Site Servicing and Stormwater Management Report 1740-1760 St. Laurent Boulevard Development, Ottawa, ON

Client:
11421247 Canada Inc.
768 Boulevard Saint-Joseph,
Gatineau,
Quebec, QC J8Y 4B8

Submitted for:
Rezoning and Site Plan Application

Project Name:
1740-1760 St. Laurent Boulevard Development

Project Number:
OTT-00260579-B0

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Date Submitted:
August 24, 2021

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1 Introduction

1.1 Overview

EXP Services Inc. (EXP) was retained by 11421247 Canada Inc. to prepare a Site Servicing and Stormwater Management Report for the proposed redevelopment of 1740 St. Laurent Boulevard in support of a Rezoning and Site Plan Application.

The 1.9 hectare site is situated along St. Laurent Boulevard between Innes Road and Bourassa Street, as illustrated in **Figure 2-1** below. The site is within the City of Ottawa urban boundary and situated in Alta Vista Ward (Ward 18). The description of the subject property is noted below:

- PIN 04262-0210 comprised of:
  - Block 14, PIN 04261-0229
  - Block 15, PIN 04261-0230
  - Plan 4M-1476, PIN 04261-0231
  - Block 17, PIN 04261-0232
  - Part 1 Plan 5R – 997, PIN 04261 - 0177

The development proposed will consist of four (4) high-rise buildings. Below the towers, three (3) levels of underground parking will be provided. One underground parking structure below Tower 1 and 2, and another underground parking structure below Tower 3 and 4.

The north-east tower (Tower 1) is a 15-storey high-rise comprised of 116 residential units located on the 3rd to 15th floors, with ground floor retail/common area and 2nd floor common area.

The north-west tower (Tower 2) is a 12-storey tower, with 95 residential units located on the 2nd to 12th floors, having ground floor common area.

The south-east tower (Tower 3) is a 15-storey high-rise comprised of 268 residential units located on the 2nd to 15th floors, with ground floor commercial area.

The south-west tower (Tower 4) is a 12-storey tower, with 193 residential units located on the 1st to 12th floors.

This report will discuss the adequacy of the adjacent municipal watermain, sanitary sewers and storm sewers to provide the required water supply, convey the sewage and stormwater flows that will result from the proposed development.

2 Existing Conditions

Within the site, there are four (4) existing buildings. The current zoning of the property is Arterial Mainstreet Zone, (AM10) and includes retail and commercial uses. The following summarizes the current building uses within the property.

- Existing Building 1 (north) Petrol station, car wash, parking areas.
- Existing Building 2 (middle) Restaurant, parking areas.
- Existing Building 3 (south) Restaurant, commercial, parking areas.
- Existing Building 4 (south) Commercial, parking areas.

The topography of the subject site is gently slopped in a north-east direction towards St. Laurent Boulevard. There is an easement bisecting the property from east to west for a local site access road.

Currently, there are six (6) vehicular access points from the site, all from St. Laurent Boulevard. Inbound (into the site) traffic using any of the six (6) access locations would be south bound from St. Laurent Boulevard only. All outbound traffic would be for south bound traffic on St. Laurent Boulevard, due to a raised concrete median present on St. Laurent Boulevard.



Figure 2-1 - Site Location

3 Existing Infrastructure

The site includes four (4) buildings that will be removed during the redevelopment of the site. It is proposed to develop the site in two phases. The northern two (2) towers (tower 1 & 2) will be constructed first, with the southern two (2) towers (tower 3 & 4) to follow.

From review of the sewer and watermain mapping, as-built drawings and Utility Central Registry (UCC) plans, the following summarizes the onsite and adjacent offsite infrastructure:

Within property

- Storm sewers and catch basins, sanitary sewer laterals and manhole, watermain services to the four (4) existing buildings.
- 525 storm sewer bisecting the proposed Tower 3 & 4 location (will require re-routing).
- Sanitary sewer located below the proposed tower 1 location (will require re-routing).
- Private 203-305mm watermain connected to St. Laurent Boulevard in Everest Private.

On St. Laurent Boulevard

- 406mm watermains
- 525mm sanitary sewer
- 1050mm storm sewer

4 Pre-Consultation / Permits / Approvals

A pre-consultation meeting was held with the City prior to design commencement. This online Teams meeting, held May 19, 2020, outlined the submission requirements and provided information to assist with the development proposal.

The proposed site is located within the Rideau Valley Conservation Authority (RVCA) jurisdiction (Ottawa River East), therefore signoff from the RVCA will be required prior to Site Plan approval. The RVCA will be contacted to confirm the stormwater management quality control requirements.

Generally, an Environmental Compliance Approval (ECA) would be obtained from the Ministry of Environment, Conservation and Parks (MECP) for any onsite private Sewage Works. The onsite Sewage Works would generally include the onsite stormwater works such as flow controls, associated stormwater detention, and treatment works. However, an Approval Exemption under Ontario Regulation 525/98 can be applied. Under Section 3 of O'Reg 525/98, Section 53 (1) and (3) do not apply to the alteration, extension, replacement or a change to a stormwater management facility that 1) is designed to service one lot or parcel of land, b) discharges into a storm sewer that is not a combined sewer, c) does not service industrial land or a structure located on industrial land, and finally d) is not located on industrial land. Based on this exemption, if the stormwater management works within the site remain located within one property parcel, then an Approval Exemptions under O'Reg 525/98 would apply and therefore not necessitate an ECA.

In addition, various design guidelines were referred to in preparing the current report including:

- Ottawa Design Guidelines – Sewer Design, October 2012 (SGD002), including:
  - Technical Bulletin ISDTB-2012-4 (20 June 2012)
  - Technical Bulletin ISDTB-2014-01 (05 February 2014)
  - Technical Bulletin PIEDTB-2016-01 (September 6, 2016)
  - Technical Bulletin ISDTB-2018-01 (21 March 2018)
  - Technical Bulletin ISDTB-2018-04 (27 June 2018)
- Ottawa Design Guidelines – Water Distribution, July 2010 (WDG001), including:
  - Technical Bulletin ISDTB-2014-02 (May 27, 2014)
  - Technical Bulletin ISTB-2018-02 (21 March 2018)
- Stormwater Management Planning and Design Manual, Ontario Ministry of the Environment and Climate Change, March 2003 (SMPDM).
- Design Guidelines for Drinking-Water Systems, Ontario Ministry of the Environment and Climate Change, 2008 (GDWS).
- Fire Underwriters Survey, Water Supply for Public Fire Protection (FUS), 1999.
- Ontario Building Code 2012, Ministry of Municipal Affairs and Housing.

5 Water Servicing

5.1 Existing Water Servicing

The subject site is within the City of Ottawa 1E pressure zone. The site is currently serviced by two connections to the watermain on St. Laurent Boulevard, one (1) service and one (1) private watermain connection. From GeoOttawa, it is shown that a 152mm water service supplies the southern building and a 203mm (increased to 305mm on site) watermain connects through the property to supply buildings on site and to the west of the subject site and ultimately connect back to the watermain in Russel Road. Both noted water services are connected of the existing 406mm watermain in St. Laurent Boulevard. Figure 5-1 below illustrates the existing water services onsite.



Figure 5-1 – Water Servicing for Existing Buildings

5.2 Water Servicing Proposal

The development proposed will consist of four (4) high-rise buildings. Tower 1 is comprised of 116 residential units and ±1,047 square metres of office and retail space. Tower 2 is comprised of 95 residential units. Tower 3 is comprised of 268 residential units and ±1,844 square metres of office and retail space. Tower 4 is comprised of 193 residential units.

Water supply for the site will be provided by the proposed 300mm diameter watermain that will bisect the site connecting to the existing municipal 406mm diameter watermain on St Laurent Boulevard and the existing municipal 305mm diameter watermain along Everest Private. As each tower will be constructed in phases, it is necessary to provide separate services for each. In addition, each building will require independent and twin watermain, which is the result of the average day water demands exceeding 50 m^3/day. The watermain feeds from the underground parking level will connect directly to the proposed 300mm diameter watermain and will have an isolation valve between them, consistent with City of Ottawa Water Design Guidelines.

The buildings will be protected by an automatic sprinkler system. A fire department (or siamese) connection will be located within 45 metres of an adjacent municipally owned fire hydrant. In order to achieve this, it is proposed that

two (2) new hydrants will be installed off the proposed 300mm diameter watermain on site. Refer to the Site Servicing plan (DWG# C100) in **Appendix A** for the water servicing layout.

5.3 Water Servicing Design

The water servicing requirements for the proposed building is designed in accordance with the City Design Guidelines (July 2010). The following steps indicate the basic methodology that was used in our analysis:

- Estimated water demands under average day, maximum day and peak hour conditions. As the total population estimate was greater than 500, standard residential peaking factors were used, rather than based on MECP Table 3-3 which would be necessary when the design population is than 500 persons.
- Estimated the required fire flow (RFF) based on the Fire Underwriters Survey (FUS).
- Obtained hydraulic boundary conditions (HGL) from the City, based on the above water demands and required fire flows.
- Boundary condition data and water demands were used to estimate the pressure at the proposed building, and this was compared to the City's design criteria. Refer to **Appendix A** for the boundary conditions received from the City.

Since the average day demand exceed 50 m^3 per day, two 150mm diameter PVC DR18 watermain feeds for each building will be necessary as per Section 4.31 of the WDG001. Please refer to **Email from** City of Ottawa on Water System Boundary Conditions

Table A in **Appendix A** for detailed calculations of the total water demands.

A review of the estimated watermain pressure at the building connection, based on the boundary conditions provided, was completed based on using two watermains. **Table A-, A-9, A-10** and **A11** in **Appendix A** provides a comparison of anticipated pressures at the buildings' connection based on using a single or double watermain feed. The analysis results determined that double water services are required to meet the City's water requirements during either the maximum day plus fire flow or peak hour condition.

Based on the hydraulic grade line (HGL) provided from the City it is evident that existing static pressure of ±72.8 psi (502.1 kPa) is available in the municipal 406mm diameter watermain on St. Laurent Boulevard. Due to the relatively short distance between the buildings and the watermain connection, minimal pressure loss is anticipated. Based on the existing watermain pressure and the max day + fire flow conditions, the residual pressure at the proposed buildings are 53.0 psi (365.7 kPa) for Tower 1, 44.6 psi (307.3 kPa) for Tower 2, 48.5 psi (334.7 kPa) for Tower 3, and 40.9 psi (281.7 kPa) for Tower 4. The residual water pressures in the proposed watermain are greater than the minimum requirement of 20psi (140kPa) and less than the maximum requirement of 80 psi (552 kPa) as per the City of Ottawa Guidelines. Therefore, the existing water supply system will have adequate capacity to meet the domestic and fire demands for the proposed buildings. Refer to **Appendix A** for detailed calculations.

5.4 Water Servicing Design Criteria

Table 5-1 below summarizes the Design Criteria that was used to establish the water demands and the required fire flows, based on the proposed building uses. The design parameters that apply to this project and used for calculations are identified below.

Table 5-1 - Summary of Water Supply Design Criteria

Design Parameter	Value	Applies
Population Density – Single-family Home	3.4 persons/unit	
Population Density – Semi-detached Home	2.7 persons/unit	
Population Density – Townhome or Terrace Flat	1.8 persons/unit	
Population Density – Bachelor Apartment	1.4 persons/unit	
Population Density – Bachelor + Den Apartment	1.4 persons/unit	
Population Density – One Bedroom Apartment	1.4 persons/unit	✓
Population Density – One Bedroom plus Den Apartment	1.4 persons/unit	
Population Density – Two Bedroom Apartment	2.1 persons/unit	✓
Population Density – Two Bedroom plus Den Apartment	2.1 persons/unit	
Population Density – Three Bedroom Apartment	3.1 persons/unit	✓
Average Day Demands – Residential	350 L/person/day	✓
Average Day Demands – Commercial / Institutional	28,000 L/gross ha/day	✓
Average Day Demands – Light Industrial / Heavy Industrial	35,000 or 55,000 L/gross ha/day	
Maximum Day Demands – Residential	2.5 x Average Day Demands	✓
Maximum Day Demands – Commercial / Institutional	1.5 x Average Day Demands	✓
Peak Hour Demands – Residential	5.5 x Average Day Demands	✓
Peak Hour Demands – Commercial / Institutional	2.7 x Average Day Demands	✓
Fire Flow Requirements Calculation	FUS	✓
Depth of Cover Required	2.4m	✓
Maximum Allowable Pressure	551.6 kPa (80 psi)	✓
Minimum Allowable Pressure	275.8 kPa (40 psi)	✓
Minimum Allowable Pressure during fire flow conditions	137.9 kPa (20 psi)	✓

5.5 Estimated Water Demands

The following **Table 5-2** below summarizes the anticipated water demands for the proposed development based on following:

- Tower 1 having 116 residential units and 965 m^2 of commercial space. Estimated residential population of 181 persons.
- Tower 2 having 95 residential units and 1,288 m^2 of commercial space. Estimated residential population of 151 persons.
- Tower 3 having 268 residential units. Estimated residential population of 412 persons.
- Tower 4 having 193 residential units. Estimated residential population of 284 persons.

Table 5-2 : Water Demand Summary

Water Demand Conditions	Tower 1 - Water Demands (L/sec)	Tower 2 - Water Demands (L/sec)	Tower 3 - Water Demands (L/sec)	Tower 4 - Water Demands (L/sec)	Total Water Demands (L/sec)
Average Day	0.79	0.69	1.67	1.15	4.3
Max Day	1.91	1.64	4.18	2.87	10.6
Peak Hour	4.17	3.57	9.19	6.32	23.25

5.6 Boundary Conditions

Hydraulic Grade Line (HGL) boundary conditions were obtained from the City for design purposes. A copy of the correspondence received from the City is provided in **Appendix B**.

The following hydraulic grade line (HGL) boundary conditions were provided for the connection on St. Laurent Boulevard:

- Minimum HGL = 108.9 m
- Maximum HGL = 118.2 m
- MaxDay + Fire Flow = 107.4 m

The provided HGL ranges were used to estimate pressures at each proposed building. Under Max Day Plus Fire Flow conditions the HGL of 107.4 m was used, for Max Day and Peak Hour conditions the HGL of 108.9 m was used, and for the Average Day conditions the HGL of 118.2 m was used.

5.7 Fire Flow Requirements

Water for fire protection will be available utilizing the proposed fire hydrants located along on St. Laurent Boulevard. The required fire flows for the proposed buildings were calculated based on typical values as established by the Fire Underwriters Survey 1999 (FUS).

The following equation from the Fire Underwriters document “Water Supply for Public Fire Protection”, 1991, was used for calculation of the on-site supply rates required to be supplied by the hydrants:

$F = 200 * C * \sqrt{(A)}$

where:

F = Required Fire flow in Litres per minute
C = Coefficient related to type of Construction
A = Total Floor Area in square metres

The Required Fire Flows were estimated in accordance with ISTB-2018-02 and based on floor areas provided by the architect. The following summarizes the parameters used for the proposed buildings:

- Type of Construction — Non-combustible
- Occupancy — Limited combustible
- Sprinkler Protection — Fully Supervised Automatic Sprinkler

The estimated required fire flows, based on the FUS methods are: 133 L/sec for Tower 1, 167 L/sec for Tower 2, 183 L/sec for Tower 3, and 200 L/sec for Tower 4. Refer to **Tables A-3, A-4, A-5,** and **A-6** in **Appendix A** for detailed calculations.

5.8 Review of Hydrant Spacing

A review of the hydrant spacing was completed to ensure compliance with Appendix I of Technical Bulletin ISTB-2018-02. As per Section 3 of Appendix I all hydrants within 150 metres were reviewed to assess the total possible available flow from these contributing hydrants.

For each hydrant the distance to the proposed building was determined to arrive at the contribution of fire flow from each. All hydrants are expected to be of Class AA as per Section 5.1 of Appendix I. For each hydrant the straight-line distance, distance measured along a fire route or roadway, whether its location is accessible, and its contribution to the required fire flow. It was determined that two (2) existing hydrants, one along St. Laurent Boulevard and one along Everest Private, and two (2) proposed hydrants on the frontage of Towers 1 and 4 along Everest Private are required to provide adequate fire flow for the proposed buildings. Refer to the Site Servicing plan (DWG# C100) in **Appendix A** for the fire hydrants locations. A summary table of the total fire flows available versus the required fire flows (RFFs) is presented in **Table 5-** below.

Table 5-3 –Fire Flows Based on Hydrant Spacing

Building	Required Fire Flow (L/min)	Available Fire Flow Based on Hydrant Spacing as per ISTB-2018-02 (L/min)
Tower 1	8,000 (or 133 L/sec)	9,500
Tower 2	10,000 (or 167 L/sec)	17,100
Tower 3	11,000 (or 183 L/sec)	15,200
Tower 4	12,000 (or 200 L/sec)	19,000

Without the addition of two(2) new hydrants the available fire flow available for each tower would be approximately 5,700 L/min, 7,600 L/min, 5,700 L/min, and 9,500 L/min for Towers 1, 2, 3 and 4 respectively, which is below the required fire flow described above. Therefore, the available flows from the hydrants exceed each tower's fire flow requirements as identified in Appendix I of Technical Bulletin ISTB-2018-02 and is based on two (2) new hydrants being installed.

6 Sewage Servicing

6.1 Existing Sewage Conditions

Sewage is currently discharged to the municipal sanitary sewer on St. Laurent Boulevard, which then discharges to the Innes Road collector. The route is as follows:

- East on Everest Private (±153m of 200-300mm pipe) to St. Laurent Boulevard Collector,
- North on St. Laurent Boulevard (±141m of 525mm pipe) to Innes Road Collector,
- East on Innes Road (±2,535m of 900mm, 1650mm pipes) to Stonehenge Crescent
- North on Stonehenge Crescent, north-east through open field, north on Shefford Road and eventually discharging to the Robert O. Pickard Environment Centre.

Sewage flows within the property were estimated in order to compare with developed conditons. **Table 6-1** below summarizes the approximate sewage flows generated from the existing properties, based on a commerical flow allowance of 28,000 m3/ha/day, commercial peaking factor of 1.5, and infiltration allowance of 0.33 L/sec/gross hectare.

Table 6-1 – Summary of Existing Sewage Flows

Sewage Condition	Sanitary Sewage Flow (L/sec)
Peak Commercial Sewage Flow	0.70
Infiltration Flow (at 0.33 L/ha/sec)	0.47
Peak Wet Weather Sewage Flow	1.17

6.2 Proposed Sewage Conditions

It is proposed to provide separate sanitary sewer connections from each tower to sanitary manholes on-site, which will then discharge to the sewer on Everest Private. The sanitary laterals for Towers 2 and 4 will connect to the existing manhole no. 64454 and laterals for Towers 1 and 3 will connect to the proposed manhole SANMH201. Proposed SANMH201 will serve as the monitoring manhole for the site.

The sanitary sewer system was designed based on a population flow with an area-based infiltration allowance. A 200mm diameter PVC SDR35 sanitary sewer is proposed with a minimum 2% slope, having a capacity of 51 L/sec based on Manning's Equation under full flow conditions. The Alta Vista Ridge subdivision (355 and 374 Everest Private) is located to the west of the proposed site and has a total sewage flow of **11.86 L/sec** as per the Servicing and Stormwater Management brief prepared by Stantec dated June 2, 2021. The estimated peak sanitary flow rate from the proposed property is **11.44 L/sec** based on City Design Guidelines. Sewage rates in **Table 6-1** below include a total infiltration allowance of 0.33 L/ha/sec based on the total gross site area. Refer to **Tables B-1**in **Appendix B** for detailed calculations. The proposed sanitary sewer will have adequate capacity to convey the effluents from the Alta Vista Ridge Subdivision and the proposed towers.

Table 6-2 – Summary of Anticipated Sewage Rates

Sewage Condition	Sanitary Sewage Flow (L/sec)
Peak Residential / Commercial Flow	10.87
Infiltration Flow	0.57
Peak Design Flow	11.39

The estimated sewage effluent from Towers 1, 2, 3, and 4 are 2.49, 2.15, 5.52, 3.83, respectively. As each building will require its own sanitary sewer connection, a 200mm diameter PVC SDR35 lateral with a minimum slope of 2.0% and estimated capacity of 51 L/sec will be installed. The proposed laterals will have adequate capacity to convey the effluents from each building.

7 Storm Servicing & Stormwater Management

The proposed stormwater system is designed in conformance with the latest version of the City of Ottawa Design Guidelines (October 2012). Section 5 "Storm and Combined Sewer Design" and Section 8 "Stormwater Management". A summary of the design criteria that relates to this design report is the proceeding sections below.

7.1 Minor System Design Criteria

- The storm sewer was sized based on the Rational Method and Manning's Equation under free flow conditions for the 2-year storm using a 10-minute inlet time.
- The allowable discharge from the site is established using the peak flows derived based on a 5-year return period storm, a maximum runoff coefficient of 0.50 and a standard time of concentration of 10 minutes as per Section 8.3.7.3 of the SDG002.
- On-site storage shall be provided up to the 100-year event based on the controlled allowable discharge previously noted.
- Additional requirements from the pre-consultation meeting are noted below:
    - *Demonstrate that the approved Stormwater Management design for the Alta Vista Ridge Subdivision will not impact negatively. The Alta Vista Ridge subdivision flows were obtained from the Servicing and Stormwater Management brief prepared by Stantec dated June 2, 2021. Refer to Storm Drainage plan drawing no. SD-1 prepared by Stantec dated 28 May 2021 in* ***Appendix E****.*
- Minimum sewer slopes to be based on minimum velocities for storm sewers of 0.80 m/sec.

7.2 Major System Design Criteria

- As per Technical Bulletin PIEDTB-2016-01 section 8.3.11.1 (p.12 of 14) there shall be no surface ponding on private parking areas during the 2-year storm rainfall event. Depending on the SWM strategy proposed underground or additional underground storage may be required to satisfy this requirement.
- The major system has been designed to accommodate on-site detention with sufficient capacity to attenuate the 100-year design storm. On-site storage is calculated based on the 100-year design storm with on-site detention storage provided on the roof and within the underground parking structures (stormwater cisterns).
- Overland flow routes are provided.

- The vertical distance from the spill elevation on the street and the ground elevation at the buildings is at least 150mm.
- The emergency overflow spill elevation is at least 300mm below the lowest building opening.

7.3 Runoff Coefficients

Runoff coefficients used for were based on actual areas taken from CAD. Runoff coefficients for impervious surfaces (roofs, asphalt, and concrete) were taken as 0.90, whereas those for pervious surfaces (grass/landscaping) were taken as 0.20. Average runoff coefficients were calculated for catchments (or drainage areas) using weighted average method.

The runoff coefficients for pre-development and post-development catchments are provided in **Table C6** and **Table C7** in **Appendix C** and summarized in **Table 7-1** and **Table7-2** below.

Table 7-1 – Summary of Pre-Development Runoff Coefficients

Location	Area (hectares)	Runoff Coefficient, C_{AVG}
Entire Site	1.90	0.50

Table 7-2 – Summary of Post-Development Runoff Coefficients

Location	Area (hectares)	Runoff Coefficient, C_{AVG}
T1	0.160	0.90
T2	0.172	0.57
T3	0.256	0.90
T4	0.186	0.90
A1	0.079	0.62
A2	0.003	0.90
A3	0.049	0.84
A4	0.045	0.64
A5	0.080	0.54
A6	0.113	0.20
A7	0.010	0.57
A8	0.120	0.20
A9	0.252	0.68
A10	0.020	0.56
A11	0.023	0.85
A12	0.011	0.76
A13	0.013	0.81
A14	0.022	0.90
A15	0.015	0.79
A16	0.057	0.80
A17	0.166	0.20
A18	0.048	0.25

7.4 Pre-Development Conditions

Under current conditions stormwater runoff from the 1.9-hectare site flows via on-site storm outlets to the existing 1050mm storm sewer on St. Laurent Boulevard. The overland flow route for stormwater is east towards St. Laurent Boulevard. **Table 7-3** below summarizes the estimated peak flows under pre-development conditions using the standard 10-minute time of concentration (time to inlet).

Table 7-3 – Summary of Pre-Development Flows

Return Period Storm	Total Peak Flows (L/sec)
2-year	202.8
5-year	275.4
100-year	943.1

7.5 Allowable Release Rate

Rather than meeting pre-development released rates, the City of Ottawa imposes a more restrictive stormwater release rate as noted in Section 8.3.7.3 of the SDG002. The allowable discharge release rate from the site was established using the peak flows derived based on a 5-year return period storm, a maximum runoff coefficient of 0.50 and a standard time of concentration of 10 minutes.

The allowable release rate of 275.4 L/sec from the proposed site will be based on a 5-year storm event. **Table A-8** in **Appendix C** provides detailed calculations on the total allowable peak flow.

7.6 Proposed Stormwater System

Stormwater runoff from the proposed site will drain from a combination of controlled and uncontrolled areas. The overall site release rate will meet or be less than the allowable release rate via design control measures and on-site storage. The Post-Development Catchments plan drawing no. C-400 is included in **Appendix E**. A total of 21 subcatchments (or drainage areas) within the development site are shown on this drawing with the average runoff coefficients calculated for each drainage area. The detailed calculations of the post-development average runoff coefficients for each drainage area are provided in **Table C-7** in **Appendix C**. As the entire site property contains underground parking structures, the stormwater works shall consist of the following elements:

- Flow-control roof drains for Towers 1, 2, 3 and 4. Each building to have a separate storm lateral connection, which will discharge to an onsite storm manhole, which will then convey the stormwater to the municipal system on St. Laurent Boulevard.
- Runoff from surface areas will be collected by area drains and discharge to underground storage (stormwater cisterns) located in the underground parking structures. This in turn discharges to one of the storm laterals noted above.

In order to achieve the quantity control requirements and meet the allowable discharge rates roof drains on all four (4) Towers will require flow-controlled weirs. The number of roof drains are indicated on the Architectural Roof plan drawing no. P204 in **Appendix E**. WATTS ACCUTROL weirs were used to determine the total discharge rates from the roof areas based on the number of drains. In addition, the total cumulative prism volumes on the roofs were calculated at a maximum permitted depth of 150mm. Refer to **Tables C-1**, **C-2**, **C-3**, **C-4**, and **C-5** for the detailed roof release rates and available storage for each tower.

Table 7-4 below provides a summary of the stormwater peak flows under post-development conditions. Refer to the **Table C-8** in **Appendix C** for detailed calculations of the post-development peak flows.

Table 7-4 – Summary of Post-Development Flows

Return Period Storm	Max Allowable Peak Flow (L/sec)	[1]Total Uncontrolled Peak Stormwater Flows (L/sec)	[2]Total Controlled Peak Stormwater Flows (L/sec)
2-year	275.4 L/sec Based on pre-development 5-year Storm	255.9	97.8
5-year		347.2	132.7
100-year		702.8	274.9

Note 1-Uncontrolled peak flows, or peak flows that would result if no flow control used.
Note 2-Contolled flows.

Since flow control is being utilized onsite, it is necessary to provide appropriate flow attenuation (storage). Additional information on the estimated 100-year volumes is provided in **Section 7.7** below.

7.7 Flow Attenuation & Storage

The attenuation of stormwater will be achieved by utilizing roof storage and stormwater storage in the underground parking structure (cisterns). Using the allowable release rates, the Modified Rational Method was used to determine the 2-year, 5-year, and 100-year volumes that will occur for corresponding release rates.

Refer to **Table C-10** through **C-29** in **Appendix C** for the detailed calculations for the storage volumes required on the roof and in the underground parking structure to attenuate the controlled release rates. **Table C-8** summarizes the combined controlled and uncontrolled flows leaving the subject site and **Table C-9** summarizes the required and provided storage for the subject site. A summary of release rates, storage volume requirements, and provided storage volumes are identified in **Table 7-5** below.

