Site Servicing & Stormwater Management Report
CECCE Secondary School – Riverside South – 675 Borbridge Avenue, Manotick, Ontario

Client:
Provencher Roy Associés Architectes Inc.

Project Number:
OTT-24005530-A0

Application Stage:
Site Plan Control

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Date Submitted:
April 4, 2025

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Legal Notification

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1 Introduction

EXP Services Inc. (EXP) was retained by Provencher Roy Associés Architectes Inc. to provide Site Servicing and Stormwater Management report for the proposed Conseil des écoles catholiques du Centre-Est (CECCE) Secondary School.

The site is 6.01 hectares and located at 675 Borbridge Avenue in Manotick, Ontario. The site is bound by Borbridge Avenue along the north property line, by Brian Good Avenue along the west property line, and by existing residential streets Elder Street and Atrium Ridge along the east and south property lines respectively. Refer to **Figure A1** in **Appendix A** for the site location.

This servicing design report will address the Servicing requirements for the proposed development including the domestic and fire water, sanitary and storm servicing. The report will also cover the storm water management requirements and proposed methods to meet those requirements.

2 Existing Conditions

The subject property is currently vacant with dense vegetation cover throughout. The topography of the site generally slopes from its highpoint located at the southeast property corner and tapers down to each of Borbridge Avenue and Brian Good Avenue with a low point at their intersection corresponding to the northwest property corner.

There is no known services or infrastructure within the property. The existing municipal infrastructure near the property within Borbridge Avenue and Brian Good Avenue are noted below:

- Borbridge Avenue:
    - Storm:
        - 2400mm Ø Concrete CL 65-D Storm Sewer
        - 2550mm Ø Concrete CL 65-D Storm Sewer
    - Sanitary:
        - 525mm Ø Concrete CL 100-D Sanitary Sewer
    - Water:
        - 300mm Ø PVC DR18 CL-150 Watermain
- Brian Good Avenue:
    - Storm:
        - 2700mm Ø Concrete CL 65-D Storm Sewer
    - Sanitary:
        - 525mm Ø Concrete CL 100-D Sanitary Sewer
    - Water:
        - 300mm Ø PVC DR18 CL-150 Watermain

3 References

Various documents were referred to in preparing the current report including:

- Sewer Design Guidelines, Second Edition, Document SDG002, October 2012, City of Ottawa (Guidelines) 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)
  - Technical Bulletin ISDTB-2019-02 (08 July 2019)
- 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)
  - Technical Bulletin ISTB-2021-03 (18 August, 2021)
- 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), 2020
- Ontario Building Code 2012, Ministry of Municipal Affairs and Housing
- Geotechnical Investigation Report – Prepared by Exp. Services Inc, Dated Jan 20, 2025.

4 Watermain Design

4.1 Required Fire Flow

The fire flow demand calculations were prepared based on the Fire Underwriters Survey (FUS, 2020) criteria. The construction type for the proposed school is classified as non-combustible based on the response received from the Architect (Included in **Appendix B**). The building will have a fully supervised sprinkler system based on the correspondence with the Architect and limited combustible contents based on the occupancy type specified by the architect. The required fire flow was determined to be 116.7 L/s (7,000 L/min). Refer to **Table B2** in **Appendix B** for detailed fire flow demand calculations.

4.2 Watermain Design

The domestic water demands for the proposed building were calculated per the City of Ottawa Water Design Guidelines (July 2010). The proposed development is considered as an institutional building with an average demand of 70 L/student/day per ISD-2010-02. Staff were included in the total population. The

demands are inclusive of the currently proposed development and future expansion. The peaking factors were considered as 1.5 and 1.8 for the max. day and peak hour demands, respectively. Refer to **Table B1** in **Appendix B** for detailed calculations. The proposed building's domestic demands based on 1286 students + staff, were calculated as follows:

Water Demands:

Average daily demand = 1.04 L/s

Maximum daily demand = 1.56 L/s

Maximum hourly daily demand = 2.81 L/s

There is an existing 300mm diameter municipal watermain on Borbridge Avenue. The estimated average daily demand of the proposed development is greater than 50 m^3/day. Therefore, two 150mm diameter water services separated by an isolation valve are proposed for domestic and sprinkler demands. The proposed water services are to be connected to the 300mm diameter municipal watermain on Borbridge Avenue.

4.3 Pressure Check

The City of Ottawa provided boundary conditions based on the domestic and fire flow demands, calculated during early design stages as shown in the table below:

Scenario	Demand	
	L/min	L/s
Average Daily Demand	71	1.19
Maximum Daily Demand	107	1.79
Peak Hour	193	3.22
Fire Flow Demand #1	7,000	116.67

The boundary conditions provided by the City are as follows:

Existing Condition		
Connection 1 - Borbridge Ave		
Demand Scenario	**Head (m)**	**Pressure[1] (psi)**
Maximum HGL	132.3	58.4
Peak Hour	124.9	47.9
Max Day plus Fire Flow #1	124.9	47.9
[1] Ground Elevation =	91.2	m

Future Condition		
Connection 1 - Borbridge Ave		
Demand Scenario	**Head (m)**	**Pressure[1] (psi)**
Maximum HGL	146.8	79
Peak Hour	143.7	74.6
Max Day plus Fire Flow #1	144.1	75.1
[1] Ground Elevation =	91.2	m

As the design progressed, occupancy numbers were confirmed by the client and domestic demands were adjusted accordingly as noted in Section 4.2 above. The revised demands are similar to the original demands submitted to request the water boundary conditions. Therefore, the water boundary conditions noted above should still suffice. The fire flow demands remain unchanged.

Based on these boundary conditions the residual pressure at the building FFE during existing conditions will be 57.2 psi during average day demand, 46.7 psi during max. daily demand, and 46.7 psi during peak hour demands.

During future conditions the residual pressure at the building FFE will be 77.8 psi during average day demands, 73.4 psi during max. daily demands, and 73.4 psi during peak hour demands.

During existing and future conditions, the residual pressures at building FFE will be between 40 psi and 80 psi, as required by the City of Ottawa Water Design Guidelines. Therefore, no pressure reducing or boosting measures will be required.

The residual pressure in the municipal watermain along Borbridge Avenue during max Day + Fire Flow demands was noted as 47.9 psi during existing conditions and 75.1 psi during future conditions. Which are more than the minimum required pressure of 20 psi.

Based on the above noted analysis, the existing water supply system and the proposed services will have adequate capacity to meet the domestic and fire demands for the proposed building. Refer to **Table B3** and **Table B4** in **Appendix B** for detailed pressure calculations.

4.4 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 meters were reviewed to assess the total possible contribution of flow from these contributing hydrants. For each hydrant, the distance along a fire route was measured and assigned contributing flows. A review of the available fire hydrant within 150m distance along the fire route from the building was carried out which is summarized in the table below. A new hydrant will be added within the school parking lot as part of the proposed work to comply with the minimum distance required between a hydrant and the building Siamese connection.

Table 4-1: Summary of Nearby Municipal Hydrants

Hydrant #	Location	City / Private	Color Code	Distance from the Building (m)	Fire Flow Contribution for Class AA Hydrant (L/min)
368013H014	Borbridge Avenue	City	Blue	84.5	3,800
368013H015	Borbridge Avenue	City	Blue	56.0	5,700
368013H034	Brian Good Avenue	City	Blue	51.7	5,700
368013H033	Brian Good Avenue	City	Blue	85.4	3,800
New Hydrant	New Parking Lot	Private	Blue	40	5,700
				Total:	24,700

As noted in the table above, there are total four (4) existing municipal fire hydrants within 150m distance along a fire route and a new private hydrant within the school parking lot; which equates to a total accessible fire flow of 24,700 L/min. This is well above the required fire flow of 7,000 L/min. Refer to **Figure A2** in **Appendix A** for the hydrant location plan.

Based on the boundary conditions received from the city and review of the available municipal hydrants as noted above, the proposed development can be serviced for the required fire flow.

5 Sanitary Sewer Design

5.1 Peak Design Flow

There is an existing municipal 525mm diameter sanitary sewer on Borbridge Avenue flowing west towards Spratt Road. The anticipated peak sanitary flows from the proposed industrial site have been calculated as per the City of Ottawa Sewer Design Guidelines (October 2012). The anticipated peak sanitary flows for currently proposed development and future expansion are calculated as follows:

Design Flows (Proposed + Future)

Institutional Design Flow:		90 L/person/day
Development Area:		6.01 hectares
Peak Factor:		1.5
Extraneous Flow:		0.33 L/s/ha
Total Flow:	=	(90L/person/day)*(1286 persons)*(1/86400)*(1.5)+(6.01ha)*(0.33L/s/ha)
	=	**3.99 L/s**

The proposed high school will be serviced by a new 250mm diameter sanitary service installed at a minimum slope of 2.0%. At this slope, the 250mm diameter sanitary services will have a capacity of 85.4 L/s and a full flow velocity of 1.7 m/s, which will be sufficient to service proposed development. The proposed sanitary service will connect to 525mm dia. municipal sanitary sewer on Borbridge Ave. City had confirmed that the

municipal sanitary sewer has sufficient capacity to accommodate the sanitary flows from the proposed development. Refer to Site Servicing plan and the sanitary sewer design sheet **Table C1** and email correspondence with the City in **Appendix C**.

6 Stormwater Management

6.1 Storm Design Criteria

The storm sewer system and stormwater management for the proposed development were designed in conformance with the City of Ottawa Sewer Design Guidelines (October 2012). The stormwater servicing design criteria for the proposed development are as follows:

- The proposed on-site storm sewer network / minor system is designed using Rational Method and Manning's Equation to convey runoff under free flow conditions for the 5-year return period.
- Post-development peak run-off during 100-year storm event to be controlled to 915 L/sec as identified in the "*Design Brief - Riverside South phase 15-2, 4 & Spratt Road*", prepared by IBI Group dated August 2019.
- Maximum allowable ponding depth is 300 mm for surface ponding and 150mm for roof ponding.
- Flows from storm events greater than 100-year return period to be directed overland, away from the building towards Borbridge Avenue and Brian Good Avenue.
- Minimum freeboard of 300mm between the 100-year overland spill elevation and finished floor elevation. Minimum freeboard of 150mm between the 100-year overland spill elevation and lowest grades against the building foundation.
- Quality control measures are not required on site as downstream quality treatment is provided by an end-of-pipe stormwater management wet pond per the reports "*Riverside South Community Infrastructure Servicing Study Update*", prepared by Stantec dated June 21, 2017 and "*Design Brief - Riverside South phase 15-2, 4 & Spratt Road*", prepared by IBI Group dated August, 2019. It is noted that Pond 5 (end of pipe wet pond facility) was designed to provide enhanced level of quality control for the upstream catchments.

6.2 Pre-Development Conditions

The 6.01-hectare site at 675 Borbridge Avenue The subject property is currently vacant with dense vegetation cover throughout. The topography of the site generally slopes from its highpoint located at the southeast property corner and tapers down to each of Borbridge Avenue and Brian Good Avenue with a low point at their intersection corresponding to the northwest property corner.

Under post development conditions changes are proposed in the city right of way. The changes consist of additional curb line for the proposed bus layup and student drop off areas and their associated concrete areas. Therefore, the pre-development conditions of this off-site area denoted POS-1 have been considered. The pre-development runoff coefficient of the catchment is 0.44. The Pre-development runoff rate for this catchment for the 100-year storm event is 84.4 L/s.

6.3 Allowable Release Rate

The allowable release rate for the site was identified in the report "*Design Brief - Riverside South phase 15-2, 4 & Spratt Road*", prepared by IBI Group dated August 2019. Therefore, the allowable release rate for up-to 100-year storm for the proposed development is considered as 915 L/sec.

6.4 Post-Development Conditions

Stormwater from the 6.01 ha drainage area will be controlled and released at a rate less than the allowable release rate for storms up to and including the 100-year storm event. An overland flow route is provided for storms greater than the 100-year event. In the post-development conditions, the stormwater run-off coefficients for the hard surfaces (concrete, asphalt, roof, pavers etc.), gravel, and soft landscaping (grass etc.) are considered as 0.9, 0.7 and 0.2, respectively. The estimated post-development average run-off coefficient is 0.37. Time of concentration of 10 mins was used for the post-development storm calculations as per the City of Ottawa Sewer Design Guidelines.

During post-development conditions, the uncontrolled flowrates during 2-year, 5-year and 100-year storm events were calculated as 474.3 L/sec, 643.4 L/sec and 1330.2 L/sec, respectively. Controlled flowrates during 2-year, 5-year and 100-year storm events will be 389.2 L/sec, 522.4 L/sec and 904.2 L/sec, respectively.

As noted previously changes within the City right of way are proposed. The post-development runoff coefficient of the catchment is 0.51. The post-development runoff rate for this catchment for the 100-year storm event is 97.7 L/s.

6.4.1 Storage Requirements and Allocation

Post development runoff will be detained on-site for storms up to and including the 100-year storm events. The required SWM storage volumes will be achieved using surface ponding in the landscaped areas, parking area, and ponding on the roof of the new building for up to 100-year storm event.

Surface ponding volumes over catch basins and roof drains were determined by the conic volume method. Ponding depths for the subject site must be equal to or less than 300 mm for the landscape and parking surfaces and 150mm for the roof during a 100-year storm event.

Refer to drawing #C500 in **Appendix F** for post development drainage areas, associated ponding limits, ponding depth and control methods and refer to **Appendix D** for the detailed stormwater management calculations. **Table 6-1** in the following section summarizes the release rates and storage requirements for the proposed drainage areas within the subject site.

The proposed 100-year controlled release rate is 904.2 L/s, which complies with the allowable release rate of 915 L/s noted in section 6.1 above. The total available storage volume within the site will be 613.1 m^3 which is more than the required volume of 301.1 m^3.

6.4.2 Flow Control Device Sizing

Stormwater runoff from the proposed development will be detained using inlet control devices (ICDs) and flow control roof drains. ICDs in the catchbasins were sized based on the required storage volume and associated head of water during 100-year storm events, using the orifice equation shown below:

$$Q_{ORIFICE} = CA\sqrt{2gH}$$

Where,

$Q_{ORIFICE}$ = Flow Through the Orifice

C = Orifice Coefficient = 0.61

A = Area of the Orifice

g = Gravitational Acceleration = 9.81 m/s^2

H = Head of Water over the Center of the Orifice

The proposed ICD size and/or models are summarized in Table 6-1 below. The required flow control from the roof will be achieved by mounting Watts Accutrol flow control weirs on the roof drains. The required flow control from parking lot cathbasins and landscape area catchbasins will be achieved by mounting circular orifice plates on the outlets. Further details regarding the ICDs and roof drains are provided in **Appendix D**. The 5-year and 100-year ponding limits, total ponding depth and location of the flow control measures are provided on drawing #C500 in **Appendix F**.

