.13m<sup>2</sup>

Grass Area =247.27m<sup>2</sup>

$$C = \frac{(305.1 \times 0.9) + (107.13 \times 0.8) + (247.27 \times 0.2)}{659.5}$$

$$C = \frac{409.75}{659.5}$$

$$C = 0.621$$

Say "C"=0.63

Therefore, the average post-development "C" for this site is 0.63.

### 2. Controlled Area Data

Roof Surface Area =299.4m<sup>2</sup>

Total Storm-water Controlled Area =299.4m<sup>2</sup>

$$C = \frac{(299.4 \times 0.9)}{299.4}$$

$$C = \frac{236.7}{263.0}$$

$$C = 0.9$$

Say "C"=0.9

Therefore, the post-development "C" for the controlled storm-water drainage area is 0.90.

### 3. Uncontrolled Area Data

Roof Area	= 5.7m <sup>2</sup>
Grass Area	=247.27m <sup>2</sup>
Interlock/Concrete Area	=107.13m <sup>2</sup>
Total Storm-water Uncontrolled Area	=360.1m <sup>2</sup>

$$C = \frac{(107.13 \times 0.8) + (247.27 \times 0.2) + (5.7 \times 0.9)}{360.10}$$

$$C = \frac{140.288}{360.10}$$

$$C = 0.3896$$

Say C=0.39

Therefore, the post-development “C” for the uncontrolled storm-water drainage area of the site is 0.39.

The tributary area consisting of approximately 360.10 square metres will be out-letting off site uncontrolled from the residential apartment building site.

The SWM area to be controlled is 299.4m<sup>2</sup>. Refer to the attached “Drainage Area Plan” in Figure 1 for details.

### **Pre-Development Flow Estimation**

Maximum allowable off-site flow: five(5)-year storm

Pre-Development Site Area Characteristics

Development Lot Area	=659.5m <sup>2</sup>
Asphalt Area	=262.5m <sup>2</sup>
Concrete Area	= 45.8m <sup>2</sup>
Roof Area	=186.3m <sup>2</sup>
Grass Area	=164.8m <sup>2</sup>

$$C = \frac{(186.3 \times 0.9) + (45.8 \times 0.8) + (164.8 \times 0.2) + (262.5 \times 0.9)}{659.5}$$

$$C = \frac{473.52}{659.5}$$

$$C = 0.718$$

Say C=0.72

Use  $C_{pre}=0.5$  maximum allowable for redevelopment

$T_c=D/V$  where  $D=36.0m$ ,  $\Delta H=3.46m$ ,  $S=9.6\%$ , and  $V=5.5\text{feet/second}=1.68m/s$

Therefore,

$$T_c = \frac{36.0m}{1.68m/s}$$

$T_c=0.36$  minutes

Use  $T_c=10$  minutes

$I_5=104.4\text{mm/hour}$  [City of Ottawa, five(5)-year storm]

Using the Rational Method

$$Q=2.78 (0.5) (104.4) (0.066)$$

$$Q=9.58L/s$$

Because 360.1 square metres are drained uncontrolled off site, the **net** allowable discharge for this site into the existing Champagne Avenue storm sewer system is  $Q=\{2.78 (0.5) (104.4) (0.066)-[2.78 (0.39) (178.6) (0.0306)]\}=9.58L/s-6.97L/s=2.61L/s$ .

### **Storm-Water Management Analysis**

The calculated net allowable controlled flow rate of 2.61L/s for on-site storm-water management detention volume storage will be used for this SWM analysis. Two(2) controlled roof drains are proposed to restrict flow from the building at a rate of  $2 \times 1.26=2.52L/s$  into the Champagne Avenue storm sewer.

