450 Rochester

Site Servicing and Stormwater Management Report

ISSUED FOR SITE PLAN APPROVAL

Arnon Corporation

RVA 184355

November 20, 2019

450 Rochester
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1.0 INTRODUCTION

R.V. Anderson Associates Limited has been retained by Arnon Corporation to provide the site servicing design and stormwater management for the proposed residential and commercial complex at 450 Rochester Street between Aberdeen Street and Beech Street. This report will outline the proposed stormwater management measures and site services that will be implemented with the site to be in compliance with the City of Ottawa requirements.

1.1 Site Description

The site is located at 450 Rochester Street in the City of Ottawa, bordered by Rochester Street, Aberdeen Street, Preston Street and Beech Street. The site is currently occupied by a public surface parking lot and three two-storey buildings facing Preston Street, as shown in Figure 1.

Figure 1. Project Location.

The proposed development of the site includes two mixed-use buildings with underground parking, to be constructed into two phases.

Phase 1: The proposed building for Phase 1 consists of 295 residential units and commercial space on the ground floor.

Phase 2: The proposed building for Phase 2 consists of 269 residential units and commercial space on the ground floor.

Refer to the architectural plans for the building layout.

2.0 DESIGN REQUIREMENTS

The site is in a combined sewer area; therefore, stringent quantity control requirements apply. Following discussions with the City of Ottawa, it was determined that the allowable runoff for this site must be controlled to a runoff coefficient of 0.4 for a 2-year storm with a time of concentration of 20 minutes.

This report is intended to outline the proposed servicing and stormwater management plan, and to demonstrate that the overall outflow for the site meets the requirements set out above.

2.1 Design Criteria – Combined Sewer Discharge

The following design criteria are proposed as a result of discussions with the City of Ottawa:

Peak Flow - 2-year peak post-development flows controlled to a runoff coefficient of 0.4.

Calculated Method - Modified Rational Method using spreadsheet.

Storage Method - Surface and underground storage.

Proposed Drainage - The proposed site sanitary and storm services will discharge to the existing combined sewers on Rochester Street, and Aberdeen Street.

Coefficients of Runoff -

	2 Year	100 Year
Roof:	C=0.95	C=1.00
Asphalt:	C=0.90	C=1.00
Grass:	C=0.20	C=0.25

Rainfall Intensities - City of Ottawa IDF rainfall curve for 100-year storms to generate the intensity formula as follows (See Appendix B for IDF curves):

$$i_{2yr} = \frac{732.951}{(T + 6.199)^{0.810}} - \text{equation (1)}$$

$$i_{5yr} = \frac{998.071}{(T + 6.053)^{0.814}} - \text{equation (2)}$$

$$i_{100yr} = \frac{1735.668}{(T + 6.014)^{0.820}} - \text{equation (3)}$$

where:
i – Rainfall intensity (mm/hr), T – Time (min)

3.0 SITE SERVICING

This section of the report is intended as a summary of the water supply and sanitary servicing to the site. Stormwater management follows in Section 4.0.

Drawing C-01 in Appendix A shows the layout of site servicing, including water, sanitary and storm services and connections. The site will be developed in two phases, with each phase being serviced separately.

3.1 Water Service

This section addresses water supply for Phase 1 and Phase 2 of the proposed development.

Note that proposed development requires two separate service connections from the city watermains where basic day demand is greater than 50m^3/day to avoid the creation of a vulnerable service area. A water meter is required for each service connection and the service connections must be looped.

3.1.1 Phase 1 – Water

Based on the size and use of the proposed building, the water demand can be calculated using the City of Ottawa Design Guidelines for Water Distribution (July 2010). The proposed building consists of residential and commercial areas. Phase 1 includes 182 1-bedroom units (1.4 persons/ unit) and 113 2-bedroom units (2.1 persons/unit). In addition, there is 5174 m^2 of commercial space on the ground floor.

For residential development, an average water consumption rate of 350 L/c/day is used. The maximum daily flow is calculated as:

$$\text{Residential Max Daily Flow (W)} = 2.5 \text{ x Average Daily Flow}$$

The maximum hourly flow is calculated as:

$$\text{Residential Max Hourly Flow (W)} = 2.2 \text{ x Max Daily Flow}$$

For commercial development, an average water consumption rate of 2500 L/gross ha/d, as per Section 4.2.8 of the design guidelines. The maximum daily flow for commercial areas is calculated as:

$$\text{Commercial Max Daily Flow (W)} = 1.5 \text{ x Average Daily Flow}$$

The maximum hourly flow for commercial areas is calculated as:

$$\text{Commercial Max Hourly Flow (W)} = 1.8 \text{ x Max Daily Flow}$$

Water flows for the proposed Phase 1 building calculated using the method above are presented below in Table 1.

Table 1: Phase 1 Water Flows

Type	Units / Area	Average Daily Flow (L/s)	Maximum Daily Flow (L/s)	Maximum Hourly Flow (L/s)
Residential	295 units	1.99	4.98	10.96
Commercial	0.52 ha	0.15	0.22	0.40
	Total	**2.14**	**5.20**	**11.36**

Given that the basic water demand is greater that 50 m^3/day, the Phase 1 building will be serviced with two (2) connections from city watermains to avoid the creation of a vulnerable service area.

The proposed water service connections are:

- 150mm water service entering the new building on the south face of the building parking garage and connecting to the existing 203mm watermain on Beech St
- 150mm water service entering the new building on the north face of the building parking garage and connecting to the existing 203mm watermain on Aberdeen St.

The locations of the service connections are shown on Drawing C-01 in Appendix A.

3.1.2 Phase 2 – Water

The water demand for the proposed Phase 2 building was calculated using the method outlined above in Section 3.1.1.

The proposed building for Phase 2 includes 269 residential units. Per section 4.2.8 of the design guidelines a rate of 1.8 persons per unit was assumed for Phase 2. In addition, there is 1367 m^2 of commercial space on the ground floor.

Water flows for the proposed Phase 2 building calculated using the method above are presented below in Table 2.

Table 2: Phase 2 Water Flows

Type	Units / Area	Average Daily Flow (L/s)	Maximum Daily Flow (L/s)	Maximum Hourly Flow (L/s)
Residential	269 units	1.96	4.90	10.79
Commercial	0.14 ha	0.04	0.06	0.11
TOTAL		**2.00**	**4.96**	**10.90**

Given that the basic water demand is greater that 50 m^3/day, the Phase 2 building will be serviced with two (2) connections from city watermains to avoid the creation of a vulnerable service area.

The proposed water service connections are:

- 150mm water service entering the new building on the south face of the building parking garage and connecting to the existing 203mm watermain on Beech St
- 150mm water service entering the new building on the east face of the building parking garage and connecting to the existing 305mm watermain on Rochester Street.

The locations of the service connections are shown on drawing C-01 in Appendix A.

3.1.3 Fire Flow

The fire flow required for each building was calculated using the Fire Underwriters Survey Method (1999), as follows:

$$F = 220C\sqrt{A}$$

where:

F = the required fire flow in litres per minute.
C = coefficient related to the type of construction
A = total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building

It was assumed that the buildings will both be of non-combustible construction, which corresponds to a coefficient of 0.8.

The maximum fire flow required for each building as calculated per the method above is:

- Phase 1: 22,000 L/min (367 L/s)
- Phase 2: 17,000 L/min (283 L/s)

Refer to calculations included in Appendix B.

Note that the required fire flow could be reduced if the buildings were of fire-resistive construction (fully protected frame, floors, roof).

City of Ottawa hydrant testing was not made available in preparation of this study to confirm availability of adequate fire flow for the proposed building. This shall be confirmed in consultation with the City.

3.2 Sanitary Service

As noted above, the site is in a combined sewer area; therefore, wastewater from the proposed development will discharge to a combined sewer. Separate service laterals for sanitary wastewater and storm water will be provided to facilitate future separation of sewers in the area.

3.2.1 Phase 1 - Wastewater

For residential developments an average wastewater rate of 280 L/c/day is used, based on the City of Ottawa Sewer Design Guidelines (October 2012) and accompanying technical bulletins. The maximum daily flow is calculated as:

$$\text{Residential Max Daily Flow (Sanitary)} = \text{Residential Average Daily Flow (Sanitary)} * \text{Peak Factor}$$

where: $$\text{Peak Factor} = 1 + \left(\frac{14}{4+\left(\frac{\text{Population}}{1000}\right)^{0.5}}\right) * \text{K}$$

In addition, according to the design guidelines an average wastewater rate of 17,000 L/gross ha/d is used for the commercial areas. According to the guidelines, since the commercial area on site less than 20% of the total area, the maximum daily flow is:

$$\text{Commercial Max Daily Flow (Sanitary)} = 1.0 \text{ x Average Daily Flow(Sanitary)}$$

Additionally, extraneous flows can be calculated as follows:

$$\text{Q}_{\text{extraneous}} = 0.33\text{L/s} * Area$$

Wastewater flow for the proposed Phase 1 building calculated using the method above is summarized below in Table 3.

Table 3: Phase 1 Wastewater Flows

Type	Units / Area	Average Daily Flow (L/s)	Maximum Daily Flow (L/s)
Residential	295 units	1.60	5.66
Commercial	0.52 ha	0.10	0.10
Extraneous	0.729 ha	0.24	0.24
Total		**1.94**	**6.00**

The proposed sanitary sewer lateral for Phase 1 is a 200mm sanitary service, exiting the building on the north side and draining into the existing 1200mm city combined sewer on Aberdeen Street. Refer to drawing C-01 in Appendix A for details.

3.2.2 Phase 2 - Wastewater

The wastewater flow for the proposed Phase 2 building was calculated using the same method outlined above in Section 3.2.1.

Wastewater flow for the proposed Phase 2 building calculated using the method above is summarized below in Table 4.

Table 4: Phase 2 Wastewater Flows

Type	Units / Area	Average Daily Flow (L/s)	Maximum Daily Flow (L/s)
Residential	269 units	1.57	5.31
Commercial	0.14 ha	0.03	0.03
Extraneous	0.192 ha	0.06	0.06
Total		**1.66**	**5.40**

The proposed sanitary sewer lateral for Phase 2 is a 200mm sanitary service, exiting the building on the north side and draining into the existing 750mm city combined sewer on Rochester Street. Refer to drawing C-01 in Appendix A for details.

3.2.3 Existing Conditions

Existing wastewater flow from the 5 two-storey buildings currently occupying the site is assumed to drain to Preston Street. There appears to be 4 single family homes and 1 two-storey building with 1 apartment (1.8 persons/unit) and 135m^2 of commercial space on the current site. Table 5 below presents the wastewater flows for the existing site.