Table 6-1: Summary of SWM Storage Requirements

Area ID	Outlet Location	Area (ha)	Runoff Coefficient 'C'	100 Year Release (L/s)	100 Year Storage Required (m3)	Max. Surface Storage Provided (m3)	Control Method	Storage Method
P-1	CB 307	0.126	0.59	**30.0**	9.7	134.3	90mmØ Orifice Plate	Surface Ponding
P-2	CB 305	0.203	0.84	**78.0**	17.7		150mmØ Orifice Plate	Surface Ponding
P-3	CB 304	0.179	0.84	**72.0**	14.7		145mmØ Orifice Plate	Surface Ponding
P-4	DCB 306	1.903	0.24	**177.0**	66.9	161.95	228mmØ Orifice Plate	Surface Ponding
P-5	DCB 309	0.804	0.28	138.7	-	-	Uncontrolled	-
P-6	DCB 303	0.859	0.25	132.5	-	-	Uncontrolled	-
P-7	DCB 308	0.730	0.21	95.1	-	-	Uncontrolled	-
P-8	CB 301, 302	0.150	0.65	60.1	-	-	Uncontrolled	-
P-9	ROW	0.420	0.25	65.2	-	-	Uncontrolled	-
P-R	STMMH 106	0.634	0.90	**55.7**	193.4	316.8	WATTS Accutrol Roof Drains	Surface Ponding
675 Borbridge Totals		6.007		905.5	301.3	613.1		

*__Bold__ flows are controlled.

6.5 Storm Sewer Design

Proposed building foundation drain will discharge into a 150mm dia. storm service lateral at 2.0% slope, having the Manning's full flow capacity of 23.5 L/sec. Proposed building roof drains will discharge into a separate 375mm dia. storm service lateral at 3.5%, having Manning's full flow

capacity of 308.4 L/sec. All stormwater runoff captured by the minor system on-site and storm service lateral from the proposed building will ultimately discharge to the 2550 mm diameter municipal storm sewer on Borbridge Avenue from a 525mm diameter storm service lateral at 2.5% slope. All storm sewers were sized for the 5-year peak flow with no overcapacity. Refer to **Appendix D** for detailed storm sewer sizing calculations.

7 Erosion and Sediment Control

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

- Extent of exposed soils shall be limited at any given time;
- Exposed areas shall be re-vegetated as soon as possible;
- Minimize the area to be cleared and disruption of adjacent areas;
- Siltsack or approved equivalent shall be installed inside all catch basins, catch basin manholes, and storm manholes as identified on the erosion and sediment control plan;
- Visual inspection shall be completed daily on sediment control barriers and any damage will be 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 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; and,
- Construction and maintenance requirements for erosion and sediment controls are to comply with Ontario Provincial Standard Specification (OPSS) 805.

8 Conclusions

This report addresses the site servicing and stormwater management requirements for the site plan control application for the proposed development. Based on the analysis provided in this report, the conclusions are as follows:

- The proposed highschool building will be serviced by 150mm diameter dual watermains, which will adequately service the proposed development for the domestic and fire flow demands. Additionally, water boundary conditions from the City suggests sufficient flow and pressure availability in the municipal watermain on Borbridge Ave. to service the new highschool building for domestic and fire demands.
- The proposed building will be serviced by a 250mm diameter sanitary sewer, which will have adequate capacity to service the new building for the sanitary flows. No capacity constraints were noted in the municipal sanitary sewer on Borbridge Ave by the City.

- Stormwater Management criteria for the proposed development will be achieved by restricting the post-development stormwater discharge rates up to and including the 100-year to the allowable release rates.
- Required on-site SWM storage volumes will be achieved using the surface storage in the landscaped areas, parking areas and roof storage using the flow control orifice plate ICD's and flow control roof drains.
- The stormwater quality control forthe proposed site is provided by the existing end-of-pipe stormwater management facility (wet pond). Therefore, no additional quality control measures are proposed.
- Temporary erosion and sediment control measures for the subject site have been identified.

Appendix A – Figures

Figure A1 – Site Location Plan

Figure A2 – Hydrant Location Plan

Figure A1: Site Location Plan

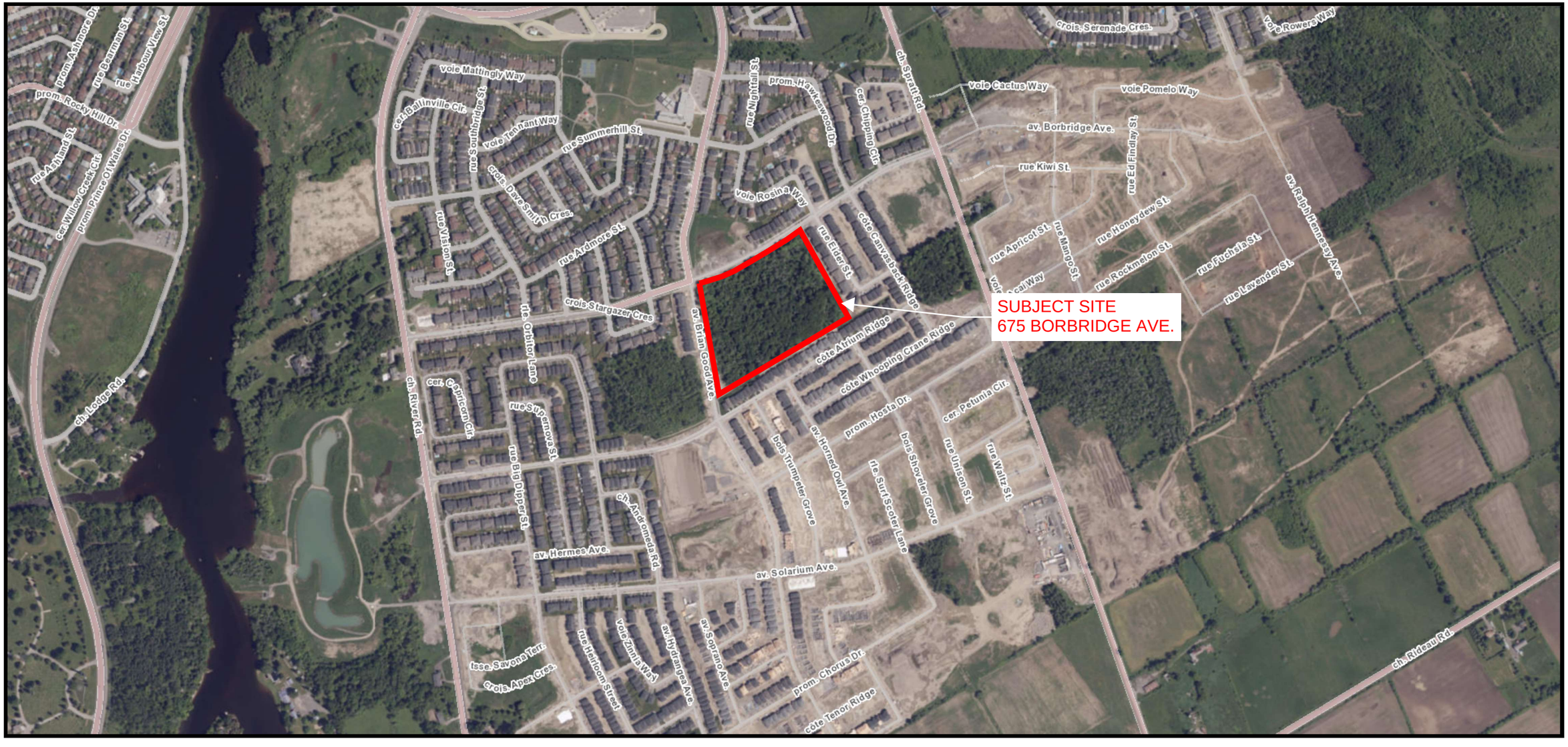


Figure A2: Hydrant Location Plan

Appendix B – Water Servicing

Table B1 - Water Demand Chart

Table B2 - FUS Fire Flow Demand Calculations

Table B3 - Estimated Water Pressure at Proposed Building FFE (Existing)

Table B4 - Estimated Water Pressure at Proposed Building FFE (Future Scenario)

Correspondence from Architect Re Fire Flow Requirements

Water Boundary Conditions from the City

TABLE B1: Water Demand Chart

Location: CECCE Riverside South - New Secondary School
Project No: OTT-24005530-A0
Designed by: A. Jariwala
Checked By: A. Jariwala
Date Revised: March 2025

Water Consumption

School	=	**70**	L/Student/day
Max. Day Peaking Factor	=	**1.50**	x Avg. Day
Peak Hour Peaking Factor	=	**1.80**	x Max. Day

Proposed	No. of Residential Units						Total Demands (L/sec)		
	Population	Avg. Day Demands (L/day)	Max. Day Peaking Factor	Max. Day Demands (L/day)	Peak Hour Peaking Factor	Peak Hour Deamnds (L/day)	Avg Day (L/s)	Max Day (L/s)	Peak Hour (L/s)
New CECCE School	906	63420	1.50	95130	1.80	171234	0.73	1.10	1.98
Future Expansion	380	26600	1.50	39900	1.80	71820	0.31	0.46	0.83
	1,286	90,020		135,030		243,054	***1.04***	***1.56***	***2.81***

Note: per capita water consuption and peaking factors from Ottawa Design Guidelines - Water Distribution - 2010 - ISD-2010-02

TABLE B2: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 2020
PROJECT: OTT-24005530-A0
Building: **CECCE Riverside South - New Secorndary School**

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			
	Second Floor		3163	9531.0 m²	
	First Floor		6368		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				17,182
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	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)	
	West	40	5	30.1 to 45	Type V	123	2	246	6	0%	0%	0	7,225
	East	170	5	30.1 to 45	Type V	200	2	400	6	0%			
	South	116	5	30.1 to 45	Type V	323	2	646	6	0%			
	North	66	5	30.1 to 45	Type V	134	2	268	6	0%			
Obtain Required Fire Flow										Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =			**7,000**
										Total Required Fire Flow, L/s =			**116.7**

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

Type V	Wood Frame
Type IV-III (U)	Mass Timber or Ordinary with Unprotected Openings
Type IV-III (P)	Mass Timber or Ordinary with Protected Openings
Type II-I (U)	Noncombustible or Fire Resistive with Unprotected Openings
Type II-I (P)	Noncombustible or Fire Resistive with Protected Openings

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	5

TABLE B3

ESTIMATED WATER PRESSURE AT PROPOSED BUILDING FFE (EXISTING)

Description	From	To	Demand (L/sec)	Pipe Length (m)	Pipe Dia (mm)	Dia (m)	Q (m3/sec)	Area (m2)	C	Vel (m/s)	Slope of HGL (m/m)	Head Loss (m)	Elev From (m)	Elev To (m)	*Elev Diff (m)	Pressure From kPa	(psi)	Pressure To kPa	(psi)	Pressure Drop (psi)
Avg Day Conditons																				
Single 150mm water service	Main	Building	1.04	24 m	150	0.150	0.0010	0.017671	110	0.059	5.5E-05	0.0013	91.20	92.10	-0.9	403.2	(58.5)	394.3	(57.2)	1.3
Max Day Conditons																				
Single 150mm watermain	Main	Building	1.56	24 m	150	0.150	0.0016	0.017671	110	0.0884	0.00012	0.0028	91.20	92.10	-0.9	330.6	(47.9)	321.7	(46.7)	1.3
Peak Hour Conditons																				
Single 150mm watermain	Main	Building	2.81	24 m	150	0.150	0.0028	0.017671	110	0.1592	0.00034	0.0084	91.20	92.10	-0.9	330.6	(47.9)	321.7	(46.7)	1.3
Max Day plus Sprinkler Demands																				
Single 150mm watermain	Main	Building	31.56	24 m	150	0.150	0.0316	0.017671	110	1.7861	0.03022	0.7374	91.20	92.10	-0.9	330.6	(47.9)	314.5	(45.6)	2.3

Water Demand Info

Average Demand =	1.04	L/sec
Max Day Demand =	1.56	L/sec
Peak Hr Deamand =	2.81	L/sec
Fireflow Requriement =	116.7	L/sec
Max Day Plus FF Demand =	118.2	L/sec
Assumed Sprinkler Demands =	30.0	L/sec

Pipe Lengths

From watermain to building =	24 m
Hazen Williams C Factor for Friction Loss in Pipe, C=	110

Boundary Conditon

	Min HGL	Max HGL	Max Day + Fireflow	Max Day + FireFlow (OBC)	
HGL (m)	124.9	132.3	124.9	124.9	(From City of Ottawa)
Approx Ground Elev (m) =	91.20	91.20	91.20	91.20	
Approx Bldg FF Elev (m) =	92.10	92.10	92.10	92.10	
Pressure (m) =	33.7	41.1	33.7	33.7	
Pressure (Pa) =	330,597	403,191	330,597	330,597	
Pressure (psi) =	47.9	58.5	47.9	47.9	

TABLE B4

ESTIMATED WATER PRESSURE AT PROPOSED BUILDING FFE (FUTURE SCENARIO)

Description	From	To	Demand (L/sec)	Pipe Length (m)	Pipe Dia (mm)	Dia (m)	Q (m3/sec)	Area (m2)	C	Vel (m/s)	Slope of HGL (m/m)	Head Loss (m)	Elev From (m)	Elev To (m)	*Elev Diff (m)	Pressure From kPa	(psi)	Pressure To kPa	(psi)	Pressure Drop (psi)
Avg Day Conditons																				
Single 150mm water service	Main	Building	1.04	24 m	150	0.150	0.0010	0.017671	110	0.059	5.5E-05	0.0013	91.20	92.10	-0.9	545.4	(79.1)	536.6	(77.8)	1.3
Max Day Conditons																				
Single 150mm watermain	Main	Building	1.56	24 m	150	0.150	0.0016	0.017671	110	0.0884	0.00012	0.0028	91.20	92.10	-0.9	515.0	(74.7)	506.2	(73.4)	1.3
Peak Hour Conditons																				
Single 150mm watermain	Main	Building	2.81	24 m	150	0.150	0.0028	0.017671	110	0.1592	0.00034	0.0084	91.20	92.10	-0.9	515.0	(74.7)	506.1	(73.4)	1.3
Max Day plus Sprinkler Demands																				
Single 150mm watermain	Main	Building	31.56	24 m	150	0.150	0.0316	0.017671	110	1.7861	0.03022	0.7374	91.20	92.10	-0.9	518.9	(75.3)	502.9	(72.9)	2.3

Water Demand Info

Average Demand =	1.04	L/sec
Max Day Demand =	1.56	L/sec
Peak Hr Deamand =	2.81	L/sec
Fireflow Requriement =	116.7	L/sec
Max Day Plus FF Demand =	118.2	L/sec
Assumed Sprinkler Demands =	30.0	L/sec

Pipe Lengths

From watermain to building =	24 m
Hazen Williams C Factor for Friction Loss in Pipe, C=	110

Boundary Conditon

	Min HGL	Max HGL	Max Day + Fireflow	Max Day + FireFlow (OBC)	
HGL (m)	143.7	146.8	144.1	144.1	(From City of Ottawa)
Approx Ground Elev (m) =	91.20	91.20	91.20	91.20	
Approx Bldg FF Elev (m) =	92.10	92.10	92.10	92.10	
Pressure (m) =	52.5	55.6	52.9	52.9	
Pressure (Pa) =	515,025	545,436	518,949	518,949	
Pressure (psi) =	74.7	79.1	75.3	75.3	

Alexander Johnson

From: Pamela Reid <preid@provencherroy.ca>
Sent: Thursday, November 7, 2024 5:21 PM
To: Aaditya Jariwala
Subject: RE: CECCE Riverside South: FUS Calculations

Hi Aaditya,

Please see my responses below.