Therefore, the total allowable five(5)-year release rate of 9.58L/s will be entering into the existing 1200mm diameter Champagne Avenue storm sewer. The runoff that is greater than the allowable release rate will be stored on site at the flat rooftops of the proposed apartment building, all of which 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 apartment building on the property will incorporate two(2) roof drains to control flow off site. The specified roof drain flow rate is each at 1.26L/s (20 U.S. gallons/minute). Therefore, the minimum storm-water flow that can be controlled from this rooftop and outletted off site is  $1.26\text{L/s} \times 2 = 2.52\text{L/s} < 2.61\text{L/s}$ , 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

$C_5=0.90$

$A=150.3\text{m}^2$

$I$ =mm/hr

$Q_1=2.78 (0.90)(0.0151\text{ha.})I=0.0378I$

100-Year Event

$C_{100}=1.0$

$A=150.3\text{m}^2$

$I$ =mm/hr

$Q_1=2.78 (1.0)(0.0151\text{ha.})I=0.042I$

For Roof Area 2,  $Q=2.78 CIA$

Five(5)-Year Event

$C_5=0.90$

$A=149.1\text{m}^2$

$I$ =mm/hr

$Q_2=2.78 (0.90)(0.0149)I=0.0373I$

100-Year Event

$C_{100}=1.0$

$$A=149.10\text{m}^2$$

$$I=\text{mm/hr}$$

$$Q_2=2.78 (1.0)(0.0149)I=0.0415I$$

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 4 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 Champagne Avenue 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 residential site ( $\pm 0.066\text{ha.}$ ) and in controlling the five(5)-year storm-water release rate off site to a net allowable rate of  $2.61\text{L/s}$ , a site storage volume of approximately  $3.38\text{m}^3$  minimum is required during the five(5)-year event. For this site, two(2) 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 on this rooftop is estimated at  $110\text{mm}$  at the drain and  $0\text{mm}$  at the roof perimeter, assuming a  $1.7\%$  minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is  $3.11\text{m}^3$ , and the rooftop storage available at Roof Area 2 is  $3.02\text{m}^3$ , for a total of  $6.13\text{m}^3$ , which is greater than the required volume of  $3.38\text{m}^3$ .

To control the 100-year storm-water release rate off site to a net allowable rate of  $2.61\text{L/s}$ , a site storage volume of approximately  $9.27\text{m}^3$  minimum is required during the 100-year event.

During the 100-year storm event for the flat rooftop storage, the ponding depth on this rooftop is estimated at  $150\text{mm}$  at the drain and  $0\text{mm}$  at the roof perimeter, assuming a  $1.7\%$  minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is  $7.70\text{m}^3$ , and the rooftop storage available at Roof Area 2 is  $7.58\text{m}^3$ , for a total of  $15.28\text{m}^3$ , which is greater than the required volume of  $9.27\text{m}^3$ .

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 Dwg. 818-54 G-1 and the

Proposed Rooftop Storm-water Management Plan Dwg. 818-54 SWM-1, the desirable five(5)-year storm and 100-year storm event detention volume of 6.13m<sup>3</sup> and 15.28m<sup>3</sup> respectively will be available on site.

The building weeping tile drainage will outlet via its separate 150mm diameter PVC storm lateral. The roof drains will be outletted via a proposed 125mm PVC storm lateral, which wyes into the proposed 150mm diameter storm lateral where both roof storm-water and weeping-tile water will be outletted to the existing Champagne Avenue 1200mm diameter storm sewer.

**PREPARED BY T.L. MAK ENGINEERING CONSULTANTS LTD.**



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**PROPOSED 16-20 CHAMPAGNE AVENUE RESIDENTIAL DEVELOPMENT SITE**

**TABLE 1**

**FIVE(5)-YEAR EVENT**

**REQUIRED BUILDING ROOF AREA 1 STORAGE VOLUME**

<b>t<sub>c</sub> TIME (minutes)</b>	<b>I FIVE(5)-YEAR (mm/hr)</b>	<b>Q ACTUAL (L/s)</b>	<b>Q ALLOW (L/s)</b>	<b>Q STORED (L/s)</b>	<b>VOLUME STORED (m<sup>3</sup>)</b>
5	141.20	5.34	1.26	4.08	1.22
10	104.20	3.94	1.26	2.68	1.61
15	83.50	3.16	1.26	1.90	1.71
20	70.30	2.66	1.26	1.40	1.68
25	60.90	2.30	1.26	1.04	1.56

Therefore, the required storage volume is 1.71m<sup>3</sup>.