Table 7-5 – Summary of Post-Development Release Rates and Storage

Area	Release Rate (L/s)			Storage Required (m^3) (MRM)			Storage Provided (m^3)		Flow Control Method
	2-yr	5-yr	100-yr	2-yr	5-yr	100-yr	Roof	Cistern	
T1	7.0	9.5	18.0	7.6	9.7	24.7	64.0		Flow Controlled Roof Drains with Weir (Set at 25% Open Position)
T2	3.6	4.9	10.4	7.2	9.3	23.2	36.0		
T3	9.5	12.9	24.6	15.3	19.7	45.6	102.5		
T4	5.1	6.9	13.2	14.2	18.3	38.6	74.5		
Surface - Uncontrolled	12.9	17.6	37.8						None
Surface - Controlled	59.7	80.9	170.9	28.0	38.0	80.6		80.6	Pump Rate from Cistern
Totals =	97.8	132.7	274.9	72.3	95.0	212.7	277.0	80.6	

8 Erosion & Sediment Control

During all construction activities, erosion and sedimentation shall be controlled by the following techniques:

- Filter cloth shall be installed between the frame and cover of all adjacent catch basins and catch basin manhole structures.
- Heavy duty silt fencing will be used to control runoff around the construction area. Silt fencing locations are identified on the Erosion and Sediment Control plan drawing no. C-300.
- A mud mat will be installed at the construction entrance to help avoid mud from being transported to off-site roads.
- Visual inspection shall be completed daily on sediment control barriers and any damage repaired immediately. Care will be taken to prevent damage during construction operations.
- In some cases, barriers may be removed temporarily to accommodate the construction operations. The affected barriers will be reinstated at night when construction is completed.
- Sediment control devices will be cleaned of accumulated silt as required. The deposits will be disposed of as per the requirements of the contract.
- During the course of construction, if the engineer believes that additional prevention methods are required to control erosion and sedimentation, the contractor will install additional silt fences or other methods as required to the satisfaction of the engineer.
- Construction and maintenance requirements for erosion and sediment controls are to comply with Ontario Provincial Standard Specification (OPSS) OPSS 805 and City of Ottawa specifications.

9 Conclusions and Recommendations

The Servicing & Stormwater Report outlines the rationale which will be used to service the proposed development. The following summarizes the servicing requirements for the site:

Water

- Two parallel 150mm diameter watermains are proposed to service each of Towers 1, 2, 3, and 4 as the average day demands exceed 50 m^3 per day, which is mandatory as per Section 4.31 of the WDG001.
- The Required Fire Flows (RFFs) were estimated at **8,000 L/min** (133 L/sec) for Tower 1, **10,000 L/min** (167 L/sec) for Tower 2, **11,000 L/min** (183 L/sec) for Tower 3, and **12,000 L/min** (200 L/sec) for Tower 4. The total minimum available flows for firefighting purposes, based on the contribution from hydrants, was estimated at **9,500 L/min**, **17,100 L/min**, **15,200 L/min**, and **19,000 L/min** for each tower, respectively. The available flows are based on the two (2) existing fire hydrants along St. Laurent and the installation of two (2) new fire hydrants along Everest Private.
- Based on hydraulic boundary conditions (HGL) provided by the City of Ottawa, anticipated system pressures of **53.0 psi**, **44.6 psi**, **48.5 psi** and **40.9 psi** for Towers 1, 2, 3, and 4, respectively, under max day + fire flow demands. This exceeds the minimum requirement of 20 psi and is less than the maximum requirement of 80psi as per the City's guideline.

Sewage

- Estimated peak sewage flows of **11.44 L/sec** are anticipated. The sanitary sewer system will consist of 200mm diameter sewers with a minimum 2% slope and having a capacity of **51 L/sec**, which will be adequate to convey the anticipated sewage flow.

Stormwater

- For the stormwater system, the allowable capture rate from the entire site was calculated based on a 5-year return period storm, a maximum runoff coefficient of 0.50 and a standard time of concentration of 10 minutes as per Section 8.3.7.3 of the SDG002. The allowable release rate for the entire site was calculated to be **275.4 L/sec**. Runoff in excess of this will be detained onsite for up to the 100-year storm.
- In order to meet the allowable release rate, a total retention volume of **± 212.7 m^3** is required.
- Runoff on the building roofs will be controlled using flow-controlled roof drains. For each roof-drain will be equipped with WATTS ACCUTROL weirs. Based on the number of roof drains, it was determined that the maximum 100-year discharge rates for Towers 1, 2, 3, and 4 are **18.0 L/sec**, **10.4 L/sec**, **24.6 L/sec**, and **13.2 L/sec**, respectively.
- The 100-year storage volume requirements on the roofs for Towers 1, 2, 3, and 4 was estimated as **24.7 m^3**, **23.2 m^3**, **45.6 m^3**, and **38.6 m^3**, respectively, based on the above release rates, using the Modified Rational Method. The required storage volumes will be provided on the roofs.
- Runoff from the surface areas above the parking structure will be collected and detained in underground stormwater chamber (cisterns) located in the parking structures. Runoff from the catchment areas between the buildings will be directed to one of the cisterns. The maximum discharge from the site will be **274.9 L/sec** during the 100-year storm event, which is well below the allowable release rate.
- The volume necessary to detain the 100-year event from the surface areas (via pumping from the cisterns) will be based on using 50% of the allowable release rate as required by the City of Ottawa. The stormwater tanks (cisterns) will be sized to hold a minimum volume of **80.6 m^3**.

10 Legal Notification

This report was prepared by EXP Services Inc. for the account of 11421247 Canada Inc.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

Appendix A – Water

Email from City of Ottawa on Water System Boundary Conditions

Table A-1 – Water Demand Chart

Table A-2 – Fire Flow Requirements Based on Fire Underwriters Survey (FUS) – Summary

Table A-3 – Fire Flow Requirements Based on Fire Underwriters Survey (FUS) – Tower 1

Table A-4 – Fire Flow Requirements Based on Fire Underwriters Survey (FUS) – Tower 2

Table A-5 – Fire Flow Requirements Based on Fire Underwriters Survey (FUS) – Tower 3

Table A-6 – Fire Flow Requirements Based on Fire Underwriters Survey (FUS) – Tower 4

Table A-7 – Available Fire Flows Based on Hydrant Spacing

Table A-8 – Estimated Water Pressures at Buildings – Tower 1

Table A-9 – Estimated Water Pressures at Buildings – Tower 2

Table A-10 – Estimated Water Pressures at Buildings – Tower 3

Table A-11 – Estimated Water Pressures at Buildings – Tower 4

Aly Elgayar

From: Sharif, Golam <sharif.sharif@ottawa.ca>
Sent: Monday, October 26, 2020 11:10 AM
To: Jason Fitzpatrick; Bruce Thomas
Cc: Scaramozzino, Tracey
Subject: RE: 1740 St Laurent Boulevard,
Attachments: 1740 St Laurent Boulevard October 2020.pdf

exp. CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good Morning Jason,

I have the BC from our water modelling unit. However, the connection was showing at the private watermain at the site, and we don't provide the BC for private watermain. Therefore, I have the BC at the Russel Rd and St Laurent Blvd. Please see following information from the water modelling unit:

The following are boundary conditions, HGL, for hydraulic analysis at 1740 St Laurent (zone 1E) assumed to be connected to the 203mm on St Laurent Boulevard and 305mm on Russell Road (see attached PDF for location).

Connection 1 (203mm on St Laurent):

Minimum HGL = 108.9m

Maximum HGL = 118.2m

MaxDay + Fire Flow (133 L/s) = 110.4m

MaxDay + Fire Flow (167 L/s) = 109.0m

MaxDay + Fire Flow (183 L/s) = 108.2m

MaxDay + Fire Flow (200 L/s) = 107.4m

Connection 2 (305mm on Russell):

Minimum HGL = 108.3m

Maximum HGL = 118.4m

MaxDay + Fire Flow (133 L/s) = 107.0m

MaxDay + Fire Flow (167 L/s) = 104.0m

MaxDay + Fire Flow (183 L/s) = 102.5m

MaxDay + Fire Flow (200 L/s) = 100.6m

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions.

The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

If you have any question, please let me know. Thanks.

Sharif

Golam Sharif, P.Eng., M.Eng.
Project Manager, Infrastructure Approvals
Development Review, South Services
Planning, Infrastructure and Economic Development Department |
Services de planification, d'infrastructure et de développement économique
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West. Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2424 ext./poste **20763**, fax/téléc:613-580-2576, sharif.sharif@ottawa.ca

From: Scaramozzino, Tracey <Tracey.Scaramozzino@ottawa.ca>
Sent: October 20, 2020 1:57 PM
To: Jason Fitzpatrick <jason.fitzpatrick@exp.com>; Sharif, Golam <sharif.sharif@ottawa.ca>
Cc: Bruce Thomas <Bruce.Thomas@exp.com>
Subject: Re: 1740 St Laurent Boulevard,

Hi Sharif - please see attached.

From: Jason Fitzpatrick <jason.fitzpatrick@exp.com>
Sent: October 20, 2020 1:05 PM
To: Scaramozzino, Tracey <Tracey.Scaramozzino@ottawa.ca>
Cc: Bruce Thomas <Bruce.Thomas@exp.com>
Subject: FW: 1740 St Laurent Boulevard,

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ATTENTION : Ce courriel provient d'un expéditeur externe. Ne cliquez sur aucun lien et n'ouvrez pas de pièce jointe, excepté si vous connaissez l'expéditeur.

Hi Tracey,

I tried to email Golam Sharif my request below, but the email bounced back.

I believe he is the IAD contact for this project, as noted in the pre-consultation minutes.

Perhaps I didn't get the correct email address. Can you confirm the proper contact person, or let me know his proper email address.

Thanks

Jason Fitzpatrick, P.Eng.
EXP | Project Engineer
t : +1.613.688.1899 | m : +1.613.302.7441 | e : jason.fitzpatrick@exp.com

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From: Jason Fitzpatrick
Sent: Tuesday, October 20, 2020 12:54 PM
To: 'golam.sharif@ottawa.ca' <golam.sharif@ottawa.ca>
Cc: Bruce Thomas <bruce.thomas@exp.com>; Alexander O'Beirn <Alexander.OBeirn@exp.com>
Subject: 1740 St Laurent Boulevard,

Hi Golam,

As noted in the pre-consultation meeting minutes, I'm providing the required background information that is necessary in order for the City to provide hydraulic boundary conditions on the water system, that we can use for our design.

Please find attached the following information:

- Estimated Required Fire Flows (RFF) for each building based on FUS Method.
- Water demands for each building and total.
- Concept Site Plan.
- Site Location Plan

Based on calculations, the following summarizes the domestic and fire flow demands:

- Average Day Demands = 4.2 L/sec
- Maximum Day Demands = 10.4 L/sec
- Peak Hour Demands = 22.8 L/sec
- Required Fire Flow (RFF) = 133 L/sec, 183 L/sec, 167 L/sec, 200 L/sec (Towers 1, 2, 3, 4)

If you have any questions, let me know.

Thanks

Jason Fitzpatrick, P.Eng.
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Boundary Conditons for 1740 St Laurent Boulevard

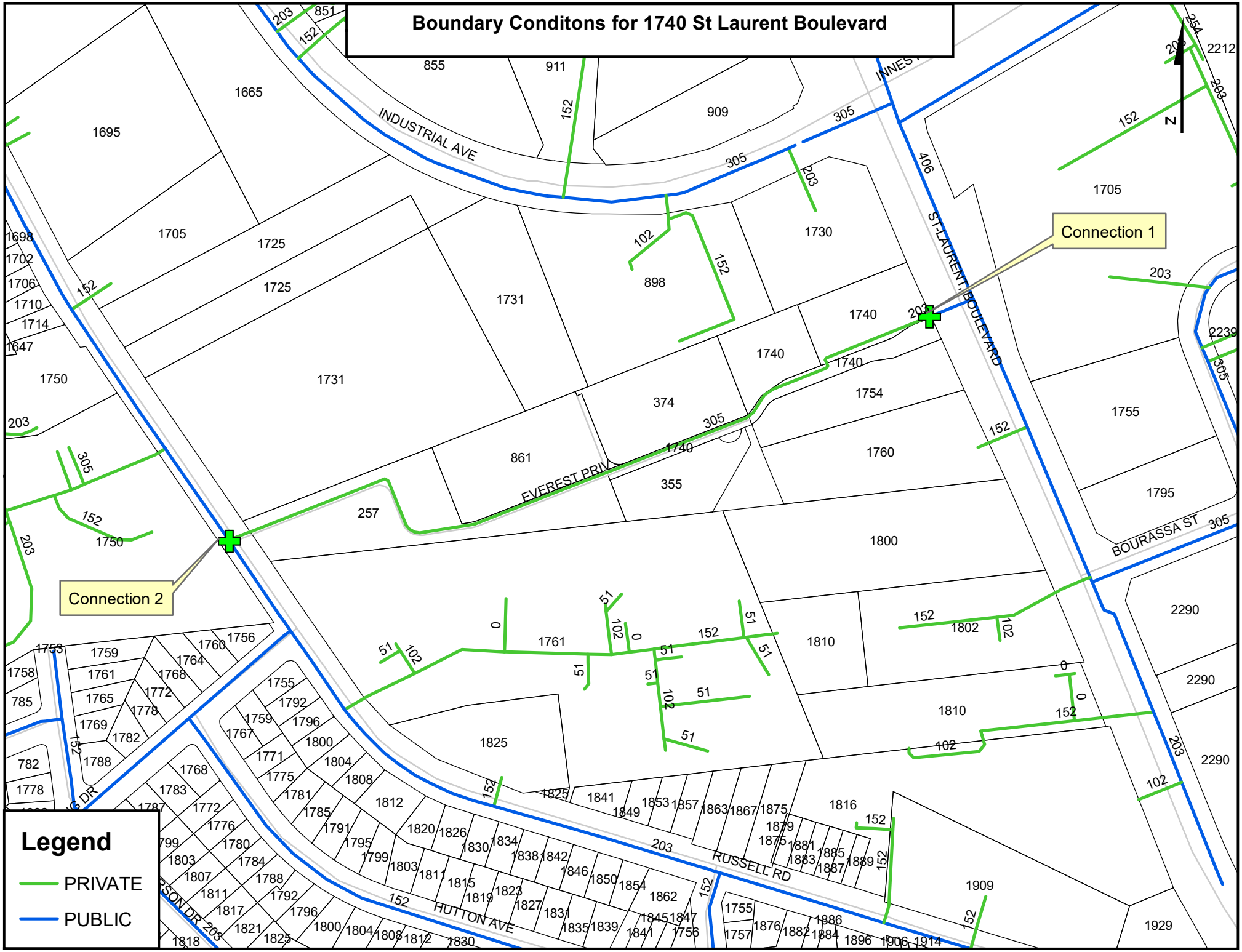


TABLE A-1 Summary
WATER DEMAND CHART

Location:	1740 St Laurent
Project No:	OTT-00260579-B0
Designed by:	A. Elgayar
Checked By:	C. Collins
Date Revised:	June 2021

Water Consumption

Residential =	**350**	L/cap/day
Commercial =	5.0	L/m^2/day

Population Densities

Single Family	3.4	person/unit
Semi-Detahced	2.7	person/unit
Duplex	2.3	person/unit
Townhome (Row)	2.7	person/unit
Bachelor Apartment	1.4	person/unit
1 Bedroom Apartment	1.4	person/unit
2 Bedroom Apartment	2.1	person/unit
3 Bedroom Apartment	3.1	person/unit
4 Bedroom Apartment	4.1	person/unit
Avg. Apartment	1.8	person/unit

Proposed Buildings (Everest Private)	No. of Residential Units										Total Persons (pop)	Residential Demands in (L/sec)					Commercial						Total Demands (L/sec)		
	Singles/Semis/Towns				Apartments								Peaking Factors (x Avg Day)						Peaking Factors (x Avg Day)						
	Single Family	Semi-Detached	Duplex	Townhome	Studio	1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom	Avg Apt.		Avg. Day Demand (L/day)	Max Day	Peak Hour	Max Day Demand (L/day)	Peak Hour Demand (L/day)	Area (m^2)	Avg Demand (L/day)	Max Day	Peak Hour	Max Day Demand (L/day)	Peak Hour Demand (L/day)	Avg Day (L/s)	Max Day (L/s)	Max Hour (L/s)
Tower 1						90	26				180.6	63,210	2.50	5.50	158,025	347,655	965.0	4,825.0	1.50	2.70	7,237.50	13,028	0.79	1.91	4.17
Tower 2						69	26				151.2	52,920	2.50	5.50	132,300	291,060	1,288.0	6,440.0	1.50	2.70	9,660.00	17,388	0.69	1.64	3.57
Tower 3						232	24	12			412.4	144,340	2.50	5.50	360,850	793,870							1.67	4.18	9.19
Tower 4						174	19				283.5	99,225	2.50	5.50	248,063	545,738							1.15	2.87	6.32
Block 1				16							43.2	15,120	2.50	5.50	37,800	83,160							0.18	0.44	0.96
Block 2				16							43.2	15,120	2.50	5.50	37,800	83,160							0.18	0.44	0.96
Block 3				24							64.8	22,680	2.50	5.50	56,700	124,740							0.26	0.66	1.44
Block 4,5,6 & 7				82							221.4	77,490	2.50	5.50	193,725	426,195							0.90	2.24	4.93
Block 10 (374 Everest Private)										192	345.6	120,960	2.50	5.50	302,400	665,280							1.40	3.50	7.70
BLOCK 12 (355 Everest Private)										101	181.8	63,630	2.50	5.50	159,075	349,965							0.74	1.84	4.05
Total =				138		565	95	12		293	1,927.7	674,695			1,686,738	3,710,823	2,253.00	11,265.00					7.94	19.72	43.30

TABLE A2
SUMMARY OF REQUIRED FIREFLOWS (RFFs)

Building #	Description	[1]No of Storeys	Fire Flow, F (L/min)	[2]Type of Constr. Coeff, C	[3]Reduction Due to Occupancy (%)	[4]Reduction Due to Sprinklers (%)	Total Increase due to Exposures (%)	[6]Required Fire Flow in	
								(L/min)	(L/sec)
PROPOSED TOWER 1	high-rise condo	15	13,000	0.8	-15%	-50%	25%	8,000	133
PROPOSED TOWER 2	high-rise condo	12	13,000	0.8	-15%	-50%	40%	10,000	167
PROPOSED TOWER 3	high-rise condo	15	19,000	0.8	-15%	-50%	16%	11,000	183
PROPOSED TOWER 4	high-rise condo	12	17,000	0.8	-15%	-50%	35%	12,000	200

Notes

1 - If basements are included (<50% below grade) then denoted as +.

2 -Types of constructions: 0.8 for non-combustible, 1.0 for ordinary construction,1.5 for wood frame construction.

3 - Reductions due to Occupancy are -25% for non-combustible or -15% for limited combustible.

4 - Reductions due to Sprinkler Systems

5 – Increase due to exposures were calculated based on FUS and technical bulletin ISTB-2018-02.

6 – Required Fire Flows are rounded to nearest 1,000 L/min.

TABLE A3 (Tower 1)
FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999 FOR PROPOSED TOWER 1

An estimate of the Fire Flow required for a given fire area may be estimated by:

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

where: F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction

Task	Options	Multiplier	Input				Value Used	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Non-combustible Construction				0.8	
	Ordinary Construction	1						
	Non-combustible Construction	0.8						
	Fire Resistive Construction	0.6						
Input Building Floor Areas (A)			Area	% Used	Area Used	Comment		
	Floor 15		704	0%	0	Two largest adjoining floors+ 50% of floors above (up to eight)		
	Floor 14		829	0%	0			
	Floor 11 to 13		836	0%	0			
	Floor 10		836	50%	418			
	Floor 9		836	50%	418			
	Floor 8		836	50%	418			
	Floor 7		836	50%	418			
	Floor 6		836	50%	418			
	Floor 5		836	50%	418			
	Floor 4		793	50%	397			
	Floor 3		930	50%	465			
	Floor 2		1031	100%	1,031			
	Floor 1 (Ground)		1148	100%	1,148			
	Basement (At least 50% below grade, not included)				5,549			
Fire Flow (F)	F = 220 * C * SQRT(A)							13,110
Fire Flow (F)	Rounded to nearest 1,000							**13,000**

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-1,950	11,050
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	Adequate Sprinkler Conforms to NFPA13	-30%	-3,315	7,735
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	-1,105	6,630
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Fully Supervised Sprinkler System	-10%	-1,105	5,525
	Not Fully Supervised or N/A	0%				

Choose Structure Exposure Distance	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposed Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-Height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
	Front (east)	74.5	6	> 45.1	Type B	34	2	68	6	0%	25%	2,763	8,288
	Side 1 (south)	24.5	4	20.1 to 30	Type B	48	15	720	4E	10%			
	Back (west)	28.4	4	20.1 to 30	Type B	14	12	168	4E	10%			
	Side 2 (north)	33	5	30.1 to 45	Type B	26	8	30	5A	5%			
Obtain Required Fire Flow											Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =		**8,000**
											Total Required Fire Flow, L/s =		**133**

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Type A	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE A4 (Tower 2)
FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999 FOR PROPOSED TOWER 2

An estimate of the Fire Flow required for a given fire area may be estimated by:

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

where: F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction

Task	Options	Multiplier	Input				Value Used	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Non-combustible Construction				0.8	
	Ordinary Construction	1						
	Non-combustible Construction	0.8						
	Fire Resistive Construction	0.6						
Input Building Floor Areas (A)			Area	% Used	Area Used	Comment		
	Floor 12		637	0%	0	Two largest adjoining floors+ 50% of floors above (up to eight)		
	Floor 11		793	50%	397			
	Floor 10		802	50%	401			
	Floor 9		802	50%	401			
	Floor 8		802	50%	401			
	Floor 7		802	50%	401			
	Floor 6		902	50%	451			
	Floor 5		890	50%	445			
	Floor 4		890	50%	445			
	Floor 3		937	100%	937			
	Floor 2		928	100%	928			
	Floor 1 (Ground)		889	0%	0			
	Basement (At least 50% below grade, not included)				5,207			
Fire Flow (F)	F = 220 * C * SQRT(A)							12,699
Fire Flow (F)	Rounded to nearest 1,000							**13,000**

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-1,950	11,050
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	Adequate Sprinkler Conforms to NFPA13	-30%	-3,315	7,735
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	-1,105	6,630
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Fully Supervised Sprinkler System	-10%	-1,105	5,525
	Not Fully Supervised or N/A	0%				

Choose Structure Exposure Distance	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposed Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-Height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
	Front (east)	28	4	20.1 to 30	Type B	15	15	225	4E	10%	40%	4,420	9,945
	Side 1 (south)	19.8	3	10.1 to 20	Type B	23	11	253	3E	15%			
	Back (west)	12	3	10.1 to 20	Type B	40	3	120	3E	15%			
	Side 2 (nrth)	50	6	> 45.1	Type B	0	0	30	6	0%			
Obtain Required Fire Flow										Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =			**10,000**
										Total Required Fire Flow, L/s =			**167**

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Type A	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE A5 (Tower 3)
FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999 FOR PROPOSED TOWER 3

An estimate of the Fire Flow required for a given fire area may be estimated by:

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

where: F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction

Task	Options	Multiplier	Input				Value Used	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Non-combustible Construction				0.8	
	Ordinary Construction	1						
	Non-combustible Construction	0.8						
	Fire Resistive Construction	0.6						
Input Building Floor Areas (A)			Area	% Used	Area Used	Comment		
	Floor 15		1453	0%	0	Two largest adjoining floors+ 50% of floors above (up to eight)		
	Floor 14		1770	0%	0			
	Floor 11 to 13		1785	0%	0			
	Floor 10		1785	50%	893			
	Floor 9		1785	50%	893			
	Floor 8		1785	50%	893			
	Floor 7		1785	50%	893			
	Floor 6		1785	50%	893			
	Floor 5		1785	50%	893			
	Floor 4		1753	50%	877			
	Floor 3		1874	50%	937			
	Floor 2		2361	100%	2,361			
	Floor 1 (Ground)		1754	100%	1,754			
	Basement (At least 50% below grade, not included)				11,284			
Fire Flow (F)	F = 220 * C * SQRT(A)							18,695
Fire Flow (F)	Rounded to nearest 1,000							**19,000**

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-2,850	16,150
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	Adequate Sprinkler Conforms to NFPA13	-30%	-4,845	11,305
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	-1,615	9,690
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Fully Supervised Sprinkler System	-10%	-1,615	8,075
	Not Fully Supervised or N/A	0%				

Choose Structure Exposure Distance	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposed Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-Height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
	Front (east)	64.8	6	> 45.1	Type B	70	2	140	6	0%	16%	2,584	10,659
	Side 1 (south)	31.2	5	30.1 to 45	Type B	34	2	68	5C	5%			
	Back (west)	32.5	5	30.1 to 45	Type B	23	11	253	5E	5%			
	Side 2 (north)	24.5	4	20.1 to 30	Type B	48	12	30	4A	6%			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =												**11,000**
	Total Required Fire Flow, L/s =												**183**

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Type A	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE A6 (Tower 4)
FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999 FOR PROPOSED TOWER 4

An estimate of the Fire Flow required for a given fire area may be estimated by:

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

where: F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction

Task	Options	Multiplier	Input				Value Used	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Non-combustible Construction				0.8	
	Ordinary Construction	1						
	Non-combustible Construction	0.8						
	Fire Resistive Construction	0.6						
Input Building Floor Areas (A)			Area	% Used	Area Used	Comment		
	Floor 12		1049	0%	0	Two largest adjoining floors+ 50% of floors above (up to eight)		
	Floor 11		1495	50%	748			
	Floor 10		1510	50%	755			
	Floor 9		1510	50%	755			
	Floor 8		1510	50%	755			
	Floor 7		1510	50%	755			
	Floor 6		1495	50%	748			
	Floor 5		1495	50%	748			
	Floor 4		1495	50%	748			
	Floor 3		1558	100%	1,558			
	Floor 2		1558	100%	1,558			
	Floor 1 (Ground)		1465	0%	0			
	Basement (At least 50% below grade, not included)				9,126			
Fire Flow (F)	F = 220 * C * SQRT(A)							16,813
Fire Flow (F)	Rounded to nearest 1,000							**17,000**

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-2,550	14,450
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	Adequate Sprinkler Conforms to NFPA13	-30%	-4,335	10,115
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	-1,445	8,670
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Fully Supervised Sprinkler System	-10%	-1,445	7,225
	Not Fully Supervised or N/A	0%				

Choose Structure Exposure Distance	Exposures	Separation Dist (m)	Cond	Separation Conditon	Exposed Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-Height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
	Front (east)	32.5	5	30.1 to 45	Type B	22	15	330	5E	5%	35%	5,058	12,283
	Side 1 (south)	31.8	5	30.1 to 45	Type B	55	2	110	5D	5%			
	Back (west)	17.0	3	10.1 to 20	Type B	42	3	126	3E	15%			
	Side 2 (north)	19.8	3	10.1 to 20	Type B	25	12	30	3A	10%			
Obtain Required Fire Flow										Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =			**12,000**
										Total Required Fire Flow, L/s =			**200**

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Type A	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE A7 Hydrants Spacing
FIRE FLOW REQUIREMENTS BASED ON HYDRANT SPACING

Hydrant #	Tower 1		Tower 2		Tower 3		Tower 4	
	[1]Distance (m)	[2]Fire Flow Contribution (L/min)	[1]Distance (m)	[2]Fire Flow Contribution (L/min)	[1]Distance (m)	[2]Fire Flow Contribution (L/min)	[1]Distance (m)	[2]Fire Flow Contribution (L/min)
372029H196	36	5,700	130	3,800	49	5,700	146	3,800
372029HP168	218	0	91	3,800	173	0	57	5,700
Proposed FH-1	106	3,800	89	3,800	61	5,700	86	3,800
Proposed FH-2	160	0	34	5,700	130	3,800	32	5,700
Total (L/min)		9,500		17,100		15,200		19,000
FUS RFF in L/min or (L/sec)		8,000 (133)		10,000 (167)		11,000 (183)		12,000 (200)
Meets Requreiment (Yes/No)		Yes		Yes		Yes		Yes

Notes:
[1]Distance is measured along a road or fire route.
[2]Fire Flow Contribution for Class AA Hydrant from Table 1 of Appendix I, ISTB-2018-02

TABLE A-8 ESTIMATED WATER PRESSURE CHART (TOWER 1)

Location:	1740 St Laurent	**Average day(L/s)=**	0.79	**Minimum HGL(m)=**	108.9
Project No.:	OTT-00260579-B0	**Peak Hour(L/s)=**	4.17	**Maximum HGL(m)=**	118.2
Designed by:	A. Elgayar	**Max day(L/s)=**	1.91	**Max day+Fireflow(m)=**	110.4
Checked by:	C. Collins	**Fireflow(L/s)=**	133		
Date Revised:	August 2021				