Thank you,

PAMELA REID
CANDIDATE À LA PROFESSION D'ARCHITECTE / INTERN ARCHITECT
613-686-6339,2284 | C 438-492-6781

PROVENCHER_ROY

47 RUE CLARENCE, BUREAU 440
OTTAWA, ONTARIO, CANADA K1N 9K1

From: Aaditya Jariwala <Aaditya.Jariwala@exp.com>
Sent: 7 novembre 2024 16:29
To: Pamela Reid <preid@provencherroy.ca>
Subject: CECCE Riverside South: FUS Calculations

Hi Pam,

To calculate the Required Fire Flow based on Fire Underwriter's Survey, can you please provide answers for the following items:

1. What will be the GFA for each storey.

With the latest plans, here are the areas.

GROSS BUILDING AREA		
LEVEL	**AREA (m²)**	**Level**
RDC	6368 m²	T/O GROUND FLOOR
NIVEAU 02	3163 m²	T/O 2nd FLOOR
Total GFA	9531 m²	

2. What will be the construction type of the building. See the list of construction type below. I can elaborate more as per FUS 2020, if needed.

None apply. I would say this: Non-Combustible Construction, where floors, mezzanines and structural elements have min. 1-hour fire rating.

- Wood Frame Construction
- Mass Timber Construction
- Ordinary or Joisted Masonry Construction, where exterior wall have min. 1-hour fire rating but interior partitions do not have min. 1-hour fire rating.
- Non-Combustible Construction, where and interior walls, arches, floors, roofs and structural elements have min. 1-hour fire rating.
- Fire Resistive Construction, where exterior and interior walls, arches, floors, roofs and structural elements have min. 2-hour fire rating.

3. Will the vertical and horizontal (if any) opening be protected as per NBC?

No

4. Will there be any fire separations with min. 2-hour fire rating?

No. Only 1hr.

5. What is the building occupancy group and division based on OBC.

3.2.2.24. Group A, Division 2, up to 6 Storeys, Any Area, Sprinklered

6. Will the building be fully equipped with an automatic sprinkler system?

Yes, as required by code.

Let me know if you need further clarification or information.

Thanks,

Aaditya Jariwala, M.Eng, P.Eng.
EXP | Project Manager
t : +1.613.688.1899, 63240 | m : +1.613.816.5961 | e : aaditya.jariwala@exp.com
2650 Queensview Drive
Suite 100
Ottawa, ON K2B 8H6
CANADA
exp.com | legal disclaimer
keep it green, read from the screen

Boundary Conditions
675 Borbridge Ave.

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	71	1.19
Maximum Daily Demand	107	1.79
Peak Hour	193	3.22
Fire Flow Demand #1	7,000	116.67

Location

Results

Existing Condition
Connection 1 – Borbridge Ave.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	132.3	58.4
Peak Hour	124.9	47.9
Max Day plus Fire Flow #1	124.9	47.9

[1] Ground Elevation = 91.2 m

Future SUC
Connection 1 – Borbridge Ave.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.8	79.0
Peak Hour	143.7	74.6
Max Day plus Fire Flow #1	144.1	75.1

[1] Ground Elevation = 91.2 m

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. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

Appendix C – Sanitary Sewer Design Sheet

C1 - Sanitary Sewer Design Sheet

Email Confirmation from the City on Municipal Sanitary Sewer Capacity

TABLE C1 - SANITARY SEWER CALCULATION SHEET

LOCATION				INSTITUTIONAL					INFILTRATION				SEWER DATA						
									AREA (ha)										
Street	U/S MH	D/S MH	Desc	STUDENT POPULATION	STAFF POPULATION	TOTAL POPULATION (Persons)	ACCU POPULATION (Persons)	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)
Borbridge Ave	BLDG	SANMH 201	Proposed	826	80	906	906	1.42	6.01	6.01	1.98	3.40	250	251.46	2.00	3.80	85.4	4.0%	1.7
			Future	360	20	380	1286	2.01	6.01	6.01	1.98	3.99	250	251.46	2.00	3.80	85.4	4.7%	1.7
	SANMH 201	SANMH 202										3.99	250	251.46	2.00	9.74	85.4	4.7%	1.7
	SANMH 202	525 MUNI SAN										3.99	250	251.46	2.00	14.46	85.4	4.7%	1.7
Totals							**1286**			**6.01**		**3.99**							

Notes:

gross site area (ha)	6.07
population - new school	906
population - future expansion	380
Total population post future expansion	1,286
Manning N =	0.013
per City of Ottawa Sewer Design Guidelines - 2012:	
Avg. Daily Flow (School) (L/person/day) =	90.00
Institutional Peak Factor =	1.50
Peak extraneous flow, I (L/s/ha) =	0.33

Designed:	Project:
A. Jariwala., M.Eng., P.Eng.	CECCE Riverside South - New Secondary School
Checked:	Location:
A. Jariwala., M.Eng., P.Eng.	675 Borbridge Ave., Ottawa, ON.
File Reference:	Page No:
24005530 - SAN - Sanitary Design Sheet.xlsx	**1 of 1**

From: Giovannitti, Terenzo <terenzo.giovannitti@ottawa.ca>
Sent: Friday, November 22, 2024 9:21 AM
To: Aaditya Jariwala
Cc: Pamela Reid
Subject: RE: 675 Borbridge Ave - Water Boundary Conditions and Sanitary Capacity Check

Hi Aaditya,

This is just a brief follow up for the downstream sanitary check.
The proposed peak flow you provided seems to be in line with what was allocated in the subdivision design and is therefore acceptable.
There are no downstream capacity concerns for this proposed design at this time.

Regards,
Terenzo Giovannitti
Project Manager
Development Review – All Wards (DRAW)
Planning, Development and Building Services Department
City of Ottawa
110 Laurier Ave W. Ottawa, ON
613-580-2424 (ext. 23436)
terenzo.giovannitti@ottawa.ca

From: Giovannitti, Terenzo
Sent: November 14, 2024 9:27 AM
To: Aaditya Jariwala <Aaditya.Jariwala@exp.com>
Cc: Pamela Reid <preid@provencherroy.ca>
Subject: RE: 675 Borbridge Ave - Water Boundary Conditions and Sanitary Capacity Check

Good morning Aaditya,

Please see attached Boundary conditions result.

I am still waiting for a response about the downstream sanitary capacity. I will provide you with a response as soon as I get it.

If you have any questions, let me know.
Thanks,

Terenzo Giovannitti
Project Manager
Development Review – All Wards (DRAW)
Planning, Development and Building Services Department
City of Ottawa
110 Laurier Ave W. Ottawa, ON
613-580-2424 (ext. 23436)

terenzo.giovannitti@ottawa.ca

From: Aaditya Jariwala <Aaditya.Jariwala@exp.com>
Sent: November 11, 2024 3:27 PM
To: Giovannitti, Terenzo <terenzo.giovannitti@ottawa.ca>
Cc: Pamela Reid <preid@provencherroy.ca>
Subject: 675 Borbridge Ave - Water Boundary Conditions and Sanitary Capacity Check
Importance: High

Hi Terenzo,

Sending the request for water boundary condition and sanitary sewer capacity check as per the notes from PH1 feedback form on the above mentioned SPA.

Please see attached figure for the location of anticipated new water connection. Domestic and fire demands are as follows:

Avg. Day Demands: 1.19 L/sec
Max. Day Demands: 1.79 L/sec
Peak Hour Demands: 3.22 L/sec
RFF as per FUS (2020): 116.7 L/sec

Associated calculation sheets are attached to the email for your reference.

Additionally, the anticipated sanitary flows including infiltration allowances will be 4.9 L/sec. Please confirm if there are any capacity constraints in the receiving sanitary sewer on Borbridge Ave.

Let me know if you have any questions or concerns regarding this.

Best regards,

Aaditya Jariwala, M.Eng, P.Eng.
EXP | Project Manager
t : +1.613.688.1899, 63240 | m : +1.613.816.5961 | e : aaditya.jariwala@exp.com
2650 Queensview Drive
Suite 100

Ottawa, ON K2B 8H6
CANADA

'

'

Appendix D – Stormwater Management Design Sheet

TABLE D1: Stormwater Management Summary

Area ID	Outlet Location	Area (ha)	Runoff Coefficient 'C'	100 Year Release (L/s)	100 Year Storage Required (m^3)	Max. Surface Storage Provided (m3)	Control Method	Storage Method
P-1	CB 307	0.126	0.59	**30.0**	9.7	134.3	**ICD**	Surface Ponding
P-2	CB 305	0.203	0.84	**78.0**	17.7		**ICD**	Surface Ponding
P-3	CB 304	0.179	0.84	**72.0**	14.7		**ICD**	Surface Ponding
P-4	DCB 306	1.903	0.24	**177.0**	66.9	161.95	**ICD**	Surface Ponding
P-5	DCB 309	0.804	0.28	138.7	-	-	Uncontrolled	-
P-6	DCB 303	0.859	0.25	132.5	-	-	Uncontrolled	-
P-7	DCB 308	0.730	0.21	95.1	-	-	Uncontrolled	-
P-8	CB 301, 302	0.150	0.65	60.1	-	-	Uncontrolled	-
P-9	Brian Good/Borebridge	0.420	0.25	65.2	-	-	Uncontrolled	-
P-R	STMMH 106	0.634	0.90	**55.7**	193.4	316.8	**Flow Control Roof Drains**	Surface Ponding
675 Borbridge Totals		**6.007**		**904.2**	**302.4**	**613.1**		
POS-1	Brian Good/Borebridge ROW	0.309	0.51	97.7	-	-	Uncontrolled	-

Total Allowable Release Rate for 675 Borbridge (L/s): **915.0** (*From Design Brief - Riverside South phase 15-2, 4 & Spratt Road, prepared by IBI Group dated August, 2019*)

TABLE D2 - CALCULATION OF AVERAGE RUNOFF COEFFICIENT CITY ROW (PRE-DEVELOPMENT)

Area No.	Outlet Location	Asphalt/Concrete		Roof		Pavers		Gravel		Soft Landscaping		Sum AC	Total Area (m^2)	C_{AVG}
		Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C			
		C=0.90		C=0.90		C=0.90		C=0.70		C=0.20				
POS-1	Brian Good/Borebridge ROW	1060.57	954.5	0.00	0.0	0.00	0.0	0.00	0.00	2029.95	405.99	1360.5	3090.52	0.44

TABLE D3 PRE-DEVELOPMENT RUNOFF CITY ROW

Area No	Outlet Location	Area (ha)	Time of Conc. T_c (min)	Storm = 2-year				Storm = 5-year				Storm = 100-year			
				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)	$C_{AVG-100Yr}$	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)
POS-1	Brian Good/Borebridge ROW	0.309	10	0.44	76.81	29.0	29.0	0.44	104.19	39.4	39.4	0.55	178.56	84.4	84.4

Notes

1) Intensity, $I_2 = 732.951/(Tc+6.199)^{0.810}$ (2-year, City of Ottawa)

2) Intensity, $I_5 = 998.071/(Tc+6.035)^{0.814}$ (5-year, City of Ottawa)

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

4) Time of Concentration: T_c=10min

TABLE D4 - CALCULATION OF AVERAGE RUNOFF COEFFICIENT CITY ROW (POST-DEVELOPMENT)

Area No.	Outlet Location	Asphalt/Concrete		Roof		Pavers		Gravel		Soft Landscaping		Sum AC	Total Area (m^2)	C_{AVG}
		Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C			
		C=0.90		C=0.90		C=0.90		C=0.70		C=0.20				
POS-1	Brian Good/Borebridge ROW	1367.08	1230.4	0.00	0.0	0.00	0.0	0.00	0.00	1723.44	344.69	1575.1	3090.52	0.51

TABLE D5 - POST-DEVELOPMENT RUNOFF CITY ROW

Area No	Outlet Location	Area (ha)	Time of Conc. T_c (min)	Storm = 2-year				Storm = 5-year				Storm = 100-year			
				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)	$C_{AVG-100Yr}$	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)
POS-1	Brian Good/Borebridge ROW	0.309	10	0.51	76.81	33.6	33.6	0.51	104.19	45.6	45.6	0.64	178.56	97.7	97.7

Notes

1) Intensity, $I_2 = 732.951/(Tc+6.199)^{0.810}$ (2-year, City of Ottawa)

2) Intensity, $I_5 = 998.071/(Tc+6.035)^{0.814}$ (5-year, City of Ottawa)