**PROPOSED 16-20 CHAMPAGNE AVENUE RESIDENTIAL DEVELOPMENT SITE**

**TABLE 2**

**FIVE(5)-YEAR EVENT**

**REQUIRED BUILDING ROOF AREA 2 STORAGE VOLUME**

<b>t<sub>c</sub> TIME (minutes)</b>	<b>I 5-YEAR (mm/hr)</b>	<b>Q ACTUAL (L/s)</b>	<b>Q ALLOW (L/s)</b>	<b>Q STORED (L/s)</b>	<b>VOLUME STORED (m<sup>3</sup>)</b>
5	141.20	5.27	1.26	4.01	1.20
10	104.20	3.89	1.26	2.63	1.58
15	83.50	3.12	1.26	1.86	1.67
20	70.30	2.62	1.26	1.36	1.63
25	60.90	2.27	1.26	1.01	1.52

Therefore, the required rooftop storage volume is 1.67m<sup>3</sup>.

**PROPOSED 16-20 CHAMPAGNE AVENUE RESIDENTIAL DEVELOPMENT SITE**

**TABLE 3**

**100-YEAR EVENT**

**REQUIRED BUILDING ROOF AREA 1 STORAGE VOLUME**

<b>t<sub>c</sub> TIME (minutes)</b>	<b>I 100-YEAR (mm/hr)</b>	<b>Q ACTUAL (L/s)</b>	<b>Q ALLOW (L/s)</b>	<b>Q STORED (L/s)</b>	<b>VOLUME STORED (m<sup>3</sup>)</b>
10	178.6	7.50	1.26	6.24	3.74
15	142.9	6.00	1.26	4.74	4.27
20	120.0	5.04	1.26	3.78	4.54
25	103.9	4.36	1.26	3.10	4.65
30	91.9	3.86	1.26	2.60	4.68
35	82.6	3.47	1.26	2.21	4.64
40	75.2	3.16	1.26	1.90	4.56

Therefore, the required rooftop storage volume is 4.68m<sup>3</sup>.

**PROPOSED 16-20 CHAMPAGNE AVENUE RESIDENTIAL DEVELOPMENT SITE**

**TABLE 4**

**100-YEAR EVENT**

**REQUIRED BUILDING ROOF AREA 2 STORAGE VOLUME**

<b>t<sub>c</sub> TIME (minutes)</b>	<b>I 100-YEAR (mm/hr)</b>	<b>Q ACTUAL (L/s)</b>	<b>Q ALLOW (L/s)</b>	<b>Q STORED (L/s)</b>	<b>VOLUME STORED (m<sup>3</sup>)</b>
10	178.6	7.41	1.26	6.15	3.69
15	142.9	5.93	1.26	4.67	4.20
20	120.0	4.98	1.26	3.72	4.46
25	103.9	4.31	1.26	3.05	4.58
30	91.9	3.81	1.26	2.55	4.59
35	82.6	3.43	1.26	2.17	4.56
40	75.2	3.12	1.26	1.86	4.46

Therefore, the required rooftop storage volume is 4.59m<sup>3</sup>.