Table 5: Existing Site Wastewater Flows

Type	Units / Area	Average Daily Flow (L/s)	Maximum Daily Flow (L/s)
Residential	5 units	0.03	0.14
Commercial	0.01 ha	0.00	0.00
Extraneous	0.921 ha	0.30	0.30
Total		**0.33**	**0.44**

The existing buildings on the site will be demolished as part of Phase 1 of the proposed development. The existing service connections will be removed from the site during construction, and capped at the property line.

4.0 STORMWATER MANAGEMENT

4.1 Proposed Approach

The stormwater management approach best suited to the site to achieve the allowable discharge rate is a combination of methods of stormwater retention, based on the volume of storage required and the proposed site configuration. To accommodate the volumes calculated below, storage will be provided on roof top surfaces and in storage tanks in each building.

For the purposes of this report, we have used a modified rational method approach. This method was selected considering the relatively small size of individual drainage areas for the site.

This approach involves using the City of Ottawa IDF charts and equations described above to determine the storage required. For each five-minute interval, an associated flow is calculated using the rational method:

$$Q = \frac{CIA}{3600}$$

where:

Q = Flow (L/s)
C = Runoff Coefficient
I = Rainfall Intensity (mm/hr)
A = Area (m^2)

The flow contributing to storage on-site is the post-development flow minus the allowable discharge rate (through the inlet control device). The quantity of storage required is calculated by multiplying the flow contributing to storage by the five-minute time interval. The accumulated storage is summed for each five-minute time interval to determine the peak storage required.

4.2 Design Parameters

4.2.1 Site Characteristics

Drawing C-1 (Appendix A) shows the proposed building and site layout. The total area of the site is 9214 m^2.

The proposed site development consists of roof and hard landscape areas with runoff standard City of Ottawa runoff coefficients as follows in Table 6.

Table 6: Surface Drainage Areas

Surface Type Coefficient	Phase 1 Surface Area (m^2)	Phase 2 Surface Area (m^2)	Total Site Surface Area (m^2)
Hard (0.90)	2049	651	2700
Roof (0.95)	5241	1273	6514
Total	**7290**	**1924**	**9214**

4.2.2 Allowable Discharge

The allowable peak discharge rate for the site is equal to the 2-year peak development flow controlled at a time of concentration of 20 minutes and a maximum runoff coefficient of 0.4. Based on this time of concentration, the 2-year rainfall intensity can be calculated as follows:

$$i_{2yr} = \frac{732.951}{(T + 6.199)^{0.810}}$$

$$i_{2yr} = 52.0 mm/hr$$

The allowable runoff for the site can then be calculated as follows:

$$Q_{ALL} = \frac{0.4 \text{ x } 52.0 mm/hr \text{ x } 9214 m^2}{3600}$$

$$Q_{ALL} = 53.2 L/s$$

This is the total allowable flow (sanitary and storm combined) from the site, given the requirements of the site.

Since the two buildings will be serviced separately, this allowable discharge will be divided between the buildings based on total area as follows:

Phase 1 – $Q_{ALLPHASE1}$ = 32.1L/s
Phase 2 – $Q_{ALLPHASE2}$ = 21.1L/s

This allocation will allow each building to be serviced separately, while still meeting the allowable discharge requirements on a site level.

4.3 Storage Requirements

As outlined above, in order to control the total flow from the site to the allowable flow rate of 53.2 L/s, a combination of roof top and underground storage will be used. Roof top storage for each building Phase is outlined in this section and underground storage is addressed in Section 4.4.

4.3.1 Phase 1

As outlined in Section 4.2.2, the allowable discharge for Phase 1 has been set at 32.1 L/s. The sections below outline how stormwater will be captured and stored to limit the discharge rate.

4.3.1.1 Rooftop Storage

The area of the new rooftop in Phase 1 is 5241m^2. The drainage from the rooftop will be limited to a flow of 4.5 L/s through six roof drains. The mechanical engineer will design the six proposed roof drains to control the flow to 0.75 L/s each.

$$C_{roof-5year} = \frac{[0.90(0) + 0.20(0) + 0.95(5251)]}{5251} = 0.95$$

$$C_{roof-100year} = \frac{[1.0(298) + 0.25(0) + 1.0(5251)]}{5251} = 1.0$$

Using the selected rooftop discharge rate of 4.5 L/s, the resulting storage volume was computed, and Appendix B provides the storage volumes for the rooftop drainage. The volume of roof storage required in the 100-year storm is summarized in Table 7. As per discussions with the City of Ottawa, a 20-minute time of concentration was used.

Table 7: Rooftop Discharge and Storage Summary (Phase 1)

Bldg.	Area (m^2)	Allowable Discharge (L/s)	5-Year Event		100-Year Event	
			Storage Required (m^3)	Maximum Ponding Depth (mm)	Storage Required (m^3)	Maximum Ponding Depth (mm)
Phase 1	5251	5.5	163.8	31	330.8	63

4.3.1.2 Phase 1 Additional Storage Requirements

The total surface area of the Phase 1 site excluding the rooftop described above is 2049m^2, consisting of paved surface and hard landscaping.

Of this surface area, the section between the building and the back of the sidewalk around the building will generally sheet drain freely onto the surrounding streets. This area is 609m^2, consisting of entirely hard surface. Flow from this area is as follows:

$$C_{free-100year} = \frac{[1.0(609) + 0.25(0) + 1.0(0)]}{1114} = 1.0$$

$$Q_{free} = \frac{1 \text{ x } 120.0 mm/hr \text{ x } 609 m^2}{3600}$$
$$Q_{free} = 20.3 \text{ L/s}$$

The allowable stormwater flow for the remaining controlled surface areas can be calculated by removing the proposed rooftop flow, the free flowing surface, and the proposed sanitary flow (calculated in Section 3) from the overall allowable flow for Phase 1.

$$Q_{surface} = Q_{ALLPHASE1} - Q_{roof} - Q_{free} - Q_{sanitary}$$
$$Q_{surface} = 32.1 \text{L/s} - 4.5 L/s - 20.3 L/s - 1.94 L/s$$
$$Q_{surface} = 5.4 \text{L/s}$$

The remaining surface area is 1440m^2, consisting of paved surface parking lot (1121m^2) and one hard landscaped area (319m^2), from which runoff will be contained in a storage tank inside the parking garage.

The overall weighted runoff coefficients for this remaining controlled surface area are calculated using standard City of Ottawa runoff coefficients as:

$$C_{surface-100year} = \frac{[1.0(1440) + 0.25(0)]}{1440} = 1.0$$
$$C_{surface-5year} = \frac{[0.9(1440) + 0.25(0)]}{1440} = 0.9$$

See Table 8 below for the summary of required storage of surface runoff. Refer to Appendix B for the design calculations.

Table 8: Surface Discharge and Storage Summary (Phase 1)

Surface	Area (m^2)	Weighted Runoff Coefficient 5-year	Weighted Runoff Coefficient 100-year	Allowable Discharge (L/s)	5-Year Storage Required (m^3)	100-Year Storage Required (m^3)
Parking Lot and Landscaped Areas	1440	0.90	1.00	5.4	25.3	61.1

4.3.1.3 Phase 1 Storage Tank Details

The tank will be sized to contain the full 100-year storage in the approximate location shown on Drawing C-01. Final dimensions and layout will be confirmed through

coordination with the Structural and Mechanical designers. Depending on the final layout of the tank, the flow will be restricted to the allowable discharge rate by either an Inlet Control Device on the outlet (if flow is achieved by gravity) or by controlled pumping (if gravity is not achievable). In the event that the 100-year storm is exceeded, water will drain overland to the driveway through storm drain RD#8 at the north east corner of Phase 1.

Refer to Appendix B for the storm design sheets, detailing how the flow is achieved.

The proposed storm lateral for Phase 1 is a 375mm storm service, exiting the building on the north side and draining into the existing 1200mm city combined sewer on Aberdeen Street. Refer to drawing C-01 in Appendix A for details.

4.3.2 Phase 2

As outlined in Section 4.2.2, the allowable discharge for Phase 2 has been set at 21.1 L/s. The sections below outline how stormwater will be captured and stored to limit the discharge rate from Phase 2.

4.3.2.1 Rooftop Storage

The area of the new rooftop in Phase 2 is 1273m^2. The drainage from the rooftop will be limited to a flow of 2.25 L/s through three roof drains. The mechanical engineer will design the three proposed roof drains to control the flow to 0.75 L/s each.

$$C_{roof-5year} = \frac{[0.90(0) + 0.20(0) + 0.95(1273)]}{1273} = 0.95$$

$$C_{roof-100year} = \frac{[1.0(298) + 0.25(0) + 1.0(1273)]}{1273} = 1.0$$

Using the selected rooftop discharge rate of 2.25 L/s, the resulting storage volume was computed, and Appendix B provides the storage volumes for the rooftop drainage. The volume of roof storage required in the 100-year storm is summarized in Table 9. As per discussions with the City of Ottawa, a 20-minute time of concentration was used.

Table 9: Rooftop Discharge and Storage Summary (Phase 2)

Bldg.	Area (m^2)	Allowable Discharge (L/s)	5-Year Event		100-Year Event	
			Storage Required (m^3)	Maximum Ponding Depth (mm)	Storage Required (m^3)	Maximum Ponding Depth (mm)
Phase 2	1273	2.25	32.0	25	67.7	53

4.3.2.2 Phase 2 Additional Storage Requirements

The total surface area of the Phase 2 site excluding the new rooftop described above is 651m^2, consisting of paved surface and hard landscaping.

Of this surface area, the section between the building and the back of the sidewalk around the building will generally sheet drain freely onto the surrounding streets. This area is 403m^2, consisting of entirely hard surface. Flow from this area is as follows:

$$C_{free-100year} = \frac{[1.0(403) + 0.25(0) + 1.0(0)]}{403} = 1.0$$

$$Q_{free} = \frac{1 \text{ x } 120.0\text{mm/hr x } 403\text{m}^2}{3600}$$
$$Q_{free} = 13.4 \text{ L/s}$$

The allowable stormwater flow for the remaining controlled surface areas can be calculated by removing the proposed rooftop flow, the free flowing surface, and the proposed sanitary flow (calculated in Section 3) from the overall allowable flow for Phase 2.

$$Q_{surface} = Q_{ALLPHASE2} - Q_{roof} - Q_{free} - Q_{sanitary}$$
$$Q_{surface} = 21.1\text{L/s} - 2.25L/s - 13.4\ L/s - 1.66\ L/s$$
$$Q_{surface} = 3.79\text{L/s}$$

The remaining surface area is 248m^2, consisting of hard landscaped areas, from which runoff will be contained in a storage tank inside the parking garage.

The overall weighted runoff coefficients for this remaining controlled surface area are calculated using standard City of Ottawa runoff coefficients as:

$$C_{surface-100year} = \frac{[1.0(248) + 0.25(0)]}{248} = 1.0$$
$$C_{surface-5year} = \frac{[0.9(248) + 0.25(0)]}{248} = 0.9$$

See Table 10 below for the summary of required storage of surface runoff.