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

4) Time of Concentration: T_c=10min

TABLE D6 - CALCULATION OF AVERAGE RUNOFF COEFFICIENTS 675 BORBRIDGE (POST-DEVELOPMENT)

Area No.	Outlet Location	Asphalt/Concrete		Roof		Pavers		Gravel		Soft Landscaping		Sum AC	Total Area (m^2)	C_{AVG}
		Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C			
		C=0.90		C=0.90		C=0.90		C=0.70		C=0.20				
P-1	CB 307	696.71	627.0	0.00	0.0	0.00	0.0	0.00	0.00	560.57	112.11	739.2	1257.28	0.59
P-2	CB 305	1469.66	1322.7	0.00	0.0	380.28	342.3	0.00	0.00	181.85	36.37	1701.3	2031.79	0.84
P-3	CB 304	1600.29	1440.3	0.00	0.0	26.45	23.8	0.00	0.00	164.87	32.97	1497.0	1791.61	0.84
P-4	DCB 306	4.63	4.2	0.00	0.0	0.00	0.0	1682.04	1177.43	17342.32	3468.46	4650.1	19028.98	0.24
P-5	DCB 309	360.96	324.9	0.00	0.0	0.00	0.0	750.81	525.57	6924.97	1384.99	2235.4	8036.74	0.28
P-6	DCB 303	595.24	535.7	0.00	0.0	0.00	0.0	0.00	0.00	7996.61	1599.32	2135.0	8591.86	0.25
P-7	DCB 308	81.12	73.0	0.00	0.0	21.50	19.3	0.00	0.00	7199.01	1439.80	1532.2	7301.63	0.21
P-8	CB 301, 302	71.55	64.4	0.00	0.0	884.59	796.1	0.00	0.00	540.77	108.15	968.7	1496.91	0.65
P-9	Brian Good/Borebridge	82.70	74.4	0.00	0.0	218.57	196.7	0.00	0.00	3896.61	779.32	1050.5	4197.88	0.25
P-R	STMMH 106	0.00	0.0	6335.69	5702.1	0.00	0.0	0.00	0.00	0.00	0.00	5702.1	6335.69	0.90
Average Runoff Coeff for 675 Borbridge =												C_{AVG} = 22,211 / 60,070		**= 0.37**

TABLE D7

SWM POST-DEVELOPMENT RUNOFF 675 BORBRIDGE (UNCONTROLLED AND CONTROLLED)

Area No	Outlet Location	Area (ha)	Time of Conc. T_c (min)	Storm = 2-year				Storm = 5-year				Storm = 100-year			
				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)	$C_{AVG-100Yr}$	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)
P-1	CB 307	0.126	10	0.59	76.81	15.8	**15.8**	0.59	104.19	21.4	**21.4**	0.73	178.56	45.9	**30.0**
P-2	CB 305	0.203	10	0.84	76.81	36.3	**36.3**	0.84	104.19	49.3	**49.3**	1.00	178.56	100.9	**78.0**
P-3	CB 304	0.179	10	0.84	76.81	32.0	**32.0**	0.84	104.19	43.4	**43.4**	1.00	178.56	88.9	**72.0**
P-4	DCB 306	1.903	10	0.24	76.81	99.3	**99.3**	0.24	104.19	134.7	**134.7**	0.31	178.56	288.5	**177.0**
P-5	DCB 309	0.804	10	0.28	76.81	47.7	47.7	0.28	104.19	64.8	64.8	0.35	178.56	138.7	138.7
P-6	DCB 303	0.859	10	0.25	76.81	45.6	45.6	0.25	104.19	61.8	61.8	0.31	178.56	132.5	132.5
P-7	DCB 308	0.730	10	0.21	76.81	32.7	32.7	0.21	104.19	44.4	44.4	0.26	178.56	95.1	95.1
P-8	CB 301, 302	0.150	10	0.65	76.81	20.7	20.7	0.65	104.19	28.1	28.1	0.81	178.56	60.1	60.1
P-9	Brian Good/Borebridge	0.420	10	0.25	76.81	22.4	22.4	0.25	104.19	30.4	30.4	0.31	178.56	65.2	65.2
P-R	STMMH 106	0.634	10	0.90	76.81	121.8	**36.7**	0.90	104.19	165.2	**44.2**	1.00	178.56	314.5	**55.7**
Total for 675 Borbridge		**6.007**				474.3	**389.2**			643.4	**522.4**			1330.2	**904.2**

Notes

1) Intensity, $I_2 = 732.951/(Tc+6.199)^{0.810}$ (2-year, City of Ottawa)

2) Intensity, $I_5 = 998.071/(Tc+6.035)^{0.814}$ (5-year, City of Ottawa)

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

4) Time of Concentration: T_c=10min

5) Flows under column $Q_{CAP\ that\ denotes}$ controlled: **100.00**

TABLE D8: 2-year, 5-year & 100-year Roof Drains Design Sheet - Using Flow Controlled Roof Drains

Project: 1485 UPPER CANADA STREET
Location: City of Ottawa
Date: SEPTEMBER 2023

Area #	Roof Drain Type	No Drains per Area	Total No of Weirs	Weir Position	Runoff Coeff (Cavg)		Drainage Area		2-year Event						5-year Event						100-year Event						Storage Required *(MRM)*			Maximium Storage Provided at Spill Elevation					
					2-year & 5-year	100-year	m^2	ha	Runoff Rate (L/sec)	2yr Ponding Depth (mm)	Roof Drain Capacity Per Weir (gpm)	Roof Drain Capacity Per Drain per weir (gpm)	Roof Drain Capacity Per Drain (L/sec)	Total Flow From Roof Drains (L/sec)	Runoff Rate (L/sec)	5yr Ponding Depth (mm)	Roof Drain Capacity Per Weir (gpm)	Roof Drain Capacity Per Drain per weir (gpm)	Roof Drain Capacity Per Drain (L/sec)	Total Flow From Roof Drains (L/sec)	Runoff Rate (L/sec)	100yr Ponding Depth (mm)	Roof Drain Capacity Per Weir (gpm)	Roof Drain Capacity Per Drain per weir (gpm)	Roof Drain Capacity Per Drain (L/sec)	Total Flow From Roof Drains (L/sec)	2-year (m^3)	5-year (m^3)	100-year (m^3)	Area Available for Storage (m^2)	Max Prism Depth (mm)	Max Prisim Volume (m^3)	% Volume Used for Ponding		
																																2-year	5-year	100-year
P-R-1	RD2	1	2	6-Full	0.90	1.00	529.86	0.0530	10.183	89	17.8	35.6	2.246	2.246	13.813	107	21.4	42.8	2.700	2.700	26.302	133	26.6	53.2	3.356	3.356	5.61	9.44	18.51	529.9	150	26.5	21%	36%	70%
P-R-2	RD2	1	2	6-Full	0.90	1.00	426.55	0.0427	8.197	86	17.2	34.4	2.170	2.170	11.120	104	20.8	41.6	2.625	2.625	21.174	130	26.0	52.0	3.281	3.281	4.06	6.89	13.70	426.6	150	21.3	19%	32%	64%
P-R-3	RD2	1	2	6-Full	0.90	1.00	450.29	0.0450	8.654	87	17.4	34.8	2.196	2.196	11.739	104	20.8	41.6	2.625	2.625	22.352	130	26.0	52.0	3.281	3.281	4.40	7.50	14.82	450.3	150	22.5	20%	33%	66%
P-R-4	RD2	1	2	6-Full	0.90	1.00	586.21	0.0586	11.266	91	18.2	36.4	2.296	2.296	15.282	108	21.6	43.2	2.725	2.725	29.099	135	27.0	54.0	3.407	3.407	6.49	10.91	21.21	586.2	150	29.3	22%	37%	72%
P-R-5	RD3	1	2	6-Full	0.90	1.00	282.58	0.0283	5.431	80	16.0	32.0	2.019	2.019	7.367	97	19.4	38.8	2.448	2.448	14.027	122	24.4	48.8	3.079	3.079	2.11	3.70	7.62	282.6	150	14.1	15%	26%	54%
P-R-6	RD3	1	3	6-Full	0.90	1.00	448.73	0.0449	8.624	81	16.2	48.6	3.066	3.066	11.698	97	19.4	58.2	3.672	3.672	22.275	123	24.6	73.8	4.656	4.656	3.48	6.11	12.45	448.7	150	22.4	16%	27%	55%
P-R-7	RD3	1	3	6-Full	0.90	1.00	552.38	0.0552	10.616	84	16.8	50.4	3.180	3.180	14.400	101	20.2	60.6	3.823	3.823	27.420	127	25.4	76.2	4.807	4.807	4.82	8.36	16.74	552.4	150	27.6	17%	30%	61%
P-R-8	RD3	1	3	6-Full	0.90	1.00	488.91	0.0489	9.396	82	16.4	49.2	3.104	3.104	12.745	98	19.6	58.8	3.710	3.710	24.269	125	25.0	75.0	4.732	4.732	4.01	7.01	14.07	488.9	150	24.4	16%	29%	58%
P-R-9	RD3	1	3	6-Full	0.90	1.00	424.79	0.0425	8.164	80	16.0	48.0	3.028	3.028	11.074	96	19.2	57.6	3.634	3.634	21.086	123	24.6	73.8	4.656	4.656	3.18	5.61	11.41	424.8	150	21.2	15%	26%	54%
P-R-10	RD3	3	6	6-Full	0.90	1.00	1233.91	0.1234	23.713	86	17.2	103.2	6.511	6.511	32.167	103	20.6	123.6	7.798	7.798	61.251	129	25.8	154.8	9.766	9.766	11.46	19.64	39.14	1,233.9	150	61.7	19%	32%	63%
P-R-11	RD3	1	3	6-Full	0.90	1.00	394.02	0.0394	7.572	78	15.6	46.8	2.953	2.953	10.272	95	19.0	57.0	3.596	3.596	19.559	121	24.2	72.6	4.580	4.580	2.82	5.00	10.27	394.0	150	19.7	14%	25%	52%
P-R-12	RD3	1	2	6-Full	0.90	1.00	255.38	0.0255	4.908	78	15.6	31.2	1.968	1.968	6.658	95	19.0	38.0	2.397	2.397	12.677	120	24.0	48.0	3.028	3.028	1.78	3.18	6.59	255.4	150	12.8	14%	25%	52%
P-R-13	RD2	1	1	6-Full	0.90	1.00	132.29	0.0132	2.542	79	15.8	15.8	0.997	0.997	3.449	95	19.0	19.0	1.199	1.199	6.567	121	24.2	24.2	1.527	1.527	0.94	1.69	3.46	132.3	150	6.6	14%	26%	52%
P-R-14	RD2	1	1	6-Full	0.90	1.00	129.86	0.0130	2.496	79	15.8	15.8	0.997	0.997	3.385	95	19.0	19.0	1.199	1.199	6.446	121	24.2	24.2	1.527	1.527	0.91	1.64	3.36	129.9	150	6.5	14%	25%	52%
Totals					0.9	0.9	**6,335.8**	**0.6336**	**121.76**		**232.00**		**36.73**	**36.73**	**165.17**		**279.00**		**44.15**	**44.15**	**314.50**		**352.00**		**55.68**	**55.68**	**56.09**	**96.67**	**193.36**	**6335.8**		**316.8**			
Min										**80**						**97**						**122**													
Max										**91**						**108**						**135**													

Runoff Based on the Following:

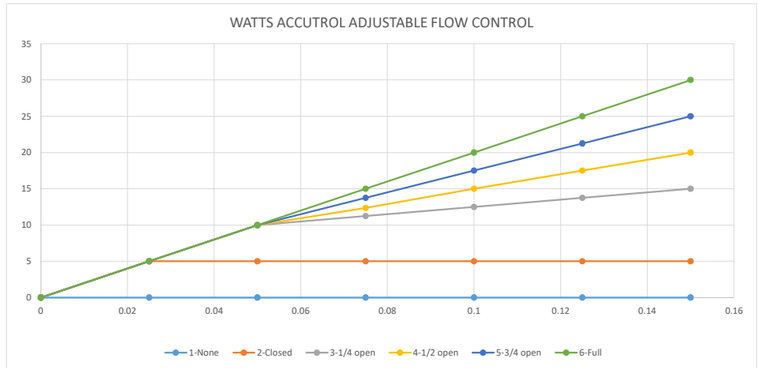
Storm Frequency (years) =	2	5	100
Time of Conc (mins) =	10	10	10
Storm Intensity (mm/hr) =	76.8	104.2	178.6

Roof Drains have Following Flow Rates per weir: WATTS Flow Controlled Drain

Weir Position	Flow (gpm) per depth							Max Flow Rate per Weir @150mm (L/s)
	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	0.000
2-Closed	0	5	5	5	5	5	5	0.315
3-1/4 open	0	5	10	11	13	14	15	0.946
4-1/2 open	0	5	10	12	15	18	20	1.262
5-3/4 open	0	5	10	14	18	21	25	1.577
6-Full	0	5	10	15	20	25	30	1.890

Roof Drain Types

Drain Type =	RD1	RD2	RD3
Max Overflow Depth (mm)	150 mm	150 mm	150 mm
Flow Controlled (Yes/No)	Yes	Yes	Yes
Ponding	Yes	Yes	Yes
Weir Desc	Accutrol	Accutrol	Accutrol
No. Weirs	1	2	3



Storage Volumes Roof Area P-R-1 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.05299 (hectares)