Description	From	To	Flow (L/sec)	Pipe Dia (mm)	Dia (m)	Q (m^3/sec)	Area (m2)	C	Velocity V (m/s)	Slope of HGL (m/m)	Pipe Length (m)	Frictional Head Loss h_f (m)	Equivalent Pipe Length of Fittings (m)	Minor Loss of Fittings h_b (m)	Total Losses (m) $h_b + h_f$	Start Ground Elev(m)	End Ground Elev (m)	Static Head (m)	Pressure From kPa	Pressure From (psi)	Pressure To kPa	Pressure To (psi)	Pressure Drop (psi)
TOWER 1 - SINGLE 150mm WATER SERVICE																							
Average Day	Ex. 406mm Main	Lateral	0.8	300	0.300	0.00079	0.070685775	120	0.01118	0.0000	36.7	3.49046E-05	7.8	0.00001	0.00004	±69.33	69.42	-0.09	479.3	(69.5)	478.4	(69.4)	0.1
	New 300mm Main	Tower 1	0.8	150	0.150	0.00079	0.017671444	100	0.0447	0.0000	7.2	0.000280678	13.5	0.00053	0.00081	69.42	69.90	-0.48	478.4	(69.4)	473.7	(68.7)	0.7
Peak Hour	Ex. 406mm Main	Lateral	4.2	300	0.300	0.00417	0.070685775	120	0.05899	0.0000	36.7	0.000760272	7.8	0.00016	0.00092	±69.33	69.42	-0.09	388.1	(51.0)	387.2	(56.2)	-5.2
	New 300mm Main	Tower 1	4.2	150	0.150	0.00417	0.017671444	100	0.23597	0.0008	7.2	0.006113571	13.5	0.01146	0.01758	69.42	69.90	-0.48	387.2	(52.0)	382.3	(55.4)	-3.4
Max Day + Fire Flow	Ex. 406mm Main	Lateral	134.9	300	0.300	0.13491	0.070685775	120	1.90859	0.0130	36.7	0.475684014	7.8	0.10110	0.57678	±69.33	69.42	-0.09	402.8	(51.0)	396.2	(57.5)	-6.5
	New 300mm Main	Tower 1	134.9	150	0.150	0.13491	0.017671444	100	7.63435	0.5313	7.2	3.825117102	13.5	7.17209	10.99721	69.42	69.90	-0.48	396.2	(52.0)	283.7	(41.1)	10.9
TOWER 1 - DOUBLE 150mm WATER SERVICE																							
Average Day	Ex. 406mm Main	Lateral	0.4	300	0.300	0.0004	0.070685775	120	0.00566	0.0000	36.7	9.89673E-06	7.8	0.00000	0.00001	±69.33	69.42	-0.09	479.3	(69.5)	478.4	(69.4)	0.1
	New 300mm Main	Tower 1	0.4	150	0.150	0.0004	0.017671444	100	0.02264	0.0000	7.2	7.95826E-05	13.5	0.00015	0.00023	69.42	69.90	-0.48	478.4	(69.4)	473.7	(68.7)	0.7
Peak Hour	Ex. 406mm Main	Lateral	2.1	300	0.300	0.0021	0.070685775	120	0.02971	0.0000	36.7	0.000213416	7.8	0.00005	0.00026	±69.33	69.42	-0.09	388.1	(51.0)	387.2	(56.2)	-5.2
	New 300mm Main	Tower 1	2.1	150	0.150	0.0021	0.017671444	100	0.11884	0.0002	7.2	0.001716142	13.5	0.00322	0.00493	69.42	69.90	-0.48	387.2	(52.0)	382.4	(55.5)	-3.5
Max Day + Fire Flow	Ex. 406mm Main	Lateral	67.5	300	0.300	0.06745	0.070685775	120	0.95422	0.0036	36.7	0.13175023	7.8	0.02800	0.15975	±69.33	69.42	-0.09	402.8	(51.0)	400.3	(58.1)	-7.1
	New 300mm Main	Tower 1	67.5	150	0.150	0.06745	0.017671444	100	3.81689	0.1471	7.2	1.059442919	13.5	1.98646	3.04590	69.42	69.90	-0.48	400.3	(52.0)	365.7	(53.0)	-1.0

V=Q/A

Slope of HGL= $(\frac{3.59}{C})^{1.852} \frac{Q}{D^{4.87}}^{1.852}$

hf = Slope of HGL * Pipe Length

Resistance of Fittings and Valves **300mm WM** **150mm WM**

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)	Quantity (each)	Total Equiv. (m)	Length
Standard 90^0 Elbow	32	9.60	0	0	1	9.6	
11.25 Degree Elbow	8	2.40	0	0	0	0	
45 Degree Elbow	16	4.80	0	0	0	0	
Gate Valve Full -Open	13	3.90	2	7.8	1	3.9	
		Total:	**2**	**7.8**	**2**	**13.5**	

TABLE A-9 ESTIMATED WATER PRESSURE CHART (TOWER 2)

Location:	1740 St Laurent	**Average day(L/s)=**	0.69	**Minimum HGL(m)=**	108.9
Project No.:	OTT-00260579-B0	**Peak Hour(L/s)=**	3.57	**Maximum HGL(m)=**	118.2
Designed by:	A. Elgayar	**Max day(L/s)=**	1.64	**Max day+Fireflow(m)=**	110.4
Checked by:	C. Collins	**Fireflow(L/s)=**	167		
Date Revised:	August 2021				

Description	From	To	Flow (L/sec)	Pipe Dia (mm)	Dia (m)	Q (m^3/sec)	Area (m2)	C	Velocity V (m/s)	Slope of HGL (m/m)	Pipe Length (m)	Frictional Head Loss h_f (m)	Equivalent Pipe Length of Fittings (m)	Minor Loss of Fittings h_b (m)	Total Losses (m) $h_b + h_f$	Start Ground Elev(m)	End Ground Elev (m)	Static Head (m)	Pressure From kPa	(psi)	Pressure To kPa	(psi)	Pressure Drop (psi)
TOWER 2 - SINGLE 150mm WATER SERVICE																							
Average Day	Ex. 406mm Main	Lateral	0.7	300	0.300	0.00069	0.070685775	120	0.00976	0.0000	142	0.000105111	15.6	0.00001	0.00012	±69.33	73.34	-4.01	479.3	(69.5)	439.9	(63.8)	5.7
	New 300mm Main	Tower 2	0.7	150	0.150	0.00069	0.017671444	100	0.03905	0.0000	7.1	0.000215416	13.5	0.00041	0.00063	73.34	73.63	-0.29	439.9	(63.8)	437.1	(63.4)	0.4
Peak Hour	Ex. 406mm Main	Lateral	3.6	300	0.300	0.00357	0.070685775	120	0.05051	0.0000	142	0.002206178	15.6	0.00024	0.00245	±69.33	73.34	-4.01	388.1	(51.0)	348.7	(50.6)	0.4
	New 300mm Main	Tower 2	3.6	150	0.150	0.00357	0.017671444	100	0.20202	0.0006	7.1	0.004521373	13.5	0.00860	0.01312	73.34	73.63	-0.29	348.7	(52.0)	345.7	(50.1)	1.9
Max Day + Fire Flow	Ex. 406mm Main	Lateral	168.6	300	0.300	0.16864	0.070685775	120	2.38577	0.0196	142	2.782467525	15.6	0.30568	3.08815	±69.33	73.34	-4.01	402.8	(51.0)	333.2	(48.3)	2.7
	New 300mm Main	Tower 2	168.6	150	0.150	0.16864	0.017671444	100	9.54308	0.8032	7.1	5.702428586	13.5	10.84265	16.54507	73.34	73.63	-0.29	333.2	(52.0)	168.1	(24.4)	27.6
TOWER 2 - DOUBLE 150mm WATER SERVICE																							
Average Day	Ex. 406mm Main	Lateral	0.3	300	0.300	0.000345	0.070685775	120	0.00488	0.0000	142	2.91166E-05	15.6	0.00000	0.00003	±69.33	73.34	-4.01	479.3	(69.5)	439.9	(63.8)	5.7
	New 300mm Main	Tower 2	0.3	150	0.150	0.000345	0.017671444	100	0.01952	0.0000	7.1	5.96719E-05	13.5	0.00011	0.00017	73.34	73.63	-0.29	439.9	(63.8)	437.1	(63.4)	0.4
Peak Hour	Ex. 406mm Main	Lateral	1.8	300	0.300	0.001785	0.070685775	120	0.02525	0.0000	142	0.000611129	15.6	0.00007	0.00068	±69.33	73.34	-4.01	388.1	(51.0)	348.7	(50.6)	0.4
	New 300mm Main	Tower 2	1.8	150	0.150	0.001785	0.017671444	100	0.10101	0.0002	7.1	0.001252457	13.5	0.00238	0.00363	73.34	73.63	-0.29	348.7	(52.0)	345.9	(50.2)	1.8
Max Day + Fire Flow	Ex. 406mm Main	Lateral	84.3	300	0.300	0.08432	0.070685775	120	1.19288	0.0054	142	0.770766006	15.6	0.08468	0.85544	±69.33	73.34	-4.01	402.8	(51.0)	355.1	(51.5)	-0.5
	New 300mm Main	Tower 2	84.3	150	0.150	0.08432	0.017671444	100	4.77154	0.2225	7.1	1.579618834	13.5	3.00350	4.58312	73.34	73.63	-0.29	355.1	(52.0)	307.3	(44.6)	7.4

V=Q/A

Slope of HGL= $\left(\frac{3.59}{C}\right)^{1.852} \frac{Q}{D^{4.87}}^{1.852}$

hf = Slope of HGL * Pipe Length

Resistance of Fittings and Valves

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	300mm WM Quantity (each)	300mm WM Total Equiv. Length (m)	150mm WM Quantity (each)	150mm WM Total Equiv. (m)	Length
Standard 90^0 Elbow	32	9.60	0	0	1	9.6	
11.25 Degree Elbow	8	2.40	0	0	0	0	
45 Degree Elbow	16	4.80	0	0	0	0	
Gate Valve Full -Open	13	3.90	4	15.6	1	3.9	
		Total:	**4**	**15.6**	**2**	**13.5**	

TABLE A-10 ESTIMATED WATER PRESSURE CHART (TOWER 3)

Location:	1740 St Laurent	**Average day(L/s)=**	1.67	**Minimum HGL(m)=**	108.9
Project No.:	OTT-00260579-B0	**Peak Hour(L/s)=**	9.19	**Maximum HGL(m)=**	118.2
Designed by:	A. Elgayar	**Max day(L/s)=**	4.18	**Max day+Fireflow(m)=**	110.4
Checked by:	C. Collins	**Fireflow(L/s)=**	183		
Date Revised:	August 2021				

Description	From	To	Flow (L/sec)	Pipe Dia (mm)	Dia (m)	Q (m^3/sec)	Area (m2)	C	Velocity V (m/s)	Slope of HGL (m/m)	Pipe Length (m)	Frictional Head Loss h_f (m)	Equivalent Pipe Length of Fittings (m)	Minor Loss of Fittings h_b (m)	Total Losses (m) $h_b + h_f$	Start Ground Elev(m)	End Ground Elev (m)	Static Head (m)	Pressure From kPa	(psi)	Pressure To kPa	(psi)	Pressure Drop (psi)
TOWER 3 - SINGLE 150mm WATER SERVICE																							
Average Day	Ex. 406mm Main	Lateral	1.7	300	0.300	0.00167	0.070685775	120	0.02363	0.0000	33.7	0.000128207	3.9	0.00001	0.00014	±69.33	69.45	-0.12	479.3	(69.5)	478.1	(69.3)	0.2
	New 300mm Main	Tower 3	1.7	150	0.150	0.00167	0.017671444	100	0.0945	0.0002	9.4	0.001465782	13.5	0.00211	0.00357	69.45	69.84	-0.39	478.1	(69.3)	474.2	(68.8)	0.6
Peak Hour	Ex. 406mm Main	Lateral	9.2	300	0.300	0.00919	0.070685775	120	0.13001	0.0001	33.7	0.003016484	3.9	0.00035	0.00337	±69.33	69.45	-0.12	388.1	(51.0)	386.9	(56.1)	-5.1
	New 300mm Main	Tower 3	9.2	150	0.150	0.00919	0.017671444	100	0.52005	0.0037	9.4	0.034487258	13.5	0.04953	0.08402	69.45	69.84	-0.39	386.9	(52.0)	382.2	(55.4)	-3.4
Max Day + Fire Flow	Ex. 406mm Main	Lateral	187.2	300	0.300	0.18718	0.070685775	120	2.64806	0.0238	33.7	0.801060154	3.9	0.09270	0.89376	±69.33	69.45	-0.12	402.8	(51.0)	392.8	(57.0)	-6.0
	New 300mm Main	Tower 3	187.2	150	0.150	0.18718	0.017671444	100	10.5922	0.9743	9.4	9.158467932	13.5	13.15312	22.31159	69.45	69.84	-0.39	392.8	(52.0)	170.2	(24.7)	27.3
TOWER 3 - DOUBLE 150mm WATER SERVICE																							
Average Day	Ex. 406mm Main	Lateral	0.8	300	0.300	0.000835	0.070685775	120	0.01181	0.0000	33.7	3.55144E-05	3.9	0.00000	0.00004	±69.33	69.45	-0.12	479.3	(69.5)	478.1	(69.3)	0.2
	New 300mm Main	Tower 3	0.8	150	0.150	0.000835	0.017671444	100	0.04725	0.0000	9.4	0.000406033	13.5	0.00058	0.00099	69.45	69.84	-0.39	478.1	(69.3)	474.3	(68.8)	0.6
Peak Hour	Ex. 406mm Main	Lateral	4.6	300	0.300	0.004595	0.070685775	120	0.06501	0.0000	33.7	0.00083559	3.9	0.00010	0.00093	±69.33	69.45	-0.12	388.1	(51.0)	386.9	(56.1)	-5.1
	New 300mm Main	Tower 3	4.6	150	0.150	0.004595	0.017671444	100	0.26002	0.0010	9.4	0.009553249	13.5	0.01372	0.02327	69.45	69.84	-0.39	386.9	(52.0)	382.8	(55.5)	-3.5
Max Day + Fire Flow	Ex. 406mm Main	Lateral	93.6	300	0.300	0.09359	0.070685775	120	1.32403	0.0066	33.7	0.221900141	3.9	0.02568	0.24758	±69.33	69.45	-0.12	402.8	(51.0)	399.2	(57.9)	-6.9
	New 300mm Main	Tower 3	93.6	150	0.150	0.09359	0.017671444	100	5.29612	0.2699	9.4	2.536969681	13.5	3.64352	6.18049	69.45	69.84	-0.39	399.2	(52.0)	334.7	(48.5)	3.5

V=Q/A

Slope of HGL= $\left(\frac{3.59}{C}\right)^{1.852} \frac{Q}{D^{4.87}}^{1.852}$

hf = Slope of HGL * Pipe Length

Resistance of Fittings and Valves

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	300mm WM Quantity (each)	300mm WM Total Equiv. Length (m)	150mm WM Quantity (each)	150mm WM Total Equiv. (m)	Length
Standard 90^0 Elbow	32	9.60	0	0	1	9.6	
11.25 Degree Elbow	8	2.40	0	0	0	0	
45 Degree Elbow	16	4.80	0	0	0	0	
Gate Valve Full -Open	13	3.90	1	3.9	1	3.9	
		Total:	**1**	**3.9**	**2**	**13.5**	

TABLE A-11 ESTIMATED WATER PRESSURE CHART (TOWER 4)

Location:	1740 St Laurent	**Average day(L/s)=**	1.15	**Minimum HGL(m)=**	108.9
Project No.:	OTT-00260579-B0	**Peak Hour(L/s)=**	6.32	**Maximum HGL(m)=**	118.2
Designed by:	A. Elgayar	**Max day(L/s)=**	2.87	**Max day+Fireflow(m)=**	110.4
Checked by:	C. Collins	**Fireflow(L/s)=**	200		
Date Revised:	August 2021				

Description	From	To	Flow (L/sec)	Pipe Dia (mm)	Dia (m)	Q (m^3/sec)	Area (m2)	C	Velocity V (m/s)	Slope of HGL (m/m)	Pipe Length (m)	Frictional Head Loss h_f (m)	Equivalent Pipe Length of Fittings (m)	Minor Loss of Fittings h_b (m)	Total Losses (m) $h_b + h_f$	Start Ground Elev(m)	End Ground Elev (m)	Static Head (m)	Pressure From kPa	Pressure From (psi)	Pressure To kPa	Pressure To (psi)	Pressure Drop (psi)
TOWER 4 - SINGLE 150mm WATER SERVICE																							
Average Day	Ex. 406mm Main	Lateral	1.2	300	0.300	0.00115	0.070685775	120	0.01627	0.0000	139	0.000264995	11.7	0.00002	0.00029	±69.33	73.25	-3.92	479.3	(69.5)	440.8	(63.9)	5.6
	New 300mm Main	Tower 4	1.2	150	0.150	0.00115	0.017671444	100	0.06508	0.0001	9.4	0.000734532	13.5	0.00105	0.00179	73.25	73.35	-0.10	440.8	(63.9)	439.8	(63.8)	0.1
Peak Hour	Ex. 406mm Main	Lateral	6.3	300	0.300	0.00632	0.070685775	120	0.08941	0.0000	139	0.006219473	11.7	0.00052	0.00674	±69.33	73.25	-3.92	388.1	(51.0)	349.6	(50.7)	0.3
	New 300mm Main	Tower 4	6.3	150	0.150	0.00632	0.017671444	100	0.35764	0.0018	9.4	0.017239568	13.5	0.02476	0.04200	73.25	73.35	-0.10	349.6	(52.0)	348.2	(50.5)	1.5
Max Day + Fire Flow	Ex. 406mm Main	Lateral	202.9	300	0.300	0.20287	0.070685775	120	2.87003	0.0276	139	3.835243659	11.7	0.32282	4.15807	±69.33	73.25	-3.92	402.8	(51.0)	323.6	(46.9)	4.1
	New 300mm Main	Tower 4	202.9	150	0.150	0.20287	0.017671444	100	11.4801	1.1309	9.4	10.63079542	13.5	15.26763	25.89843	73.25	73.35	-0.10	323.6	(52.0)	68.6	(9.9)	42.1
TOWER 4 - DOUBLE 150mm WATER SERVICE																							
Average Day	Ex. 406mm Main	Lateral	0.6	300	0.300	0.000575	0.070685775	120	0.00813	0.0000	139	7.34058E-05	11.7	0.00001	0.00008	±69.33	73.25	-3.92	479.3	(69.5)	440.8	(63.9)	5.6
	New 300mm Main	Tower 4	0.6	150	0.150	0.000575	0.017671444	100	0.03254	0.0000	9.4	0.000203471	13.5	0.00029	0.00050	73.25	73.35	-0.10	440.8	(63.9)	439.8	(63.8)	0.1
Peak Hour	Ex. 406mm Main	Lateral	3.2	300	0.300	0.00316	0.070685775	120	0.0447	0.0000	139	0.001722844	11.7	0.00015	0.00187	±69.33	73.25	-3.92	388.1	(51.0)	349.6	(50.7)	0.3
	New 300mm Main	Tower 4	3.2	150	0.150	0.00316	0.017671444	100	0.17882	0.0005	9.4	0.0047755	13.5	0.00686	0.01163	73.25	73.35	-0.10	349.6	(52.0)	348.5	(50.5)	1.5
Max Day + Fire Flow	Ex. 406mm Main	Lateral	101.4	300	0.300	0.101435	0.070685775	120	1.43501	0.0076	139	1.062393509	11.7	0.08942	1.15182	±69.33	73.25	-3.92	402.8	(51.0)	353.0	(51.2)	-0.2
	New 300mm Main	Tower 4	101.4	150	0.150	0.101435	0.017671444	100	5.74005	0.3133	9.4	2.944816301	13.5	4.22926	7.17407	73.25	73.35	-0.10	353.0	(52.0)	281.7	(40.9)	11.1

V=Q/A

Slope of HGL= $\left(\frac{3.59}{C}\right)^{1.852} \frac{Q}{D^{4.87}}^{1.852}$

hf = Slope of HGL * Pipe Length

Resistance of Fittings and Valves

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	300mm WM Quantity (each)	300mm WM Total Equiv. Length (m)	150mm WM Quantity (each)	150mm WM Total Equiv. (m)	Length
Standard 90^0 Elbow	32	9.60	0	0	1	9.6	
11.25 Degree Elbow	8	2.40	0	0	0	0	
45 Degree Elbow	16	4.80	0	0	0	0	
Gate Valve Full -Open	13	3.90	3	11.7	1	3.9	
		Total:	**3**	**11.7**	**2**	**13.5**	

Appendix B – Sanitary

Table B-1 – Sanitary Sewer Design Sheet

B-1 SANITARY SEWER CALCULATION SHEET

LOCATION				RESEDENTIAL AREAS AND POPULAITONS											COMMERCIAL			INDUSTRIAL			INSTITUTIONAL			INFILTRATION				SEWER DATA						
					NUMBER OF UNITS							POPULATION				AREA (ha)			AREA (ha)						AREA (ha)									
Street	U/S MH	D/S MH	Desc	Area (ha)	Singles	Semis	Towns	1-Bed Apt.	2-Bed Apt.	3-Bed Apt.	4-Bed Apt.	INDIV	ACCU	Peak Factor	Peak Flow (L/sec)	INDIV	ACCU	Peak Flow (L/sec)	INDIV	ACCU	Peak Factor (per MOE)	AREA (Ha)	ACCU AREA (Ha)	Peak Flow (L/sec)	INDIV	ACCU	INFILT FLOW (L/s)	TOTAL FLOW (L/s)	Nom Dia (mm)	Actual Dia (mm)	Slope (%)	Length (m)	Capacity (L/sec)	Q/Q_{CAP} (%)	Full Velocity (m/s)
Everest Pvt.	Alta Vista Ridge Subdivision	Ex. SANMH-64453																									11.86	200	207.26	1.76	99.5	47.9	25%	1.61
	Ex. SANMH-64453	Ex. SANMH-64454																									11.86	200	207.26	0.46	19.5	24.5	48%	0.82
	Tower 2	Ex. SANMH-64454		0.39				69	26			151.2	151.2	4.00	1.96	0.129	0.129	0.062708							0.390	0.390	0.13	2.15	200	207.26	2.00	1.0	51.0	4%	1.72
	Tower 4	Ex. SANMH-64454		0.48				174	19			283.5	283.5	4.00	3.68										0.480	0.480	0.16	3.83	200	207.26	2.00	14.6	51.0	8%	1.72
	Ex. SANMH-64454	Ex. SANMH-66716											434.7	4.00	5.64		0.129	0.062708								0.480	0.16	17.72	200	207.26	2.50	40.5	57.0	31%	1.92
	Ex. SANMH-66716	SANMH-201											434.7	4.00	5.64		0.129	0.062708								0.480	0.16	17.72	200	207.26	2.00	64.8	51.0	35%	1.72
	Tower 1	SANMH-201		0.32				90	26			180.6	180.6	4.00	2.34	0.097	0.097	0.047153							0.320	0.320	0.11	2.49	200	207.26	2.00	1.9	51.0	5%	1.72
	Tower 3	SANMH-201		0.53				232	24	12		412.4	412.4	4.00	5.35										0.530	0.530	0.17	5.52	200	207.26	2.00	14.7	51.0	11%	1.72
	SANMH-201	SANMH-200											1027.7	3.23	10.76		0.226	0.109861								1.720	0.57	23.30	200	207.26	2.00	25.9	51.0	46%	1.72
				1.720				**565**	**95**	**12**		**1028**															**1.720**							

Residential Avg. Daily Flow, q (L/p/day) =	280	Commercial Peak Factor =	1.5	(when area >20%)	Peak Population Flow, (L/sec) =	P*q*M/86.4	Unti Type	Persons/Unit
Commercial Avg. Daily Flow (L/gross ha/day) =	28,000		1.0	(when area <20%)	Peak Extraneous Flow, (L/sec) =	I*Ac	Singles	3.0
or L/gross ha/sec =	0.324				Residential Peaking Factor, M =	1 + (14/(4+P^0.5)) * K	Semi-Detached	2.7
Institutianal Avg. Daily Flow (L/s/ha) =	28,000	Institutional Peak Factor =	1.5	(when area >20%)	A_c = Cumulative Area (hectares)		Townhomes	2.7
or L/gross ha/sec =	0.324		1.0	(when area <20%)	P = Population (thousands)		Single Apt. Unit	1.4
Light Industrial Flow (L/gross ha/day) =	35,000						2-bed Apt. Unit	2.1
or L/gross ha/sec =	0.40509	Residential Correction Factor, K =	0.80		Sewer Capacity, Qcap (L/sec) =	$1/N \; S^{1/2} \; R^{2/3} \; A_c$	3-bed Apt. Unit	3.1
Light Industrial Flow (L/gross ha/day) =	55,000	Manning N =	0.013		(Manning's Equation)		4-bed Apt. Unit	3.8
or L/gross ha/sec =	0.637	Peak extraneous flow, I (L/s/ha) =	0.33	(Total I/I)				

Designed:	Project:
A. Elgayar	1740 St. Laurent Boulevard Development
Checked:	Location:
C. Collins	1740 St. Laurent Boulevard, Ottawa, Ontario
File Reference:	Page No:
260579 B1 - SAN Design Sheet, June 2021.xlsx	**1 of 1**

Appendix C – Storm

Table C-1 – Summary of Roof Storage and Outflow

Table C-2 through 5– Estimation of Roof Storage and Outflow - Tower 1, 2, 3 & 4

Table C-6 – Estimation of Pre-Development Peak Flows

Table C-7 – Average Runoff Coefficients for Post-Development

Table C-8 – Summary of Post-Development Peak Flows (Uncontrolled and Controlled)

Table C-9 – Summary of Storage

Table C-10 through 29 – Storage Volumes for 2-year, 5-year and 100-Year Storms (All Areas)

Table C-30 – ICD Orifice Sizing and Type Selection

Table C-31 – Storm Sewer Design Sheet

C-1

SUMMARY OF ROOF STORAGE AND OUTFLOW

	TOWER 1	TOWER 2	TOWER 3	TOWER 4
Reference Table	**C-2**	**C-3**	**C-4**	**C-5**
Total Roof Area (m^2)	1600	899	2562	1864
Total Roof Effictive Area Percentage	80%	80%	80%	80%
Effective Roof Area (m2)	1280	719.2	2049.6	1491.2
Actual Number of Drains Used	19	11	26	14
Flow Controled (Yes /No)	Yes	Yes	Yes	Yes
Weir Position	3-25% open	3-25% open	3-25% open	3-25% open
Max Roof Drian Release Rate (usgpm)	**15**	**15**	**15**	**15**
Max Roof Drian Release Rate (L/sec)	0.946	0.946	0.946	0.946
Total Roof Release Rate (All drians)	18.0	10.4	24.6	13.2
Total Ponding Area (m3)	64	36.0	102.48	74.56

C-2
ESTIMATION OF ROOF STORAGE AND OUTFLOW - TOWER 1

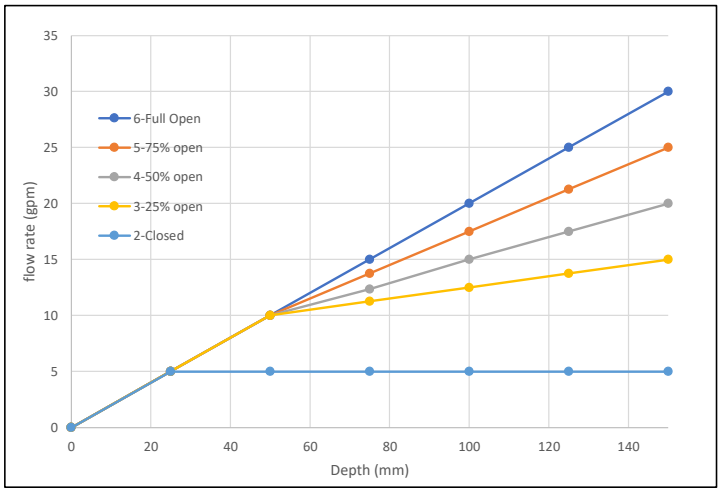
WATTS ADJ ACCUTROL WEIR FLOW RATES (Flow Rates at Various Depths)

Depth	Weir Position					
	1-None	2-Closed	3-25% open	4-50% open	5-75% open	6-Full Open
	Max Flow Rate per wier @150mm in gpm					
0	0	0	0	0	0	0
0.025	0	5	5	5	5	5
0.05	0	5	10	10	10	10
0.075	0	5	11.25	12.35	13.75	15
0.1	0	5	12.5	15	17.5	20
0.125	0	5	13.75	17.5	21.25	25
0.15	0	5	15	20	25	30