Table 10: Surface Discharge and Storage Summary (Phase 2)

Surface	Area (m^2)	Weighted Runoff Coefficient 5-year	Weighted Runoff Coefficient 100-year	Allowable Discharge (L/s)	5-Year Storage Required (m^3)	100-Year Storage Required (m^3)
Hard Landscaped Areas	248	0.90	1.00	3.79	1.6	5.5

4.3.2.3 Phase 2 Storage Tank Details

The tank will be sized to contain the full 100-year storage in the approximate location shown on Drawing C-01. Final dimensions and layout will be confirmed through coordination with the Structural and Mechanical designers. Depending on the final layout of the tank, the flow will be restricted to the allowable discharge rate by either an Inlet Control Device on the outlet (if flow is achieved by gravity) or by controlled pumping (if gravity is not achievable). In the event that the 100-year storm is exceeded, water will drain overland to the hard landscaped area through storm drain RD#4 at the south east corner of the site.

Refer to Appendix B for the storm design sheets, detailing how the flow is achieved.

The proposed storm lateral for Phase 2 is a 250mm storm service, exiting the building on the north side and draining into the existing 1200mm city combined sewer on Aberdeen Street.

5.0 EROSION AND SEDIMENT CONTROL

Erosion and sediment control measures (in accordance with the requirements of OPSS 805 – November 2018 for temporary measures) consisting of both permanent and temporary measures shall be implemented prior to the commencement of construction activities to ensure that sediment is contained within the site. Permanent erosion control measures shall ensure that potential long-term and localized erosion problems are dealt with prior to their occurrence.

5.1 Temporary Sediment Control Measures

Filter fabric shall be installed under the frame of all proposed and existing catchbasins and storm manholes immediately adjacent to any disturbed areas prior to construction to prevent sediment from entering into the sewer system. The filter fabric shall remain in-place for the duration of construction activities and shall not be removed until such time as the landscaping has been established and upon authorization by the Engineer. Light duty sediment fencing shall also be placed around the perimeter of the site for the duration of the construction.

Refer to Drawing C-01 for specific erosion and sediment control measures to be installed and monitored during construction.

6.0 CONCLUSION

The design of the stormwater management system serves to control the 100-year peak post-development flows to that of the 2-year peak flow at a runoff coefficient 0.4 as recommended by the City of Ottawa. On-site storage is proposed on the roof of the new buildings and below the surface within storage tanks at basement level during the 5-year and 100-year storm events. Discharge from the storage tanks into City's sewer system will be controlled either by using Inlet Control Devices (ICD) or via controlled pumping, pending the final layout and placement of the tanks by the mechanical and structural engineers. It will be the owners' responsibility to maintain the roof drains, stormwater storage tanks, pumps and ICDs in good working condition.

Given that the runoff coefficient for the site is being lowered to 0.4 which is lower than the runoff coefficient under existing conditions, the existing combined sewers on Rochester Street and Aberdeen Street are assumed to have adequate capacity to accommodate combined flow from the proposed buildings.

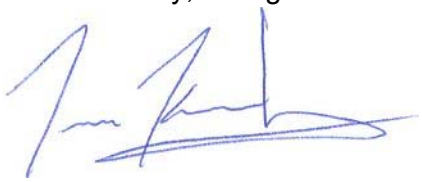
Fire flow requirements were calculated; however, capacity in the system must be confirmed with the City, based on boundary flow conditions.

We trust this Site Servicing and Stormwater Management report complies with the City of Ottawa requirements and we look forward to receiving your approval.

R.V. ANDERSON ASSOCIATES LIMITED

Prepared by:
Nathaniel Rodgers, P.Eng.

Reviewed by:
Trevor Kealey, P.Eng.



APPENDIX A

Site Servicing and Grading Plan

PRIVATE WATERMAIN TABLE

	STATION	DESCRIPTION	TOP OF PIPE ELEVATION	GROUND ELEVATION	COMMENTS
150mm PVC WATER SERVICE	1+00.0	BUILDING/PARKING GARAGE CONNECTION	58.19	60.59	CONNECTION TO BUILDING SERVICES: SEE MECHANICAL
	1+01.0	VALVE & VALVE BOX	58.17	60.57	VALVE AND VALVE BOX PER W24
	1+07.7	COMBINED SEWER CROSSING	59.04	60.48	WM CROSSES OVER COMBINED SEWER PER W25.2 AND INSULATION PER W22. TOP OF SEWER PIPE PIPE = 58.64
	1+09.6	CONNECTION TO 203mmØ WM.	58.04	60.44	CONNECT TO CITY SEWER AS PER W33
150mm PVC WATER SERVICE	2+00.0	BUILDING/PARKING GARAGE CONNECTION	57.91	60.31	CONNECTION TO BUILDING SERVICES: SEE MECHANICAL
	2+04.8	VALVE & VALVE BOX	57.82	60.22	VALVE AND VALVE BOX PER W24
	2+09.0	COMBINED SEWER CROSSING	58.74	60.28	WM CROSSES OVER COMBINED SEWER PER W25.2 AND INSULATION PER W22. TOP OF SEWER PIPE PIPE = 58.34
	2+13.1	CONNECTION TO 305mmØ WM.	57.80	60.20	CONNECT TO CITY SEWER AS PER W33
150mm PVC WATER SERVICE	3+00.0	BUILDING/PARKING GARAGE CONNECTION	59.82	62.22	CONNECTION TO BUILDING SERVICES: SEE MECHANICAL
	3+01.5	VALVE & VALVE BOX	59.79	62.19	VALVE AND VALVE BOX PER W24
	3+16.1	CONNECTION TO 203mmØ WM.	59.68	62.08	CONNECT TO CITY SEWER AS PER W33
150mm PVC WATER SERVICE	4+00.0	BUILDING/PARKING GARAGE CONNECTION	57.96	60.36	CONNECTION TO BUILDING SERVICES: SEE MECHANICAL
	4+02.7	VALVE & VALVE BOX	57.94	60.34	VALVE AND VALVE BOX PER W24
	4+16.1	CONNECTION TO 203mmØ WM.	57.88	60.28	CONNECT TO CITY SEWER AS PER W33

STORM INVERT SCHEDULE

	STRUCTURE	TOP	INVERT	COMMENTS
	RD#1	62.00	SEE MECHANICAL	ROOF DRAIN: SEE MECHANICAL
	RD#2	61.89	SEE MECHANICAL	ROOF DRAIN: SEE MECHANICAL
	RD#3	60.46	SEE MECHANICAL	ROOF DRAIN: SEE MECHANICAL
	RD#4	60.20	SEE MECHANICAL	ROOF DRAIN: SEE MECHANICAL
	RD#5	60.71	SEE MECHANICAL	ROOF DRAIN: SEE MECHANICAL
	RD#6	60.26	SEE MECHANICAL	ROOF DRAIN: SEE MECHANICAL
	RD#7	60.11	SEE MECHANICAL	ROOF DRAIN: SEE MECHANICAL
	RD#8	59.86	SEE MECHANICAL	ROOF DRAIN: SEE MECHANICAL
PHASE 1 375mm PVC	STORM CISTERN	60.01	58.17	STM CISTERN OBSERVATION WELL: SEE MECHANICAL FOR DETAILS
	BUILDING/PARKING GARAGE CONNECTION	59.99	58.17	CONNECTION TO BUILDING SERVICES: SEE MECHANICAL
	CONNECTION TO CITY SEWER	59.03	58.09	CONNECT TO 1200mm COMBINED SEWER AS PER CITY DWG S11. CITY SEWER INVERT 57.37.
PHASE 2 250mm PVC	STORM CISTERN	59.86	58.31	STM CISTERN OBSERVATION WELL: SEE MECHANICAL FOR DETAILS
	BUILDING/PARKING GARAGE CONNECTION	59.85	58.31	CONNECTION TO BUILDING SERVICES: SEE MECHANICAL
	CONNECTION TO CITY SEWER	59.91	58.24	CONNECT TO 1200mm COMBINED SEWER AS PER CITY DWG S11. CITY SEWER INVERT57.39.

SANITARY INVERT SCHEDULE

	STRUCTURE	GROUND	INVERT	COMMENTS
PHASE 1 200mm PVC	BUILDING/PARKING GARAGE CONNECTION	60.42	58.28	CONNECTION TO BUILDING SERVICES: SEE MECHANICAL FOR MONITORING PORT IN PARKING GARAGE
	CONNECTION TO MAIN SEWER	60.30	58.20	CONNECT TO 1200mm COMBINED SEWER AS PER CITY DWG S11. CITY SEWER INVERT 57.31.
PHASE 2 200mm PVC	BUILDING/PARKING GARAGE CONNECTION	60.16	58.41	CONNECTION TO BUILDING SERVICES: SEE MECHANICAL FOR MONITORING PORT IN PARKING GARAGE
	CONNECTION TO MAIN SEWER	60.06	58.34	CONNECT TO 1200mm COMBINED SEWER AS PER CITY DWG S11. CITY SEWER INVERT 57.44.

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ARCHITECTURAL DRAWINGS BY HOBIN ARCHITURE.

2. ALL WATERMAINS TO BE INSULATED IF LESS THAN 2.4 METERS COVER AS PER CITY OF OTTAWA STANDARD DETAIL W22. AT ANY PROXIMITY OF SEWER MANHOLES, INSULATE WATERMAIN AS PER CITY DETAIL W23.

3. SEWERS ARE TO MAINTAIN 500mm BARRELL TO BARRELL CLEARANCE ABOVE AND 250mm BARRELL TO BARRELL CLEARANCE BELOW WATERMAINS AT ALL CROSSINGS (AS PER CITY DWGS W25 AND W25.2), IF 22° BENDS ARE USED ON THE WATER MAIN, THEY MUST BE ONE METER AWAY FROM THE SEWER.

4. THRUST BLOCKS TO BE AS PER CITY OF OTTAWA STANDARD DRAWINGS W25.3 AND W25.4. RESTRAINING AND RETAINING RINGS TO BE INSTALLED IN ACCORDANCE WITH CITY STANDARD DETAILS W25.5 AND W25.6.

5. TEMPORARY SUPPORT OF EXISTING UNDERGROUND UTILITIES IN ACCORDANCE WITH CITY STANDARD DETAIL W28.

6. WATERMAIN TRENCH AND BEDDING TO BE INSTALLED AS PER CITY DETAIL W17.

7. TAPPING VALVE SYSTEM CONNECTION TO CITY WATERMAIN BY CITY FORCES; EXCAVATION, BACKFILLING AND REINSTATEMENT BY CONTRACTOR.

8. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION OF ALL EXISTING U/G AND OVERHEAD UTILITIES. VARIOUS UTILITIES CONCERNED TO BE GIVEN REQUIRED ADVANCE NOTICE PRIOR TO ANY DIGGING FOR STAKE OUT. THE OWNER AND CONSULTANT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE LOCATION OF EXISTING UTILITIES AS INDICATED ON THIS DRAWING.

9. UTILITY INFORMATION WAS VERIFIED IN THE FIELD WHERE POSSIBLE, INDIVIDUAL COMPANIES SHOULD BE CONTACTED BY THE CONTRACTOR PRIOR TO COMMENCEMENT FOR CONFIRMATION OF EXISTENCE AND LOCATION OF UTILITIES.

10. WATER SERVICE, STORM SEWERS AND APPURTENANCE TO COMPLY WITH THE REQUIREMENTS OF THE LATEST REVISION OF THE ONTARIO PLUMBING CODE AND APPLICABLE CITY OF OTTAWA ENGINEERING STANDARDS.

11. ALL SANITARY SEWERS TO BE INSULATED IF LESS THAN 2.0 METERS COVER. ALL STORM SEWERS TO BE INSULATED IF LESS THAN 2.0 METERS COVER, INSULATE AS PER CITY OF OTTAWA STANDARD DETAIL W22. ALL BUILDING CONNECTIONS TO HAVE SUFFICIENT COVER OR INSULATION IS REQUIRED.

12. CONTRACTOR SHALL CONTACT THE CONSULTANT, R.V. ANDERSON PRIOR TO BACKFILLING OF THE WATER SERVICE CONNECTIONS FOR THE PROPOSED LINES AND TIE-INS TO EXISTING LINES FOR AS-BUILT LOCATION RECORDS AND INSPECTION.

13. ANY ASPHALT CUT SHALL BE SAW CUT ON BOTH SIDES OF THE TRENCH FOR THE ENTIRE LENGTH OF THE EXCAVATION FOR PIPE INSTALLATIONS. REINSTATEMENT OF THE ROADS SHALL MATCH EXISTING OR MEET CITY STANDARD R10.

14. ANY CONCRETE CUT SHALL BE REMOVED AT EXPANSION JOINTS, IF NO JOINTS EXIST, THE CONCRETE SHALL BE SAW CUT ON BOTH SIDES OF THE TRENCH FOR THE ENTIRE LENGTH OF THE EXCAVATION FOR PIPE INSTALLATIONS. REINSTATEMENT SHALL MATCH EXISTING OR MEET CITY REQUIREMENTS.

15. PIPE BEDDING SHALL BE GRANULAR "A" AS PER CITY DETAIL S6, AND SHALL BE COMPACTED TO 95% SPD AND APPROVED SELECT NATIVE BACK FILL COMPACTED TO 95% SPD.

16. DRAWINGS TO BE READ IN CONJUNCTION WITH CONTRACT SPECIFICATIONS.

17. GRANULAR LAYERS BENEATH NEW ASPHALT SURFACES ON PROPERTY SHALL BE PLACED AT A THICKNESS NOT EXCEEDING 300mm, THE GRANULAR 'A' AND GRANULAR 'B' TYPE II IS TO BE COMPACTED TO A MINIMUM OF 100% SPMDD USING SUITABLE VIBRATORY EQUIPMENT.

18. THE APPROVAL OF THIS PLAN DOES NOT EXEMPT THE OWNER'S BONDED CONTRACTOR FROM THE REQUIREMENTS TO OBTAIN THE VARIOUS PERMITS/APPROVALS NORMALLY REQUIRED TO COMPLETE A CONSTRUCTION PROJECT, SUCH AS, BUT NOT LIMITED TO THE FOLLOWING: ROAD CUT PERMITS, SEWER PERMITS, APPROACH APPROVAL PERMITS, RELOCATION OF SERVICES, COMMITTEE OF ADJUSTMENT, ENCROACHMENT AGREEMENTS, WATER PERMIT, ETC

19. THE OWNER SHALL REQUIRE THAT THE SITE SERVICING CONTRACTOR PERFORM FIELD TESTS FOR QUALITY CONTROL OF ALL SANITARY SEWERS. SPECIFICALLY, THE LEAKAGE TESTING SHALL BE COMPLETED IN ACCORDANCE WITH OPSS 410.07.01,16 AND 407.07.26. THE FIELD TESTS SHALL BE PERFORMED IN THE PRESENCE OF A CERTIFIED PROFESSIONAL ENGINEER WHO SHALL SUBMIT A CERTIFIED COPY OF THE TEST RESULTS.

20. REFER TO LANDSCAPE DRAWINGS FOR DETAILS ON LANDSCAPING AND PLANTINGS.

21. SEWERS TO BE CONSTRUCTED AS PER CITY OF OTTAWA SPECIFICATIONS - SPECIAL PROVISION F-4100, ALL SEWER STRUCTURES AS PER F-4070, ALL WATER MAINS AS PER F-7010 AND ALL ASSOCIATED SPECIFICATIONS.

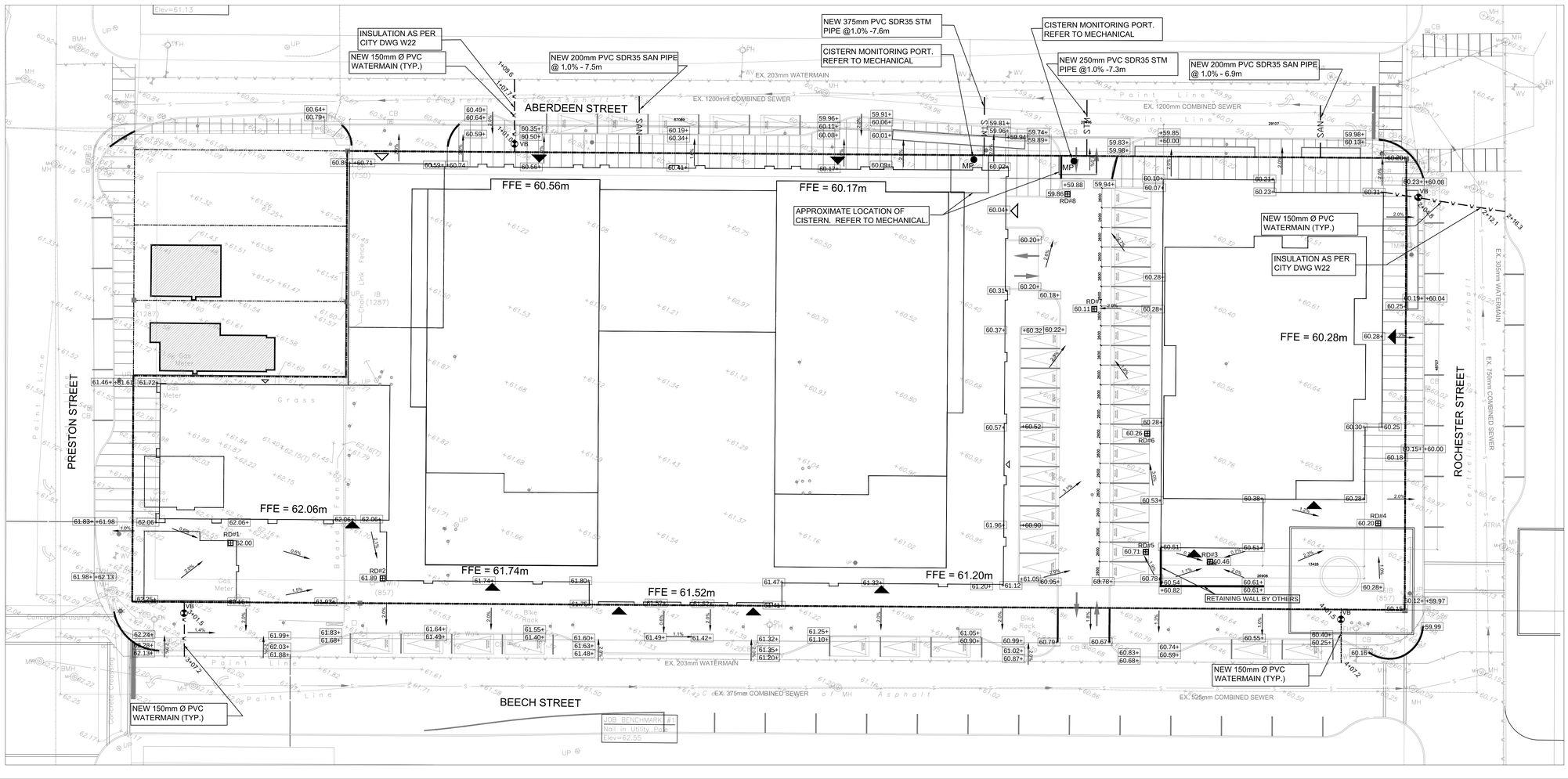
22. EROSION AND SEDIMENT CONTROL MEASURES (IN ACCORDANCE WITH THE REQUIREMENTS OF OPSS 805 - NOVEMBER 2018 FOR TEMPORARY MEASURES) CONSISTING OF BOTH PERMANENT AND TEMPORARY MEASURES SHALL BE IMPLEMENTED PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES TO ENSURE THAT SEDIMENT IS CONTAINED WITHIN THE SITE. PERMANENT EROSION CONTROL MEASURES SHALL ENSURE THAT POTENTIAL LONG-TERM AND LOCALIZED EROSION PROBLEMS ARE DEALT WITH PRIOR TO THEIR OCCURRENCE. FILTER FABRIC SHALL BE INSTALLED UNDER THE FRAME OF ALL PROPOSED AND EXISTING CATCHBASINS AND STORM MANHOLES IMMEDIATELY ADJACENT TO ANY DISTURBED AREAS PRIOR TO CONSTRUCTION TO PREVENT SEDIMENT FROM ENTERING INTO THE STORM SEWER SYSTEM. THE FILTER FABRIC SHALL REMAIN IN-PLACE FOR THE DURATION OF CONSTRUCTION ACTIVITIES AND SHALL NOT BE REMOVED UNTIL SUCH TIME AS THE LANDSCAPING HAS BEEN ESTABLISHED AND UPON AUTHORIZATION BY THE ENGINEER. LIGHT DUTY SEDIMENT FENCING SHALL ALSO BE PLACED AROUND THE PERIMETER OF THE SITE FOR THE DURATION OF THE CONSTRUCTION.

23. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.

24. CONNECTION OF THE WATER SERVICES TO THE CITY WATERMAIN BY CITY FORCES; EXCAVATION, BACKFILLING AND REINSTATEMENT BY CONTRACTOR.

25. REFER TO THE STORM WATER MANAGEMENT & SITE SERVICING REPORTS FROM RV ANDERSON DATED OCTOBER 21, 2019 FOR FURTHER DETAILS.