	Release Rate = 2.246 (L/sec)					Release Rate = 2.7003 (L/sec)					Release Rate = 3.3564 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951			, B = 0.810		IDF Parameters, A = 998.071			, B = 0.814		IDF Parameters, A = 1735.69			, B = 0.820	
	($I = A/(T_c+C)$			, C = 6.199		($I = A/(T_c+C)$			, C = 6.053		($I = A/(T_c+C)$			, C = 6.014	
Duration (min)	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	22.2	2.25	19.9	0.00	230.5	34.0	2.700	31.3	0.00	398.6	58.7	3.4	55.4	0.00
5	103.6	13.7	2.25	11.5	3.45	141.2	20.8	2.700	18.1	5.43	242.7	35.8	3.4	32.4	9.72
10	76.8	10.2	2.25	7.9	4.76	104.2	15.3	2.700	12.6	7.59	178.6	26.3	3.4	22.9	13.77
15	61.8	8.2	2.25	5.9	5.35	83.6	12.3	2.700	9.6	8.65	142.9	21.0	3.4	17.7	15.92
20	52.0	6.9	2.25	4.7	5.58	70.3	10.3	2.700	7.6	9.18	120.0	17.7	3.4	14.3	17.17
25	45.2	6.0	2.25	3.7	5.61	60.9	9.0	2.700	6.3	9.40	103.8	15.3	3.4	11.9	17.91
30	40.0	5.3	2.25	3.1	5.51	53.9	7.9	2.700	5.2	9.44	91.9	13.5	3.4	10.2	18.32
35	36.1	4.8	2.25	2.5	5.32	48.5	7.1	2.700	4.4	9.34	82.6	12.2	3.4	8.8	18.50
40	32.9	4.4	2.25	2.1	5.07	44.2	6.5	2.700	3.8	9.14	75.1	11.1	3.4	7.7	18.51
45	30.2	4.0	2.25	1.8	4.76	40.6	6.0	2.700	3.3	8.87	69.1	10.2	3.4	6.8	18.40
50	28.0	3.7	2.25	1.5	4.41	37.7	5.5	2.700	2.8	8.54	64.0	9.4	3.4	6.1	18.19
55	26.2	3.5	2.25	1.2	4.04	35.1	5.2	2.700	2.5	8.16	59.6	8.8	3.4	5.4	17.91
60	24.6	3.3	2.25	1.0	3.63	32.9	4.9	2.700	2.2	7.75	55.9	8.2	3.4	4.9	17.56
65	23.2	3.1	2.25	0.8	3.21	31.0	4.6	2.700	1.9	7.30	52.6	7.8	3.4	4.4	17.15
70	21.9	2.9	2.25	0.7	2.77	29.4	4.3	2.700	1.6	6.83	49.8	7.3	3.4	4.0	16.71
75	20.8	2.8	2.25	0.5	2.31	27.9	4.1	2.700	1.4	6.33	47.3	7.0	3.4	3.6	16.22
80	19.8	2.6	2.25	0.4	1.84	26.6	3.9	2.700	1.2	5.82	45.0	6.6	3.4	3.3	15.70
85	18.9	2.5	2.25	0.3	1.35	25.4	3.7	2.700	1.0	5.29	43.0	6.3	3.4	3.0	15.15
90	18.1	2.4	2.25	0.2	0.86	24.3	3.6	2.700	0.9	4.74	41.1	6.1	3.4	2.7	14.58
95	17.4	2.3	2.25	0.1	0.36	23.3	3.4	2.700	0.7	4.18	39.4	5.8	3.4	2.5	13.98
100	16.7	2.2	2.25	0.0	-0.16	22.4	3.3	2.700	0.6	3.60	37.9	5.6	3.4	2.2	13.36
105	16.1	2.1	2.25	-0.1	-0.68	21.6	3.2	2.700	0.5	3.02	36.5	5.4	3.4	2.0	12.72
110	15.6	2.1	2.25	-0.2	-1.20	20.8	3.1	2.700	0.4	2.42	35.2	5.2	3.4	1.8	12.07
115	15.0	2.0	2.25	-0.3	-1.73	20.1	3.0	2.700	0.3	1.82	34.0	5.0	3.4	1.7	11.40
120	14.6	1.9	2.25	-0.3	-2.27	19.5	2.9	2.700	0.2	1.20	32.9	4.8	3.4	1.5	10.72
Max =					**5.61**					**9.44**					**18.51**

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

Storage Volumes Roof Area P-R-2 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.04266 (hectares)

	Release Rate = 2.170 (L/sec)					Release Rate = 2.6246 (L/sec)					Release Rate = 3.2807 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951, B = 0.810					IDF Parameters, A = 998.071, B = 0.814					IDF Parameters, A = 1735.688, B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	17.8	2.17	15.7	0.00	230.5	27.3	2.625	24.7	0.00	398.6	47.3	3.3	44.0	0.00
5	103.6	11.1	2.17	8.9	2.66	141.2	16.7	2.625	14.1	4.23	242.7	28.8	3.3	25.5	7.65
10	76.8	8.2	2.17	6.0	3.62	104.2	12.4	2.625	9.7	5.84	178.6	21.2	3.3	17.9	10.74
15	61.8	6.6	2.17	4.4	3.98	83.6	9.9	2.625	7.3	6.56	142.9	16.9	3.3	13.7	12.30
20	52.0	5.6	2.17	3.4	4.06	70.3	8.3	2.625	5.7	6.85	120.0	14.2	3.3	10.9	13.13
25	45.2	4.8	2.17	2.7	3.98	60.9	7.2	2.625	4.6	6.89	103.8	12.3	3.3	9.0	13.55
30	40.0	4.3	2.17	2.1	3.79	53.9	6.4	2.625	3.8	6.79	91.9	10.9	3.3	7.6	13.70
35	36.1	3.8	2.17	1.7	3.52	48.5	5.8	2.625	3.1	6.57	82.6	9.8	3.3	6.5	13.67
40	32.9	3.5	2.17	1.3	3.21	44.2	5.2	2.625	2.6	6.28	75.1	8.9	3.3	5.6	13.51
45	30.2	3.2	2.17	1.1	2.85	40.6	4.8	2.625	2.2	5.92	69.1	8.2	3.3	4.9	13.25
50	28.0	3.0	2.17	0.8	2.47	37.7	4.5	2.625	1.8	5.52	64.0	7.6	3.3	4.3	12.91
55	26.2	2.8	2.17	0.6	2.05	35.1	4.2	2.625	1.5	5.08	59.6	7.1	3.3	3.8	12.51
60	24.6	2.6	2.17	0.5	1.62	32.9	3.9	2.625	1.3	4.61	55.9	6.6	3.3	3.3	12.05
65	23.2	2.5	2.17	0.3	1.17	31.0	3.7	2.625	1.1	4.12	52.6	6.2	3.3	3.0	11.55
70	21.9	2.3	2.17	0.2	0.71	29.4	3.5	2.625	0.9	3.61	49.8	5.9	3.3	2.6	11.02
75	20.8	2.2	2.17	0.1	0.23	27.9	3.3	2.625	0.7	3.07	47.3	5.6	3.3	2.3	10.45
80	19.8	2.1	2.17	-0.1	-0.26	26.6	3.1	2.625	0.5	2.52	45.0	5.3	3.3	2.1	9.86
85	18.9	2.0	2.17	-0.1	-0.76	25.4	3.0	2.625	0.4	1.96	43.0	5.1	3.3	1.8	9.25
90	18.1	1.9	2.17	-0.2	-1.26	24.3	2.9	2.625	0.3	1.38	41.1	4.9	3.3	1.6	8.61
95	17.4	1.9	2.17	-0.3	-1.78	23.3	2.8	2.625	0.1	0.79	39.4	4.7	3.3	1.4	7.95
100	16.7	1.8	2.17	-0.4	-2.30	22.4	2.7	2.625	0.0	0.20	37.9	4.5	3.3	1.2	7.28
105	16.1	1.7	2.17	-0.4	-2.83	21.6	2.6	2.625	-0.1	-0.41	36.5	4.3	3.3	1.0	6.60
110	15.6	1.7	2.17	-0.5	-3.36	20.8	2.5	2.625	-0.2	-1.03	35.2	4.2	3.3	0.9	5.90
115	15.0	1.6	2.17	-0.6	-3.89	20.1	2.4	2.625	-0.2	-1.65	34.0	4.0	3.3	0.8	5.19
120	14.6	1.6	2.17	-0.6	-4.44	19.5	2.3	2.625	-0.3	-2.28	32.9	3.9	3.3	0.6	4.46
Max =					**4.06**					**6.89**					**13.70**

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

Storage Volumes Roof Area P-R-3 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)
C_{AVG} = 1.00
Time Interval = 5 (mins)
Drainage Area = 0.04503 (hectares)

	Release Rate = 2.196 (L/sec)					Release Rate = 2.6246 (L/sec)					Release Rate = 3.2807 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.69 , B = 0.820				
	(I = A/(T_c+C) , C = 6.199					(I = A/(T_c+C) , C = 6.053					(I = A/(T_c+C) , C = 6.014				
Duration (min)	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	18.8	2.20	16.6	0.00	230.5	28.9	2.625	26.2	0.00	398.6	49.9	3.3	46.6	0.00
5	103.6	11.7	2.20	9.5	2.84	141.2	17.7	2.625	15.0	4.51	242.7	30.4	3.3	27.1	8.13
10	76.8	8.7	2.20	6.5	3.87	104.2	13.0	2.625	10.4	6.25	178.6	22.4	3.3	19.1	11.44
15	61.8	7.0	2.20	4.8	4.29	83.6	10.5	2.625	7.8	7.05	142.9	17.9	3.3	14.6	13.15
20	52.0	5.9	2.20	3.7	4.40	70.3	8.8	2.625	6.2	7.40	120.0	15.0	3.3	11.7	14.08
25	45.2	5.1	2.20	2.9	4.34	60.9	7.6	2.625	5.0	7.50	103.8	13.0	3.3	9.7	14.58
30	40.0	4.5	2.20	2.3	4.17	53.9	6.8	2.625	4.1	7.43	91.9	11.5	3.3	8.2	14.79
35	36.1	4.1	2.20	1.9	3.92	48.5	6.1	2.625	3.4	7.24	82.6	10.3	3.3	7.1	14.82
40	32.9	3.7	2.20	1.5	3.62	44.2	5.5	2.625	2.9	6.98	75.1	9.4	3.3	6.1	14.70
45	30.2	3.4	2.20	1.2	3.27	40.6	5.1	2.625	2.5	6.65	69.1	8.6	3.3	5.4	14.48
50	28.0	3.2	2.20	1.0	2.89	37.7	4.7	2.625	2.1	6.27	64.0	8.0	3.3	4.7	14.18
55	26.2	2.9	2.20	0.8	2.48	35.1	4.4	2.625	1.8	5.85	59.6	7.5	3.3	4.2	13.80
60	24.6	2.8	2.20	0.6	2.06	32.9	4.1	2.625	1.5	5.40	55.9	7.0	3.3	3.7	13.38
65	23.2	2.6	2.20	0.4	1.61	31.0	3.9	2.625	1.3	4.92	52.6	6.6	3.3	3.3	12.91
70	21.9	2.5	2.20	0.3	1.15	29.4	3.7	2.625	1.1	4.42	49.8	6.2	3.3	3.0	12.40
75	20.8	2.3	2.20	0.1	0.67	27.9	3.5	2.625	0.9	3.90	47.3	5.9	3.3	2.6	11.86
80	19.8	2.2	2.20	0.0	0.18	26.6	3.3	2.625	0.7	3.36	45.0	5.6	3.3	2.4	11.29
85	18.9	2.1	2.20	-0.1	-0.31	25.4	3.2	2.625	0.6	2.81	43.0	5.4	3.3	2.1	10.69
90	18.1	2.0	2.20	-0.2	-0.82	24.3	3.0	2.625	0.4	2.25	41.1	5.1	3.3	1.9	10.07
95	17.4	2.0	2.20	-0.2	-1.33	23.3	2.9	2.625	0.3	1.67	39.4	4.9	3.3	1.7	9.44
100	16.7	1.9	2.20	-0.3	-1.85	22.4	2.8	2.625	0.2	1.08	37.9	4.7	3.3	1.5	8.78
105	16.1	1.8	2.20	-0.4	-2.38	21.6	2.7	2.625	0.1	0.49	36.5	4.6	3.3	1.3	8.11
110	15.6	1.8	2.20	-0.4	-2.91	20.8	2.6	2.625	0.0	-0.12	35.2	4.4	3.3	1.1	7.43
115	15.0	1.7	2.20	-0.5	-3.45	20.1	2.5	2.625	-0.1	-0.73	34.0	4.3	3.3	1.0	6.74
120	14.6	1.6	2.20	-0.6	-4.00	19.5	2.4	2.625	-0.2	-1.35	32.9	4.1	3.3	0.8	6.03
Max =					**4.40**					**7.50**					**14.82**

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) Maximum Storage = Max Storage Over Duration

Storage Volumes Roof Area P-R-4 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)
C_{AVG} = 1.00
Time Interval = 5 (mins)
Drainage Area = 0.05862 (hectares)

	Release Rate = 2.296 (L/sec)					Release Rate = 2.7255 (L/sec)					Release Rate = 3.4069 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	(I = A/(T_c+C) , C = 6.199					(I = A/(T_c+C) , C = 6.053					(I = A/(T_c+C) , C = 6.014				
Duration (min)	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	24.5	2.30	22.2	0.00	230.5	37.6	2.725	34.8	0.00	398.6	65.0	3.4	61.6	0.00
5	103.6	15.2	2.30	12.9	3.87	141.2	23.0	2.725	20.3	6.08	242.7	39.6	3.4	36.1	10.84
10	76.8	11.3	2.30	9.0	5.38	104.2	17.0	2.725	14.3	8.55	178.6	29.1	3.4	25.7	15.42
15	61.8	9.1	2.30	6.8	6.09	83.6	13.6	2.725	10.9	9.80	142.9	23.3	3.4	19.9	17.89
20	52.0	7.6	2.30	5.3	6.40	70.3	11.4	2.725	8.7	10.47	120.0	19.5	3.4	16.1	19.37
25	45.2	6.6	2.30	4.3	6.49	60.9	9.9	2.725	7.2	10.80	103.8	16.9	3.4	13.5	20.28
30	40.0	5.9	2.30	3.6	6.44	53.9	8.8	2.725	6.1	10.91	91.9	15.0	3.4	11.6	20.82
35	36.1	5.3	2.30	3.0	6.28	48.5	7.9	2.725	5.2	10.88	82.6	13.5	3.4	10.1	21.11
40	32.9	4.8	2.30	2.5	6.06	44.2	7.2	2.725	4.5	10.74	75.1	12.2	3.4	8.8	21.21
45	30.2	4.4	2.30	2.1	5.77	40.6	6.6	2.725	3.9	10.52	69.1	11.3	3.4	7.8	21.18
50	28.0	4.1	2.30	1.8	5.45	37.7	6.1	2.725	3.4	10.23	64.0	10.4	3.4	7.0	21.05
55	26.2	3.8	2.30	1.5	5.09	35.1	5.7	2.725	3.0	9.89	59.6	9.7	3.4	6.3	20.82
60	24.6	3.6	2.30	1.3	4.70	32.9	5.4	2.725	2.6	9.52	55.9	9.1	3.4	5.7	20.53
65	23.2	3.4	2.30	1.1	4.29	31.0	5.1	2.725	2.3	9.10	52.6	8.6	3.4	5.2	20.17
70	21.9	3.2	2.30	0.9	3.85	29.4	4.8	2.725	2.1	8.66	49.8	8.1	3.4	4.7	19.77
75	20.8	3.1	2.30	0.8	3.40	27.9	4.5	2.725	1.8	8.19	47.3	7.7	3.4	4.3	19.32
80	19.8	2.9	2.30	0.6	2.94	26.6	4.3	2.725	1.6	7.70	45.0	7.3	3.4	3.9	18.84
85	18.9	2.8	2.30	0.5	2.46	25.4	4.1	2.725	1.4	7.18	43.0	7.0	3.4	3.6	18.33
90	18.1	2.7	2.30	0.4	1.97	24.3	4.0	2.725	1.2	6.66	41.1	6.7	3.4	3.3	17.78
95	17.4	2.6	2.30	0.3	1.47	23.3	3.8	2.725	1.1	6.11	39.4	6.4	3.4	3.0	17.21
100	16.7	2.5	2.30	0.2	0.96	22.4	3.7	2.725	0.9	5.56	37.9	6.2	3.4	2.8	16.62
105	16.1	2.4	2.30	0.1	0.44	21.6	3.5	2.725	0.8	4.99	36.5	5.9	3.4	2.5	16.01
110	15.6	2.3	2.30	0.0	-0.09	20.8	3.4	2.725	0.7	4.41	35.2	5.7	3.4	2.3	15.38
115	15.0	2.2	2.30	-0.1	-0.62	20.1	3.3	2.725	0.6	3.82	34.0	5.5	3.4	2.1	14.73
120	14.6	2.1	2.30	-0.2	-1.16	19.5	3.2	2.725	0.4	3.22	32.9	5.4	3.4	2.0	14.07
Max =					**6.49**					**10.91**					**21.21**