WATTS ADJ ACCUTROL WEIR FLOW RATES (Data From Manufacturer's Catalog)

Weir Position	Flow (gpm) per depth							Max Flow Rate per Weir @150mm
	0	25	50	75	100	125	150	
	0	0.025	0.05	0.075	0.1	0.125	0.15	
1-None	0	0	0	0	0	0	0	0
2-Closed	0	5	5	5	5	5	5	0.315
3-25% open	0	5	10	11.25	12.5	13.75	15	0.946
4-50% open	0	5	10	12.35	15	17.5	20	1.262
5-75% open	0	5	10	13.75	17.5	21.25	25	1.577
6-Full Open	0	5	10	15	20	25	30	1.893

GRAPH OF FLOW RATE VERSUS DEPTH FOR VARIOUS WEIR POSITIONS



BUILDING ROOF INFORMATION

Buidling Number	**TOWER 1**	
Total Roof Area (m2)	**1600**	
Minimium Number of Drains Required	1.8	*Minimium of 1 drain every 900 sqaure metres (OBC 7.4.10.4)*
15-min Rainfall Factor for Ottawa (mm)	**23**	*(OBC Supp SB-1)*
Max Permitted Load from All Drains (Litres)	36,800	
Max Permitted Load from All Drains (L/sec)	40.9	*Hydraulic Load expressed in L/sec (OBC Section 7.4.10.3)*
Estimated area per drain (m2)	144	
Estimated Distance from roof edge to drains (m)	**6**	*Not more than 15m from Edge of Roof and 30m to Adjacent Dains (OBC Section 7.4.10.3)*
Estimated No. of Drains Requried	12	*Based on Total Roof Area / Area per Drain*
Actual No. of Drains Used	19	*Use if known*
Effecive Roof Percentage (%)	**80%**	*Allowance for Mechanical units on roof*
Effecive Total Roof Area (m2)	1280	
Area per Drain (m2)	67	*Based on Effectiive Roof Area / Actual Number of Drains Used*
Max Depth of Ponding at Drains (mm)	**150**	
Estimated Total Volume for Ponding on Roof (m3)	80.0	*Prisim formula, V = 1/3*A*d*
Maximium release rate per drain at 150mm (usgpm)	**15**	*Based on 1 Wier Per Drain and Fully Open Position*
Max Release Rate from Roof (L/sec)	18.0	*Based on Maximum Depth of Ponding of 150mm*
Equiv Runoff C for 100-yr Storm	0.23	*Based on 100-yr storm Intensity of 178.6 mm/hr, where I =1735.688 / (Tc + 6.014)^0.820, with Tc=10min)*

RATING CURVE FOR ROOF

DISCHARGE VERSUS DEPTH				AREA VERSUS DEPTH			Total Ponding Volume - All Drains (m3)
Ponding Depth (m)	Discharge Rate Per Drain (gpm)	Discharge Rate Per Drain (m3/sec)	Total Discharge All Drains (m3/sec)	Ponding Depth (m)	Ponding Area (m2)	Ponding Volume Per Drain (m3)	
0	0	0.00	0.00000	0	0.0	0.0	0.0
0.025	5	0.32	0.00599	0.025	1.9	0.0	0.3
0.05	10	0.63	0.01199	0.05	7.5	0.1	2.4
0.075	11.25	0.71	0.01349	0.075	16.8	0.4	8.0
0.1	12.5	0.79	0.01498	0.1	29.9	1.0	19.0
0.125	13.75	0.87	0.01648	0.125	46.8	1.9	37.0
0.15	15	0.95	0.01798	0.15	67.4	3.4	64.0
Weir Position = **3-25% open**							

RATING CURVE FOR MODELLING OUTLET

Head or Ponding Depth (m)	Outlfow (L/sec)
0	0.0000
0.025	5.9936
0.05	11.9871
0.075	13.4855
0.1	14.9839
0.125	16.4823
0.15	17.9807

RATING CURVE FOR MODELLING ROOF STORAGE

Head or Ponding Depth (m)	Ponding Area (m2)
0	0.0
0.025	1.9
0.05	7.5
0.075	16.8
0.1	29.9
0.125	46.8
0.15	67.4

C-3
ESTIMATION OF ROOF STORAGE AND OUTFLOW - TOWER 2

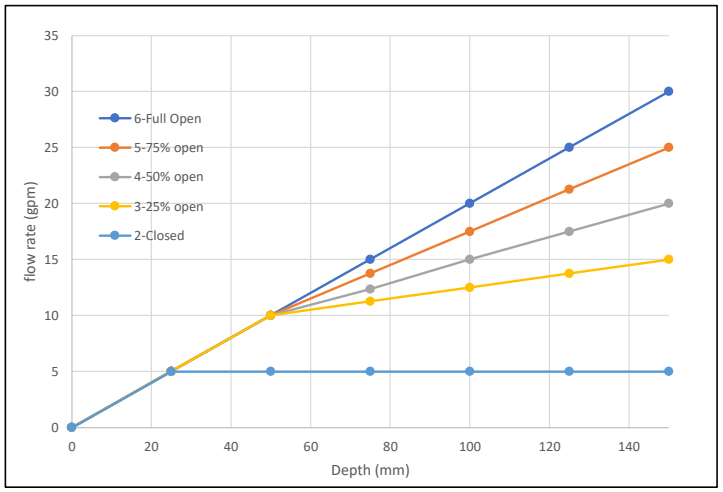
WATTS ADJ ACCUTROL WEIR FLOW RATES (Flow Rates at Various Depths)

Depth	Weir Position					
	1-None	2-Closed	3-25% open	4-50% open	5-75% open	6-Full Open
	Max Flow Rate per wier @150mm in gpm					
0	0	0	0	0	0	0
0.025	0	5	5	5	5	5
0.05	0	5	10	10	10	10
0.075	0	5	11.25	12.35	13.75	15
0.1	0	5	12.5	15	17.5	20
0.125	0	5	13.75	17.5	21.25	25
0.15	0	5	15	20	25	30

WATTS ADJ ACCUTROL WEIR FLOW RATES (Data From Manufacturer's Catalog)

Weir Position	Flow (gpm) per depth							Max Flow Rate per Weir @150mm
	0	25	50	75	100	125	150	
	0	0.025	0.05	0.075	0.1	0.125	0.15	
1-None	0	0	0	0	0	0	0	0
2-Closed	0	5	5	5	5	5	5	0.315
3-25% open	0	5	10	11.25	12.5	13.75	15	0.946
4-50% open	0	5	10	12.35	15	17.5	20	1.262
5-75% open	0	5	10	13.75	17.5	21.25	25	1.577
6-Full Open	0	5	10	15	20	25	30	1.893

GRAPH OF FLOW RATE VERSUS DEPTH FOR VARIOUS WEIR POSITIONS



BUILDING ROOF INFORMATION

Buidling Number	**TOWER 2**	
Total Roof Area (m2)	**899**	
Minimum Number of Drains Required	1.0	*Minimium of 1 drain every 900 sqaure metres (OBC 7.4.10.4)*
15-min Rainfall Factor for Ottawa (mm)	**23**	*(OBC Supp SB-1)*
Max Permitted Load from All Drains (Litres)	20,677	
Max Permitted Load from All Drains (L/sec)	23.0	*Hydraulic Load expressed in L/sec (OBC Section 7.4.10.3)*
Estimated area per drain (m2)	144	
Estimated Distance from roof edge to drains (m)	**6**	*Not more than 15m from Edge of Roof and 30m to Adjacent Dains (OBC Section 7.4.10.3)*
Estimated No. of Drains Requried	7	*Based on Total Roof Area / Area per Drain*
Actual No. of Drains Used	11	*Use if known*
Effecive Roof Percentage (%)	**80%**	*Allowance for Mechanical units on roof*
Effecive Total Roof Area (m2)	719	
Area per Drain (m2)	65	*Based on Effectiive Roof Area / Actual Number of Drains Used*
Max Depth of Ponding at Drains (mm)	**150**	
Estimated Total Volume for Ponding on Roof (m3)	45.0	*Prisim formula, V = 1/3*A*d*
Maximium release rate per drain at 150mm (usgpm)	**15**	*Based on 1 Wier Per Drain and Fully Open Position*
Max Release Rate from Roof (L/sec)	10.4	*Based on Maximum Depth of Ponding of 150mm*
Equiv Runoff C for 100-yr Storm	0.23	*Based on 100-yr storm Intensity of 178.6 mm/hr, where I =1735.688 / (Tc + 6.014)^0.820, with Tc=10min)*

RATING CURVE FOR ROOF

DISCHARGE VERSUS DEPTH				AREA VERSUS DEPTH			Total Ponding Volume - All Drains (m3)
Ponding Depth (m)	Discharge Rate Per Drain (gpm)	Discharge Rate Per Drain (m3/sec)	Total Discharge All Drains (m3/sec)	Ponding Depth (m)	Ponding Area (m2)	Ponding Volume Per Drain (m3)	
0	0	0.00	0.00000	0	0.0	0.0	0.0
0.025	5	0.32	0.00347	0.025	1.8	0.0	0.2
0.05	10	0.63	0.00694	0.05	7.3	0.1	1.3
0.075	11.25	0.71	0.00781	0.075	16.3	0.4	4.5
0.1	12.5	0.79	0.00867	0.1	29.1	1.0	10.7
0.125	13.75	0.87	0.00954	0.125	45.4	1.9	20.8
0.15	15	0.95	0.01041	0.15	65.4	3.3	36.0
Weir Position =	**3-25% open**						

RATING CURVE FOR MODELLING OUTLET

Head or Ponding Depth (m)	Outlfow (L/sec)
0	0.0000
0.025	3.4700
0.05	6.9399
0.075	7.8074
0.1	8.6749
0.125	9.5424
0.15	10.4099

RATING CURVE FOR MODELLING ROOF STORAGE

Head or Ponding Depth (m)	Ponding Area (m2)
0	0.0
0.025	1.8
0.05	7.3
0.075	16.3
0.1	29.1
0.125	45.4
0.15	65.4

C-4
ESTIMATION OF ROOF STORAGE AND OUTFLOW - TOWER 3

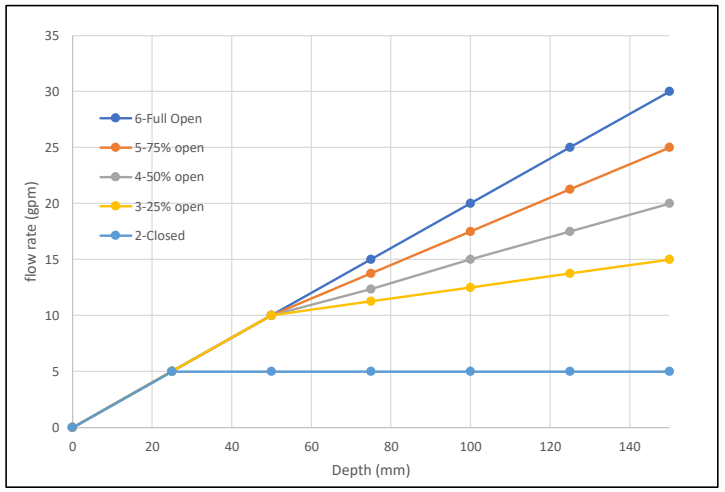
WATTS ADJ ACCUTROL WEIR FLOW RATES (Flow Rates at Various Depths)

Depth	Weir Position					
	1-None	2-Closed	3-25% open	4-50% open	5-75% open	6-Full Open
	Max Flow Rate per wier @150mm in gpm					
0	0	0	0	0	0	0
0.025	0	5	5	5	5	5
0.05	0	5	10	10	10	10
0.075	0	5	11.25	12.35	13.75	15
0.1	0	5	12.5	15	17.5	20
0.125	0	5	13.75	17.5	21.25	25
0.15	0	5	15	20	25	30

WATTS ADJ ACCUTROL WEIR FLOW RATES (Data From Manufacturer's Catalog)

Weir Position	Flow (gpm) per depth							Max Flow Rate per Weir @150mm
	0	25	50	75	100	125	150	
	0	0.025	0.05	0.075	0.1	0.125	0.15	
1-None	0	0	0	0	0	0	0	0
2-Closed	0	5	5	5	5	5	5	0.315
3-25% open	0	5	10	11.25	12.5	13.75	15	0.946
4-50% open	0	5	10	12.35	15	17.5	20	1.262
5-75% open	0	5	10	13.75	17.5	21.25	25	1.577
6-Full Open	0	5	10	15	20	25	30	1.893

GRAPH OF FLOW RATE VERSUS DEPTH FOR VARIOUS WEIR POSITIONS



BUILDING ROOF INFORMATION

Buidling Number	**TOWER 3**	
Total Roof Area (m2)	**2562**	
Minimum Number of Drains Required	2.8	*Minimium of 1 drain every 900 sqaure metres (OBC 7.4.10.4)*
15-min Rainfall Factor for Ottawa (mm)	**23**	*(OBC Supp SB-1)*
Max Permitted Load from All Drains (Litres)	58,926	
Max Permitted Load from All Drains (L/sec)	65.5	*Hydraulic Load expressed in L/sec (OBC Section 7.4.10.3)*
Estimated area per drain (m2)	144	
Estimated Distance from roof edge to drains (m)	**6**	*Not more than 15m from Edge of Roof and 30m to Adjacent Dains (OBC Section 7.4.10.3)*
Estimated No. of Drains Requried	18	*Based on Total Roof Area / Area per Drain*
Actual No. of Drains Used	26	*Use if known*
Effecive Roof Percentage (%)	**80%**	*N0 Allowance for Mechanical units on this roof*
Effecive Total Roof Area (m2)	2050	
Area per Drain (m2)	79	*Based on Effectiive Roof Area / Actual Number of Drains Used*
Max Depth of Ponding at Drains (mm)	**150**	
Estimated Total Volume for Ponding on Roof (m3)	128.1	*Prisim formula, V = 1/3*A*d*
Maximium release rate per drain at 150mm (usgpm)	**15**	*Based on 1 Wier Per Drain and Fully Open Position*
Max Release Rate from Roof (L/sec)	24.6	*Based on Maximum Depth of Ponding of 150mm*
Equiv Runoff C for 100-yr Storm	0.19	*Based on 100-yr storm Intensity of 178.6 mm/hr, where I =1735.688 / (Tc + 6.014)^0.820, with Tc=10min)*

RATING CURVE FOR ROOF

DISCHARGE VERSUS DEPTH				AREA VERSUS DEPTH			Total Ponding Volume - All Drains (m3)
Ponding Depth (m)	Discharge Rate Per Drain (gpm)	Discharge Rate Per Drain (m3/sec)	Total Discharge All Drains (m3/sec)	Ponding Depth (m)	Ponding Area (m2)	Ponding Volume Per Drain (m3)	
0	0	0.00	0.00000	0	0.0	0.0	0.0
0.025	5	0.32	0.00820	0.025	2.2	0.0	0.5
0.05	10	0.63	0.01640	0.05	8.8	0.1	3.8
0.075	11.25	0.71	0.01845	0.075	19.7	0.5	12.8
0.1	12.5	0.79	0.02050	0.1	35.0	1.2	30.4
0.125	13.75	0.87	0.02255	0.125	54.7	2.3	59.3
0.15	15	0.95	0.02461	0.15	78.8	3.9	102.5
Weir Position =	**3-25% open**						

RATING CURVE FOR MODELLING OUTLET

Head or Ponding Depth (m)	Outlfow (L/sec)
0	0.0000
0.025	8.2017
0.05	16.4035
0.075	18.4539
0.1	20.5043
0.125	22.5547
0.15	24.6052

RATING CURVE FOR MODELLING ROOF STORAGE

Head or Ponding Depth (m)	Ponding Area (m2)
0	0.0
0.025	2.2
0.05	8.8
0.075	19.7
0.1	35.0
0.125	54.7
0.15	78.8

C-5
ESTIMATION OF ROOF STORAGE AND OUTFLOW - TOWER 4

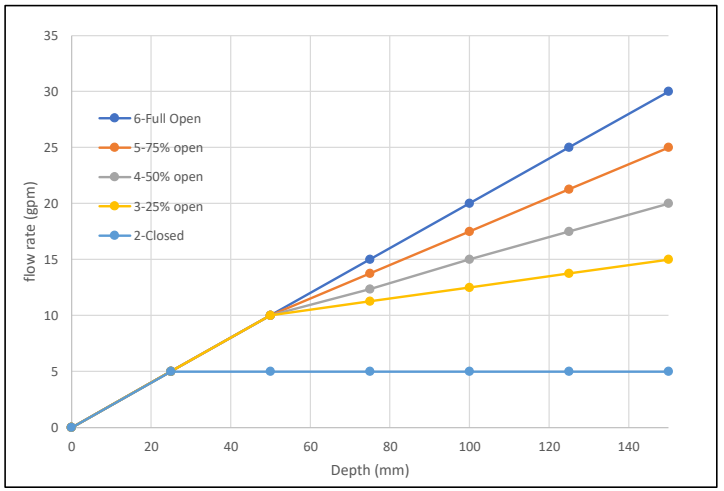
WATTS ADJ ACCUTROL WEIR FLOW RATES (Flow Rates at Various Depths)

Depth	Weir Position					
	1-None	2-Closed	3-25% open	4-50% open	5-75% open	6-Full Open
	Max Flow Rate per wier @150mm in gpm					
0	0	0	0	0	0	0
0.025	0	5	5	5	5	5
0.05	0	5	10	10	10	10
0.075	0	5	11.25	12.35	13.75	15
0.1	0	5	12.5	15	17.5	20
0.125	0	5	13.75	17.5	21.25	25
0.15	0	5	15	20	25	30

WATTS ADJ ACCUTROL WEIR FLOW RATES (Data From Manufacturer's Catalog)

Weir Position	Flow (gpm) per depth							Max Flow Rate per Weir @150mm
	0	25	50	75	100	125	150	
	0	0.025	0.05	0.075	0.1	0.125	0.15	
1-None	0	0	0	0	0	0	0	0
2-Closed	0	5	5	5	5	5	5	0.315
3-25% open	0	5	10	11.25	12.5	13.75	15	0.946
4-50% open	0	5	10	12.35	15	17.5	20	1.262
5-75% open	0	5	10	13.75	17.5	21.25	25	1.577
6-Full Open	0	5	10	15	20	25	30	1.893

GRAPH OF FLOW RATE VERSUS DEPTH FOR VARIOUS WEIR POSITIONS



BUILDING ROOF INFORMATION

Buidling Number	**TOWER 4**	
Total Roof Area (m2)	**1864**	
Minimum Number of Drains Required	2.1	*Minimium of 1 drain every 900 sqaure metres (OBC 7.4.10.4)*
15-min Rainfall Factor for Ottawa (mm)	**23**	*(OBC Supp SB-1)*
Max Permitted Load from All Drains (Litres)	42,872	
Max Permitted Load from All Drains (L/sec)	47.6	*Hydraulic Load expressed in L/sec (OBC Section 7.4.10.3)*
Estimated area per drain (m2)	100	
Estimated Distance from roof edge to drains (m)	**5**	*Not more than 15m from Edge of Roof and 30m to Adjacent Dains (OBC Section 7.4.10.3)*
Estimated No. of Drains Requried	19	*Based on Total Roof Area / Area per Drain*
Actual No. of Drains Used	14	*Use if known*
Effecive Roof Percentage (%)	**80%**	*N0 Allowance for Mechanical units on this roof*
Effecive Total Roof Area (m2)	1491	
Area per Drain (m2)	107	*Based on Effectiive Roof Area / Actual Number of Drains Used*
Max Depth of Ponding at Drains (mm)	**150**	
Estimated Total Volume for Ponding on Roof (m3)	93.2	*Prisim formula, V = 1/3*A*d*
Maximium release rate per drain at 150mm (usgpm)	**15**	*Based on 1 Wier Per Drain and Fully Open Position*
Max Release Rate from Roof (L/sec)	13.2	*Based on Maximum Depth of Ponding of 150mm*
Equiv Runoff C for 100-yr Storm	0.14	*Based on 100-yr storm Intensity of 178.6 mm/hr, where I =1735.688 / (Tc + 6.014)^0.820, with Tc=10min)*

RATING CURVE FOR ROOF

DISCHARGE VERSUS DEPTH				AREA VERSUS DEPTH			Total Ponding Volume - All Drains (m3)
Ponding Depth (m)	Discharge Rate Per Drain (gpm)	Discharge Rate Per Drain (m3/sec)	Total Discharge All Drains (m3/sec)	Ponding Depth (m)	Ponding Area (m2)	Ponding Volume Per Drain (m3)	
0	0	0.00	0.00000	0	0.0	0.0	0.0
0.025	5	0.32	0.00442	0.025	3.0	0.0	0.3
0.05	10	0.63	0.00883	0.05	11.8	0.2	2.8
0.075	11.25	0.71	0.00994	0.075	26.6	0.7	9.3
0.1	12.5	0.79	0.01104	0.1	47.3	1.6	22.1
0.125	13.75	0.87	0.01214	0.125	74.0	3.1	43.1
0.15	15	0.95	0.01325	0.15	106.5	5.3	74.6
Weir Position =	**3-25% open**						

RATING CURVE FOR MODELLING OUTLET

Head or Ponding Depth (m)	Outlfow (L/sec)
0	0.0000
0.025	4.4163
0.05	8.8326
0.075	9.9367
0.1	11.0408
0.125	12.1449
0.15	13.2489

RATING CURVE FOR MODELLING ROOF STORAGE

Head or Ponding Depth (m)	Ponding Area (m2)
0	0.0
0.025	3.0
0.05	11.8
0.075	26.6
0.1	47.3
0.125	74.0
0.15	106.5

Table C-6 ESTIMATION OF PRE-DEVELOPMENT PEAK FLOWS (Based on Tc=10mins & 5-yr Storm)

Catchment No.	Area (ha)	Outlet Location	Time of Conc, Tc (min)	Storm = 2 yr			Storm = 5 yr			Storm = 100 yr		
				I_2 (mm/hr)	Cavg	Q_{2PRE} (L/sec)	I_5 (mm/hr)	Cavg	Q_{5PRE} (L/sec)	I_{100} (mm/hr)	Cavg	Q_{100PRE} (L/sec)
Entire Site	1.90	D/S STM System	10.0	76.81	0.50	202.8	104.29	0.50	275.4	178.56	1.00	943.1
Totals	1.90					202.8			**275.4**			943.1

Notes

1) Intensity, $I = 732.951/(Tc+6.199)^{0.810}$ (2-year, City of 0ttawa)

2) Intensity, $I = 998.071/(Tc+6.035)^{0.814}$ (5-year, City of 0ttawa)

3) Intensity, $I = 1735.688/(Tc+6.014)^{0.820}$ (100-year, City of Ottawa)

4) Cavg for 100-year is increased by 25% to a maximum of 1.0

Allowable Discharge (based on 5-yr storm)

Table C-7 AVERAGE RUNOFF COEFFICIENTS FOR POST-DEVELOPMENT

Runoff Coeffients	$C_{ASPH/CONC}$ = 0.90	C_{ROOF} = 0.90	C_{GRASS} = 0.20								
Area No.	Outlet Location	Asphalt & Conc Areas (m^2)	A * C_{ASPH}	Roof Areas (m^2)	A * C_{ROOF}	Grassed Areas (m^2)	A * C_{GRASS}	Sum AC	Total Area (m^2)	C_{AVG} (see note)	Comment
T1	Tower 1 Roof Drains			1600.0	1440.0			1440.0	1600	0.90	
T2	Tower 2 Roof Drains			899.0	809.1	824	164.8	973.9	1723	0.57	
T3	Tower 3 Roof Drains			2562.0	2305.8			2305.8	2562	0.90	
T4	Tower 4 Roof Drains			1864.0	1677.6			1677.6	1864	0.90	
A1	ROW	473	425.7			318	63.6	489.3	791	0.62	
A2	Trench Drains	30	27.0					27.0	30	0.90	
A3	Area Drain 1	447	402.3			44	8.8	411.1	491	0.84	
A4	Area Drain 2	278	250.2			169	33.8	284.0	447	0.64	
A5	Area Drain 3	390	351.0			413	82.6	433.6	803	0.54	
A6	Area Drain 5					1130	226.0	226.0	1130	0.20	
A7	Area Drain 4	54	48.6			48	9.6	58.2	102	0.57	
A8	CBE 5, 6, 7 & 8					1199	239.8	239.8	1199	0.20	
A9	Ex.CB1,Ex.CB2, CB300, CB301	1715	1543.5			802	160.4	1703.9	2517	0.68	
A10	Area Drain 6	104	93.6			96	19.2	112.8	200	0.56	
A11	Area Drain 7	212	190.8			17	3.4	194.2	229	0.85	
A12	Area Drain 8	90	81.0			23	4.6	85.6	113	0.76	
A13	Area Drain 9	113	101.7			16	3.2	104.9	129	0.81	
A14	Area Drain 11	216	194.4					194.4	216	0.90	
A15	Area Drain 10	124	111.6			23	4.6	116.2	147	0.79	
A16	Area Drain 12	489	440.1			79	15.8	455.9	568	0.80	
A17	CBE 1, 2, 3 & 4					1664	332.8	332.8	1664	0.20	
A18	ROW	34	30.6			441	88.2	118.8	475	0.25	
Totals		4,769	4,292.1	6,925	6,232.5	7,306	1,461.2	11,986	19,000	0.63	

Notes

1) Cavg derived as per area-weighting method

Table C-8 SUMMARY OF POST-DEVELOPMENT PEAK FLOWS (Uncontrolled and Controlled)

Area No	Area (ha)	Time of Conc, Tc (min)	Storm = 2 yr				Storm = 5 yr				Storm = 100 yr				Outlet	Comments
			C_{AVG}	I_2 (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	I_5 (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)		
T1	0.160	10	0.90	76.81	30.7	**(7.0)**	0.90	104.19	41.7	**(9.5)**	1.00	178.56	79.4	**(18.0)**	Tower 1 Roof Drains	Controlled
T2	0.172	10	0.57	76.81	20.8	**(3.6)**	0.57	104.19	28.2	**(4.9)**	0.71	178.56	60.4	**(10.4)**	Tower 2 Roof Drains	
T3	0.256	10	0.90	76.81	49.2	**(9.5)**	0.90	104.19	66.8	**(12.9)**	1.00	178.56	127.2	**(24.6)**	Tower 3 Roof Drains	
T4	0.186	10	0.90	76.81	35.8	**(5.1)**	0.90	104.19	48.6	**(6.9)**	1.00	178.56	92.5	**(13.2)**	Tower 4 Roof Drains	
A1	0.079	10	0.62	76.81	10.4	10.4	0.62	104.19	14.2	14.2	0.77	178.56	30.4	30.4	ROW	Uncontrolled
A2	0.003	10	0.90	76.81	0.6	**(0.3)**	0.90	104.19	0.8	**(0.4)**	1.00	178.56	1.5	**(0.7)**	Trench Drains	Controlled at cistern
A3	0.049	10	0.84	76.81	8.8	**(5.9)**	0.84	104.19	11.9	**(7.9)**	1.00	178.56	24.4	**(16.2)**	Area Drain 1	
A4	0.045	10	0.64	76.81	6.1	**(4.0)**	0.64	104.19	8.2	**(5.5)**	0.79	178.56	17.6	**(11.7)**	Area Drain 2	
A5	0.080	10	0.54	76.81	9.3	**(6.2)**	0.54	104.19	12.6	**(8.4)**	0.67	178.56	26.9	**(17.9)**	Area Drain 3	
A6	0.113	10	0.20	76.81	4.8	**(3.2)**	0.20	104.19	6.5	**(4.4)**	0.25	178.56	14.0	**(9.3)**	Area Drain 5	
A7	0.010	10	0.57	76.81	1.2	**(0.8)**	0.57	104.19	1.7	**(1.1)**	0.71	178.56	3.6	**(2.4)**	Area Drain 4	
A8	0.120	10	0.20	76.81	5.1	**(3.4)**	0.20	104.19	6.9	**(4.6)**	0.25	178.56	14.9	**(9.9)**	CBE 5, 6, 7 & 8	
A9	0.252	10	0.68	76.81	36.4	**(13.1)**	0.68	104.19	49.4	**(17.7)**	0.85	178.56	105.7	**(38.0)**	Ex.CB1,Ex.CB2, CB300, CB301	ICD & Controlled at cistern
A10	0.020	10	0.56	76.81	2.4	**(1.6)**	0.56	104.19	3.3	**(2.2)**	0.71	178.56	7.0	**(4.7)**	Area Drain 6	Controlled at cistern
A11	0.023	10	0.85	76.81	4.1	**(2.8)**	0.85	104.19	5.6	**(3.8)**	1.00	178.56	11.4	**(7.6)**	Area Drain 7	
A12	0.011	10	0.76	76.81	1.8	**(1.2)**	0.76	104.19	2.5	**(1.7)**	0.95	178.56	5.3	**(3.5)**	Area Drain 8	
A13	0.013	10	0.81	76.81	2.2	**(1.5)**	0.81	104.19	3.0	**(2.0)**	1.00	178.56	6.4	**(4.3)**	Area Drain 9	
A14	0.022	10	0.90	76.81	4.2	**(2.8)**	0.90	104.19	5.6	**(3.8)**	1.00	178.56	10.7	**(7.1)**	Area Drain 11	
A15	0.015	10	0.79	76.81	2.5	**(1.7)**	0.79	104.19	3.4	**(2.2)**	0.99	178.56	7.2	**(4.8)**	Area Drain 10	
A16	0.057	10	0.80	76.81	9.7	**(6.5)**	0.80	104.19	13.2	**(8.8)**	1.00	178.56	28.2	**(18.8)**	Area Drain 12	
A17	0.166	10	0.20	76.81	7.1	**(4.7)**	0.20	104.19	9.6	**(6.4)**	0.25	178.56	20.6	**(13.8)**	CBE 1, 2, 3 & 4	
A18	0.048	10	0.25	76.81	2.5	2.5	0.25	104.19	3.4	3.4	0.31	178.56	7.4	7.4	ROW	Uncontrolled
Totals	1.9000				255.9	**97.8**			347.2	**132.7**			702.8	**274.9**		