26. ROADWAY DESIGN TO BE COMPLETED BY OTHERS AT A LATER DATE.



no.	date	revision
2	11/20/19	SITE PLAN APPROVAL
1	10/21/19	SITE PLAN APPROVAL

It is the responsibility of the appropriate contractor to check and verify all dimensions on site and report all errors and/or omissions to the architect.

All contractors must comply with all pertinent codes and by-laws.

Do not scale drawings.

This drawing may not be used for construction until signed.

R.V. Anderson Associates Limited
engineering • environment • infrastructure

PROJECT/LOCATION:
450 ROCHESTER
450 ROCHESTER STREET, OTTAWA

DRAWING TITLE:
C-01
SITE SERVICING AND GRADING

DRAWN BY:	DATE:	SCALE:
NR	10/21/19	1:250

PROJECT: 184335

DRAWING NO.: C-01

REVISION NO.:

DWGNAME

APPENDIX B

Stormwater Design Calculations

450 ROCHESTER (PHASE 1)
FIRE DEMAND CALCULATIONS - FUS METHOD (1999)

			TOTAL
A	Coefficient for type of construction:		0.8
B	Total Floor Area (excl. basement)	m^2	25,819
C	Height in Stories		15
D	Fire Flow Required	L/min	29,000
E	25% Reduction for Occupancy Charge - low fire hazard	L/min	-7,250
	Fire Flow Required	L/min	21,750
F	50% Reduction for Automatic Sprinklers	L/min	-10,875
G	Charge for Building Separation		
	North: Nearest Building	21.6	10%
	West: Nearest Building	9.7	20%
	South: Nearest Building	21.7	10%
	East: Nearest Building	20.7	10%
	Charge for Building Separation	L/min	10,875
H	Fire Flow Required	L/min	22,000
	Fire Flow Required	L/s	367

450 ROCHESTER (PHASE 2)
FIRE DEMAND CALCULATIONS - FUS METHOD (1999)

			TOTAL
A	Coefficient for type of construction:		0.8
B	Total Floor Area (excl. basement)	m^2	20,123
C	Height in Stories		26
D	Fire Flow Required	L/min	25,000
E	25% Reduction for Occupancy Charge - low fire hazard	L/min	-6,250
	Fire Flow Required	L/min	18,750
F	50% Reduction for Automatic Sprinklers	L/min	-9,375
G	Charge for Building Separation		
	North: Nearest Building	23	10%
	West: Nearest Building	20.7	10%
	South: Nearest Building	26.2	10%
	East: Nearest Building	23.4	10%
	Charge for Building Separation	L/min	7,500
H	Fire Flow Required	L/min	17,000
	Fire Flow Required	L/s	283

450 Rochester - Phase 1

ROOF

5 yr Storm Post-Development Flow

100 yr Peak Allow. Discharge	**4.50**	**L/s**

Elapsed time		**Intensity**		**Acc Depth**	**C**	**Area**	**Flow**	**Discharge**	**Storage flow**	**Storage volume**	
(min)	**(s)**	**(mm/hr)**	**(mm/s)**	**(mm)**		**(m^2)**	**(l/s)**	**(l/s)**	**(l/s)**	**(m^3)**	
0	0	0.00	0.0000	0.00	0.95	5251	0.00	0.00	0.00	0.00	
5	300	141.18	0.0392	11.76	0.95	5251	97.81	4.50	93.31	27.99	
10	600	104.19	0.0289	20.45	0.95	5251	144.38	4.50	139.88	83.93	
15	900	83.56	0.0232	27.41	0.95	5251	115.78	4.50	111.28	100.16	
20	1200	70.25	0.0195	33.26	0.95	5251	97.35	4.50	92.85	111.41	
25	1500	60.90	0.0169	38.34	0.95	5251	84.38	4.50	79.88	119.82	
30	1800	53.93	0.0150	42.83	0.95	5251	74.73	4.50	70.23	126.41	
35	2100	48.52	0.0135	46.88	0.95	5251	67.23	4.50	62.73	131.73	
40	2400	44.18	0.0123	50.56	0.95	5251	61.23	4.50	56.73	136.14	
45	2700	40.63	0.0113	53.94	0.95	5251	56.30	4.50	51.80	139.86	
50	3000	37.65	0.0105	57.08	0.95	5251	52.18	4.50	47.68	143.03	
55	3300	35.12	0.0098	60.01	0.95	5251	48.67	4.50	44.17	145.76	
60	3600	32.94	0.0092	62.75	0.95	5251	45.65	4.50	41.15	148.14	
65	3900	31.04	0.0086	65.34	0.95	5251	43.02	4.50	38.52	150.21	
70	4200	29.37	0.0082	67.79	0.95	5251	40.70	4.50	36.20	152.04	
75	4500	27.89	0.0077	70.11	0.95	5251	38.64	4.50	34.14	153.65	
80	4800	26.56	0.0074	72.33	0.95	5251	36.81	4.50	32.31	155.07	
85	5100	25.37	0.0070	74.44	0.95	5251	35.15	4.50	30.65	156.33	
90	5400	24.29	0.0067	76.46	0.95	5251	33.66	4.50	29.16	157.44	
95	5700	23.31	0.0065	78.41	0.95	5251	32.29	4.50	27.79	158.43	
100	6000	22.41	0.0062	80.27	0.95	5251	31.05	4.50	26.55	159.29	
105	6300	21.58	0.0060	82.07	0.95	5251	29.91	4.50	25.41	160.06	
110	6600	20.82	0.0058	83.81	0.95	5251	28.85	4.50	24.35	160.73	
115	6900	20.12	0.0056	85.48	0.95	5251	27.88	4.50	23.38	161.32	
120	7200	19.47	0.0054	87.11	0.95	5251	26.98	4.50	22.48	161.83	
125	7500	18.86	0.0052	88.68	0.95	5251	26.14	4.50	21.64	162.26	
130	7800	18.29	0.0051	90.20	0.95	5251	25.35	4.50	20.85	162.63	
135	8100	17.76	0.0049	91.68	0.95	5251	24.62	4.50	20.12	162.94	
140	8400	17.27	0.0048	93.12	0.95	5251	23.93	4.50	19.43	163.20	
145	8700	16.80	0.0047	94.52	0.95	5251	23.28	4.50	18.78	163.40	
150	9000	16.36	0.0045	95.89	0.95	5251	22.67	4.50	18.17	163.55	
155	9300	15.95	0.0044	97.22	0.95	5251	22.10	4.50	17.60	163.66	
160	9600	15.56	0.0043	98.51	0.95	5251	21.55	4.50	17.05	163.73	
165	9900	15.18	0.0042	99.78	0.95	5251	21.04	4.50	16.54	163.75	-peak storage
170	10200	14.83	0.0041	101.01	0.95	5251	20.55	4.50	16.05	163.74	
175	10500	14.50	0.0040	102.22	0.95	5251	20.09	4.50	15.59	163.69	
180	10800	14.18	0.0039	103.40	0.95	5251	19.65	4.50	15.15	163.61	
185	11100	13.88	0.0039	104.56	0.95	5251	19.23	4.50	14.73	163.50	
190	11400	13.59	0.0038	105.69	0.95	5251	18.83	4.50	14.33	163.35	
195	11700	13.31	0.0037	106.80	0.95	5251	18.45	4.50	13.95	163.18	
200	12000	13.05	0.0036	107.89	0.95	5251	18.08	4.50	13.58	162.98	
205	12300	12.80	0.0036	108.95	0.95	5251	17.73	4.50	13.23	162.76	
210	12600	12.56	0.0035	110.00	0.95	5251	17.40	4.50	12.90	162.51	
215	12900	12.32	0.0034	111.03	0.95	5251	17.08	4.50	12.58	162.24	
220	13200	12.10	0.0034	112.04	0.95	5251	16.77	4.50	12.27	161.95	
225	13500	11.89	0.0033	113.03	0.95	5251	16.47	4.50	11.97	161.63	
230	13800	11.68	0.0032	114.00	0.95	5251	16.19	4.50	11.69	161.30	
235	14100	11.48	0.0032	114.96	0.95	5251	15.91	4.50	11.41	160.94	

Flow Calculations:
For 5m (300s) interval
t/600*A*C*I
(300)/600*1076*0.95*0.0392=20.04

450 Rochester - Phase 1

ROOF

100 yr Storm Post-Development Flow

100 yr Peak Allow. Discharge	**4.50**	**L/s**

Elapsed time (min)	Elapsed time (s)	Intensity (mm/hr)	Intensity (mm/s)	Acc Depth (mm)	C	Area (m^2)	Flow (l/s)	Discharge (l/s)	Storage flow (l/s)	Storage volume (m^3)	
0	0	0.00	0.0000	0.00	1	5251	0.00	0.00	0.00	0.00	
5	300	242.70	0.0674	20.23	1	5251	177.01	4.50	172.51	51.75	
10	600	178.56	0.0496	35.11	1	5251	260.45	4.50	255.95	153.57	
15	900	142.89	0.0397	47.01	1	5251	208.43	4.50	203.93	183.53	
20	1200	119.95	0.0333	57.01	1	5251	174.96	4.50	170.46	204.55	
25	1500	103.85	0.0288	65.66	1	5251	151.47	4.50	146.97	220.46	
30	1800	91.87	0.0255	73.32	1	5251	134.00	4.50	129.50	233.10	
35	2100	82.58	0.0229	80.20	1	5251	120.45	4.50	115.95	243.50	
40	2400	75.15	0.0209	86.46	1	5251	109.61	4.50	105.11	252.26	
45	2700	69.05	0.0192	92.22	1	5251	100.72	4.50	96.22	259.79	
50	3000	63.95	0.0178	97.55	1	5251	93.28	4.50	88.78	266.35	
55	3300	59.62	0.0166	102.51	1	5251	86.97	4.50	82.47	272.14	
60	3600	55.89	0.0155	107.17	1	5251	81.53	4.50	77.03	277.30	
65	3900	52.65	0.0146	111.56	1	5251	76.79	4.50	72.29	281.93	
70	4200	49.79	0.0138	115.71	1	5251	72.62	4.50	68.12	286.12	
75	4500	47.26	0.0131	119.65	1	5251	68.93	4.50	64.43	289.92	
80	4800	44.99	0.0125	123.40	1	5251	65.62	4.50	61.12	293.40	
85	5100	42.95	0.0119	126.98	1	5251	62.65	4.50	58.15	296.58	
90	5400	41.11	0.0114	130.40	1	5251	59.96	4.50	55.46	299.51	
95	5700	39.43	0.0110	133.69	1	5251	57.52	4.50	53.02	302.21	
100	6000	37.90	0.0105	136.85	1	5251	55.29	4.50	50.79	304.71	
105	6300	36.50	0.0101	139.89	1	5251	53.24	4.50	48.74	307.03	
110	6600	35.20	0.0098	142.82	1	5251	51.35	4.50	46.85	309.19	
115	6900	34.01	0.0094	145.65	1	5251	49.60	4.50	45.10	311.19	
120	7200	32.89	0.0091	148.40	1	5251	47.98	4.50	43.48	313.06	
125	7500	31.86	0.0089	151.05	1	5251	46.47	4.50	41.97	314.81	
130	7800	30.90	0.0086	153.63	1	5251	45.07	4.50	40.57	316.43	
135	8100	30.00	0.0083	156.13	1	5251	43.75	4.50	39.25	317.96	
140	8400	29.15	0.0081	158.56	1	5251	42.52	4.50	38.02	319.38	
145	8700	28.36	0.0079	160.92	1	5251	41.36	4.50	36.86	320.71	
150	9000	27.61	0.0077	163.22	1	5251	40.27	4.50	35.77	321.96	
155	9300	26.91	0.0075	165.46	1	5251	39.24	4.50	34.74	323.13	
160	9600	26.24	0.0073	167.65	1	5251	38.27	4.50	33.77	324.22	
165	9900	25.61	0.0071	169.78	1	5251	37.35	4.50	32.85	325.24	
170	10200	25.01	0.0069	171.87	1	5251	36.48	4.50	31.98	326.20	
175	10500	24.44	0.0068	173.90	1	5251	35.65	4.50	31.15	327.10	
180	10800	23.90	0.0066	175.90	1	5251	34.86	4.50	30.36	327.94	
185	11100	23.39	0.0065	177.84	1	5251	34.11	4.50	29.61	328.72	
190	11400	22.90	0.0064	179.75	1	5251	33.40	4.50	28.90	329.45	
195	11700	22.43	0.0062	181.62	1	5251	32.72	4.50	28.22	330.13	
200	12000	21.98	0.0061	183.45	1	5251	32.06	4.50	27.56	330.77	-peak storage
205	12300	21.55	0.0060	185.25	1	5251	31.44	4.50	26.94	331.36	
210	12600	21.14	0.0059	187.01	1	5251	30.84	4.50	26.34	331.90	
215	12900	20.75	0.0058	188.74	1	5251	30.27	4.50	25.77	332.41	
220	13200	20.37	0.0057	190.44	1	5251	29.72	4.50	25.22	332.88	
225	13500	20.01	0.0056	192.11	1	5251	29.19	4.50	24.69	333.31	
230	13800	19.66	0.0055	193.75	1	5251	28.68	4.50	24.18	333.71	