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) Maximum Storage = Max Storage Over Duration

Storage Volumes Roof Area P-R-5 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.02826 (hectares)

	Release Rate = 2.019 (L/sec)					Release Rate = 2.4479 (L/sec)					Release Rate = 3.0788 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	11.8	2.02	9.8	0.00	230.5	18.1	2.448	15.7	0.00	398.6	31.3	3.1	28.2	0.00
5	103.6	7.3	2.02	5.3	1.59	141.2	11.1	2.448	8.6	2.59	242.7	19.1	3.1	16.0	4.80
10	76.8	5.4	2.02	3.4	2.05	104.2	8.2	2.448	5.7	3.44	178.6	14.0	3.1	10.9	6.57
15	61.8	4.4	2.02	2.3	2.11	83.6	6.6	2.448	4.1	3.70	142.9	11.2	3.1	8.1	7.33
20	52.0	3.7	2.02	1.7	1.99	70.3	5.5	2.448	3.1	3.69	120.0	9.4	3.1	6.3	7.61
25	45.2	3.2	2.02	1.2	1.76	60.9	4.8	2.448	2.3	3.50	103.8	8.2	3.1	5.1	7.62
30	40.0	2.8	2.02	0.8	1.46	53.9	4.2	2.448	1.8	3.22	91.9	7.2	3.1	4.1	7.45
35	36.1	2.5	2.02	0.5	1.11	48.5	3.8	2.448	1.4	2.86	82.6	6.5	3.1	3.4	7.16
40	32.9	2.3	2.02	0.3	0.73	44.2	3.5	2.448	1.0	2.46	75.1	5.9	3.1	2.8	6.78
45	30.2	2.1	2.02	0.1	0.32	40.6	3.2	2.448	0.7	2.01	69.1	5.4	3.1	2.3	6.33
50	28.0	2.0	2.02	0.0	-0.11	37.7	3.0	2.448	0.5	1.53	64.0	5.0	3.1	1.9	5.84
55	26.2	1.9	2.02	-0.2	-0.56	35.1	2.8	2.448	0.3	1.03	59.6	4.7	3.1	1.6	5.30
60	24.6	1.7	2.02	-0.3	-1.02	32.9	2.6	2.448	0.1	0.50	55.9	4.4	3.1	1.3	4.72
65	23.2	1.6	2.02	-0.4	-1.49	31.0	2.4	2.448	0.0	-0.04	52.6	4.1	3.1	1.1	4.12
70	21.9	1.5	2.02	-0.5	-1.97	29.4	2.3	2.448	-0.1	-0.59	49.8	3.9	3.1	0.8	3.50
75	20.8	1.5	2.02	-0.5	-2.46	27.9	2.2	2.448	-0.3	-1.16	47.3	3.7	3.1	0.6	2.85
80	19.8	1.4	2.02	-0.6	-2.96	26.6	2.1	2.448	-0.4	-1.73	45.0	3.5	3.1	0.5	2.19
85	18.9	1.3	2.02	-0.7	-3.47	25.4	2.0	2.448	-0.5	-2.32	43.0	3.4	3.1	0.3	1.51
90	18.1	1.3	2.02	-0.7	-3.98	24.3	1.9	2.448	-0.5	-2.92	41.1	3.2	3.1	0.2	0.81
95	17.4	1.2	2.02	-0.8	-4.49	23.3	1.8	2.448	-0.6	-3.52	39.4	3.1	3.1	0.0	0.11
100	16.7	1.2	2.02	-0.8	-5.01	22.4	1.8	2.448	-0.7	-4.13	37.9	3.0	3.1	-0.1	-0.61
105	16.1	1.1	2.02	-0.9	-5.53	21.6	1.7	2.448	-0.8	-4.74	36.5	2.9	3.1	-0.2	-1.33
110	15.6	1.1	2.02	-0.9	-6.06	20.8	1.6	2.448	-0.8	-5.36	35.2	2.8	3.1	-0.3	-2.07
115	15.0	1.1	2.02	-1.0	-6.59	20.1	1.6	2.448	-0.9	-5.98	34.0	2.7	3.1	-0.4	-2.81
120	14.6	1.0	2.02	-1.0	-7.12	19.5	1.5	2.448	-0.9	-6.61	32.9	2.6	3.1	-0.5	-3.56
Max =					**2.11**					**3.70**					**7.62**

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

Storage Volumes Roof Area P-R-6 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.04487 (hectares)

	Release Rate = 3.066 (L/sec)					Release Rate = 3.6718 (L/sec)					Release Rate = 4.6561 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	18.8	3.07	15.7	0.00	230.5	28.8	3.672	25.1	0.00	398.6	49.7	4.7	45.1	0.00
5	103.6	11.6	3.07	8.6	2.57	141.2	17.6	3.672	13.9	4.18	242.7	30.3	4.7	25.6	7.69
10	76.8	8.6	3.07	5.6	3.33	104.2	13.0	3.672	9.3	5.60	178.6	22.3	4.7	17.6	10.57
15	61.8	6.9	3.07	3.9	3.48	83.6	10.4	3.672	6.8	6.08	142.9	17.8	4.7	13.2	11.85
20	52.0	5.8	3.07	2.8	3.33	70.3	8.8	3.672	5.1	6.11	120.0	15.0	4.7	10.3	12.37
25	45.2	5.1	3.07	2.0	3.01	60.9	7.6	3.672	3.9	5.89	103.8	13.0	4.7	8.3	12.45
30	40.0	4.5	3.07	1.4	2.57	53.9	6.7	3.672	3.1	5.50	91.9	11.5	4.7	6.8	12.25
35	36.1	4.0	3.07	1.0	2.06	48.5	6.1	3.672	2.4	5.00	82.6	10.3	4.7	5.6	11.86
40	32.9	3.7	3.07	0.6	1.50	44.2	5.5	3.672	1.8	4.42	75.1	9.4	4.7	4.7	11.32
45	30.2	3.4	3.07	0.3	0.89	40.6	5.1	3.672	1.4	3.77	69.1	8.6	4.7	4.0	10.69
50	28.0	3.1	3.07	0.1	0.25	37.7	4.7	3.672	1.0	3.08	64.0	8.0	4.7	3.3	9.97
55	26.2	2.9	3.07	-0.1	-0.42	35.1	4.4	3.672	0.7	2.34	59.6	7.4	4.7	2.8	9.18
60	24.6	2.8	3.07	-0.3	-1.11	32.9	4.1	3.672	0.4	1.58	55.9	7.0	4.7	2.3	8.34
65	23.2	2.6	3.07	-0.5	-1.82	31.0	3.9	3.672	0.2	0.78	52.6	6.6	4.7	1.9	7.45
70	21.9	2.5	3.07	-0.6	-2.55	29.4	3.7	3.672	0.0	-0.03	49.8	6.2	4.7	1.6	6.53
75	20.8	2.3	3.07	-0.7	-3.28	27.9	3.5	3.672	-0.2	-0.87	47.3	5.9	4.7	1.2	5.58
80	19.8	2.2	3.07	-0.8	-4.03	26.6	3.3	3.672	-0.4	-1.72	45.0	5.6	4.7	1.0	4.59
85	18.9	2.1	3.07	-0.9	-4.79	25.4	3.2	3.672	-0.5	-2.59	43.0	5.4	4.7	0.7	3.58
90	18.1	2.0	3.07	-1.0	-5.56	24.3	3.0	3.672	-0.6	-3.47	41.1	5.1	4.7	0.5	2.55
95	17.4	2.0	3.07	-1.1	-6.33	23.3	2.9	3.672	-0.8	-4.36	39.4	4.9	4.7	0.3	1.50
100	16.7	1.9	3.07	-1.2	-7.12	22.4	2.8	3.672	-0.9	-5.26	37.9	4.7	4.7	0.1	0.43
105	16.1	1.8	3.07	-1.3	-7.91	21.6	2.7	3.672	-1.0	-6.17	36.5	4.6	4.7	-0.1	-0.65
110	15.6	1.7	3.07	-1.3	-8.70	20.8	2.6	3.672	-1.1	-7.09	35.2	4.4	4.7	-0.3	-1.75
115	15.0	1.7	3.07	-1.4	-9.50	20.1	2.5	3.672	-1.2	-8.02	34.0	4.2	4.7	-0.4	-2.86
120	14.6	1.6	3.07	-1.4	-10.31	19.5	2.4	3.672	-1.2	-8.95	32.9	4.1	4.7	-0.6	-3.98
Max =					**3.48**					**6.11**					**12.45**

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

Storage Volumes Roof Area P-R-7 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.05524 (hectares)

	Release Rate = 3.180 (L/sec)					Release Rate = 3.8233 (L/sec)					Release Rate = 4.8075 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	23.1	3.18	19.9	0.00	230.5	35.4	3.823	31.6	0.00	398.6	61.2	4.8	56.4	0.00
5	103.6	14.3	3.18	11.1	3.34	141.2	21.7	3.823	17.9	5.36	242.7	37.3	4.8	32.5	9.74
10	76.8	10.6	3.18	7.4	4.46	104.2	16.0	3.823	12.2	7.31	178.6	27.4	4.8	22.6	13.57
15	61.8	8.5	3.18	5.4	4.82	83.6	12.8	3.823	9.0	8.11	142.9	21.9	4.8	17.1	15.42
20	52.0	7.2	3.18	4.0	4.81	70.3	10.8	3.823	7.0	8.36	120.0	18.4	4.8	13.6	16.33
25	45.2	6.2	3.18	3.1	4.59	60.9	9.4	3.823	5.5	8.29	103.8	15.9	4.8	11.1	16.71
30	40.0	5.5	3.18	2.4	4.24	53.9	8.3	3.823	4.5	8.02	91.9	14.1	4.8	9.3	16.74
35	36.1	5.0	3.18	1.8	3.79	48.5	7.5	3.823	3.6	7.62	82.6	12.7	4.8	7.9	16.53
40	32.9	4.5	3.18	1.4	3.27	44.2	6.8	3.823	3.0	7.11	75.1	11.5	4.8	6.7	16.16
45	30.2	4.2	3.18	1.0	2.70	40.6	6.2	3.823	2.4	6.52	69.1	10.6	4.8	5.8	15.65
50	28.0	3.9	3.18	0.7	2.09	37.7	5.8	3.823	2.0	5.88	64.0	9.8	4.8	5.0	15.04
55	26.2	3.6	3.18	0.4	1.44	35.1	5.4	3.823	1.6	5.18	59.6	9.2	4.8	4.3	14.35
60	24.6	3.4	3.18	0.2	0.77	32.9	5.1	3.823	1.2	4.45	55.9	8.6	4.8	3.8	13.59
65	23.2	3.2	3.18	0.0	0.08	31.0	4.8	3.823	0.9	3.68	52.6	8.1	4.8	3.3	12.78
70	21.9	3.0	3.18	-0.2	-0.64	29.4	4.5	3.823	0.7	2.89	49.8	7.6	4.8	2.8	11.92
75	20.8	2.9	3.18	-0.3	-1.36	27.9	4.3	3.823	0.5	2.07	47.3	7.3	4.8	2.4	11.02
80	19.8	2.7	3.18	-0.4	-2.11	26.6	4.1	3.823	0.3	1.23	45.0	6.9	4.8	2.1	10.09
85	18.9	2.6	3.18	-0.6	-2.86	25.4	3.9	3.823	0.1	0.37	43.0	6.6	4.8	1.8	9.12
90	18.1	2.5	3.18	-0.7	-3.63	24.3	3.7	3.823	-0.1	-0.50	41.1	6.3	4.8	1.5	8.13
95	17.4	2.4	3.18	-0.8	-4.41	23.3	3.6	3.823	-0.2	-1.39	39.4	6.1	4.8	1.2	7.11
100	16.7	2.3	3.18	-0.9	-5.19	22.4	3.4	3.823	-0.4	-2.29	37.9	5.8	4.8	1.0	6.08
105	16.1	2.2	3.18	-0.9	-5.98	21.6	3.3	3.823	-0.5	-3.21	36.5	5.6	4.8	0.8	5.02
110	15.6	2.2	3.18	-1.0	-6.78	20.8	3.2	3.823	-0.6	-4.13	35.2	5.4	4.8	0.6	3.95
115	15.0	2.1	3.18	-1.1	-7.59	20.1	3.1	3.823	-0.7	-5.06	34.0	5.2	4.8	0.4	2.86
120	14.6	2.0	3.18	-1.2	-8.40	19.5	3.0	3.823	-0.8	-6.00	32.9	5.1	4.8	0.2	1.76
Max =					**4.82**					**8.36**					**16.74**