Notes

2-yr Storm Intensity, I = 732.951/(Tc+6.199)^0.810 (City of Ottawa)

5-yr Storm Intensity, I = 998.071/(Tc+6.035)^0.814 (City of Ottawa)

100-yr Storm Intensity, I = 1735.688/(Tc+6.014)&^0.820 (City of Ottawa)

*Time of Concentration (min), Tc = **10***

*For Flows under column Qcap which are shown in brackets **(0.0)** , denotes flows that are controlled*

Table C-9 SUMMARY OF STORAGE

Area No	Release Rate (L/s)			Storage Required (m^3) (MRM)			Storage Provided (m^3)			Control Method
	2-yr	5-yr	100-yr	2-yr	5-yr	100-yr	Roof	Cistern	Ponding	
T1	7.0	9.5	18.0	7.6	9.7	24.7	64.0			Flow Controlled Roof Drains with Weir (Set at 25% Open Position)
T2	3.6	4.9	10.4	7.2	9.3	23.2	36.0			
T3	9.5	12.9	24.6	15.3	19.7	45.6	102.5			
T4	5.1	6.9	13.2	14.2	18.3	38.6	74.5			
A1	10.4	14.2	30.4							None
A2	0.3	0.4	0.7	0.1	0.2	0.3		0.3		Pump Rate from Cistern
A3	5.9	7.9	16.2	1.8	2.4	4.9		4.9		
A4	4.0	5.5	11.7	1.2	1.6	3.5		3.5		
A5	6.2	8.4	17.9	1.9	2.5	5.4		5.4		
A6	3.2	4.4	9.3	1.0	1.3	2.8		2.8		
A7	0.8	1.1	2.4	0.2	0.3	0.7		0.7		
A8	3.4	4.6	9.9	1.0	1.4	3.0		3.0		
A9	13.1	17.7	38.0	14.0	19.0	40.6		40.5	0.1	ICD & Pump Rate from Cistern
A10	1.6	2.2	4.7	0.5	0.7	1.4		1.4		Pump Rate from Cistern
A11	2.8	3.8	7.6	0.8	1.1	2.3		2.3		
A12	1.2	1.7	3.5	0.4	0.5	1.1		1.1		
A13	1.5	2.0	4.3	0.4	0.6	1.3		1.3		
A14	2.8	3.8	7.1	0.8	1.1	2.1		2.1		
A15	1.7	2.2	4.8	0.5	0.7	1.4		1.4		
A16	6.5	8.8	18.8	1.9	2.6	5.6		5.6		
A17	4.7	6.4	13.8	1.4	1.9	4.1		4.1		
A18	2.5	3.4	7.4							None
Totals	**97.8**	**132.7**	**274.9**	**72.3**	**95.0**	**212.7**	**277.0**	**80.5**	**0.1**	

TABLE C-10

Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: T1 **Controlled**

C_{AVG} = 0.90 (2-yr)

C_{AVG} = 0.90 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.1600 (hectares)

Duration (min)	Release Rate = 7.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 9.5 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 18.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	66.9	6.97	60.0	0.00	230.5	92.3	9.453	82.8	0.00	398.6	177.3	18.000	159.3	0.00
10	76.8	30.7	6.97	23.8	14.27	104.2	41.7	9.453	32.3	19.35	178.6	79.4	18.000	61.4	36.85
20	52.0	20.8	6.97	13.9	16.63	70.3	28.1	9.453	18.7	22.40	120.0	53.4	18.000	35.4	42.42
30	40.0	16.0	6.97	9.1	16.31	53.9	21.6	9.453	12.1	21.84	91.9	40.9	18.000	22.9	41.15
40	32.9	13.2	6.97	6.2	14.85	44.2	17.7	9.453	8.2	19.76	75.1	33.4	18.000	15.4	37.02
50	28.0	11.2	6.97	4.3	12.77	37.7	15.1	9.453	5.6	16.86	64.0	28.4	18.000	10.4	31.34
60	24.6	9.8	6.97	2.9	10.31	32.9	13.2	9.453	3.7	13.45	55.9	24.9	18.000	6.9	24.70
70	21.9	8.8	6.97	1.8	7.58	29.4	11.8	9.453	2.3	9.68	49.8	22.1	18.000	4.1	17.41
80	19.8	7.9	6.97	1.0	4.66	26.6	10.6	9.453	1.2	5.67	45.0	20.0	18.000	2.0	9.66
90	18.1	7.3	6.97	0.3	1.59	24.3	9.7	9.453	0.3	1.46	41.1	18.3	18.000	0.3	1.55
100	16.7	6.7	6.97	-0.3	-1.59	22.4	9.0	9.453	-0.5	-2.90	37.9	16.9	18.000	-1.1	-6.84
110	15.6	6.2	6.97	-0.7	-4.86	20.8	8.3	9.453	-1.1	-7.37	35.2	15.7	18.000	-2.3	-15.46
120	14.6	5.8	6.97	-1.1	-8.20	19.5	7.8	9.453	-1.7	-11.95	32.9	14.6	18.000	-3.4	-24.25
130	13.7	5.5	6.97	-1.5	-11.61	18.3	7.3	9.453	-2.1	-16.61	30.9	13.7	18.000	-4.3	-33.20
140	12.9	5.2	6.97	-1.8	-15.07	17.3	6.9	9.453	-2.5	-21.34	29.2	13.0	18.000	-5.0	-42.28
150	12.3	4.9	6.97	-2.1	-18.57	16.4	6.6	9.453	-2.9	-26.13	27.6	12.3	18.000	-5.7	-51.47
160	11.7	4.7	6.97	-2.3	-22.12	15.6	6.2	9.453	-3.2	-30.97	26.2	11.7	18.000	-6.3	-60.76
170	11.1	4.4	6.97	-2.5	-25.70	14.8	5.9	9.453	-3.5	-35.86	25.0	11.1	18.000	-6.9	-70.13
180	10.6	4.3	6.97	-2.7	-29.31	14.2	5.7	9.453	-3.8	-40.79	23.9	10.6	18.000	-7.4	-79.58
190	10.2	4.1	6.97	-2.9	-32.95	13.6	5.4	9.453	-4.0	-45.75	22.9	10.2	18.000	-7.8	-89.09
200	9.8	3.9	6.97	-3.1	-36.62	13.0	5.2	9.453	-4.2	-50.75	22.0	9.8	18.000	-8.2	-98.67
Max =					**16.63**					**22.40**					**42.42**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-11

Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **T2** **Controlled**

C_{AVG} = 0.57 (2-yr)

C_{AVG} = 0.57 (5-yr)

C_{AVG} = 0.71 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.1723 (hectares)

Duration (min)	Release Rate = 3.6 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 4.9 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 10.4 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	45.3	3.58	41.7	0.00	230.5	62.4	4.855	57.5	0.00	398.6	134.9	10.400	124.5	0.00
10	76.8	20.8	3.58	17.2	10.33	104.2	28.2	4.855	23.4	14.01	178.6	60.4	10.400	50.0	30.02
20	52.0	14.1	3.58	10.5	12.61	70.3	19.0	4.855	14.2	17.00	120.0	40.6	10.400	30.2	36.23
30	40.0	10.8	3.58	7.3	13.07	53.9	14.6	4.855	9.7	17.54	91.9	31.1	10.400	20.7	37.24
40	32.9	8.9	3.58	5.3	12.77	44.2	12.0	4.855	7.1	17.06	75.1	25.4	10.400	15.0	36.08
50	28.0	7.6	3.58	4.0	12.04	37.7	10.2	4.855	5.3	16.02	64.0	21.6	10.400	11.2	33.73
60	24.6	6.6	3.58	3.1	11.05	32.9	8.9	4.855	4.1	14.63	55.9	18.9	10.400	8.5	30.66
70	21.9	5.9	3.58	2.4	9.89	29.4	8.0	4.855	3.1	13.01	49.8	16.9	10.400	6.5	27.09
80	19.8	5.4	3.58	1.8	8.59	26.6	7.2	4.855	2.3	11.22	45.0	15.2	10.400	4.8	23.17
90	18.1	4.9	3.58	1.3	7.20	24.3	6.6	4.855	1.7	9.29	41.1	13.9	10.400	3.5	18.97
100	16.7	4.5	3.58	1.0	5.73	22.4	6.1	4.855	1.2	7.27	37.9	12.8	10.400	2.4	14.57
110	15.6	4.2	3.58	0.6	4.20	20.8	5.6	4.855	0.8	5.17	35.2	11.9	10.400	1.5	9.99
120	14.6	3.9	3.58	0.4	2.62	19.5	5.3	4.855	0.4	2.99	32.9	11.1	10.400	0.7	5.27
130	13.7	3.7	3.58	0.1	1.00	18.3	5.0	4.855	0.1	0.77	30.9	10.5	10.400	0.1	0.44
140	12.9	3.5	3.58	-0.1	-0.66	17.3	4.7	4.855	-0.2	-1.51	29.2	9.9	10.400	-0.5	-4.49
150	12.3	3.3	3.58	-0.3	-2.36	16.4	4.4	4.855	-0.4	-3.82	27.6	9.3	10.400	-1.1	-9.50
160	11.7	3.2	3.58	-0.4	-4.07	15.6	4.2	4.855	-0.6	-6.18	26.2	8.9	10.400	-1.5	-14.59
170	11.1	3.0	3.58	-0.6	-5.82	14.8	4.0	4.855	-0.8	-8.56	25.0	8.5	10.400	-1.9	-19.74
180	10.6	2.9	3.58	-0.7	-7.58	14.2	3.8	4.855	-1.0	-10.97	23.9	8.1	10.400	-2.3	-24.96
190	10.2	2.8	3.58	-0.8	-9.36	13.6	3.7	4.855	-1.2	-13.41	22.9	7.7	10.400	-2.7	-30.22
200	9.8	2.6	3.58	-0.9	-11.16	13.0	3.5	4.855	-1.3	-15.86	22.0	7.4	10.400	-3.0	-35.53
Max =					**13.07**					**17.54**					**37.24**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-12

Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: T3 **Controlled**

C_{AVG} = 0.90 (2-yr)

C_{AVG} = 0.90 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.2562 (hectares)

Duration (min)	Release Rate = 9.5 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 (I = A/(T_c+C)					Release Rate = 12.9 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 (I = A/(T_c+C)					Release Rate = 24.6 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	107.2	9.52	97.7	0.00	230.5	147.7	12.919	134.8	0.00	398.6	283.9	24.600	259.3	0.00
10	76.8	49.2	9.52	39.7	23.83	104.2	66.8	12.919	53.9	32.32	178.6	127.2	24.600	102.6	61.55
20	52.0	33.4	9.52	23.8	28.60	70.3	45.0	12.919	32.1	38.54	120.0	85.4	24.600	60.8	73.00
30	40.0	25.7	9.52	16.1	29.06	53.9	34.6	12.919	21.6	38.97	91.9	65.4	24.600	40.8	73.50
40	32.9	21.1	9.52	11.5	27.70	44.2	28.3	12.919	15.4	36.97	75.1	53.5	24.600	28.9	69.41
50	28.0	18.0	9.52	8.5	25.35	37.7	24.1	12.919	11.2	33.65	64.0	45.6	24.600	21.0	62.85
60	24.6	15.7	9.52	6.2	22.39	32.9	21.1	12.919	8.2	29.51	55.9	39.8	24.600	15.2	54.76
70	21.9	14.0	9.52	4.5	19.00	29.4	18.8	12.919	5.9	24.82	49.8	35.5	24.600	10.9	45.62
80	19.8	12.7	9.52	3.2	15.30	26.6	17.0	12.919	4.1	19.72	45.0	32.0	24.600	7.4	35.73
90	18.1	11.6	9.52	2.1	11.38	24.3	15.6	12.919	2.6	14.31	41.1	29.3	24.600	4.7	25.28
100	16.7	10.7	9.52	1.2	7.27	22.4	14.4	12.919	1.4	8.66	37.9	27.0	24.600	2.4	14.38
110	15.6	10.0	9.52	0.5	3.01	20.8	13.3	12.919	0.4	2.83	35.2	25.1	24.600	0.5	3.12
120	14.6	9.3	9.52	-0.2	-1.36	19.5	12.5	12.919	-0.4	-3.17	32.9	23.4	24.600	-1.2	-8.43
130	13.7	8.8	9.52	-0.7	-5.83	18.3	11.7	12.919	-1.2	-9.30	30.9	22.0	24.600	-2.6	-20.23
140	12.9	8.3	9.52	-1.2	-10.39	17.3	11.1	12.919	-1.8	-15.54	29.2	20.8	24.600	-3.8	-32.23
150	12.3	7.9	9.52	-1.7	-15.03	16.4	10.5	12.919	-2.4	-21.88	27.6	19.7	24.600	-4.9	-44.41
160	11.7	7.5	9.52	-2.1	-19.73	15.6	10.0	12.919	-2.9	-28.30	26.2	18.7	24.600	-5.9	-56.75
170	11.1	7.1	9.52	-2.4	-24.48	14.8	9.5	12.919	-3.4	-34.80	25.0	17.8	24.600	-6.8	-69.22
180	10.6	6.8	9.52	-2.7	-29.28	14.2	9.1	12.919	-3.8	-41.36	23.9	17.0	24.600	-7.6	-81.82
190	10.2	6.5	9.52	-3.0	-34.13	13.6	8.7	12.919	-4.2	-47.98	22.9	16.3	24.600	-8.3	-94.52
200	9.8	6.3	9.52	-3.3	-39.02	13.0	8.4	12.919	-4.6	-54.65	22.0	15.7	24.600	-8.9	-107.32
Max =					**29.06**					**38.97**					**73.50**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-13

Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **T4** **Controlled**

C_{AVG} = 0.90 (2-yr)

C_{AVG} = 0.90 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.1864 (hectares)

Duration (min)	Release Rate = 5.1 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 6.9 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 13.2 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	78.0	5.11	72.9	0.00	230.5	107.5	6.932	100.6	0.00	398.6	206.6	13.200	193.4	0.00
10	76.8	35.8	5.11	30.7	18.43	104.2	48.6	6.932	41.7	25.00	178.6	92.5	13.200	79.3	47.60
20	52.0	24.3	5.11	19.2	22.99	70.3	32.8	6.932	25.8	31.00	120.0	62.2	13.200	49.0	58.75
30	40.0	18.7	5.11	13.6	24.42	53.9	25.2	6.932	18.2	32.79	91.9	47.6	13.200	34.4	61.93
40	32.9	15.3	5.11	10.2	24.52	44.2	20.6	6.932	13.7	32.82	75.1	38.9	13.200	25.7	61.78
50	28.0	13.1	5.11	8.0	23.90	37.7	17.6	6.932	10.6	31.88	64.0	33.1	13.200	19.9	59.82
60	24.6	11.5	5.11	6.3	22.83	32.9	15.4	6.932	8.4	30.35	55.9	29.0	13.200	15.8	56.75
70	21.9	10.2	5.11	5.1	21.46	29.4	13.7	6.932	6.8	28.42	49.8	25.8	13.200	12.6	52.92
80	19.8	9.2	5.11	4.1	19.86	26.6	12.4	6.932	5.5	26.19	45.0	23.3	13.200	10.1	48.55
90	18.1	8.5	5.11	3.4	18.10	24.3	11.3	6.932	4.4	23.73	41.1	21.3	13.200	8.1	43.76
100	16.7	7.8	5.11	2.7	16.20	22.4	10.5	6.932	3.5	21.11	37.9	19.6	13.200	6.4	38.65
110	15.6	7.3	5.11	2.2	14.20	20.8	9.7	6.932	2.8	18.34	35.2	18.2	13.200	5.0	33.27
120	14.6	6.8	5.11	1.7	12.11	19.5	9.1	6.932	2.1	15.46	32.9	17.0	13.200	3.8	27.69
130	13.7	6.4	5.11	1.3	9.94	18.3	8.5	6.932	1.6	12.48	30.9	16.0	13.200	2.8	21.93
140	12.9	6.0	5.11	0.9	7.71	17.3	8.1	6.932	1.1	9.42	29.2	15.1	13.200	1.9	16.01
150	12.3	5.7	5.11	0.6	5.43	16.4	7.6	6.932	0.7	6.29	27.6	14.3	13.200	1.1	9.97
160	11.7	5.4	5.11	0.3	3.11	15.6	7.3	6.932	0.3	3.09	26.2	13.6	13.200	0.4	3.81
170	11.1	5.2	5.11	0.1	0.74	14.8	6.9	6.932	0.0	-0.15	25.0	13.0	13.200	-0.2	-2.45
180	10.6	5.0	5.11	-0.2	-1.66	14.2	6.6	6.932	-0.3	-3.45	23.9	12.4	13.200	-0.8	-8.79
190	10.2	4.8	5.11	-0.4	-4.10	13.6	6.3	6.932	-0.6	-6.78	22.9	11.9	13.200	-1.3	-15.21
200	9.8	4.6	5.11	-0.5	-6.57	13.0	6.1	6.932	-0.8	-10.16	22.0	11.4	13.200	-1.8	-21.71
Max =					**24.52**					**32.82**					**61.93**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-14

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **A2** **Controlled at cistern**

C_{AVG} = 0.90 (2-yr)

C_{AVG} = 0.90 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0030 (hectares)

Duration (min)	Release Rate = 0.3 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 0.4 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 0.74 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	1.3	0.29	1.0	0.00	230.5	1.7	0.391	1.3	0.00	398.6	3.3	0.7	2.6	0.00
10	76.8	0.6	0.29	0.3	0.17	104.2	0.8	0.391	0.4	0.23	178.6	1.5	0.7	0.7	0.45
20	52.0	0.4	0.29	0.1	0.12	70.3	0.5	0.391	0.1	0.16	120.0	1.0	0.7	0.3	0.31
30	40.0	0.3	0.29	0.0	0.02	53.9	0.4	0.391	0.0	0.02	91.9	0.8	0.7	0.0	0.04
40	32.9	0.2	0.29	0.0	-0.10	44.2	0.3	0.391	-0.1	-0.14	75.1	0.6	0.7	-0.1	-0.28
50	28.0	0.2	0.29	-0.1	-0.23	37.7	0.3	0.391	-0.1	-0.33	64.0	0.5	0.7	-0.2	-0.63
60	24.6	0.2	0.29	-0.1	-0.37	32.9	0.2	0.391	-0.1	-0.52	55.9	0.5	0.7	-0.3	-1.00
70	21.9	0.2	0.29	-0.1	-0.52	29.4	0.2	0.391	-0.2	-0.72	49.8	0.4	0.7	-0.3	-1.38
80	19.8	0.1	0.29	-0.1	-0.67	26.6	0.2	0.391	-0.2	-0.92	45.0	0.4	0.7	-0.4	-1.77
90	18.1	0.1	0.29	-0.2	-0.82	24.3	0.2	0.391	-0.2	-1.13	41.1	0.3	0.7	-0.4	-2.17
100	16.7	0.1	0.29	-0.2	-0.98	22.4	0.2	0.391	-0.2	-1.34	37.9	0.3	0.7	-0.4	-2.57
110	15.6	0.1	0.29	-0.2	-1.13	20.8	0.2	0.391	-0.2	-1.55	35.2	0.3	0.7	-0.5	-2.98
120	14.6	0.1	0.29	-0.2	-1.29	19.5	0.1	0.391	-0.2	-1.76	32.9	0.3	0.7	-0.5	-3.39
130	13.7	0.1	0.29	-0.2	-1.45	18.3	0.1	0.391	-0.3	-1.98	30.9	0.3	0.7	-0.5	-3.80
140	12.9	0.1	0.29	-0.2	-1.61	17.3	0.1	0.391	-0.3	-2.20	29.2	0.2	0.7	-0.5	-4.21
150	12.3	0.1	0.29	-0.2	-1.77	16.4	0.1	0.391	-0.3	-2.41	27.6	0.2	0.7	-0.5	-4.63
160	11.7	0.1	0.29	-0.2	-1.93	15.6	0.1	0.391	-0.3	-2.63	26.2	0.2	0.7	-0.5	-5.05
170	11.1	0.1	0.29	-0.2	-2.09	14.8	0.1	0.391	-0.3	-2.85	25.0	0.2	0.7	-0.5	-5.47
180	10.6	0.1	0.29	-0.2	-2.25	14.2	0.1	0.391	-0.3	-3.07	23.9	0.2	0.7	-0.5	-5.89
190	10.2	0.1	0.29	-0.2	-2.41	13.6	0.1	0.391	-0.3	-3.30	22.9	0.2	0.7	-0.6	-6.31
200	9.8	0.1	0.29	-0.2	-2.58	13.0	0.1	0.391	-0.3	-3.52	22.0	0.2	0.7	-0.6	-6.74
Max =					**0.17**					**0.23**					**0.45**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-15

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A3

Area No: **A3** **Controlled at cistern**

C_{AVG} = 0.84 (2-yr)

C_{AVG} = 0.84 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0491 (hectares)

Duration (min)	Release Rate = 5.9 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 7.9 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 16.25 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	19.1	5.85	13.3	0.00	230.5	26.3	7.939	18.4	0.00	398.6	54.4	16.2	38.2	0.00
10	76.8	8.8	5.85	2.9	1.76	104.2	11.9	7.939	4.0	2.38	178.6	24.4	16.2	8.1	4.87
20	52.0	5.9	5.85	0.1	0.11	70.3	8.0	7.939	0.1	0.11	120.0	16.4	16.2	0.1	0.15
30	40.0	4.6	5.85	-1.3	-2.30	53.9	6.2	7.939	-1.8	-3.20	91.9	12.5	16.2	-3.7	-6.68
40	32.9	3.8	5.85	-2.1	-5.03	44.2	5.0	7.939	-2.9	-6.93	75.1	10.3	16.2	-6.0	-14.38
50	28.0	3.2	5.85	-2.6	-7.94	37.7	4.3	7.939	-3.6	-10.91	64.0	8.7	16.2	-7.5	-22.56
60	24.6	2.8	5.85	-3.0	-10.96	32.9	3.8	7.939	-4.2	-15.02	55.9	7.6	16.2	-8.6	-31.03
70	21.9	2.5	5.85	-3.3	-14.06	29.4	3.4	7.939	-4.6	-19.24	49.8	6.8	16.2	-9.5	-39.70
80	19.8	2.3	5.85	-3.6	-17.21	26.6	3.0	7.939	-4.9	-23.53	45.0	6.1	16.2	-10.1	-48.52
90	18.1	2.1	5.85	-3.8	-20.40	24.3	2.8	7.939	-5.2	-27.88	41.1	5.6	16.2	-10.6	-57.44
100	16.7	1.9	5.85	-3.9	-23.63	22.4	2.6	7.939	-5.4	-32.27	37.9	5.2	16.2	-11.1	-66.45
110	15.6	1.8	5.85	-4.1	-26.88	20.8	2.4	7.939	-5.6	-36.69	35.2	4.8	16.2	-11.4	-75.53
120	14.6	1.7	5.85	-4.2	-30.15	19.5	2.2	7.939	-5.7	-41.14	32.9	4.5	16.2	-11.8	-84.66
130	13.7	1.6	5.85	-4.3	-33.44	18.3	2.1	7.939	-5.8	-45.61	30.9	4.2	16.2	-12.0	-93.84
140	12.9	1.5	5.85	-4.4	-36.75	17.3	2.0	7.939	-6.0	-50.11	29.2	4.0	16.2	-12.3	-103.06
150	12.3	1.4	5.85	-4.5	-40.06	16.4	1.9	7.939	-6.1	-54.62	27.6	3.8	16.2	-12.5	-112.32
160	11.7	1.3	5.85	-4.5	-43.39	15.6	1.8	7.939	-6.2	-59.14	26.2	3.6	16.2	-12.7	-121.60
170	11.1	1.3	5.85	-4.6	-46.73	14.8	1.7	7.939	-6.2	-63.68	25.0	3.4	16.2	-12.8	-130.91
180	10.6	1.2	5.85	-4.6	-50.08	14.2	1.6	7.939	-6.3	-68.23	23.9	3.3	16.2	-13.0	-140.25
190	10.2	1.2	5.85	-4.7	-53.44	13.6	1.6	7.939	-6.4	-72.80	22.9	3.1	16.2	-13.1	-149.60
200	9.8	1.1	5.85	-4.7	-56.80	13.0	1.5	7.939	-6.4	-77.37	22.0	3.0	16.2	-13.2	-158.98
Max =					**1.76**					**2.38**					**4.87**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-16

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A4

Area No: A4 **Controlled at cistern**

C_{AVG} = 0.64 (2-yr)

C_{AVG} = 0.64 (5-yr)

C_{AVG} = 0.79 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0447 (hectares)

Duration (min)	Release Rate = 4.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 (I = A/(T_c+C)					Release Rate = 5.5 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 (I = A/(T_c+C)					Release Rate = 11.75 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	13.2	4.04	9.2	0.00	230.5	18.2	5.484	12.7	0.00	398.6	39.3	11.7	27.6	0.00
10	76.8	6.1	4.04	2.0	1.21	104.2	8.2	5.484	2.7	1.65	178.6	17.6	11.7	5.9	3.52
20	52.0	4.1	4.04	0.1	0.08	70.3	5.5	5.484	0.1	0.07	120.0	11.8	11.7	0.1	0.11
30	40.0	3.2	4.04	-0.9	-1.59	53.9	4.3	5.484	-1.2	-2.21	91.9	9.1	11.7	-2.7	-4.83
40	32.9	2.6	4.04	-1.4	-3.47	44.2	3.5	5.484	-2.0	-4.79	75.1	7.4	11.7	-4.3	-10.40
50	28.0	2.2	4.04	-1.8	-5.49	37.7	3.0	5.484	-2.5	-7.53	64.0	6.3	11.7	-5.4	-16.31
60	24.6	1.9	4.04	-2.1	-7.57	32.9	2.6	5.484	-2.9	-10.38	55.9	5.5	11.7	-6.2	-22.43
70	21.9	1.7	4.04	-2.3	-9.71	29.4	2.3	5.484	-3.2	-13.29	49.8	4.9	11.7	-6.8	-28.70
80	19.8	1.6	4.04	-2.5	-11.89	26.6	2.1	5.484	-3.4	-16.26	45.0	4.4	11.7	-7.3	-35.08
90	18.1	1.4	4.04	-2.6	-14.10	24.3	1.9	5.484	-3.6	-19.26	41.1	4.1	11.7	-7.7	-41.53
100	16.7	1.3	4.04	-2.7	-16.32	22.4	1.8	5.484	-3.7	-22.29	37.9	3.7	11.7	-8.0	-48.04
110	15.6	1.2	4.04	-2.8	-18.57	20.8	1.6	5.484	-3.8	-25.35	35.2	3.5	11.7	-8.3	-54.61
120	14.6	1.1	4.04	-2.9	-20.83	19.5	1.5	5.484	-3.9	-28.42	32.9	3.2	11.7	-8.5	-61.21
130	13.7	1.1	4.04	-3.0	-23.10	18.3	1.4	5.484	-4.0	-31.51	30.9	3.0	11.7	-8.7	-67.85
140	12.9	1.0	4.04	-3.0	-25.39	17.3	1.4	5.484	-4.1	-34.61	29.2	2.9	11.7	-8.9	-74.52
150	12.3	1.0	4.04	-3.1	-27.68	16.4	1.3	5.484	-4.2	-37.73	27.6	2.7	11.7	-9.0	-81.21
160	11.7	0.9	4.04	-3.1	-29.98	15.6	1.2	5.484	-4.3	-40.86	26.2	2.6	11.7	-9.2	-87.92
170	11.1	0.9	4.04	-3.2	-32.29	14.8	1.2	5.484	-4.3	-43.99	25.0	2.5	11.7	-9.3	-94.65
180	10.6	0.8	4.04	-3.2	-34.60	14.2	1.1	5.484	-4.4	-47.14	23.9	2.4	11.7	-9.4	-101.40
190	10.2	0.8	4.04	-3.2	-36.92	13.6	1.1	5.484	-4.4	-50.29	22.9	2.3	11.7	-9.5	-108.17
200	9.8	0.8	4.04	-3.3	-39.24	13.0	1.0	5.484	-4.5	-53.45	22.0	2.2	11.7	-9.6	-114.94
Max =					**1.21**					**1.65**					**3.52**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-17