Flow Calculations:
For 5m (300s) interval
t/600*A*C*I
(300)/600*1076*1*0.0674=36.27

450 Rochester - Phase 1

SURFACE

5 yr Storm Post-Development Flow

100 yr Peak Allow. Discharge	5.40	L/s

Elapsed time (min)	Elapsed time (s)	Intensity (mm/hr)	Intensity (mm/s)	Acc Depth (mm)	C	Area (m^2)	Flow (l/s)	Discharge (l/s)	Storage flow (l/s)	Storage volume (m^3)	S
0	0	0.00	0.0000	0.00	0.9	1440	0.00	0.00	0.00	0.00	
5	300	141.18	0.0392	11.76	0.9	1440	25.41	5.40	20.01	6.00	
10	600	104.19	0.0289	20.45	0.9	1440	37.51	5.40	32.11	19.27	
15	900	83.56	0.0232	27.41	0.9	1440	30.08	5.40	24.68	22.21	
20	1200	70.25	0.0195	33.26	0.9	1440	25.29	5.40	19.89	23.87	
25	1500	60.90	0.0169	38.34	0.9	1440	21.92	5.40	16.52	24.78	
30	1800	53.93	0.0150	42.83	0.9	1440	19.41	5.40	14.01	25.23	
35	2100	48.52	0.0135	46.88	0.9	1440	17.47	5.40	12.07	25.34	-peak storage
40	2400	44.18	0.0123	50.56	0.9	1440	15.91	5.40	10.51	25.22	
45	2700	40.63	0.0113	53.94	0.9	1440	14.63	5.40	9.23	24.91	
50	3000	37.65	0.0105	57.08	0.9	1440	13.56	5.40	8.16	24.47	
55	3300	35.12	0.0098	60.01	0.9	1440	12.64	5.40	7.24	23.91	
60	3600	32.94	0.0092	62.75	0.9	1440	11.86	5.40	6.46	23.25	
65	3900	31.04	0.0086	65.34	0.9	1440	11.18	5.40	5.78	22.53	
70	4200	29.37	0.0082	67.79	0.9	1440	10.57	5.40	5.17	21.73	
75	4500	27.89	0.0077	70.11	0.9	1440	10.04	5.40	4.64	20.88	
80	4800	26.56	0.0074	72.33	0.9	1440	9.56	5.40	4.16	19.98	
85	5100	25.37	0.0070	74.44	0.9	1440	9.13	5.40	3.73	19.04	
90	5400	24.29	0.0067	76.46	0.9	1440	8.74	5.40	3.34	18.06	
95	5700	23.31	0.0065	78.41	0.9	1440	8.39	5.40	2.99	17.04	
100	6000	22.41	0.0062	80.27	0.9	1440	8.07	5.40	2.67	16.00	
105	6300	21.58	0.0060	82.07	0.9	1440	7.77	5.40	2.37	14.93	
110	6600	20.82	0.0058	83.81	0.9	1440	7.50	5.40	2.10	13.83	
115	6900	20.12	0.0056	85.48	0.9	1440	7.24	5.40	1.84	12.72	
120	7200	19.47	0.0054	87.11	0.9	1440	7.01	5.40	1.61	11.58	
125	7500	18.86	0.0052	88.68	0.9	1440	6.79	5.40	1.39	10.42	
130	7800	18.29	0.0051	90.20	0.9	1440	6.59	5.40	1.19	9.25	
135	8100	17.76	0.0049	91.68	0.9	1440	6.40	5.40	1.00	8.06	
140	8400	17.27	0.0048	93.12	0.9	1440	6.22	5.40	0.82	6.86	
145	8700	16.80	0.0047	94.52	0.9	1440	6.05	5.40	0.65	5.64	
150	9000	16.36	0.0045	95.89	0.9	1440	5.89	5.40	0.49	4.41	
155	9300	15.95	0.0044	97.22	0.9	1440	5.74	5.40	0.34	3.17	
160	9600	15.56	0.0043	98.51	0.9	1440	5.60	5.40	0.20	1.92	
165	9900	15.18	0.0042	99.78	0.9	1440	5.47	5.40	0.07	0.66	
170	10200	14.83	0.0041	101.01	0.9	1440	5.34	5.34	0.00	0.00	
175	10500	14.50	0.0040	102.22	0.9	1440	5.22	5.22	0.00	0.00	
180	10800	14.18	0.0039	103.40	0.9	1440	5.10	5.10	0.00	0.00	

Flow Calculations:
For 5m (300s) interval
t/600*A*C*I
(300)/600*1076*0.95*0.0392=20.04

450 Rochester - Phase 1

SURFACE

100 yr Storm Post-Development Flow

100 yr Peak Allow. Discharge	**5.40**	**L/s**

Elapsed time		**Intensity**		**Acc Depth**	**C**	**Area**	**Flow**	**Discharge**	**Storage flow**	**Storage volume**	**S**
(min)	**(s)**	**(mm/hr)**	**(mm/s)**	**(mm)**		**(m^2)**	**(l/s)**	**(l/s)**	**(l/s)**	**(m^3)**	
0	0	0.00	0.0000	0.00	1	1440	0.00	0.00	0.00	0.00	
5	300	242.70	0.0674	20.23	1	1440	48.54	5.40	43.14	12.94	
10	600	178.56	0.0496	35.11	1	1440	71.42	5.40	66.02	39.61	
15	900	142.89	0.0397	47.01	1	1440	57.16	5.40	51.76	46.58	
20	1200	119.95	0.0333	57.01	1	1440	47.98	5.40	42.58	51.10	
25	1500	103.85	0.0288	65.66	1	1440	41.54	5.40	36.14	54.21	
30	1800	91.87	0.0255	73.32	1	1440	36.75	5.40	31.35	56.43	
35	2100	82.58	0.0229	80.20	1	1440	33.03	5.40	27.63	58.03	
40	2400	75.15	0.0209	86.46	1	1440	30.06	5.40	24.66	59.18	
45	2700	69.05	0.0192	92.22	1	1440	27.62	5.40	22.22	59.99	
50	3000	63.95	0.0178	97.55	1	1440	25.58	5.40	20.18	60.54	
55	3300	59.62	0.0166	102.51	1	1440	23.85	5.40	18.45	60.88	
60	3600	55.89	0.0155	107.17	1	1440	22.36	5.40	16.96	61.05	
65	3900	52.65	0.0146	111.56	1	1440	21.06	5.40	15.66	61.07	-peak storage
70	4200	49.79	0.0138	115.71	1	1440	19.92	5.40	14.52	60.97	
75	4500	47.26	0.0131	119.65	1	1440	18.90	5.40	13.50	60.76	
80	4800	44.99	0.0125	123.40	1	1440	18.00	5.40	12.60	60.46	
85	5100	42.95	0.0119	126.98	1	1440	17.18	5.40	11.78	60.09	
90	5400	41.11	0.0114	130.40	1	1440	16.44	5.40	11.04	59.64	
95	5700	39.43	0.0110	133.69	1	1440	15.77	5.40	10.37	59.13	
100	6000	37.90	0.0105	136.85	1	1440	15.16	5.40	9.76	58.57	
105	6300	36.50	0.0101	139.89	1	1440	14.60	5.40	9.20	57.95	
110	6600	35.20	0.0098	142.82	1	1440	14.08	5.40	8.68	57.29	
115	6900	34.01	0.0094	145.65	1	1440	13.60	5.40	8.20	56.59	
120	7200	32.89	0.0091	148.40	1	1440	13.16	5.40	7.76	55.86	
125	7500	31.86	0.0089	151.05	1	1440	12.74	5.40	7.34	55.09	
130	7800	30.90	0.0086	153.63	1	1440	12.36	5.40	6.96	54.28	
135	8100	30.00	0.0083	156.13	1	1440	12.00	5.40	6.60	53.45	
140	8400	29.15	0.0081	158.56	1	1440	11.66	5.40	6.26	52.59	
145	8700	28.36	0.0079	160.92	1	1440	11.34	5.40	5.94	51.71	
150	9000	27.61	0.0077	163.22	1	1440	11.04	5.40	5.64	50.80	
155	9300	26.91	0.0075	165.46	1	1440	10.76	5.40	5.36	49.87	
160	9600	26.24	0.0073	167.65	1	1440	10.50	5.40	5.10	48.92	
165	9900	25.61	0.0071	169.78	1	1440	10.24	5.40	4.84	47.95	
170	10200	25.01	0.0069	171.87	1	1440	10.00	5.40	4.60	46.96	
175	10500	24.44	0.0068	173.90	1	1440	9.78	5.40	4.38	45.96	
180	10800	23.90	0.0066	175.90	1	1440	9.56	5.40	4.16	44.94	
185	11100	23.39	0.0065	177.84	1	1440	9.36	5.40	3.96	43.90	
190	11400	22.90	0.0064	179.75	1	1440	9.16	5.40	3.76	42.85	
195	11700	22.43	0.0062	181.62	1	1440	8.97	5.40	3.57	41.79	
200	12000	21.98	0.0061	183.45	1	1440	8.79	5.40	3.39	40.72	
205	12300	21.55	0.0060	185.25	1	1440	8.62	5.40	3.22	39.63	
210	12600	21.14	0.0059	187.01	1	1440	8.46	5.40	3.06	38.53	
215	12900	20.75	0.0058	188.74	1	1440	8.30	5.40	2.90	37.42	
220	13200	20.37	0.0057	190.44	1	1440	8.15	5.40	2.75	36.30	
225	13500	20.01	0.0056	192.11	1	1440	8.00	5.40	2.60	35.16	
230	13800	19.66	0.0055	193.75	1	1440	7.87	5.40	2.47	34.02	