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

Storage Volumes Roof Area P-R-8 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.04889 (hectares)

	Release Rate = 3.104 (L/sec)					Release Rate = 3.7097 (L/sec)					Release Rate = 4.7318 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	20.5	3.10	17.4	0.00	230.5	31.3	3.710	27.6	0.00	398.6	54.2	4.7	49.4	0.00
5	103.6	12.7	3.10	9.6	2.87	141.2	19.2	3.710	15.5	4.64	242.7	33.0	4.7	28.3	8.48
10	76.8	9.4	3.10	6.3	3.77	104.2	14.2	3.710	10.5	6.27	178.6	24.3	4.7	19.5	11.72
15	61.8	7.6	3.10	4.5	4.01	83.6	11.4	3.710	7.6	6.88	142.9	19.4	4.7	14.7	13.22
20	52.0	6.4	3.10	3.3	3.91	70.3	9.5	3.710	5.8	7.01	120.0	16.3	4.7	11.6	13.89
25	45.2	5.5	3.10	2.4	3.63	60.9	8.3	3.710	4.6	6.85	103.8	14.1	4.7	9.4	14.07
30	40.0	4.9	3.10	1.8	3.23	53.9	7.3	3.710	3.6	6.52	91.9	12.5	4.7	7.8	13.96
35	36.1	4.4	3.10	1.3	2.74	48.5	6.6	3.710	2.9	6.06	82.6	11.2	4.7	6.5	13.63
40	32.9	4.0	3.10	0.9	2.20	44.2	6.0	3.710	2.3	5.51	75.1	10.2	4.7	5.5	13.16
45	30.2	3.7	3.10	0.6	1.61	40.6	5.5	3.710	1.8	4.89	69.1	9.4	4.7	4.7	12.56
50	28.0	3.4	3.10	0.3	0.98	37.7	5.1	3.710	1.4	4.22	64.0	8.7	4.7	4.0	11.88
55	26.2	3.2	3.10	0.1	0.32	35.1	4.8	3.710	1.1	3.51	59.6	8.1	4.7	3.4	11.13
60	24.6	3.0	3.10	-0.1	-0.36	32.9	4.5	3.710	0.8	2.76	55.9	7.6	4.7	2.9	10.31
65	23.2	2.8	3.10	-0.3	-1.06	31.0	4.2	3.710	0.5	1.99	52.6	7.2	4.7	2.4	9.45
70	21.9	2.7	3.10	-0.4	-1.78	29.4	4.0	3.710	0.3	1.19	49.8	6.8	4.7	2.0	8.55
75	20.8	2.5	3.10	-0.6	-2.51	27.9	3.8	3.710	0.1	0.36	47.3	6.4	4.7	1.7	7.61
80	19.8	2.4	3.10	-0.7	-3.26	26.6	3.6	3.710	-0.1	-0.48	45.0	6.1	4.7	1.4	6.64
85	18.9	2.3	3.10	-0.8	-4.01	25.4	3.4	3.710	-0.3	-1.33	43.0	5.8	4.7	1.1	5.64
90	18.1	2.2	3.10	-0.9	-4.78	24.3	3.3	3.710	-0.4	-2.21	41.1	5.6	4.7	0.9	4.62
95	17.4	2.1	3.10	-1.0	-5.55	23.3	3.2	3.710	-0.5	-3.09	39.4	5.4	4.7	0.6	3.58
100	16.7	2.0	3.10	-1.1	-6.33	22.4	3.0	3.710	-0.7	-3.99	37.9	5.2	4.7	0.4	2.52
105	16.1	2.0	3.10	-1.1	-7.12	21.6	2.9	3.710	-0.8	-4.89	36.5	5.0	4.7	0.2	1.44
110	15.6	1.9	3.10	-1.2	-7.92	20.8	2.8	3.710	-0.9	-5.81	35.2	4.8	4.7	0.1	0.35
115	15.0	1.8	3.10	-1.3	-8.72	20.1	2.7	3.710	-1.0	-6.73	34.0	4.6	4.7	-0.1	-0.76
120	14.6	1.8	3.10	-1.3	-9.52	19.5	2.6	3.710	-1.1	-7.66	32.9	4.5	4.7	-0.3	-1.88
Max =					**4.01**					**7.01**					**14.07**

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

Storage Volumes Roof Area P-R-9 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.04248 (hectares)

	Release Rate = 3.028 (L/sec)					Release Rate = 3.6340 (L/sec)					Release Rate = 4.6561 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	17.8	3.03	14.7	0.00	230.5	27.2	3.634	23.6	0.00	398.6	47.1	4.7	42.4	0.00
5	103.6	11.0	3.03	8.0	2.39	141.2	16.7	3.634	13.0	3.91	242.7	28.7	4.7	24.0	7.20
10	76.8	8.2	3.03	5.1	3.08	104.2	12.3	3.634	8.7	5.20	178.6	21.1	4.7	16.4	9.86
15	61.8	6.6	3.03	3.5	3.18	83.6	9.9	3.634	6.2	5.61	142.9	16.9	4.7	12.2	11.00
20	52.0	5.5	3.03	2.5	3.00	70.3	8.3	3.634	4.7	5.59	120.0	14.2	4.7	9.5	11.41
25	45.2	4.8	3.03	1.8	2.66	60.9	7.2	3.634	3.6	5.34	103.8	12.3	4.7	7.6	11.41
30	40.0	4.3	3.03	1.2	2.21	53.9	6.4	3.634	2.7	4.92	91.9	10.8	4.7	6.2	11.15
35	36.1	3.8	3.03	0.8	1.69	48.5	5.7	3.634	2.1	4.40	82.6	9.8	4.7	5.1	10.70
40	32.9	3.5	3.03	0.5	1.11	44.2	5.2	3.634	1.6	3.80	75.1	8.9	4.7	4.2	10.12
45	30.2	3.2	3.03	0.2	0.50	40.6	4.8	3.634	1.2	3.14	69.1	8.2	4.7	3.5	9.45
50	28.0	3.0	3.03	0.0	-0.14	37.7	4.4	3.634	0.8	2.44	64.0	7.6	4.7	2.9	8.69
55	26.2	2.8	3.03	-0.2	-0.81	35.1	4.1	3.634	0.5	1.70	59.6	7.0	4.7	2.4	7.87
60	24.6	2.6	3.03	-0.4	-1.51	32.9	3.9	3.634	0.3	0.92	55.9	6.6	4.7	1.9	7.00
65	23.2	2.5	3.03	-0.6	-2.21	31.0	3.7	3.634	0.0	0.12	52.6	6.2	4.7	1.6	6.09
70	21.9	2.3	3.03	-0.7	-2.94	29.4	3.5	3.634	-0.2	-0.69	49.8	5.9	4.7	1.2	5.14
75	20.8	2.2	3.03	-0.8	-3.67	27.9	3.3	3.634	-0.3	-1.53	47.3	5.6	4.7	0.9	4.16
80	19.8	2.1	3.03	-0.9	-4.42	26.6	3.1	3.634	-0.5	-2.39	45.0	5.3	4.7	0.7	3.15
85	18.9	2.0	3.03	-1.0	-5.18	25.4	3.0	3.634	-0.6	-3.25	43.0	5.1	4.7	0.4	2.12
90	18.1	1.9	3.03	-1.1	-5.94	24.3	2.9	3.634	-0.8	-4.14	41.1	4.9	4.7	0.2	1.07
95	17.4	1.9	3.03	-1.2	-6.71	23.3	2.8	3.634	-0.9	-5.03	39.4	4.7	4.7	0.0	0.00
100	16.7	1.8	3.03	-1.2	-7.49	22.4	2.6	3.634	-1.0	-5.93	37.9	4.5	4.7	-0.2	-1.08
105	16.1	1.7	3.03	-1.3	-8.28	21.6	2.5	3.634	-1.1	-6.84	36.5	4.3	4.7	-0.3	-2.18
110	15.6	1.7	3.03	-1.4	-9.07	20.8	2.5	3.634	-1.2	-7.76	35.2	4.2	4.7	-0.5	-3.29
115	15.0	1.6	3.03	-1.4	-9.86	20.1	2.4	3.634	-1.3	-8.68	34.0	4.0	4.7	-0.6	-4.42
120	14.6	1.5	3.03	-1.5	-10.66	19.5	2.3	3.634	-1.3	-9.61	32.9	3.9	4.7	-0.8	-5.55
Max =					**3.18**					**5.61**					**11.41**

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

Storage Volumes Roof Area P-R-10 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.12339 (hectares)

	Release Rate = 6.511 (L/sec)					Release Rate = 7.7979 (L/sec)					Release Rate = 9.7664 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	51.6	6.51	45.1	0.00	230.5	79.1	7.798	71.3	0.00	398.6	136.7	9.8	127.0	0.00
5	103.6	32.0	6.51	25.5	7.64	141.2	48.4	7.798	40.6	12.19	242.7	83.3	9.8	73.5	22.05
10	76.8	23.7	6.51	17.2	10.32	104.2	35.7	7.798	27.9	16.77	178.6	61.3	9.8	51.5	30.89
15	61.8	19.1	6.51	12.6	11.30	83.6	28.7	7.798	20.9	18.78	142.9	49.0	9.8	39.3	35.33
20	52.0	16.1	6.51	9.6	11.46	70.3	24.1	7.798	16.3	19.56	120.0	41.1	9.8	31.4	37.66
25	45.2	13.9	6.51	7.4	11.15	60.9	20.9	7.798	13.1	19.64	103.8	35.6	9.8	25.9	38.78
30	40.0	12.4	6.51	5.9	10.53	53.9	18.5	7.798	10.7	19.26	91.9	31.5	9.8	21.7	39.14
35	36.1	11.1	6.51	4.6	9.71	48.5	16.6	7.798	8.8	18.57	82.6	28.3	9.8	18.6	38.98
40	32.9	10.1	6.51	3.6	8.72	44.2	15.2	7.798	7.4	17.66	75.1	25.8	9.8	16.0	38.43
45	30.2	9.3	6.51	2.8	7.63	40.6	13.9	7.798	6.1	16.57	69.1	23.7	9.8	13.9	37.58
50	28.0	8.7	6.51	2.1	6.44	37.7	12.9	7.798	5.1	15.35	64.0	21.9	9.8	12.2	36.51
55	26.2	8.1	6.51	1.6	5.18	35.1	12.0	7.798	4.3	14.03	59.6	20.5	9.8	10.7	35.26
60	24.6	7.6	6.51	1.1	3.85	32.9	11.3	7.798	3.5	12.61	55.9	19.2	9.8	9.4	33.87
65	23.2	7.1	6.51	0.6	2.48	31.0	10.6	7.798	2.9	11.12	52.6	18.1	9.8	8.3	32.34
70	21.9	6.8	6.51	0.3	1.07	29.4	10.1	7.798	2.3	9.57	49.8	17.1	9.8	7.3	30.71
75	20.8	6.4	6.51	-0.1	-0.38	27.9	9.6	7.798	1.8	7.96	47.3	16.2	9.8	6.4	29.00
80	19.8	6.1	6.51	-0.4	-1.87	26.6	9.1	7.798	1.3	6.31	45.0	15.4	9.8	5.7	27.20
85	18.9	5.8	6.51	-0.7	-3.38	25.4	8.7	7.798	0.9	4.61	43.0	14.7	9.8	5.0	25.34
90	18.1	5.6	6.51	-0.9	-4.91	24.3	8.3	7.798	0.5	2.88	41.1	14.1	9.8	4.3	23.41
95	17.4	5.4	6.51	-1.1	-6.47	23.3	8.0	7.798	0.2	1.12	39.4	13.5	9.8	3.8	21.44
100	16.7	5.2	6.51	-1.3	-8.05	22.4	7.7	7.798	-0.1	-0.67	37.9	13.0	9.8	3.2	19.41
105	16.1	5.0	6.51	-1.5	-9.64	21.6	7.4	7.798	-0.4	-2.49	36.5	12.5	9.8	2.8	17.35
110	15.6	4.8	6.51	-1.7	-11.25	20.8	7.1	7.798	-0.7	-4.32	35.2	12.1	9.8	2.3	15.24
115	15.0	4.6	6.51	-1.9	-12.87	20.1	6.9	7.798	-0.9	-6.19	34.0	11.7	9.8	1.9	13.10
120	14.6	4.5	6.51	-2.0	-14.51	19.5	6.7	7.798	-1.1	-8.06	32.9	11.3	9.8	1.5	10.93
Max =					**11.46**					**19.64**					**39.14**

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

Storage Volumes Roof Area P-R-11 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.03940 (hectares)