**PROPOSED THREE(3)-STOREY APARTMENT BUILDING SITE**

**LOT 6**

**R-PLAN 146**

**16-20 CHAMPAGNE AVENUE**

**CITY OF OTTAWA**

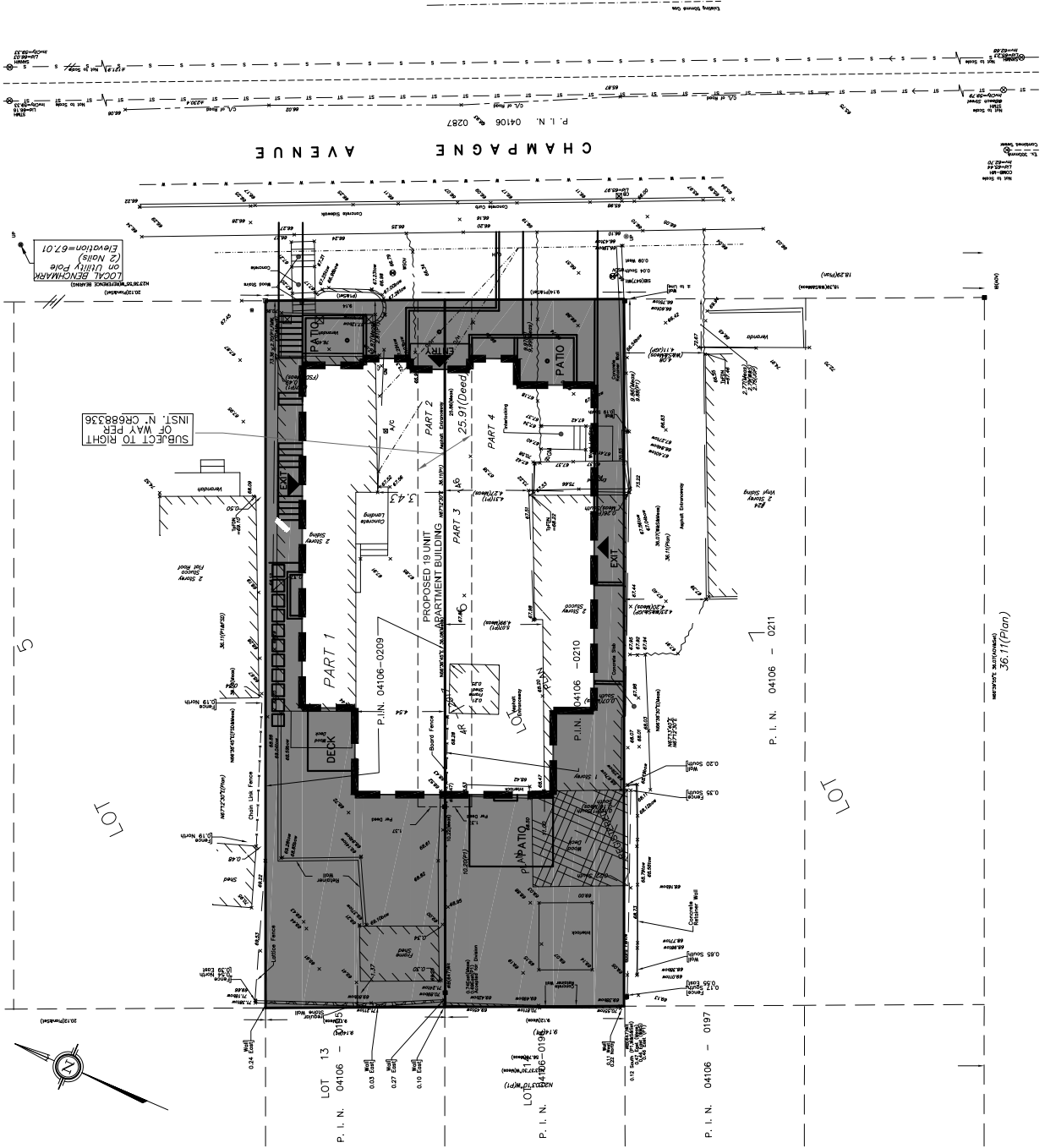
**APPENDIX A**

**STORM DRAINAGE AREA PLAN**

**FIGURE 1**

PROPOSED 16-20 CHAMPAGNE AVENUE  
 SITE DEVELOPMENT  
 DRAINAGE AREA PLAN

NOT TO SCALE



**LEGEND**

**LIMIT OF CONTROLLED  
 STORM DRAINAGE AREA  
 =299.4 SQ. M**

**UNCONTROLLED  
 STORM DRAINAGE AREA  
 =360.10 SQ. M**

**TOTAL AREA = 659.5 SQ. M**

**POST-DEVELOPMENT SITE  
 AVERAGE "C" = 0.63**

**FIGURE 1**

**PROPOSED THREE(3)-STOREY APARTMENT BUILDING SITE**

**LOT 6**

**R-PLAN 146**

**16-20 CHAMPAGNE AVENUE**

**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 and Roof Area 2 will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 20 U.S. gallons/minute or 1.26L/s.

#### Roof Storage Area 1

Available flat roof area for storage =150.3m<sup>2</sup> @roof slope of 1.7% 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.

$$V = \frac{(0.11\text{m})[84.0 + 4(21.4) + 0]}{6}$$
$$V = \frac{(0.11)(169.6)}{6}$$
$$V = 3.11\text{m}^3$$

The available Roof Area 1 storage volume of 3.11m<sup>3</sup> >required five(5)-year storage volume of 1.71m<sup>3</sup> from Table 1.

#### Roof Storage Area 2

Available flat roof area for storage =149.1m<sup>2</sup> @roof slope of 1.7% 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.

$$V = \frac{(0.11\text{m})[82.2 + 4(20.6) + 0]}{6}$$
$$V = \frac{(0.11)(164.6)}{6}$$
$$V = 3.02\text{m}^3$$

The available Roof Area 2 storage volume of 3.02m<sup>3</sup> >required five(5)-year storage volume of 1.67m<sup>3</sup> from Table 2.

Therefore, the ponding depth at the drain location is approximately 0.11m (110mm), and the five(5)-year level is estimated not to reach the roof perimeter of the building.