Flow Calculations:
For 5m (300s) interval
t/600*A*C*I
(300)/600*1076*1*0.0674=36.27

450 Rochester - Phase 2

ROOF

5 yr Storm Post-Development Flow

100 yr Peak Allow. Discharge	**2.25**	**L/s**

Elapsed time		**Intensity**		**Acc Depth**	**C**	**Area**	**Flow**	**Discharge**	**Storage flow**	**Storage volume**	
(min)	**(s)**	**(mm/hr)**	**(mm/s)**	**(mm)**		**(m^2)**	**(l/s)**	**(l/s)**	**(l/s)**	**(m^3)**	
0	0	0.00	0.0000	0.00	0.95	1273	0.00	0.00	0.00	0.00	
5	300	141.18	0.0392	11.76	0.95	1273	23.71	2.25	21.46	6.44	
10	600	104.19	0.0289	20.45	0.95	1273	35.00	2.25	32.75	19.65	
15	900	83.56	0.0232	27.41	0.95	1273	28.07	2.25	25.82	23.24	
20	1200	70.25	0.0195	33.26	0.95	1273	23.60	2.25	21.35	25.62	
25	1500	60.90	0.0169	38.34	0.95	1273	20.46	2.25	18.21	27.31	
30	1800	53.93	0.0150	42.83	0.95	1273	18.12	2.25	15.87	28.56	
35	2100	48.52	0.0135	46.88	0.95	1273	16.30	2.25	14.05	29.50	
40	2400	44.18	0.0123	50.56	0.95	1273	14.84	2.25	12.59	30.22	
45	2700	40.63	0.0113	53.94	0.95	1273	13.65	2.25	11.40	30.78	
50	3000	37.65	0.0105	57.08	0.95	1273	12.65	2.25	10.40	31.20	
55	3300	35.12	0.0098	60.01	0.95	1273	11.80	2.25	9.55	31.51	
60	3600	32.94	0.0092	62.75	0.95	1273	11.07	2.25	8.82	31.74	
65	3900	31.04	0.0086	65.34	0.95	1273	10.43	2.25	8.18	31.90	
70	4200	29.37	0.0082	67.79	0.95	1273	9.87	2.25	7.62	31.99	
75	4500	27.89	0.0077	70.11	0.95	1273	9.37	2.25	7.12	32.03	-peak storage
80	4800	26.56	0.0074	72.33	0.95	1273	8.92	2.25	6.67	32.03	
85	5100	25.37	0.0070	74.44	0.95	1273	8.52	2.25	6.27	31.99	
90	5400	24.29	0.0067	76.46	0.95	1273	8.16	2.25	5.91	31.91	
95	5700	23.31	0.0065	78.41	0.95	1273	7.83	2.25	5.58	31.80	
100	6000	22.41	0.0062	80.27	0.95	1273	7.53	2.25	5.28	31.66	
105	6300	21.58	0.0060	82.07	0.95	1273	7.25	2.25	5.00	31.50	
110	6600	20.82	0.0058	83.81	0.95	1273	6.99	2.25	4.74	31.32	
115	6900	20.12	0.0056	85.48	0.95	1273	6.76	2.25	4.51	31.11	
120	7200	19.47	0.0054	87.11	0.95	1273	6.54	2.25	4.29	30.89	
125	7500	18.86	0.0052	88.68	0.95	1273	6.34	2.25	4.09	30.64	
130	7800	18.29	0.0051	90.20	0.95	1273	6.15	2.25	3.90	30.39	
135	8100	17.76	0.0049	91.68	0.95	1273	5.97	2.25	3.72	30.11	
140	8400	17.27	0.0048	93.12	0.95	1273	5.80	2.25	3.55	29.83	
145	8700	16.80	0.0047	94.52	0.95	1273	5.64	2.25	3.39	29.53	
150	9000	16.36	0.0045	95.89	0.95	1273	5.50	2.25	3.25	29.22	
155	9300	15.95	0.0044	97.22	0.95	1273	5.36	2.25	3.11	28.90	
160	9600	15.56	0.0043	98.51	0.95	1273	5.23	2.25	2.98	28.57	
165	9900	15.18	0.0042	99.78	0.95	1273	5.10	2.25	2.85	28.22	
170	10200	14.83	0.0041	101.01	0.95	1273	4.98	2.25	2.73	27.87	
175	10500	14.50	0.0040	102.22	0.95	1273	4.87	2.25	2.62	27.51	
180	10800	14.18	0.0039	103.40	0.95	1273	4.76	2.25	2.51	27.15	
185	11100	13.88	0.0039	104.56	0.95	1273	4.66	2.25	2.41	26.77	
190	11400	13.59	0.0038	105.69	0.95	1273	4.56	2.25	2.31	26.39	
195	11700	13.31	0.0037	106.80	0.95	1273	4.47	2.25	2.22	26.00	
200	12000	13.05	0.0036	107.89	0.95	1273	4.38	2.25	2.13	25.60	
205	12300	12.80	0.0036	108.95	0.95	1273	4.30	2.25	2.05	25.20	
210	12600	12.56	0.0035	110.00	0.95	1273	4.22	2.25	1.97	24.79	
215	12900	12.32	0.0034	111.03	0.95	1273	4.14	2.25	1.89	24.38	
220	13200	12.10	0.0034	112.04	0.95	1273	4.07	2.25	1.82	23.96	
225	13500	11.89	0.0033	113.03	0.95	1273	3.99	2.25	1.74	23.54	
230	13800	11.68	0.0032	114.00	0.95	1273	3.92	2.25	1.67	23.11	
235	14100	11.48	0.0032	114.96	0.95	1273	3.86	2.25	1.61	22.67	

Flow Calculations:
For 5m (300s) interval
t/600*A*C*I
(300)/600*1076*0.95*0.0392=20.04

450 Rochester - Phase 2

ROOF

100 yr Storm Post-Development Flow

100 yr Peak Allow. Discharge	2.25	L/s

Elapsed time (min)	Elapsed time (s)	Intensity (mm/hr)	Intensity (mm/s)	Acc Depth (mm)	C	Area (m^2)	Flow (l/s)	Discharge (l/s)	Storage flow (l/s)	Storage volume (m^3)	
0	0	0.00	0.0000	0.00	1	1273	0.00	0.00	0.00	0.00	
5	300	242.70	0.0674	20.23	1	1273	42.91	2.25	40.66	12.20	
10	600	178.56	0.0496	35.11	1	1273	63.14	2.25	60.89	36.53	
15	900	142.89	0.0397	47.01	1	1273	50.53	2.25	48.28	43.45	
20	1200	119.95	0.0333	57.01	1	1273	42.42	2.25	40.17	48.20	
25	1500	103.85	0.0288	65.66	1	1273	36.72	2.25	34.47	51.71	
30	1800	91.87	0.0255	73.32	1	1273	32.49	2.25	30.24	54.42	
35	2100	82.58	0.0229	80.20	1	1273	29.20	2.25	26.95	56.60	
40	2400	75.15	0.0209	86.46	1	1273	26.57	2.25	24.32	58.37	
45	2700	69.05	0.0192	92.22	1	1273	24.42	2.25	22.17	59.85	
50	3000	63.95	0.0178	97.55	1	1273	22.61	2.25	20.36	61.09	
55	3300	59.62	0.0166	102.51	1	1273	21.08	2.25	18.83	62.15	
60	3600	55.89	0.0155	107.17	1	1273	19.76	2.25	17.51	63.05	
65	3900	52.65	0.0146	111.56	1	1273	18.62	2.25	16.37	63.83	
70	4200	49.79	0.0138	115.71	1	1273	17.61	2.25	15.36	64.50	
75	4500	47.26	0.0131	119.65	1	1273	16.71	2.25	14.46	65.07	
80	4800	44.99	0.0125	123.40	1	1273	15.91	2.25	13.66	65.56	
85	5100	42.95	0.0119	126.98	1	1273	15.19	2.25	12.94	65.99	
90	5400	41.11	0.0114	130.40	1	1273	14.54	2.25	12.29	66.35	
95	5700	39.43	0.0110	133.69	1	1273	13.94	2.25	11.69	66.66	
100	6000	37.90	0.0105	136.85	1	1273	13.40	2.25	11.15	66.92	
105	6300	36.50	0.0101	139.89	1	1273	12.91	2.25	10.66	67.13	
110	6600	35.20	0.0098	142.82	1	1273	12.45	2.25	10.20	67.31	
115	6900	34.01	0.0094	145.65	1	1273	12.02	2.25	9.77	67.45	
120	7200	32.89	0.0091	148.40	1	1273	11.63	2.25	9.38	67.55	
125	7500	31.86	0.0089	151.05	1	1273	11.27	2.25	9.02	67.63	
130	7800	30.90	0.0086	153.63	1	1273	10.93	2.25	8.68	67.67	
135	8100	30.00	0.0083	156.13	1	1273	10.61	2.25	8.36	67.69	-peak storage
140	8400	29.15	0.0081	158.56	1	1273	10.31	2.25	8.06	67.69	
145	8700	28.36	0.0079	160.92	1	1273	10.03	2.25	7.78	67.67	
150	9000	27.61	0.0077	163.22	1	1273	9.76	2.25	7.51	67.62	
155	9300	26.91	0.0075	165.46	1	1273	9.51	2.25	7.26	67.56	
160	9600	26.24	0.0073	167.65	1	1273	9.28	2.25	7.03	67.47	
165	9900	25.61	0.0071	169.78	1	1273	9.06	2.25	6.81	67.37	
170	10200	25.01	0.0069	171.87	1	1273	8.84	2.25	6.59	67.26	
175	10500	24.44	0.0068	173.90	1	1273	8.64	2.25	6.39	67.13	
180	10800	23.90	0.0066	175.90	1	1273	8.45	2.25	6.20	66.98	
185	11100	23.39	0.0065	177.84	1	1273	8.27	2.25	6.02	66.83	
190	11400	22.90	0.0064	179.75	1	1273	8.10	2.25	5.85	66.66	
195	11700	22.43	0.0062	181.62	1	1273	7.93	2.25	5.68	66.47	
200	12000	21.98	0.0061	183.45	1	1273	7.77	2.25	5.52	66.28	
205	12300	21.55	0.0060	185.25	1	1273	7.62	2.25	5.37	66.07	
210	12600	21.14	0.0059	187.01	1	1273	7.48	2.25	5.23	65.86	
215	12900	20.75	0.0058	188.74	1	1273	7.34	2.25	5.09	65.63	
220	13200	20.37	0.0057	190.44	1	1273	7.20	2.25	4.95	65.40	
225	13500	20.01	0.0056	192.11	1	1273	7.08	2.25	4.83	65.16	
230	13800	19.66	0.0055	193.75	1	1273	6.95	2.25	4.70	64.91	