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A5

Area No: **A5** **Controlled at cistern**

C_{AVG} = 0.54 (2-yr)

C_{AVG} = 0.54 (5-yr)

C_{AVG} = 0.67 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0803 (hectares)

Duration (min)	Release Rate = 6.2 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 8.4 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 17.94 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	20.2	6.17	14.0	0.00	230.5	27.8	8.373	19.4	0.00	398.6	60.1	17.9	42.1	0.00
10	76.8	9.3	6.17	3.1	1.85	104.2	12.6	8.373	4.2	2.51	178.6	26.9	17.9	9.0	5.38
20	52.0	6.3	6.17	0.1	0.12	70.3	8.5	8.373	0.1	0.11	120.0	18.1	17.9	0.1	0.16
30	40.0	4.8	6.17	-1.3	-2.42	53.9	6.5	8.373	-1.9	-3.37	91.9	13.8	17.9	-4.1	-7.37
40	32.9	4.0	6.17	-2.2	-5.31	44.2	5.3	8.373	-3.0	-7.31	75.1	11.3	17.9	-6.6	-15.87
50	28.0	3.4	6.17	-2.8	-8.38	37.7	4.5	8.373	-3.8	-11.50	64.0	9.6	17.9	-8.3	-24.90
60	24.6	3.0	6.17	-3.2	-11.56	32.9	4.0	8.373	-4.4	-15.85	55.9	8.4	17.9	-9.5	-34.25
70	21.9	2.6	6.17	-3.5	-14.83	29.4	3.5	8.373	-4.8	-20.30	49.8	7.5	17.9	-10.4	-43.82
80	19.8	2.4	6.17	-3.8	-18.15	26.6	3.2	8.373	-5.2	-24.82	45.0	6.8	17.9	-11.2	-53.56
90	18.1	2.2	6.17	-4.0	-21.52	24.3	2.9	8.373	-5.4	-29.40	41.1	6.2	17.9	-11.7	-63.41
100	16.7	2.0	6.17	-4.2	-24.92	22.4	2.7	8.373	-5.7	-34.03	37.9	5.7	17.9	-12.2	-73.35
110	15.6	1.9	6.17	-4.3	-28.35	20.8	2.5	8.373	-5.9	-38.70	35.2	5.3	17.9	-12.6	-83.37
120	14.6	1.8	6.17	-4.4	-31.80	19.5	2.3	8.373	-6.0	-43.39	32.9	5.0	17.9	-13.0	-93.46
130	13.7	1.7	6.17	-4.5	-35.27	18.3	2.2	8.373	-6.2	-48.11	30.9	4.7	17.9	-13.3	-103.59
140	12.9	1.6	6.17	-4.6	-38.76	17.3	2.1	8.373	-6.3	-52.85	29.2	4.4	17.9	-13.5	-113.77
150	12.3	1.5	6.17	-4.7	-42.26	16.4	2.0	8.373	-6.4	-57.61	27.6	4.2	17.9	-13.8	-123.98
160	11.7	1.4	6.17	-4.8	-45.77	15.6	1.9	8.373	-6.5	-62.38	26.2	4.0	17.9	-14.0	-134.23
170	11.1	1.3	6.17	-4.8	-49.29	14.8	1.8	8.373	-6.6	-67.17	25.0	3.8	17.9	-14.2	-144.51
180	10.6	1.3	6.17	-4.9	-52.82	14.2	1.7	8.373	-6.7	-71.97	23.9	3.6	17.9	-14.3	-154.82
190	10.2	1.2	6.17	-4.9	-56.37	13.6	1.6	8.373	-6.7	-76.78	22.9	3.5	17.9	-14.5	-165.14
200	9.8	1.2	6.17	-5.0	-59.91	13.0	1.6	8.373	-6.8	-81.60	22.0	3.3	17.9	-14.6	-175.49
Max =					**1.85**					**2.51**					**5.38**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-18

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A6

Area No: A6 **Controlled at cistern**

C_{AVG} = 0.20 (2-yr)

C_{AVG} = 0.20 (5-yr)

C_{AVG} = 0.25 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.1130 (hectares)

Duration (min)	Release Rate = 3.2 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 (I = A/(T_c+C)					Release Rate = 4.4 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 (I = A/(T_c+C)					Release Rate = 9.35 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	10.5	3.22	7.3	0.00	230.5	14.5	4.364	10.1	0.00	398.6	31.3	9.3	22.0	0.00
10	76.8	4.8	3.22	1.6	0.97	104.2	6.5	4.364	2.2	1.31	178.6	14.0	9.3	4.7	2.80
20	52.0	3.3	3.22	0.1	0.06	70.3	4.4	4.364	0.0	0.06	120.0	9.4	9.3	0.1	0.09
30	40.0	2.5	3.22	-0.7	-1.26	53.9	3.4	4.364	-1.0	-1.76	91.9	7.2	9.3	-2.1	-3.84
40	32.9	2.1	3.22	-1.2	-2.77	44.2	2.8	4.364	-1.6	-3.81	75.1	5.9	9.3	-3.4	-8.27
50	28.0	1.8	3.22	-1.5	-4.37	37.7	2.4	4.364	-2.0	-6.00	64.0	5.0	9.3	-4.3	-12.98
60	24.6	1.5	3.22	-1.7	-6.03	32.9	2.1	4.364	-2.3	-8.26	55.9	4.4	9.3	-5.0	-17.85
70	21.9	1.4	3.22	-1.8	-7.73	29.4	1.8	4.364	-2.5	-10.58	49.8	3.9	9.3	-5.4	-22.84
80	19.8	1.2	3.22	-2.0	-9.46	26.6	1.7	4.364	-2.7	-12.94	45.0	3.5	9.3	-5.8	-27.91
90	18.1	1.1	3.22	-2.1	-11.22	24.3	1.5	4.364	-2.8	-15.33	41.1	3.2	9.3	-6.1	-33.05
100	16.7	1.1	3.22	-2.2	-12.99	22.4	1.4	4.364	-3.0	-17.74	37.9	3.0	9.3	-6.4	-38.23
110	15.6	1.0	3.22	-2.2	-14.78	20.8	1.3	4.364	-3.1	-20.17	35.2	2.8	9.3	-6.6	-43.46
120	14.6	0.9	3.22	-2.3	-16.58	19.5	1.2	4.364	-3.1	-22.62	32.9	2.6	9.3	-6.8	-48.71
130	13.7	0.9	3.22	-2.4	-18.38	18.3	1.1	4.364	-3.2	-25.08	30.9	2.4	9.3	-6.9	-53.99
140	12.9	0.8	3.22	-2.4	-20.20	17.3	1.1	4.364	-3.3	-27.55	29.2	2.3	9.3	-7.1	-59.30
150	12.3	0.8	3.22	-2.4	-22.03	16.4	1.0	4.364	-3.3	-30.03	27.6	2.2	9.3	-7.2	-64.62
160	11.7	0.7	3.22	-2.5	-23.86	15.6	1.0	4.364	-3.4	-32.51	26.2	2.1	9.3	-7.3	-69.97
170	11.1	0.7	3.22	-2.5	-25.69	14.8	0.9	4.364	-3.4	-35.01	25.0	2.0	9.3	-7.4	-75.32
180	10.6	0.7	3.22	-2.5	-27.53	14.2	0.9	4.364	-3.5	-37.51	23.9	1.9	9.3	-7.5	-80.69
190	10.2	0.6	3.22	-2.6	-29.38	13.6	0.9	4.364	-3.5	-40.02	22.9	1.8	9.3	-7.6	-86.08
200	9.8	0.6	3.22	-2.6	-31.23	13.0	0.8	4.364	-3.5	-42.53	22.0	1.7	9.3	-7.6	-91.47
Max =					**0.97**					**1.31**					**2.80**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-19

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A7

Area No: **A7** **Controlled at cistern**

C_{AVG} = 0.57 (2-yr)

C_{AVG} = 0.57 (5-yr)

C_{AVG} = 0.71 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0102 (hectares)

Duration (min)	Release Rate = 0.8 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 1.1 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 2.41 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	2.7	0.83	1.9	0.00	230.5	3.7	1.124	2.6	0.00	398.6	8.1	2.4	5.7	0.00
10	76.8	1.2	0.83	0.4	0.25	104.2	1.7	1.124	0.6	0.34	178.6	3.6	2.4	1.2	0.72
20	52.0	0.8	0.83	0.0	0.02	70.3	1.1	1.124	0.0	0.02	120.0	2.4	2.4	0.0	0.02
30	40.0	0.6	0.83	-0.2	-0.33	53.9	0.9	1.124	-0.3	-0.45	91.9	1.9	2.4	-0.5	-0.99
40	32.9	0.5	0.83	-0.3	-0.71	44.2	0.7	1.124	-0.4	-0.98	75.1	1.5	2.4	-0.9	-2.13
50	28.0	0.5	0.83	-0.4	-1.12	37.7	0.6	1.124	-0.5	-1.54	64.0	1.3	2.4	-1.1	-3.34
60	24.6	0.4	0.83	-0.4	-1.55	32.9	0.5	1.124	-0.6	-2.13	55.9	1.1	2.4	-1.3	-4.60
70	21.9	0.4	0.83	-0.5	-1.99	29.4	0.5	1.124	-0.6	-2.72	49.8	1.0	2.4	-1.4	-5.88
80	19.8	0.3	0.83	-0.5	-2.44	26.6	0.4	1.124	-0.7	-3.33	45.0	0.9	2.4	-1.5	-7.19
90	18.1	0.3	0.83	-0.5	-2.89	24.3	0.4	1.124	-0.7	-3.95	41.1	0.8	2.4	-1.6	-8.51
100	16.7	0.3	0.83	-0.6	-3.35	22.4	0.4	1.124	-0.8	-4.57	37.9	0.8	2.4	-1.6	-9.85
110	15.6	0.3	0.83	-0.6	-3.81	20.8	0.3	1.124	-0.8	-5.19	35.2	0.7	2.4	-1.7	-11.19
120	14.6	0.2	0.83	-0.6	-4.27	19.5	0.3	1.124	-0.8	-5.82	32.9	0.7	2.4	-1.7	-12.54
130	13.7	0.2	0.83	-0.6	-4.73	18.3	0.3	1.124	-0.8	-6.46	30.9	0.6	2.4	-1.8	-13.90
140	12.9	0.2	0.83	-0.6	-5.20	17.3	0.3	1.124	-0.8	-7.09	29.2	0.6	2.4	-1.8	-15.27
150	12.3	0.2	0.83	-0.6	-5.67	16.4	0.3	1.124	-0.9	-7.73	27.6	0.6	2.4	-1.8	-16.64
160	11.7	0.2	0.83	-0.6	-6.14	15.6	0.3	1.124	-0.9	-8.37	26.2	0.5	2.4	-1.9	-18.02
170	11.1	0.2	0.83	-0.6	-6.62	14.8	0.2	1.124	-0.9	-9.02	25.0	0.5	2.4	-1.9	-19.40
180	10.6	0.2	0.83	-0.7	-7.09	14.2	0.2	1.124	-0.9	-9.66	23.9	0.5	2.4	-1.9	-20.78
190	10.2	0.2	0.83	-0.7	-7.57	13.6	0.2	1.124	-0.9	-10.31	22.9	0.5	2.4	-1.9	-22.17
200	9.8	0.2	0.83	-0.7	-8.04	13.0	0.2	1.124	-0.9	-10.95	22.0	0.4	2.4	-2.0	-23.56
Max =					**0.25**					**0.34**					**0.72**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-20

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A8

Area No: **A8** **Controlled at cistern**

C_{AVG} = 0.20 (2-yr)

C_{AVG} = 0.20 (5-yr)

C_{AVG} = 0.25 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.1199 (hectares)

Duration (min)	Release Rate = 3.4 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 4.6 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 9.92 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	11.1	3.41	7.7	0.00	230.5	15.4	4.631	10.7	0.00	398.6	33.2	9.9	23.3	0.00
10	76.8	5.1	3.41	1.7	1.02	104.2	6.9	4.631	2.3	1.39	178.6	14.9	9.9	5.0	2.98
20	52.0	3.5	3.41	0.1	0.07	70.3	4.7	4.631	0.1	0.06	120.0	10.0	9.9	0.1	0.09
30	40.0	2.7	3.41	-0.7	-1.34	53.9	3.6	4.631	-1.0	-1.86	91.9	7.7	9.9	-2.3	-4.08
40	32.9	2.2	3.41	-1.2	-2.93	44.2	2.9	4.631	-1.7	-4.04	75.1	6.3	9.9	-3.7	-8.78
50	28.0	1.9	3.41	-1.5	-4.63	37.7	2.5	4.631	-2.1	-6.36	64.0	5.3	9.9	-4.6	-13.77
60	24.6	1.6	3.41	-1.8	-6.39	32.9	2.2	4.631	-2.4	-8.76	55.9	4.7	9.9	-5.3	-18.94
70	21.9	1.5	3.41	-2.0	-8.20	29.4	2.0	4.631	-2.7	-11.22	49.8	4.1	9.9	-5.8	-24.24
80	19.8	1.3	3.41	-2.1	-10.04	26.6	1.8	4.631	-2.9	-13.73	45.0	3.7	9.9	-6.2	-29.62
90	18.1	1.2	3.41	-2.2	-11.90	24.3	1.6	4.631	-3.0	-16.26	41.1	3.4	9.9	-6.5	-35.07
100	16.7	1.1	3.41	-2.3	-13.78	22.4	1.5	4.631	-3.1	-18.82	37.9	3.2	9.9	-6.8	-40.57
110	15.6	1.0	3.41	-2.4	-15.68	20.8	1.4	4.631	-3.2	-21.40	35.2	2.9	9.9	-7.0	-46.11
120	14.6	1.0	3.41	-2.4	-17.59	19.5	1.3	4.631	-3.3	-24.00	32.9	2.7	9.9	-7.2	-51.68
130	13.7	0.9	3.41	-2.5	-19.51	18.3	1.2	4.631	-3.4	-26.61	30.9	2.6	9.9	-7.3	-57.29
140	12.9	0.9	3.41	-2.6	-21.43	17.3	1.2	4.631	-3.5	-29.23	29.2	2.4	9.9	-7.5	-62.92
150	12.3	0.8	3.41	-2.6	-23.37	16.4	1.1	4.631	-3.5	-31.86	27.6	2.3	9.9	-7.6	-68.57
160	11.7	0.8	3.41	-2.6	-25.31	15.6	1.0	4.631	-3.6	-34.50	26.2	2.2	9.9	-7.7	-74.24
170	11.1	0.7	3.41	-2.7	-27.26	14.8	1.0	4.631	-3.6	-37.15	25.0	2.1	9.9	-7.8	-79.92
180	10.6	0.7	3.41	-2.7	-29.21	14.2	0.9	4.631	-3.7	-39.80	23.9	2.0	9.9	-7.9	-85.62
190	10.2	0.7	3.41	-2.7	-31.17	13.6	0.9	4.631	-3.7	-42.46	22.9	1.9	9.9	-8.0	-91.33
200	9.8	0.7	3.41	-2.8	-33.13	13.0	0.9	4.631	-3.8	-45.13	22.0	1.8	9.9	-8.1	-97.05
Max =					**1.02**					**1.39**					**2.98**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-21

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A9

Area No: **A9** **Controlled at cistern**

C_{AVG} = 0.68 (2-yr)

C_{AVG} = 0.68 (5-yr)

C_{AVG} = 0.85 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.2517 (hectares)

Duration (min)	Release Rate = 13.1 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 17.7 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 38.00 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	79.2	13.08	66.1	0.00	230.5	109.2	17.739	91.4	0.00	398.6	236.0	38.0	198.0	0.00
10	76.8	36.4	13.08	23.3	13.98	104.2	49.4	17.739	31.6	18.97	178.6	105.7	38.0	67.7	40.64
20	52.0	24.6	13.08	11.6	13.88	70.3	33.3	17.739	15.5	18.65	120.0	71.0	38.0	33.0	39.63
30	40.0	19.0	13.08	5.9	10.61	53.9	25.5	17.739	7.8	14.05	91.9	54.4	38.0	16.4	29.51
40	32.9	15.6	13.08	2.5	5.98	44.2	20.9	17.739	3.2	7.66	75.1	44.5	38.0	6.5	15.59
50	28.0	13.3	13.08	0.2	0.62	37.7	17.8	17.739	0.1	0.29	64.0	37.9	38.0	-0.1	-0.40
60	24.6	11.6	13.08	-1.4	-5.20	32.9	15.6	17.739	-2.1	-7.68	55.9	33.1	38.0	-4.9	-17.66
70	21.9	10.4	13.08	-2.7	-11.33	29.4	13.9	17.739	-3.8	-16.07	49.8	29.5	38.0	-8.5	-35.78
80	19.8	9.4	13.08	-3.7	-17.68	26.6	12.6	17.739	-5.2	-24.75	45.0	26.6	38.0	-11.4	-54.53
90	18.1	8.6	13.08	-4.5	-24.20	24.3	11.5	17.739	-6.2	-33.66	41.1	24.3	38.0	-13.7	-73.75
100	16.7	7.9	13.08	-5.1	-30.86	22.4	10.6	17.739	-7.1	-42.75	37.9	22.4	38.0	-15.6	-93.34
110	15.6	7.4	13.08	-5.7	-37.63	20.8	9.9	17.739	-7.9	-51.98	35.2	20.8	38.0	-17.2	-113.23
120	14.6	6.9	13.08	-6.2	-44.48	19.5	9.2	17.739	-8.5	-61.33	32.9	19.5	38.0	-18.5	-133.36
130	13.7	6.5	13.08	-6.6	-51.41	18.3	8.7	17.739	-9.1	-70.77	30.9	18.3	38.0	-19.7	-153.70
140	12.9	6.1	13.08	-7.0	-58.41	17.3	8.2	17.739	-9.6	-80.30	29.2	17.3	38.0	-20.7	-174.21
150	12.3	5.8	13.08	-7.3	-65.45	16.4	7.8	17.739	-10.0	-89.90	27.6	16.3	38.0	-21.7	-194.86
160	11.7	5.5	13.08	-7.6	-72.55	15.6	7.4	17.739	-10.4	-99.56	26.2	15.5	38.0	-22.5	-215.65
170	11.1	5.3	13.08	-7.8	-79.69	14.8	7.0	17.739	-10.7	-109.28	25.0	14.8	38.0	-23.2	-236.55
180	10.6	5.0	13.08	-8.0	-86.86	14.2	6.7	17.739	-11.0	-119.04	23.9	14.2	38.0	-23.8	-257.55
190	10.2	4.8	13.08	-8.3	-94.07	13.6	6.4	17.739	-11.3	-128.85	22.9	13.6	38.0	-24.4	-278.64
200	9.8	4.6	13.08	-8.4	-101.30	13.0	6.2	17.739	-11.6	-138.69	22.0	13.0	38.0	-25.0	-299.81
Max =					**13.98**					**18.97**					**40.64**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-22

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A10

Area No: A10 Controlled at cistern

C_{AVG} = 0.56 (2-yr)

C_{AVG} = 0.56 (5-yr)

C_{AVG} = 0.71 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0200 (hectares)

Duration (min)	Release Rate = 1.6 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 2.2 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 4.67 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	5.2	1.61	3.6	0.00	230.5	7.2	2.178	5.0	0.00	398.6	15.6	4.7	11.0	0.00
10	76.8	2.4	1.61	0.8	0.48	104.2	3.3	2.178	1.1	0.65	178.6	7.0	4.7	2.3	1.40
20	52.0	1.6	1.61	0.0	0.03	70.3	2.2	2.178	0.0	0.03	120.0	4.7	4.7	0.0	0.04
30	40.0	1.3	1.61	-0.3	-0.63	53.9	1.7	2.178	-0.5	-0.88	91.9	3.6	4.7	-1.1	-1.92
40	32.9	1.0	1.61	-0.6	-1.38	44.2	1.4	2.178	-0.8	-1.90	75.1	2.9	4.7	-1.7	-4.13
50	28.0	0.9	1.61	-0.7	-2.18	37.7	1.2	2.178	-1.0	-2.99	64.0	2.5	4.7	-2.2	-6.48
60	24.6	0.8	1.61	-0.8	-3.01	32.9	1.0	2.178	-1.1	-4.12	55.9	2.2	4.7	-2.5	-8.91
70	21.9	0.7	1.61	-0.9	-3.86	29.4	0.9	2.178	-1.3	-5.28	49.8	2.0	4.7	-2.7	-11.40
80	19.8	0.6	1.61	-1.0	-4.72	26.6	0.8	2.178	-1.3	-6.46	45.0	1.8	4.7	-2.9	-13.93
90	18.1	0.6	1.61	-1.0	-5.60	24.3	0.8	2.178	-1.4	-7.65	41.1	1.6	4.7	-3.1	-16.50
100	16.7	0.5	1.61	-1.1	-6.48	22.4	0.7	2.178	-1.5	-8.85	37.9	1.5	4.7	-3.2	-19.08
110	15.6	0.5	1.61	-1.1	-7.38	20.8	0.7	2.178	-1.5	-10.07	35.2	1.4	4.7	-3.3	-21.69
120	14.6	0.5	1.61	-1.1	-8.27	19.5	0.6	2.178	-1.6	-11.29	32.9	1.3	4.7	-3.4	-24.31
130	13.7	0.4	1.61	-1.2	-9.18	18.3	0.6	2.178	-1.6	-12.52	30.9	1.2	4.7	-3.5	-26.95
140	12.9	0.4	1.61	-1.2	-10.08	17.3	0.5	2.178	-1.6	-13.75	29.2	1.1	4.7	-3.5	-29.60
150	12.3	0.4	1.61	-1.2	-10.99	16.4	0.5	2.178	-1.7	-14.99	27.6	1.1	4.7	-3.6	-32.25
160	11.7	0.4	1.61	-1.2	-11.91	15.6	0.5	2.178	-1.7	-16.23	26.2	1.0	4.7	-3.6	-34.92
170	11.1	0.3	1.61	-1.3	-12.82	14.8	0.5	2.178	-1.7	-17.47	25.0	1.0	4.7	-3.7	-37.59
180	10.6	0.3	1.61	-1.3	-13.74	14.2	0.4	2.178	-1.7	-18.72	23.9	0.9	4.7	-3.7	-40.28
190	10.2	0.3	1.61	-1.3	-14.66	13.6	0.4	2.178	-1.8	-19.97	22.9	0.9	4.7	-3.8	-42.96
200	9.8	0.3	1.61	-1.3	-15.59	13.0	0.4	2.178	-1.8	-21.23	22.0	0.9	4.7	-3.8	-45.65
Max =					**0.48**					**0.65**					**1.40**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-23

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A11

Area No: A11 **Controlled at cistern**

C_{AVG} = 0.85 (2-yr)

C_{AVG} = 0.85 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0229 (hectares)

Duration (min)	Release Rate = 2.8 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 (I = A/(T_c+C)					Release Rate = 3.8 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 (I = A/(T_c+C)					Release Rate = 7.58 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	9.0	2.76	6.3	0.00	230.5	12.4	3.750	8.7	0.00	398.6	25.4	7.6	17.8	0.00
10	76.8	4.1	2.76	1.4	0.83	104.2	5.6	3.750	1.9	1.13	178.6	11.4	7.6	3.8	2.27
20	52.0	2.8	2.76	0.0	0.05	70.3	3.8	3.750	0.0	0.05	120.0	7.6	7.6	0.1	0.07
30	40.0	2.2	2.76	-0.6	-1.08	53.9	2.9	3.750	-0.8	-1.51	91.9	5.8	7.6	-1.7	-3.11
40	32.9	1.8	2.76	-1.0	-2.38	44.2	2.4	3.750	-1.4	-3.28	75.1	4.8	7.6	-2.8	-6.71
50	28.0	1.5	2.76	-1.3	-3.75	37.7	2.0	3.750	-1.7	-5.15	64.0	4.1	7.6	-3.5	-10.52
60	24.6	1.3	2.76	-1.4	-5.18	32.9	1.8	3.750	-2.0	-7.10	55.9	3.6	7.6	-4.0	-14.47
70	21.9	1.2	2.76	-1.6	-6.64	29.4	1.6	3.750	-2.2	-9.09	49.8	3.2	7.6	-4.4	-18.52
80	19.8	1.1	2.76	-1.7	-8.13	26.6	1.4	3.750	-2.3	-11.12	45.0	2.9	7.6	-4.7	-22.63
90	18.1	1.0	2.76	-1.8	-9.64	24.3	1.3	3.750	-2.4	-13.17	41.1	2.6	7.6	-5.0	-26.79
100	16.7	0.9	2.76	-1.9	-11.16	22.4	1.2	3.750	-2.5	-15.24	37.9	2.4	7.6	-5.2	-30.99
110	15.6	0.8	2.76	-1.9	-12.70	20.8	1.1	3.750	-2.6	-17.33	35.2	2.2	7.6	-5.3	-35.23
120	14.6	0.8	2.76	-2.0	-14.24	19.5	1.1	3.750	-2.7	-19.43	32.9	2.1	7.6	-5.5	-39.49
130	13.7	0.7	2.76	-2.0	-15.80	18.3	1.0	3.750	-2.8	-21.55	30.9	2.0	7.6	-5.6	-43.77
140	12.9	0.7	2.76	-2.1	-17.36	17.3	0.9	3.750	-2.8	-23.67	29.2	1.9	7.6	-5.7	-48.07
150	12.3	0.7	2.76	-2.1	-18.93	16.4	0.9	3.750	-2.9	-25.80	27.6	1.8	7.6	-5.8	-52.38
160	11.7	0.6	2.76	-2.1	-20.50	15.6	0.8	3.750	-2.9	-27.94	26.2	1.7	7.6	-5.9	-56.72
170	11.1	0.6	2.76	-2.2	-22.08	14.8	0.8	3.750	-2.9	-30.08	25.0	1.6	7.6	-6.0	-61.06
180	10.6	0.6	2.76	-2.2	-23.66	14.2	0.8	3.750	-3.0	-32.23	23.9	1.5	7.6	-6.1	-65.41
190	10.2	0.5	2.76	-2.2	-25.24	13.6	0.7	3.750	-3.0	-34.39	22.9	1.5	7.6	-6.1	-69.77
200	9.8	0.5	2.76	-2.2	-26.83	13.0	0.7	3.750	-3.0	-36.55	22.0	1.4	7.6	-6.2	-74.15
Max =					**0.83**					**1.13**					**2.27**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-24

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A12

Area No: A12 **Controlled at cistern**

C_{AVG} = 0.76 (2-yr)

C_{AVG} = 0.76 (5-yr)

C_{AVG} = 0.95 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0113 (hectares)