Hence, Roof Area 1 and Roof Area 2 of the proposed residential building flat rooftop storage are adequate to store the minimum required five(5)-year storm event volume of 3.38m<sup>3</sup> given it can store up to 6.13m<sup>3</sup>.



## AVAILABLE STORAGE VOLUME CALCULATIONS

### 100-Year Event

#### Roof Storage at Flat Roof Building

The flat Roof Area 1 and Roof Area 2 will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 20 U.S. gallons/minute or 1.26L/s.

#### Roof Storage Area 1

Available flat roof area for storage =150.3m<sup>2</sup> @roof slope of 1.7% 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.

$$V = \frac{(0.15m)[150.3 + 4(39.4) + 0]}{6}$$

$$V = \frac{(0.15)(307.9)}{6}$$

$$V = 7.70m^3$$

The available Roof Area 1 storage volume of 7.70m<sup>3</sup> >required 100-year storage volume of 4.68m<sup>3</sup> from Table 3.

#### Roof Storage Area 2

Available flat roof area for storage =149.1m<sup>2</sup> @roof slope of 1.7% 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.

$$V = \frac{(0.15m)[149.1 + 4(38.5) + 0]}{6}$$

$$V = \frac{(0.15)(303.1)}{6}$$

$$V = 7.58m^3$$

The available Roof Area 2 storage volume of 7.58m<sup>3</sup> >required 100-year storage volume of 4.59m<sup>3</sup> from Table 4.

Therefore, the ponding depth at the drain location is approximately 0.15m (150mm), and ponding does not reach the perimeter of the flat roof area, so it is 0mm above the roof perimeter surface. Accordingly, it is recommended that four(4) roof scuppers as shown on Dwg. 818-54 G-1 and 818-54 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.

Hence, Roof Area 1 and Roof Area 2 of the proposed residential building flat rooftop storage are adequate to store the minimum required 100-year storm event volume of  $9.27\text{m}^3$  given it can store up to  $15.28\text{m}^3$ .