Flow Calculations:
For 5m (300s) interval
t/600*A*C*I
(300)/600*1076*1*0.0674=36.27

450 Rochester - Phase 2

SURFACE

100 yr Storm Post-Development Flow

100 yr Peak Allow. Discharge	**3.79**	**L/s**

Elapsed time		**Intensity**		**Acc Depth**	**C**	**Area**	**Flow**	**Discharge**	**Storage flow**	**Storage volume**	**S**
(min)	**(s)**	**(mm/hr)**	**(mm/s)**	**(mm)**		**(m^2)**	**(l/s)**	**(l/s)**	**(l/s)**	**(m^3)**	
0	0	0.00	0.0000	0.00	1	248	0.00	0.00	0.00	0.00	
5	300	242.70	0.0674	20.23	1	248	8.36	3.79	4.57	1.37	
10	600	178.56	0.0496	35.11	1	248	12.30	3.79	8.51	5.11	
15	900	142.89	0.0397	47.01	1	248	9.84	3.79	6.05	5.45	-peak storage
20	1200	119.95	0.0333	57.01	1	248	8.26	3.79	4.47	5.37	
25	1500	103.85	0.0288	65.66	1	248	7.15	3.79	3.36	5.05	
30	1800	91.87	0.0255	73.32	1	248	6.33	3.79	2.54	4.57	
35	2100	82.58	0.0229	80.20	1	248	5.69	3.79	1.90	3.99	
40	2400	75.15	0.0209	86.46	1	248	5.18	3.79	1.39	3.33	
45	2700	69.05	0.0192	92.22	1	248	4.76	3.79	0.97	2.61	
50	3000	63.95	0.0178	97.55	1	248	4.41	3.79	0.62	1.85	
55	3300	59.62	0.0166	102.51	1	248	4.11	3.79	0.32	1.05	
60	3600	55.89	0.0155	107.17	1	248	3.85	3.79	0.06	0.22	
65	3900	52.65	0.0146	111.56	1	248	3.63	3.63	0.00	0.00	
70	4200	49.79	0.0138	115.71	1	248	3.43	3.43	0.00	0.00	
75	4500	47.26	0.0131	119.65	1	248	3.26	3.26	0.00	0.00	
80	4800	44.99	0.0125	123.40	1	248	3.10	3.10	0.00	0.00	
85	5100	42.95	0.0119	126.98	1	248	2.96	2.96	0.00	0.00	
90	5400	41.11	0.0114	130.40	1	248	2.83	2.83	0.00	0.00	
95	5700	39.43	0.0110	133.69	1	248	2.72	2.72	0.00	0.00	
100	6000	37.90	0.0105	136.85	1	248	2.61	2.61	0.00	0.00	
105	6300	36.50	0.0101	139.89	1	248	2.51	2.51	0.00	0.00	
110	6600	35.20	0.0098	142.82	1	248	2.43	2.43	0.00	0.00	
115	6900	34.01	0.0094	145.65	1	248	2.34	2.34	0.00	0.00	
120	7200	32.89	0.0091	148.40	1	248	2.27	2.27	0.00	0.00	
125	7500	31.86	0.0089	151.05	1	248	2.19	2.19	0.00	0.00	
130	7800	30.90	0.0086	153.63	1	248	2.13	2.13	0.00	0.00	
135	8100	30.00	0.0083	156.13	1	248	2.07	2.07	0.00	0.00	
140	8400	29.15	0.0081	158.56	1	248	2.01	2.01	0.00	0.00	
145	8700	28.36	0.0079	160.92	1	248	1.95	1.95	0.00	0.00	
150	9000	27.61	0.0077	163.22	1	248	1.90	1.90	0.00	0.00	
155	9300	26.91	0.0075	165.46	1	248	1.85	1.85	0.00	0.00	
160	9600	26.24	0.0073	167.65	1	248	1.81	1.81	0.00	0.00	
165	9900	25.61	0.0071	169.78	1	248	1.76	1.76	0.00	0.00	
170	10200	25.01	0.0069	171.87	1	248	1.72	1.72	0.00	0.00	
175	10500	24.44	0.0068	173.90	1	248	1.68	1.68	0.00	0.00	
180	10800	23.90	0.0066	175.90	1	248	1.65	1.65	0.00	0.00	
185	11100	23.39	0.0065	177.84	1	248	1.61	1.61	0.00	0.00	
190	11400	22.90	0.0064	179.75	1	248	1.58	1.58	0.00	0.00	
195	11700	22.43	0.0062	181.62	1	248	1.55	1.55	0.00	0.00	
200	12000	21.98	0.0061	183.45	1	248	1.51	1.51	0.00	0.00	
205	12300	21.55	0.0060	185.25	1	248	1.48	1.48	0.00	0.00	
210	12600	21.14	0.0059	187.01	1	248	1.46	1.46	0.00	0.00	
215	12900	20.75	0.0058	188.74	1	248	1.43	1.43	0.00	0.00	
220	13200	20.37	0.0057	190.44	1	248	1.40	1.40	0.00	0.00	
225	13500	20.01	0.0056	192.11	1	248	1.38	1.38	0.00	0.00	
230	13800	19.66	0.0055	193.75	1	248	1.35	1.35	0.00	0.00	

Flow Calculations:
For 5m (300s) interval
t/600*A*C*I
(300)/600*1076*1*0.0674=36.27

450 Rochester - Phase 2

SURFACE
5 yr Storm Post-Development Flow

100 yr Peak Allow. Discharge	3.79	L/s

Elapsed time (min)	(s)	Intensity (mm/hr)	(mm/s)	Acc Depth (mm)	C	Area (m^2)	Flow (l/s)	Discharge (l/s)	Storage flow (l/s)	Storage volume (m^3)	
0	0	0.00	0.0000	0.00	0.9	248	0.00	0.00	0.00	0.00	
5	300	141.18	0.0392	11.76	0.9	248	4.38	3.79	0.59	0.18	
10	600	104.19	0.0289	20.45	0.9	248	6.46	3.79	2.67	1.60	-peak storage
15	900	83.56	0.0232	27.41	0.9	248	5.18	3.79	1.39	1.25	
20	1200	70.25	0.0195	33.26	0.9	248	4.36	3.79	0.57	0.68	
25	1500	60.90	0.0169	38.34	0.9	248	3.78	3.78	0.00	0.00	
30	1800	53.93	0.0150	42.83	0.9	248	3.34	3.34	0.00	0.00	
35	2100	48.52	0.0135	46.88	0.9	248	3.01	3.01	0.00	0.00	
40	2400	44.18	0.0123	50.56	0.9	248	2.74	2.74	0.00	0.00	
45	2700	40.63	0.0113	53.94	0.9	248	2.52	2.52	0.00	0.00	
50	3000	37.65	0.0105	57.08	0.9	248	2.33	2.33	0.00	0.00	
55	3300	35.12	0.0098	60.01	0.9	248	2.18	2.18	0.00	0.00	
60	3600	32.94	0.0092	62.75	0.9	248	2.04	2.04	0.00	0.00	
65	3900	31.04	0.0086	65.34	0.9	248	1.92	1.92	0.00	0.00	
70	4200	29.37	0.0082	67.79	0.9	248	1.82	1.82	0.00	0.00	
75	4500	27.89	0.0077	70.11	0.9	248	1.73	1.73	0.00	0.00	
80	4800	26.56	0.0074	72.33	0.9	248	1.65	1.65	0.00	0.00	
85	5100	25.37	0.0070	74.44	0.9	248	1.57	1.57	0.00	0.00	
90	5400	24.29	0.0067	76.46	0.9	248	1.51	1.51	0.00	0.00	
95	5700	23.31	0.0065	78.41	0.9	248	1.44	1.44	0.00	0.00	
100	6000	22.41	0.0062	80.27	0.9	248	1.39	1.39	0.00	0.00	
105	6300	21.58	0.0060	82.07	0.9	248	1.34	1.34	0.00	0.00	
110	6600	20.82	0.0058	83.81	0.9	248	1.29	1.29	0.00	0.00	
115	6900	20.12	0.0056	85.48	0.9	248	1.25	1.25	0.00	0.00	
120	7200	19.47	0.0054	87.11	0.9	248	1.21	1.21	0.00	0.00	
125	7500	18.86	0.0052	88.68	0.9	248	1.17	1.17	0.00	0.00	
130	7800	18.29	0.0051	90.20	0.9	248	1.13	1.13	0.00	0.00	
135	8100	17.76	0.0049	91.68	0.9	248	1.10	1.10	0.00	0.00	
140	8400	17.27	0.0048	93.12	0.9	248	1.07	1.07	0.00	0.00	
145	8700	16.80	0.0047	94.52	0.9	248	1.04	1.04	0.00	0.00	
150	9000	16.36	0.0045	95.89	0.9	248	1.01	1.01	0.00	0.00	
155	9300	15.95	0.0044	97.22	0.9	248	0.99	0.99	0.00	0.00	
160	9600	15.56	0.0043	98.51	0.9	248	0.96	0.96	0.00	0.00	
165	9900	15.18	0.0042	99.78	0.9	248	0.94	0.94	0.00	0.00	
170	10200	14.83	0.0041	101.01	0.9	248	0.92	0.92	0.00	0.00	
175	10500	14.50	0.0040	102.22	0.9	248	0.90	0.90	0.00	0.00	
180	10800	14.18	0.0039	103.40	0.9	248	0.88	0.88	0.00	0.00	

Flow Calculations:
For 5m (300s) interval
t/600*A*C*I
(300)/600*1076*0.95*0.0392=20.04