Duration (min)	Release Rate = 1.2 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 1.7 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 3.54 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	4.0	1.22	2.8	0.00	230.5	5.5	1.653	3.8	0.00	398.6	11.9	3.5	8.3	0.00
10	76.8	1.8	1.22	0.6	0.37	104.2	2.5	1.653	0.8	0.50	178.6	5.3	3.5	1.8	1.06
20	52.0	1.2	1.22	0.0	0.02	70.3	1.7	1.653	0.0	0.02	120.0	3.6	3.5	0.0	0.03
30	40.0	1.0	1.22	-0.3	-0.48	53.9	1.3	1.653	-0.4	-0.67	91.9	2.7	3.5	-0.8	-1.45
40	32.9	0.8	1.22	-0.4	-1.05	44.2	1.1	1.653	-0.6	-1.44	75.1	2.2	3.5	-1.3	-3.13
50	28.0	0.7	1.22	-0.6	-1.65	37.7	0.9	1.653	-0.8	-2.27	64.0	1.9	3.5	-1.6	-4.92
60	24.6	0.6	1.22	-0.6	-2.28	32.9	0.8	1.653	-0.9	-3.13	55.9	1.7	3.5	-1.9	-6.76
70	21.9	0.5	1.22	-0.7	-2.93	29.4	0.7	1.653	-1.0	-4.01	49.8	1.5	3.5	-2.1	-8.65
80	19.8	0.5	1.22	-0.7	-3.58	26.6	0.6	1.653	-1.0	-4.90	45.0	1.3	3.5	-2.2	-10.57
90	18.1	0.4	1.22	-0.8	-4.25	24.3	0.6	1.653	-1.1	-5.80	41.1	1.2	3.5	-2.3	-12.52
100	16.7	0.4	1.22	-0.8	-4.92	22.4	0.5	1.653	-1.1	-6.72	37.9	1.1	3.5	-2.4	-14.48
110	15.6	0.4	1.22	-0.8	-5.60	20.8	0.5	1.653	-1.2	-7.64	35.2	1.0	3.5	-2.5	-16.46
120	14.6	0.3	1.22	-0.9	-6.28	19.5	0.5	1.653	-1.2	-8.57	32.9	1.0	3.5	-2.6	-18.45
130	13.7	0.3	1.22	-0.9	-6.96	18.3	0.4	1.653	-1.2	-9.50	30.9	0.9	3.5	-2.6	-20.45
140	12.9	0.3	1.22	-0.9	-7.65	17.3	0.4	1.653	-1.2	-10.43	29.2	0.9	3.5	-2.7	-22.46
150	12.3	0.3	1.22	-0.9	-8.34	16.4	0.4	1.653	-1.3	-11.37	27.6	0.8	3.5	-2.7	-24.48
160	11.7	0.3	1.22	-0.9	-9.04	15.6	0.4	1.653	-1.3	-12.31	26.2	0.8	3.5	-2.8	-26.50
170	11.1	0.3	1.22	-1.0	-9.73	14.8	0.4	1.653	-1.3	-13.26	25.0	0.7	3.5	-2.8	-28.53
180	10.6	0.3	1.22	-1.0	-10.43	14.2	0.3	1.653	-1.3	-14.21	23.9	0.7	3.5	-2.8	-30.56
190	10.2	0.2	1.22	-1.0	-11.13	13.6	0.3	1.653	-1.3	-15.16	22.9	0.7	3.5	-2.9	-32.60
200	9.8	0.2	1.22	-1.0	-11.83	13.0	0.3	1.653	-1.3	-16.11	22.0	0.7	3.5	-2.9	-34.64
Max =					**0.37**					**0.50**					**1.06**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-25

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A13

Area No: **A13** **Controlled at cistern**

C_{AVG} = 0.81 (2-yr)

C_{AVG} = 0.81 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0129 (hectares)

Duration (min)	Release Rate = 1.5 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 2.0 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 4.27 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	4.9	1.49	3.4	0.00	230.5	6.7	2.026	4.7	0.00	398.6	14.3	4.3	10.0	0.00
10	76.8	2.2	1.49	0.7	0.45	104.2	3.0	2.026	1.0	0.61	178.6	6.4	4.3	2.1	1.28
20	52.0	1.5	1.49	0.0	0.03	70.3	2.0	2.026	0.0	0.03	120.0	4.3	4.3	0.0	0.04
30	40.0	1.2	1.49	-0.3	-0.59	53.9	1.6	2.026	-0.5	-0.82	91.9	3.3	4.3	-1.0	-1.75
40	32.9	1.0	1.49	-0.5	-1.28	44.2	1.3	2.026	-0.7	-1.77	75.1	2.7	4.3	-1.6	-3.78
50	28.0	0.8	1.49	-0.7	-2.03	37.7	1.1	2.026	-0.9	-2.78	64.0	2.3	4.3	-2.0	-5.93
60	24.6	0.7	1.49	-0.8	-2.80	32.9	1.0	2.026	-1.1	-3.83	55.9	2.0	4.3	-2.3	-8.15
70	21.9	0.6	1.49	-0.9	-3.59	29.4	0.9	2.026	-1.2	-4.91	49.8	1.8	4.3	-2.5	-10.43
80	19.8	0.6	1.49	-0.9	-4.39	26.6	0.8	2.026	-1.3	-6.01	45.0	1.6	4.3	-2.7	-12.75
90	18.1	0.5	1.49	-1.0	-5.21	24.3	0.7	2.026	-1.3	-7.11	41.1	1.5	4.3	-2.8	-15.09
100	16.7	0.5	1.49	-1.0	-6.03	22.4	0.7	2.026	-1.4	-8.23	37.9	1.4	4.3	-2.9	-17.46
110	15.6	0.5	1.49	-1.0	-6.86	20.8	0.6	2.026	-1.4	-9.36	35.2	1.3	4.3	-3.0	-19.84
120	14.6	0.4	1.49	-1.1	-7.69	19.5	0.6	2.026	-1.5	-10.50	32.9	1.2	4.3	-3.1	-22.24
130	13.7	0.4	1.49	-1.1	-8.53	18.3	0.5	2.026	-1.5	-11.64	30.9	1.1	4.3	-3.2	-24.66
140	12.9	0.4	1.49	-1.1	-9.38	17.3	0.5	2.026	-1.5	-12.79	29.2	1.0	4.3	-3.2	-27.08
150	12.3	0.4	1.49	-1.1	-10.22	16.4	0.5	2.026	-1.5	-13.94	27.6	1.0	4.3	-3.3	-29.51
160	11.7	0.3	1.49	-1.2	-11.07	15.6	0.5	2.026	-1.6	-15.09	26.2	0.9	4.3	-3.3	-31.95
170	11.1	0.3	1.49	-1.2	-11.93	14.8	0.4	2.026	-1.6	-16.25	25.0	0.9	4.3	-3.4	-34.40
180	10.6	0.3	1.49	-1.2	-12.78	14.2	0.4	2.026	-1.6	-17.41	23.9	0.9	4.3	-3.4	-36.85
190	10.2	0.3	1.49	-1.2	-13.64	13.6	0.4	2.026	-1.6	-18.58	22.9	0.8	4.3	-3.4	-39.31
200	9.8	0.3	1.49	-1.2	-14.49	13.0	0.4	2.026	-1.6	-19.74	22.0	0.8	4.3	-3.5	-41.77
Max =					**0.45**					**0.61**					**1.28**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-26

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A14

Area No: **A14** **Controlled at cistern**

C_{AVG} = 0.90 (2-yr)

C_{AVG} = 0.90 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0216 (hectares)

Duration (min)	Release Rate = 2.8 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 3.8 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 7.15 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	9.0	2.77	6.3	0.00	230.5	12.5	3.754	8.7	0.00	398.6	23.9	7.1	16.8	0.00
10	76.8	4.2	2.77	1.4	0.83	104.2	5.6	3.754	1.9	1.13	178.6	10.7	7.1	3.6	2.14
20	52.0	2.8	2.77	0.0	0.05	70.3	3.8	3.754	0.0	0.05	120.0	7.2	7.1	0.1	0.07
30	40.0	2.2	2.77	-0.6	-1.09	53.9	2.9	3.754	-0.8	-1.51	91.9	5.5	7.1	-1.6	-2.94
40	32.9	1.8	2.77	-1.0	-2.38	44.2	2.4	3.754	-1.4	-3.28	75.1	4.5	7.1	-2.6	-6.33
50	28.0	1.5	2.77	-1.3	-3.76	37.7	2.0	3.754	-1.7	-5.16	64.0	3.8	7.1	-3.3	-9.92
60	24.6	1.3	2.77	-1.4	-5.18	32.9	1.8	3.754	-2.0	-7.10	55.9	3.4	7.1	-3.8	-13.65
70	21.9	1.2	2.77	-1.6	-6.65	29.4	1.6	3.754	-2.2	-9.10	49.8	3.0	7.1	-4.2	-17.46
80	19.8	1.1	2.77	-1.7	-8.14	26.6	1.4	3.754	-2.3	-11.13	45.0	2.7	7.1	-4.4	-21.34
90	18.1	1.0	2.77	-1.8	-9.65	24.3	1.3	3.754	-2.4	-13.18	41.1	2.5	7.1	-4.7	-25.27
100	16.7	0.9	2.77	-1.9	-11.17	22.4	1.2	3.754	-2.5	-15.26	37.9	2.3	7.1	-4.9	-29.23
110	15.6	0.8	2.77	-1.9	-12.71	20.8	1.1	3.754	-2.6	-17.35	35.2	2.1	7.1	-5.0	-33.23
120	14.6	0.8	2.77	-2.0	-14.26	19.5	1.1	3.754	-2.7	-19.45	32.9	2.0	7.1	-5.2	-37.24
130	13.7	0.7	2.77	-2.0	-15.81	18.3	1.0	3.754	-2.8	-21.57	30.9	1.9	7.1	-5.3	-41.28
140	12.9	0.7	2.77	-2.1	-17.38	17.3	0.9	3.754	-2.8	-23.69	29.2	1.8	7.1	-5.4	-45.34
150	12.3	0.7	2.77	-2.1	-18.95	16.4	0.9	3.754	-2.9	-25.83	27.6	1.7	7.1	-5.5	-49.41
160	11.7	0.6	2.77	-2.1	-20.52	15.6	0.8	3.754	-2.9	-27.97	26.2	1.6	7.1	-5.6	-53.50
170	11.1	0.6	2.77	-2.2	-22.10	14.8	0.8	3.754	-3.0	-30.11	25.0	1.5	7.1	-5.6	-57.59
180	10.6	0.6	2.77	-2.2	-23.68	14.2	0.8	3.754	-3.0	-32.27	23.9	1.4	7.1	-5.7	-61.70
190	10.2	0.6	2.77	-2.2	-25.27	13.6	0.7	3.754	-3.0	-34.42	22.9	1.4	7.1	-5.8	-65.81
200	9.8	0.5	2.77	-2.2	-26.86	13.0	0.7	3.754	-3.0	-36.58	22.0	1.3	7.1	-5.8	-69.94
Max =					**0.83**					**1.13**					**2.14**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-27

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A15

Area No: A15 **Controlled at cistern**

C_{AVG} = 0.79 (2-yr)

C_{AVG} = 0.79 (5-yr)

C_{AVG} = 0.99 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0147 (hectares)

Duration (min)	Release Rate = 1.7 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 2.2 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 4.81 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	5.4	1.65	3.7	0.00	230.5	7.4	2.244	5.2	0.00	398.6	16.1	4.8	11.3	0.00
10	76.8	2.5	1.65	0.8	0.50	104.2	3.4	2.244	1.1	0.67	178.6	7.2	4.8	2.4	1.44
20	52.0	1.7	1.65	0.0	0.03	70.3	2.3	2.244	0.0	0.03	120.0	4.8	4.8	0.0	0.04
30	40.0	1.3	1.65	-0.4	-0.65	53.9	1.7	2.244	-0.5	-0.90	91.9	3.7	4.8	-1.1	-1.97
40	32.9	1.1	1.65	-0.6	-1.42	44.2	1.4	2.244	-0.8	-1.96	75.1	3.0	4.8	-1.8	-4.25
50	28.0	0.9	1.65	-0.7	-2.24	37.7	1.2	2.244	-1.0	-3.08	64.0	2.6	4.8	-2.2	-6.67
60	24.6	0.8	1.65	-0.9	-3.10	32.9	1.1	2.244	-1.2	-4.25	55.9	2.3	4.8	-2.5	-9.18
70	21.9	0.7	1.65	-0.9	-3.97	29.4	0.9	2.244	-1.3	-5.44	49.8	2.0	4.8	-2.8	-11.74
80	19.8	0.6	1.65	-1.0	-4.86	26.6	0.9	2.244	-1.4	-6.65	45.0	1.8	4.8	-3.0	-14.35
90	18.1	0.6	1.65	-1.1	-5.77	24.3	0.8	2.244	-1.5	-7.88	41.1	1.7	4.8	-3.1	-16.99
100	16.7	0.5	1.65	-1.1	-6.68	22.4	0.7	2.244	-1.5	-9.12	37.9	1.5	4.8	-3.3	-19.66
110	15.6	0.5	1.65	-1.2	-7.60	20.8	0.7	2.244	-1.6	-10.37	35.2	1.4	4.8	-3.4	-22.34
120	14.6	0.5	1.65	-1.2	-8.52	19.5	0.6	2.244	-1.6	-11.63	32.9	1.3	4.8	-3.5	-25.04
130	13.7	0.4	1.65	-1.2	-9.45	18.3	0.6	2.244	-1.7	-12.89	30.9	1.2	4.8	-3.6	-27.76
140	12.9	0.4	1.65	-1.2	-10.39	17.3	0.6	2.244	-1.7	-14.16	29.2	1.2	4.8	-3.6	-30.49
150	12.3	0.4	1.65	-1.3	-11.32	16.4	0.5	2.244	-1.7	-15.44	27.6	1.1	4.8	-3.7	-33.23
160	11.7	0.4	1.65	-1.3	-12.27	15.6	0.5	2.244	-1.7	-16.72	26.2	1.1	4.8	-3.7	-35.97
170	11.1	0.4	1.65	-1.3	-13.21	14.8	0.5	2.244	-1.8	-18.00	25.0	1.0	4.8	-3.8	-38.73
180	10.6	0.3	1.65	-1.3	-14.16	14.2	0.5	2.244	-1.8	-19.29	23.9	1.0	4.8	-3.8	-41.49
190	10.2	0.3	1.65	-1.3	-15.11	13.6	0.4	2.244	-1.8	-20.58	22.9	0.9	4.8	-3.9	-44.26
200	9.8	0.3	1.65	-1.3	-16.06	13.0	0.4	2.244	-1.8	-21.87	22.0	0.9	4.8	-3.9	-47.03
Max =					**0.50**					**0.67**					**1.44**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-28

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A16

Area No: A16 **Controlled at cistern**

C_{AVG} = 0.80 (2-yr)

C_{AVG} = 0.80 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.0568 (hectares)

Duration (min)	Release Rate = 6.5 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C)					Release Rate = 8.8 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053; (I = A/(T_c+C)					Release Rate = 18.80 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014; (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	21.2	6.49	14.7	0.00	230.5	29.2	8.804	20.4	0.00	398.6	62.9	18.8	44.1	0.00
10	76.8	9.7	6.49	3.2	1.95	104.2	13.2	8.804	4.4	2.64	178.6	28.2	18.8	9.4	5.64
20	52.0	6.6	6.49	0.1	0.13	70.3	8.9	8.804	0.1	0.12	120.0	18.9	18.8	0.1	0.17
30	40.0	5.1	6.49	-1.4	-2.55	53.9	6.8	8.804	-2.0	-3.54	91.9	14.5	18.8	-4.3	-7.72
40	32.9	4.2	6.49	-2.3	-5.58	44.2	5.6	8.804	-3.2	-7.69	75.1	11.9	18.8	-6.9	-16.63
50	28.0	3.6	6.49	-2.9	-8.81	37.7	4.8	8.804	-4.0	-12.09	64.0	10.1	18.8	-8.7	-26.09
60	24.6	3.1	6.49	-3.4	-12.16	32.9	4.2	8.804	-4.6	-16.66	55.9	8.8	18.8	-10.0	-35.89
70	21.9	2.8	6.49	-3.7	-15.59	29.4	3.7	8.804	-5.1	-21.34	49.8	7.9	18.8	-10.9	-45.93
80	19.8	2.5	6.49	-4.0	-19.09	26.6	3.4	8.804	-5.4	-26.10	45.0	7.1	18.8	-11.7	-56.12
90	18.1	2.3	6.49	-4.2	-22.63	24.3	3.1	8.804	-5.7	-30.92	41.1	6.5	18.8	-12.3	-66.45
100	16.7	2.1	6.49	-4.4	-26.20	22.4	2.8	8.804	-6.0	-35.78	37.9	6.0	18.8	-12.8	-76.87
110	15.6	2.0	6.49	-4.5	-29.81	20.8	2.6	8.804	-6.2	-40.69	35.2	5.6	18.8	-13.2	-87.37
120	14.6	1.8	6.49	-4.6	-33.44	19.5	2.5	8.804	-6.3	-45.62	32.9	5.2	18.8	-13.6	-97.94
130	13.7	1.7	6.49	-4.8	-37.08	18.3	2.3	8.804	-6.5	-50.58	30.9	4.9	18.8	-13.9	-108.56
140	12.9	1.6	6.49	-4.9	-40.75	17.3	2.2	8.804	-6.6	-55.57	29.2	4.6	18.8	-14.2	-119.23
150	12.3	1.6	6.49	-4.9	-44.43	16.4	2.1	8.804	-6.7	-60.57	27.6	4.4	18.8	-14.4	-129.93
160	11.7	1.5	6.49	-5.0	-48.12	15.6	2.0	8.804	-6.8	-65.59	26.2	4.1	18.8	-14.7	-140.67
170	11.1	1.4	6.49	-5.1	-51.83	14.8	1.9	8.804	-6.9	-70.62	25.0	3.9	18.8	-14.8	-151.44
180	10.6	1.3	6.49	-5.1	-55.54	14.2	1.8	8.804	-7.0	-75.67	23.9	3.8	18.8	-15.0	-162.24
190	10.2	1.3	6.49	-5.2	-59.26	13.6	1.7	8.804	-7.1	-80.73	22.9	3.6	18.8	-15.2	-173.06
200	9.8	1.2	6.49	-5.2	-62.99	13.0	1.7	8.804	-7.1	-85.80	22.0	3.5	18.8	-15.3	-183.91
Max =					**1.95**					**2.64**					**5.64**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE C-29

Storage Volum Storage Volumes for 2-year, 5-Year and 100-Year Storms Area: A17

Area No: **A17** **Controlled at cistern**

C_{AVG} = 0.20 (2-yr)

C_{AVG} = 0.20 (5-yr)

C_{AVG} = 0.25 (100-yr, Max 1.0)

Time Interval = 10.00 (mins)

Drainage Area = 0.1664 (hectares)

Duration (min)	Release Rate = 4.7 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 (I = A/(T_c+C)					Release Rate = 6.4 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 (I = A/(T_c+C)					Release Rate = 13.77 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 (I = A/(T_c+C)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	15.5	4.74	10.7	0.00	230.5	21.3	6.427	14.9	0.00	398.6	46.1	13.8	32.3	0.00
10	76.8	7.1	4.74	2.4	1.42	104.2	9.6	6.427	3.2	1.93	178.6	20.6	13.8	6.9	4.13
20	52.0	4.8	4.74	0.1	0.09	70.3	6.5	6.427	0.1	0.09	120.0	13.9	13.8	0.1	0.13
30	40.0	3.7	4.74	-1.0	-1.86	53.9	5.0	6.427	-1.4	-2.59	91.9	10.6	13.8	-3.1	-5.66
40	32.9	3.0	4.74	-1.7	-4.07	44.2	4.1	6.427	-2.3	-5.61	75.1	8.7	13.8	-5.1	-12.18
50	28.0	2.6	4.74	-2.1	-6.43	37.7	3.5	6.427	-2.9	-8.83	64.0	7.4	13.8	-6.4	-19.11
60	24.6	2.3	4.74	-2.5	-8.87	32.9	3.0	6.427	-3.4	-12.16	55.9	6.5	13.8	-7.3	-26.29
70	21.9	2.0	4.74	-2.7	-11.38	29.4	2.7	6.427	-3.7	-15.58	49.8	5.8	13.8	-8.0	-33.64
80	19.8	1.8	4.74	-2.9	-13.93	26.6	2.5	6.427	-4.0	-19.05	45.0	5.2	13.8	-8.6	-41.11
90	18.1	1.7	4.74	-3.1	-16.52	24.3	2.2	6.427	-4.2	-22.57	41.1	4.8	13.8	-9.0	-48.67
100	16.7	1.5	4.74	-3.2	-19.13	22.4	2.1	6.427	-4.4	-26.12	37.9	4.4	13.8	-9.4	-56.30
110	15.6	1.4	4.74	-3.3	-21.76	20.8	1.9	6.427	-4.5	-29.70	35.2	4.1	13.8	-9.7	-63.99
120	14.6	1.3	4.74	-3.4	-24.41	19.5	1.8	6.427	-4.6	-33.30	32.9	3.8	13.8	-10.0	-71.73
130	13.7	1.3	4.74	-3.5	-27.07	18.3	1.7	6.427	-4.7	-36.92	30.9	3.6	13.8	-10.2	-79.51
140	12.9	1.2	4.74	-3.5	-29.75	17.3	1.6	6.427	-4.8	-40.56	29.2	3.4	13.8	-10.4	-87.32
150	12.3	1.1	4.74	-3.6	-32.43	16.4	1.5	6.427	-4.9	-44.21	27.6	3.2	13.8	-10.6	-95.16
160	11.7	1.1	4.74	-3.7	-35.13	15.6	1.4	6.427	-5.0	-47.88	26.2	3.0	13.8	-10.7	-103.03
170	11.1	1.0	4.74	-3.7	-37.83	14.8	1.4	6.427	-5.1	-51.55	25.0	2.9	13.8	-10.9	-110.92
180	10.6	1.0	4.74	-3.8	-40.54	14.2	1.3	6.427	-5.1	-55.24	23.9	2.8	13.8	-11.0	-118.83
190	10.2	0.9	4.74	-3.8	-43.26	13.6	1.3	6.427	-5.2	-58.93	22.9	2.6	13.8	-11.1	-126.75
200	9.8	0.9	4.74	-3.8	-45.98	13.0	1.2	6.427	-5.2	-62.63	22.0	2.5	13.8	-11.2	-134.69
Max =					**1.42**					**1.93**					**4.13**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

Table C-30 - Orifice Sizing

Event	Outlet Location	Orifice Invert (m)	Top of Grate Elevation (m)	Ponding Elevation (m)	Flow (L/s)	Head (m)	ORIFICE AREA(m^2)	SQUARE (1-side mm)	CIRC (mmØ)	Hydrovex Model
100 Year	CB302	69.19	72.73	72.78	8.6	3.59	0.002	41	47	75 VHV-1
100 Year	CB303	69.15	72.77	72.82	8.6	3.67	0.002	41	47	75 VHV-1

Orifice Control Sizing

$Q = 0.6 \times A \times (2gh)1/2$

Where:

Q is the release rate in m^3/s

A is the orifice area in m^2

g is the acceleration due to gravity, $9.81 m/s^2$

h is the head of water above the orifice centre in m

d is the diameter of the orifice in m

Note: Orifices are located on the downstream invert of structures.

® HYDROVEX®

VHV/SVHV Vortex Flow Regulator

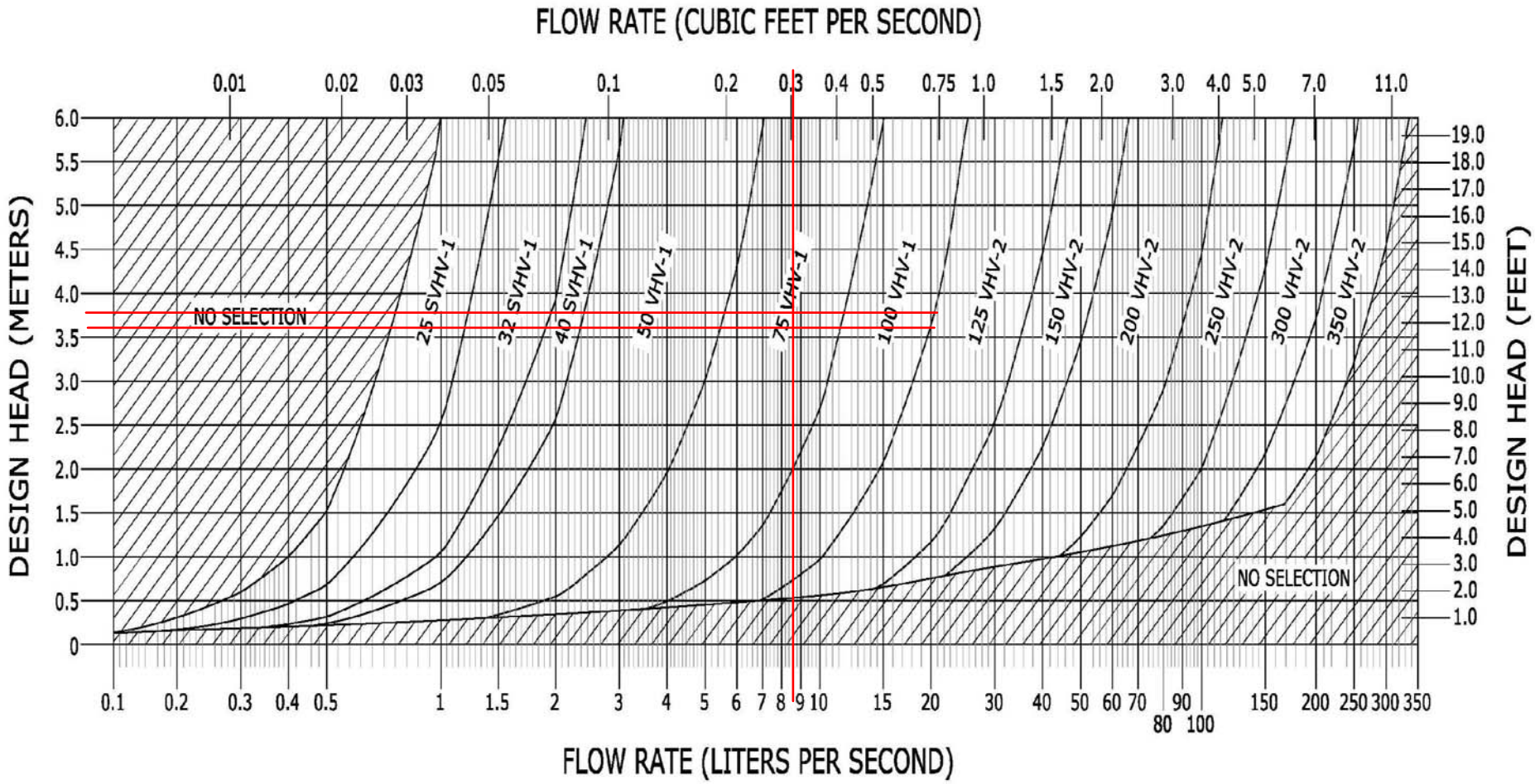


FIGURE 3

JOHN MEUNIER

TABLE C-31: 2-YEAR STORM SEWER CALCULATION SHEET

Return Period Storm =	**2-year**	(2-year, 5-year, 100-year)
Default Inlet Time=	10	(minutes)
Manning Coefficient =	0.013	(dimensionless)

From Node	To Node	Street	AREA INFO				FLOW (UNRESTRICTED)								SEWER DATA										
			Area No.	Area (ha)	∑ Area (ha)	Average R	Indiv. 2.78*A*R	Accum. 2.78*A*R	Tc (mins)	I (mm/h)	Indiv. Flow	Return Period	Q (L/s)	∑ Q (L/s)	Dia (mm) Actual	Dia (mm) Nominal	Type	Slope (%)	Length (m)	Capacity, Q_{CAP} (L/sec)	Velocity (m/s) Vf	Velocity (m/s) Va	Time in Pipe, Tt (min)	Hydraulic Ratios Q/Q_{CAP}	Hydraulic Ratios Va/Vf
Ex.STMMH	STMMH103	Everest Pvt.	EXT-1 (Alta Vista Ridge)	4.030	4.0300	0.60	6.722	6.722	10.00	76.81	516.3	2-year	516.3	516.3	610.0	600	CONC.	2.00	7.60	907.47	3.07	2.17	0.06	0.57	0.71
STMMH103	STMMH102	Everest Pvt.	Alta Vista Ridge Subdivision	1.800	1.8000	0.65	3.253	3.253	10.00	76.81	249.8	2-year	249.8	766.1	685.0	675	CONC.	2.00	33.60	1236.32	3.32	3.02	0.19	0.62	0.91
Tower 2	STMMH102	Everest Pvt.	T2	0.170	0.1700	0.57	0.269	0.269	10.00	76.81	20.7	2-year	20.7	20.7	251.5	250	PVC	1.00	3.80	60.40	1.21	0.85	0.07	0.34	0.70
Tower 4	STMMH102	Everest Pvt.	T4	0.190	0.1900	0.90	0.475	0.475	10.00	76.81	36.5	2-year	36.5	36.5	299.4	300	PVC	1.00	12.60	96.15	1.37	0.97	0.22	0.38	0.71
CB302	CB Lead	Everest Pvt.	A9	0.062	0.0620	0.65	0.112	0.112	10.00	76.81	8.6	2-year	8.6	8.6	201.2	200	PVC	1.00	10.00	33.31	1.04	0.70	0.24	0.26	0.67
CB303	CB Lead	Everest Pvt.	A9	0.062	0.0620	0.65	0.112	0.112	10.00	76.81	8.6	2-year	8.6	8.6	201.2	200	PVC	1.00	3.90	33.31	1.04	0.70	0.09	0.26	0.67
STMMH102	Ex.STMMH-2	Everest Pvt.												840.5	685.0	675	CONC.	1.20	54.60	957.65	2.57	2.57	0.35	0.88	1.00
CB300	CB Lead	Everest Pvt.	A9	0.062	0.0620	0.65	0.112	0.112	10.00	76.81	8.6	2-year	8.6	8.6	201.2	200	PVC	1.00	2.80	33.31	1.04	0.70	0.07	0.26	0.67
CB301	CB Lead	Everest Pvt.	A9	0.062	0.0620	0.65	0.112	0.112	10.00	76.81	8.6	2-year	8.6	8.6	201.2	200	PVC	1.00	14.20	33.31	1.04	0.70	0.34	0.26	0.67
Tower 1	STM Lateral	Everest Pvt.	T1	0.160	0.1600	0.90	0.400	0.400	10.00	76.81	30.7	2-year	30.7	30.7	251.5	250	PVC	1.00	3.50	60.40	1.21	0.86	0.07	0.51	0.71
Tower 3	STM Lateral	Everest Pvt.	T3	0.260	0.2600	0.90	0.651	0.651	10.00	76.81	50.0	2-year	50.0	50.0	299.4	300	PVC	1.00	13.20	96.15	1.37	0.97	0.23	0.52	0.71
Ex.STMMH-2	STMMH101	Everest Pvt.												921.2	976.0	975	CONC.	0.20	50.90	1004.97	1.34	1.34	0.63	0.92	1.00
Cistern 2	STMMH101	Everest Pvt.	A2	0.003	0.0030	0.90	0.008	0.008	10.00	76.81	0.6	2-year	0.6	0.6											
			A3	0.050	0.0500	0.84	0.117	0.117	10.00	76.81	9.0	2-year	9.0	9.0											
			A4	0.040	0.0400	0.64	0.071	0.071	10.00	76.81	5.5	2-year	5.5	5.5											
			A5	0.080	0.0800	0.54	0.120	0.120	10.00	76.81	9.2	2-year	9.2	9.2											
			A6	0.110	0.1100	0.20	0.061	0.061	10.00	76.81	4.7	2-year	4.7	4.7											
			A7	0.010	0.0100	0.57	0.016	0.016	10.00	76.81	1.2	2-year	1.2	1.2											
			A8	0.120	0.1200	0.20	0.067	0.067	10.00	76.81	5.1	2-year	5.1	5.1											
			Cistern 2											35.3	251.5	250	PVC	1.00	3.50	60.40	1.21	1.09	0.05	0.58	0.90
Cistern 1	STMMH101	Everest Pvt.	A10	0.020	0.0200	0.75	0.042	0.042	10.00	76.81	3.2	2-year	3.2	3.2											
			A11	0.020	0.0200	0.85	0.047	0.047	10.00	76.81	3.6	2-year	3.6	3.6											
			A12	0.010	0.0100	0.76	0.021	0.021	10.00	76.81	1.6	2-year	1.6	1.6											
			A13	0.010	0.0100	0.81	0.023	0.023	10.00	76.81	1.7	2-year	1.7	1.7											
			A14	0.020	0.0200	0.90	0.050	0.050	10.00	76.81	3.8	2-year	3.8	3.8											
			A15	0.010	0.0100	0.79	0.022	0.022	10.00	76.81	1.7	2-year	1.7	1.7											
			A16	0.060	0.0600	0.80	0.133	0.133	10.00	76.81	10.2	2-year	10.2	10.2											
			A17	0.120	0.1200	0.20	0.067	0.067	10.00	76.81	5.1	2-year	5.1	5.1											
			Cistern 1											31.1	366.4	375	PVC	1.00	13.20	164.84	1.59	1.02	0.22	0.19	0.64
STMMH101	STMMH100	Everest Pvt.												1004.8	976.0	975	CONC.	0.37	51.80	1366.91	1.83	1.79	0.48	0.74	0.98
TOTALS =				**7.54**			**13.082**																		

Definitions:

Q = 2.78*AIR, where

Q = Peak Flow in Litres per second (L/s)

A = Watershed Area (hectares)

I = Rainfall Intensity (mm/h)

R = Runoff Coefficients (dimensionless)

Ottawa Rainfall Intensity Values from Sewer Design Guidelines, SDG002

	a	b	c
2-year	732.951	6.199	0.810
5-year	998.071	6.053	0.814
100-year	1735.688	6.014	0.820

Designed:	Project:	
A. Elgayar, M.A.Sc.	1740 St. Laurent Boulevard Development	
Checked:	Location:	
B. Thomas, P.Eng.	1740 St. Laurent Boulevard	
Dwg Reference:	File Ref:	Sheet No:
C100 - Site Servicing Plan	**260579 C31 - STM Sewer Design Sheets, August 2021.xlsx**	1 of 1

Appendix D – Additional Documents

Pre-consultation Meeting Summary Notes with the City of Ottawa

1740 St. Laurent Blvd

Meeting Summary Notes
May 19, 2020, Online Teams Meeting

Attendees:

- Carmine Zayoun, Groupe Heafey
- Etienne Boudreault-Savageau, Groupe Heafey
- Christian Rheault, Groupe Heafey
- Raad Akrawi, Groupe Heafey
- Jaime Posen, Fotenn Consultants
- Nick Sutherland, Fotenn Consultants
- Wally Dubyk (Transportation Project Manager, City of Ottawa)
- Sharif Sharif (Project Manager, City of Ottawa)
- Christopher Moise (Urban Designer, Architect, City of Ottawa)
- Tracey Scaramozzino (File Lead, Planner, City of Ottawa)

Issue of Discussion:

- Rezoning and Site Plan for 2 15-storey mixed-used buildings with 115 units and 260 units; and 2 12-storey residential buildings with 89 units and 181 units.
- Buildings will be rental; owned and operated by Groupe Heafey
- St. Hubert will remain a tenant in the new building and will include a drive-through; the carpet and sushi stores may also remain
- The gas station will not remain.



Official Plan: designated “Arterial Mainstreet”.

1. The high-rise buildings being proposed are permitted subject to a zoning amendment since the location is within 400 metres walking distance of a Rapid Transit Station on Schedule D of this Plan;



2. The development MUST provide a community amenity and provide adequate transition to adjacent low-rise.

3. As per Policy 4

   “…the site should be planned in a coordinated fashion that will facilitate:

   a. *multi-modal (pedestrian, cycling, transit and vehicular) access between the site and the public street(s),*
   b. *multi-modal (pedestrian, cycling, transit and vehicular) access between the site and the public street(s),*
   c. *attractive, safe and usable pedestrian and cycle connections between the site and adjacent communities,*
   d. *an enhanced interconnected pedestrian environment that links individual uses on the site, transit stops and continuous public sidewalks on the adjoining streets, and which is generally distinct from internal vehicle routes,*
   e. *measures of sufficient size and quality to relieve the visual impact of surface parking areas,*
   f. *the provision of adequate landscaped areas, particularly trees, along the perimeter of the site and street frontages,*
   g. *the provision of coordinated signage.*

4. New gas bars, service stations, automobile sales, and drive-through facilities are permitted on Arterial Mainstreets and will be evaluated on the basis of the Design Objectives and Principles in Section 2.5.1, any applicable Council-approved design guidelines, and the Compatibility policies set out in Section 4.11.

5. Building formats must enclose and define the street edge with active frontages that provide direct pedestrian access to the sidewalk.

Zoning Information – Arterial Mainstreet, Subzone 10, exception 1658 (AM 10 [1658])

Infrastructure/Servicing (Golam Sharif):

Please note the following information regarding the engineering design submission for the above noted site:

1. The Servicing Study Guidelines for Development Applications are available at the following address: https://ottawa.ca/en/city-hall/planning-and-development/how-develop-property/development-application-review-process-2/guide-preparing-studies-and-plans
2. Servicing and site works shall be in accordance with the following documents:
   - ð Ottawa Sewer Design Guidelines (October 2012) and all the Technical Bulletins including, Technical Bulletin PIEDTB-2016-01 and ISTB-2018-01
   - ð Ottawa Design Guidelines – Water Distribution (2010) and Technical Bulletins ISD-2010-2, ISDTB-2014-02 and ISTB-2018-02
   - ð Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa (2007)
   - ð City of Ottawa Slope Stability Guidelines for Development Applications (revised 2012)
   - ð City of Ottawa Environmental Noise Control Guidelines (January, 2016)
   - ð City of Ottawa Park and Pathway Development Manual (2012)
   - ð City of Ottawa Accessibility Design Standards (2012)
   - ð Ottawa Standard Tender Documents (latest version)
   - ð Ontario Provincial Standards for Roads & Public Works (2013)

3. Record drawings and utility plans are also available for purchase from the City (Contact the City's Information Centre by email at InformationCentre@ottawa.ca or by phone at (613) 580-2424 x.44455).
4. The Stormwater Management Criteria, for the subject site, is to be based on the following:
   i. Demonstrate that the approved Stormwater Management design for the Alta Vista Ridge Subdivision will not impact negatively.
5. Deep Services (Storm, Sanitary & Water Supply)



i. A plan view of the approximate services may be seen above. Services should ideally be grouped in a common trench to minimize the number of road cuts. The sizing of available future services is:
   a. Everest Private:
      i. Sanitary – 200 mm (private).
      ii. Storm – 450 mm/ 525 mm (private).
      iii. Water – 200 mm/ 300 mm (private).

ii. Provide all the servicing demand (water, sanitary and storm) are as per the approved subdivision. If the demand changes, demonstrate the capacity is available.

6. Water Boundary condition requests must include the location of the service and the expected loads required by the proposed development. Please provide the following information:
   i. Location of service

ii. Type of development and the amount of fire flow required (as per FUS, 1999).
iii. Average daily demand: ___ l/s.
iv. Maximum daily demand: ___l/s.
v. Maximum hourly daily demand: ___ l/s.
vi. Hydrant location and spacing to meet City's Water Design guidelines.

7. General comments –
   i. Stormwater Management criteria must be followed from the Alta Vista Ridge Subdivision.
   ii. Site-specific Geotechnical brief is required apart from the Subdivision report.
   iii. Site-specific Noise study/brief is required apart from the Subdivision report.

Should you have any questions or require additional information, please contact me directly at (613) 580-2424, x 20763 or by email at sharif.sharif@ottawa.ca.

Initial Planning (Tracey Scaramozzino):

1. Ensure all OP policies are achieved and clearly demonstrated.
2. Ensure there is enough amenity/ green space.
3. We want active frontage along St Laurent – it appears as though there are functioning front doors
4. It should only be visitor and retail parking on surface – remaining should be u/g
5. Show bike parking – try to exceed requirement
6. Provide for car sharing and e-cars
7. In other parts of the city near transit – City is asking for the property owner to provide each unit with a prepaid presto transit pass to encourage transit ridership....
8. Cil required to a max 10% value of land
9. Speak to councillor and community groups –
10. Ensure a coordinated approach with design and development at 355 Everest.
11. Ensure compliance with Design Guidelines for the proposed drive-through.
12. Consider informal meeting with UDRP panel to obtain guidance.
13. Consider using Green/Sustainable Technology and features where possible.
14. Ensure there is a plan for where construction workers will park, to ensure no spillover onto local streets
15. Ensure safewings.ca are consulted to reduce the buildings' impacts on bird safety.

Initial Design Comments (Christopher Moise):

1. This proposal runs along one of the City's Design Priority Areas and must attend the City's UDRP. We recommend the proposal attend an Informal visit (prior to a full submission and is not a public meeting), with the City's UDRP to further discuss and evaluate various scenarios of development for the whole site;

2. We recommend a fulsome analysis of the City's Urban Design Guidelines for High-rise Buildings be provided, paying particular attention to tower floorplate maximums and transitioning to the surrounding context;
3. It appears that the two southern high-rise buildings are designed as mid-rise buildings and fall short of what the City would support;
4. Please see the Design Brief Terms of Reference provided and consult the City's website for details regarding the UDRP schedule (if applicable).
5. This is an exciting project in an area full of potential. We look forward to helping you achieve its goals with the highest level of design resolution. We are happy to assist and answer any questions regarding the above. Good luck.

Landscape Plan/Tree Conservation Report (Mark Richardson):

1. A permit is required prior to any tree removal on site. Please contact the Planning Forester, Mark Richardson (mark.richardson@ottawa.ca) for information on obtaining the tree permit.

Transportation (Wally Dubyk):

1. This section of St Laurent Blvd had a major road modifications work. I believe that the portion of the ROW protection limits that extended into private property had been conveyed to the City. The proponent's surveyor should confirm the ROW limits.
2. St. Laurent Blvd is designated as an Arterial road within the City's Official Plan with a ROW protection of 44.50 metres. The ROW limits are to be shown on all the drawings and the offset distance (22.25 metres) to be dimensioned from the existing centerline of pavement.
3. ROW interpretation – Land for a road widening will be taken equally from both sides of a road, measured from the centreline in existence at the time of the widening if required by the City. The centreline is a line running down the middle of a road surface, equidistant from both edges of the pavement. In determining the centreline, paved shoulders, bus lay-bys, auxiliary lanes, turning lanes and other special circumstances are not included in the road surface.
4. The TIA (Transportation Impact Assessment) Guidelines (2017) were approved by Transportation Committee and City Council on June 14, 2017. The new version of the TIA Guidelines (2017) that are posted on the web are now to be used for the TIA Submission for development applications.
5. The following list highlights the significant changes to the 2006 TIA Guidelines

    (a) A Screening Test (Step 1) quickly determines if a transportation study is required. Consultants should fill in the form in Appendix B.

    (b) Should the development generate 60 peak hour person trips, the TIA guidelines Step 2 – Scoping report would be required.

(c) Study Scope (Step 2) is site specifically tailored; there are no longer three defined types of TIA reports. Scoping report is required and needs to be signed off by TPM before the consultant moves on to Forecasting volumes.

(d) Sign off from City Transportation Project Manager is required at key points in the review process prior to TIA Submission (Step 5). See Figure 1 on page 9 for a good flow chart of the process.

(e) Multi Modal Level of Service (MMLOS) and Complete Street analysis is required to assess the impact of all modes of travel rather than just vehicle traffic.

(f) There is no longer a requirement for consultant pre-approval. Consultants must now sign and submit the Credentials Form included in the Appendix A with each TIA report.

(g) The TIA Submission (report, drawings and/or monitoring plan) is required with the development application.

Click on the website: https://ottawa.ca/en/transportation-impact-assessment-guidelines

6. The proposed traffic signals will require the delegated authority approval from the Manager of Development Review, Transportation Engineering Services - RMA report is required.
7. A construction Traffic Management Plan is to be provided for approval by the Senior Engineer, Traffic Management, Transportation Services Dept.
8. Further comments relating to Site Plan Application will be provided.

Waste Collection

1. Please see City's Waste Management Guidelines for multi-unit residential: http://ottawa.ca/calendar/ottawa/citycouncil/pec/2012/11-13/Solid%20Waste%20Collection%20Guidelines%20-%20Doc%201.pdf

Process/Required Applications

1. Zoning By-law Amendment and Site Plan Control – Public Consultation
2. Please name electronic files in the following format:
    1. June XX, Street Address, Landscape
    2. June XX, Street Address, SWM

    Etc Etc

General Information

1. Please ensure the zoning table on the site plan is in the following format. Ensure that all zoning provisions and rates are shown and differentiate those that require a re-zoning or variance.

ZONING INFORMATION: MC16		
PROPOSED 8 STOREY BUILDING (MID-RISE APARTMENT)		
	REQUIRED	PROPOSED
MINIMUM LOT WIDTH	NO MINIMUM	27.824m
MINIMUM LOT AREA	NO MINIMUM	881.37m²
MINIMUM BUILDING HEIGHT	6.7	27m
MAXIMUM BUILDING HEIGHT	27m	27m
MINIMUM FRONT YARD SETBACK	NO MINIMUM	2m
MINIMUM CORNER SIDE YARD SETBACK	N/A	N/A
MINIMUM REAR YARD SETBACK	3m & 7.5 ABOVE 3RD FLOOR	3m & 7.5 ABOVE 3RD FLOOR
MINIMUM INTERIOR SIDE YARD SETBACK	NO MINIMUM	0.6m & 2.44m
Parking Rate		
Motor Vehicle	NO	14 spaces
Bicycle Parking (0.5/unit)	26 spaces	27 spaces

2. Ensure that all plans and studies are prepared as per City guidelines – as available online…

   https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans

Key Policy Objectives for the City of Ottawa – as of December 2019

The approved preliminary policy directions address six key themes:

- **Growth management –** policies would encourage more growth through intensification than through expansion into new or undeveloped areas, promote growth around transit, encourage sustainable village expansion and consider housing and transportation affordability.

- **Energy and climate mitigation –** policies would ensure climate change and energy conservation considerations are integrated into city planning guidelines, promote local energy generation, set new energy standards for buildings and reduce emissions through transportation and infrastructure.

- **Climate resiliency –** policies would align with the Climate Change Master Plan to reduce the urban heat island effect, further reduce the risk and impact of flooding and encourage more resilient homes, buildings, communities and infrastructure.

- **Transportation and mobility –** policies would aim to see more than half of all trips made by sustainable transportation. The City would pursue related policies as part of the coming Transportation Master Plan update.

- **Neighbourhood context –** policies would establish a framework of six areas, including the downtown core, inner urban area, outer urban area, suburban area, rural area and Greenbelt, and policies would be tailored to each so that growth can better address neighbourhood context.

- **Economic development –** policies would direct major employment to established hubs and corridors, support economic development in rural and village areas and establish a new economic zone centred on the airport.

Appendix E – Drawings

Architectural Floor Plan – Level Rooftop DWG No. P205

Alta Vista Ridge Storm Drainage Plan DWG No. SD-1

Notes and Legend Sheet DWG No. C001

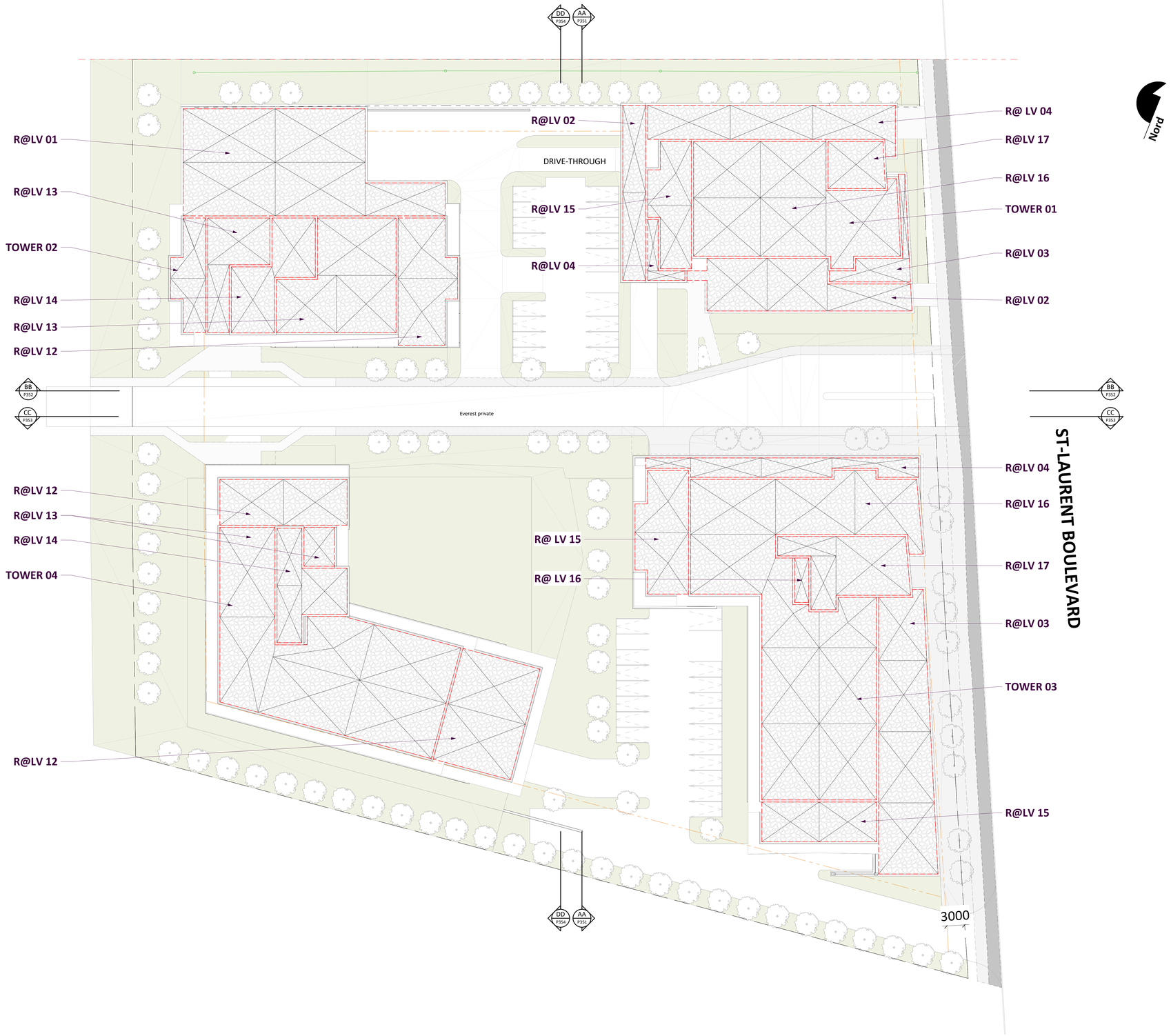
Existing Conditions and Removals Plan DWG No. C002

Site Servicing Plan DWG No. C100

Site Grading Plan DWG No. C200

Erosion and Sediment Control Plan DWG N0. C300

Post-Development Catchments DWG No. C400



BIM 360://DEV ST-LAURENT OTTAWA/20005_A-SITE-R21.rvt

PMA ARCHITECTES

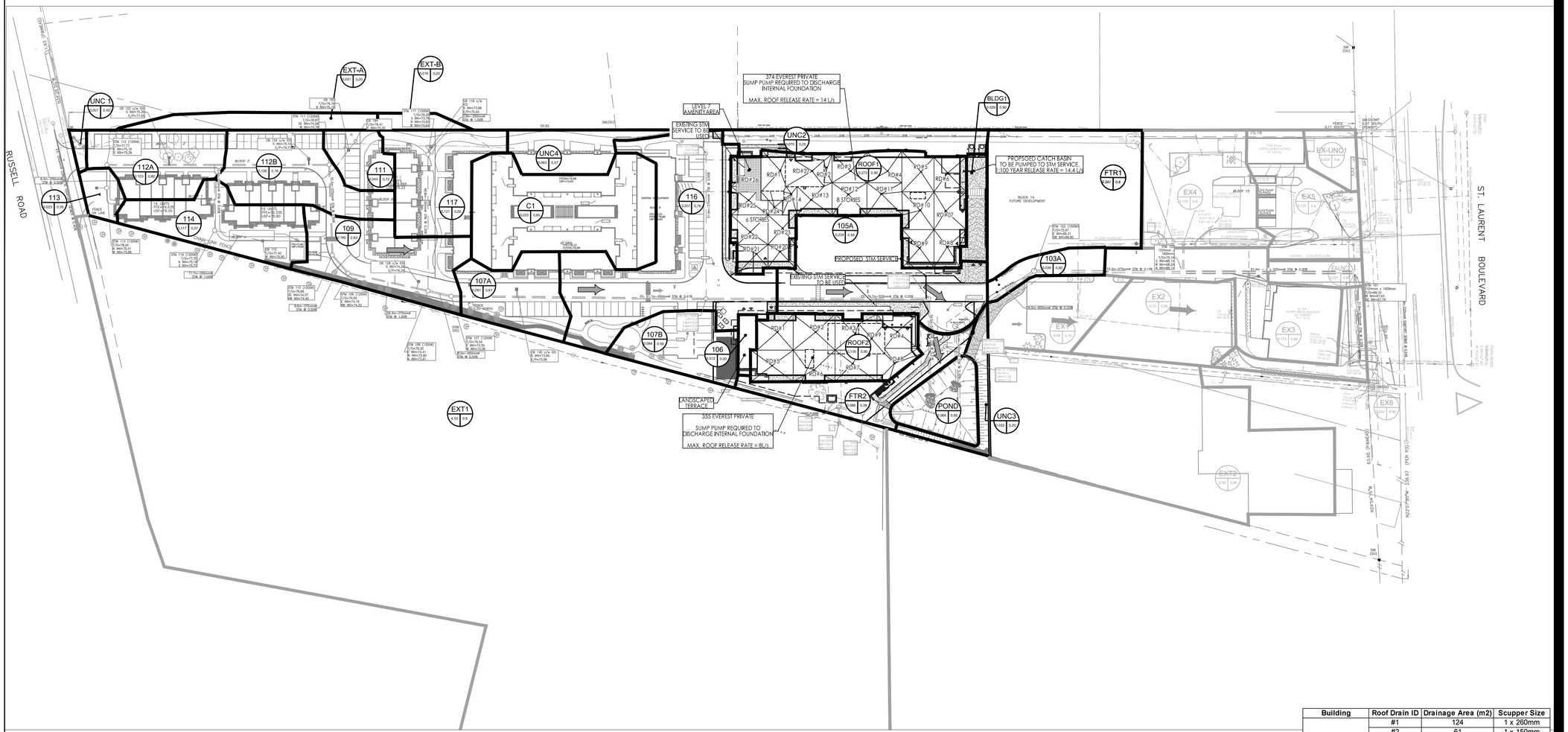
LAPALME RHEAULT + acsl
ARCHITECTES I +ASSOCIÉS

FOR DISCUSSION PURPOSES ONLY

IMPORTANT NOTICE : DO NOT USE FOR CONSTRUCTION

NO. PROJET	PROJET
20005	ST-LAURENT BOULEVARD DEVELOPMENT

ÉCHELLE	DATE		PAGE
1 : 250	2021-06-18	FLOOR PLAN - LEVEL ROOFTOP	P205


RUSSELL ROAD
ST. LAURENT BOULEVARD
UNC1
EXT-A
EXT-B
112A
112B
113
114
111
117
109
C1
UNC4
116
107A
107B
106
EXT1
UNC2
BLDG1
105A
103A
FTR1
FTR2
POND
UNC3
ROOF1
ROOF2
EX-UNC1
EX1
EX2
EX3
EX4
EX5
EX6
EX7
EX-EX1
EX-EX2
LEVEL 7 AMENITY AREA
EXISTING STM SERVICE TO BE USED
374 EVEREST PRIVATE SUMP PUMP REQUIRED TO DISCHARGE INTERNAL FOUNDATION
MAX. ROOF RELEASE RATE = 14 L/s
PROPOSED CATCH BASIN TO BE PUMPED TO STM SERVICE. 100 YEAR RELEASE RATE = 14.4 L/s
PROPOSED STM SERVICE
EXISTING STM SERVICE TO BE USED
LANDSCAPED TERRACE
355 EVEREST PRIVATE SUMP PUMP REQUIRED TO DISCHARGE INTERNAL FOUNDATION
MAX. ROOF RELEASE RATE = 8L/s
6 STORIES
8 STORIES
BLOCK 14 FUTURE DEVELOPMENT
BLOCK 15 FUTURE DEVELOPMENT
EXISTING DEVELOPMENT
EXISTING DEVELOPMENT (TO BE DEMOLISHED)
EXISTING DEVELOPMENT (TO BE DEMOLISHED)
EXISTING DEVELOPMENT (TO REMAIN)
EXISTING DEVELOPMENT (TO BE DEMOLISHED)
EXISTING DEVELOPMENT (TO BE DEMOLISHED)
EXISTING DEVELOPMENT (TO BE DEMOLISHED