	Release Rate = 2.953 (L/sec)					Release Rate = 3.5961 (L/sec)					Release Rate = 4.5803 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$) , C = 6.199					($I = A/(T_c+C)$) , C = 6.053					($I = A/(T_c+C)$) , C = 6.014				
Duration (min)	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	16.5	2.95	13.5	0.00	230.5	25.2	3.596	21.7	0.00	398.6	43.7	4.6	39.1	0.00
5	103.6	10.2	2.95	7.3	2.18	141.2	15.5	3.596	11.9	3.56	242.7	26.6	4.6	22.0	6.60
10	76.8	7.6	2.95	4.6	2.77	104.2	11.4	3.596	7.8	4.69	178.6	19.6	4.6	15.0	8.99
15	61.8	6.1	2.95	3.1	2.82	83.6	9.2	3.596	5.6	5.00	142.9	15.7	4.6	11.1	9.96
20	52.0	5.1	2.95	2.2	2.61	70.3	7.7	3.596	4.1	4.92	120.0	13.1	4.6	8.6	10.27
25	45.2	4.5	2.95	1.5	2.25	60.9	6.7	3.596	3.1	4.61	103.8	11.4	4.6	6.8	10.19
30	40.0	3.9	2.95	1.0	1.79	53.9	5.9	3.596	2.3	4.16	91.9	10.1	4.6	5.5	9.87
35	36.1	3.6	2.95	0.6	1.26	48.5	5.3	3.596	1.7	3.61	82.6	9.0	4.6	4.5	9.38
40	32.9	3.2	2.95	0.3	0.69	44.2	4.8	3.596	1.2	2.98	75.1	8.2	4.6	3.7	8.76
45	30.2	3.0	2.95	0.0	0.08	40.6	4.5	3.596	0.9	2.31	69.1	7.6	4.6	3.0	8.05
50	28.0	2.8	2.95	-0.2	-0.56	37.7	4.1	3.596	0.5	1.58	64.0	7.0	4.6	2.4	7.28
55	26.2	2.6	2.95	-0.4	-1.23	35.1	3.8	3.596	0.3	0.83	59.6	6.5	4.6	2.0	6.44
60	24.6	2.4	2.95	-0.5	-1.91	32.9	3.6	3.596	0.0	0.04	55.9	6.1	4.6	1.5	5.55
65	23.2	2.3	2.95	-0.7	-2.61	31.0	3.4	3.596	-0.2	-0.76	52.6	5.8	4.6	1.2	4.63
70	21.9	2.2	2.95	-0.8	-3.33	29.4	3.2	3.596	-0.4	-1.59	49.8	5.5	4.6	0.9	3.67
75	20.8	2.1	2.95	-0.9	-4.05	27.9	3.1	3.596	-0.5	-2.44	47.3	5.2	4.6	0.6	2.68
80	19.8	2.0	2.95	-1.0	-4.79	26.6	2.9	3.596	-0.7	-3.30	45.0	4.9	4.6	0.3	1.67
85	18.9	1.9	2.95	-1.1	-5.53	25.4	2.8	3.596	-0.8	-4.17	43.0	4.7	4.6	0.1	0.64
90	18.1	1.8	2.95	-1.2	-6.29	24.3	2.7	3.596	-0.9	-5.05	41.1	4.5	4.6	-0.1	-0.42
95	17.4	1.7	2.95	-1.2	-7.04	23.3	2.6	3.596	-1.0	-5.95	39.4	4.3	4.6	-0.3	-1.49
100	16.7	1.7	2.95	-1.3	-7.81	22.4	2.5	3.596	-1.1	-6.85	37.9	4.2	4.6	-0.4	-2.57
105	16.1	1.6	2.95	-1.4	-8.58	21.6	2.4	3.596	-1.2	-7.76	36.5	4.0	4.6	-0.6	-3.67
110	15.6	1.5	2.95	-1.4	-9.36	20.8	2.3	3.596	-1.3	-8.68	35.2	3.9	4.6	-0.7	-4.78
115	15.0	1.5	2.95	-1.5	-10.14	20.1	2.2	3.596	-1.4	-9.61	34.0	3.7	4.6	-0.9	-5.90
120	14.6	1.4	2.95	-1.5	-10.92	19.5	2.1	3.596	-1.5	-10.54	32.9	3.6	4.6	-1.0	-7.04
Max =					**2.82**					**5.00**					**10.27**

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

Storage Volumes Roof Area P-R-12 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)

C_{AVG} = 1.00

Time Interval = 5 (mins)

Drainage Area = 0.02554 (hectares)

	Release Rate = 1.968 (L/sec)					Release Rate = 2.3974 (L/sec)					Release Rate = 3.0283 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	10.7	1.97	8.7	0.00	230.5	16.4	2.397	14.0	0.00	398.6	28.3	3.0	25.3	0.00
5	103.6	6.6	1.97	4.6	1.39	141.2	10.0	2.397	7.6	2.29	242.7	17.2	3.0	14.2	4.26
10	76.8	4.9	1.97	2.9	1.76	104.2	7.4	2.397	5.0	3.00	178.6	12.7	3.0	9.6	5.79
15	61.8	3.9	1.97	2.0	1.78	83.6	5.9	2.397	3.5	3.18	142.9	10.1	3.0	7.1	6.40
20	52.0	3.3	1.97	1.4	1.63	70.3	5.0	2.397	2.6	3.11	120.0	8.5	3.0	5.5	6.59
25	45.2	2.9	1.97	0.9	1.38	60.9	4.3	2.397	1.9	2.89	103.8	7.4	3.0	4.3	6.52
30	40.0	2.6	1.97	0.6	1.06	53.9	3.8	2.397	1.4	2.58	91.9	6.5	3.0	3.5	6.29
35	36.1	2.3	1.97	0.3	0.70	48.5	3.4	2.397	1.0	2.20	82.6	5.9	3.0	2.8	5.95
40	32.9	2.1	1.97	0.1	0.32	44.2	3.1	2.397	0.7	1.77	75.1	5.3	3.0	2.3	5.54
45	30.2	1.9	1.97	0.0	-0.10	40.6	2.9	2.397	0.5	1.31	69.1	4.9	3.0	1.9	5.06
50	28.0	1.8	1.97	-0.2	-0.53	37.7	2.7	2.397	0.3	0.83	64.0	4.5	3.0	1.5	4.54
55	26.2	1.7	1.97	-0.3	-0.98	35.1	2.5	2.397	0.1	0.32	59.6	4.2	3.0	1.2	3.98
60	24.6	1.6	1.97	-0.4	-1.44	32.9	2.3	2.397	-0.1	-0.21	55.9	4.0	3.0	0.9	3.38
65	23.2	1.5	1.97	-0.5	-1.91	31.0	2.2	2.397	-0.2	-0.75	52.6	3.7	3.0	0.7	2.77
70	21.9	1.4	1.97	-0.6	-2.39	29.4	2.1	2.397	-0.3	-1.31	49.8	3.5	3.0	0.5	2.13
75	20.8	1.3	1.97	-0.6	-2.87	27.9	2.0	2.397	-0.4	-1.88	47.3	3.4	3.0	0.3	1.47
80	19.8	1.3	1.97	-0.7	-3.37	26.6	1.9	2.397	-0.5	-2.46	45.0	3.2	3.0	0.2	0.80
85	18.9	1.2	1.97	-0.8	-3.87	25.4	1.8	2.397	-0.6	-3.04	43.0	3.0	3.0	0.0	0.11
90	18.1	1.2	1.97	-0.8	-4.37	24.3	1.7	2.397	-0.7	-3.63	41.1	2.9	3.0	-0.1	-0.59
95	17.4	1.1	1.97	-0.9	-4.88	23.3	1.7	2.397	-0.7	-4.23	39.4	2.8	3.0	-0.2	-1.30
100	16.7	1.1	1.97	-0.9	-5.39	22.4	1.6	2.397	-0.8	-4.84	37.9	2.7	3.0	-0.3	-2.02
105	16.1	1.0	1.97	-0.9	-5.91	21.6	1.5	2.397	-0.9	-5.45	36.5	2.6	3.0	-0.4	-2.75
110	15.6	1.0	1.97	-1.0	-6.43	20.8	1.5	2.397	-0.9	-6.07	35.2	2.5	3.0	-0.5	-3.49
115	15.0	1.0	1.97	-1.0	-6.95	20.1	1.4	2.397	-1.0	-6.69	34.0	2.4	3.0	-0.6	-4.24
120	14.6	0.9	1.97	-1.0	-7.47	19.5	1.4	2.397	-1.0	-7.31	32.9	2.3	3.0	-0.7	-4.99
Max =					**1.78**					**3.18**					**6.59**

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

Storage Volumes Roof Area P-R-13 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)
C_{AVG} = 1.00
Time Interval = 5 (mins)
Drainage Area = 0.01323 (hectares)

	Release Rate = 0.997 (L/sec)					Release Rate = 1.1987 (L/sec)					Release Rate = 1.5268 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$, C = 6.199					($I = A/(T_c+C)$, C = 6.053					($I = A/(T_c+C)$, C = 6.014				
Duration (min)	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	5.5	1.00	4.5	0.00	230.5	8.5	1.199	7.3	0.00	398.6	14.7	1.5	13.1	0.00
5	103.6	3.4	1.00	2.4	0.73	141.2	5.2	1.199	4.0	1.20	242.7	8.9	1.5	7.4	2.22
10	76.8	2.5	1.00	1.5	0.93	104.2	3.8	1.199	2.6	1.58	178.6	6.6	1.5	5.0	3.02
15	61.8	2.0	1.00	1.0	0.94	83.6	3.1	1.199	1.9	1.69	142.9	5.3	1.5	3.7	3.36
20	52.0	1.7	1.00	0.7	0.87	70.3	2.6	1.199	1.4	1.66	120.0	4.4	1.5	2.9	3.46
25	45.2	1.5	1.00	0.5	0.75	60.9	2.2	1.199	1.0	1.56	103.8	3.8	1.5	2.3	3.44
30	40.0	1.3	1.00	0.3	0.59	53.9	2.0	1.199	0.8	1.41	91.9	3.4	1.5	1.9	3.33
35	36.1	1.2	1.00	0.2	0.41	48.5	1.8	1.199	0.6	1.23	82.6	3.0	1.5	1.5	3.17
40	32.9	1.1	1.00	0.1	0.22	44.2	1.6	1.199	0.4	1.02	75.1	2.8	1.5	1.2	2.97
45	30.2	1.0	1.00	0.0	0.01	40.6	1.5	1.199	0.3	0.80	69.1	2.5	1.5	1.0	2.73
50	28.0	0.9	1.00	-0.1	-0.21	37.7	1.4	1.199	0.2	0.56	64.0	2.4	1.5	0.8	2.48
55	26.2	0.9	1.00	-0.1	-0.43	35.1	1.3	1.199	0.1	0.31	59.6	2.2	1.5	0.7	2.20
60	24.6	0.8	1.00	-0.2	-0.66	32.9	1.2	1.199	0.0	0.05	55.9	2.1	1.5	0.5	1.90
65	23.2	0.8	1.00	-0.2	-0.90	31.0	1.1	1.199	-0.1	-0.22	52.6	1.9	1.5	0.4	1.60
70	21.9	0.7	1.00	-0.3	-1.14	29.4	1.1	1.199	-0.1	-0.50	49.8	1.8	1.5	0.3	1.28
75	20.8	0.7	1.00	-0.3	-1.39	27.9	1.0	1.199	-0.2	-0.78	47.3	1.7	1.5	0.2	0.95
80	19.8	0.7	1.00	-0.3	-1.63	26.6	1.0	1.199	-0.2	-1.06	45.0	1.7	1.5	0.1	0.61
85	18.9	0.6	1.00	-0.4	-1.89	25.4	0.9	1.199	-0.3	-1.36	43.0	1.6	1.5	0.1	0.27
90	18.1	0.6	1.00	-0.4	-2.14	24.3	0.9	1.199	-0.3	-1.65	41.1	1.5	1.5	0.0	-0.08
95	17.4	0.6	1.00	-0.4	-2.40	23.3	0.9	1.199	-0.3	-1.95	39.4	1.5	1.5	-0.1	-0.44
100	16.7	0.6	1.00	-0.4	-2.66	22.4	0.8	1.199	-0.4	-2.25	37.9	1.4	1.5	-0.1	-0.80
105	16.1	0.5	1.00	-0.5	-2.92	21.6	0.8	1.199	-0.4	-2.55	36.5	1.3	1.5	-0.2	-1.16
110	15.6	0.5	1.00	-0.5	-3.18	20.8	0.8	1.199	-0.4	-2.86	35.2	1.3	1.5	-0.2	-1.53
115	15.0	0.5	1.00	-0.5	-3.44	20.1	0.7	1.199	-0.5	-3.17	34.0	1.3	1.5	-0.3	-1.91
120	14.6	0.5	1.00	-0.5	-3.71	19.5	0.7	1.199	-0.5	-3.48	32.9	1.2	1.5	-0.3	-2.28
Max =					**0.94**					**1.69**					**3.46**

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

Storage Volumes Roof Area P-R-14 (2 Year, 5 Year and 100 Year Storms)

C_{AVG} = 0.90 (dimmensionless)
C_{AVG} = 1.00
Time Interval = 5 (mins)
Drainage Area = 0.01299 (hectares)

	Release Rate = 0.997 (L/sec)					Release Rate = 1.1987 (L/sec)					Release Rate = 1.5268 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951 , B = 0.810					IDF Parameters, A = 998.071 , B = 0.814					IDF Parameters, A = 1735.688 , B = 0.820				
	($I = A/(T_c+C)$) , C = 6.199					($I = A/(T_c+C)$) , C = 6.053					($I = A/(T_c+C)$) , C = 6.014				
Duration (min)	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	1.00	4.4	0.00	230.5	8.3	1.199	7.1	0.00	398.6	14.4	1.5	12.9	0.00
5	103.6	3.4	1.00	2.4	0.71	141.2	5.1	1.199	3.9	1.17	242.7	8.8	1.5	7.2	2.17
10	76.8	2.5	1.00	1.5	0.90	104.2	3.8	1.199	2.6	1.54	178.6	6.4	1.5	4.9	2.95
15	61.8	2.0	1.00	1.0	0.91	83.6	3.0	1.199	1.8	1.64	142.9	5.2	1.5	3.6	3.27
20	52.0	1.7	1.00	0.7	0.83	70.3	2.5	1.199	1.3	1.60	120.0	4.3	1.5	2.8	3.36
25	45.2	1.5	1.00	0.5	0.71	60.9	2.2	1.199	1.0	1.50	103.8	3.7	1.5	2.2	3.33
30	40.0	1.3	1.00	0.3	0.55	53.9	1.9	1.199	0.7	1.35	91.9	3.3	1.5	1.8	3.22
35	36.1	1.2	1.00	0.2	0.37	48.5	1.8	1.199	0.6	1.16	82.6	3.0	1.5	1.5	3.05
40	32.9	1.1	1.00	0.1	0.17	44.2	1.6	1.199	0.4	0.95	75.1	2.7	1.5	1.2	2.85
45	30.2	1.0	1.00	0.0	-0.04	40.6	1.5	1.199	0.3	0.72	69.1	2.5	1.5	1.0	2.61
50	28.0	0.9	1.00	-0.1	-0.26	37.7	1.4	1.199	0.2	0.48	64.0	2.3	1.5	0.8	2.35
55	26.2	0.9	1.00	-0.1	-0.48	35.1	1.3	1.199	0.1	0.23	59.6	2.2	1.5	0.6	2.06
60	24.6	0.8	1.00	-0.2	-0.72	32.9	1.2	1.199	0.0	-0.03	55.9	2.0	1.5	0.5	1.77
65	23.2	0.8	1.00	-0.2	-0.95	31.0	1.1	1.199	-0.1	-0.30	52.6	1.9	1.5	0.4	1.46
70	21.9	0.7	1.00	-0.3	-1.20	29.4	1.1	1.199	-0.1	-0.58	49.8	1.8	1.5	0.3	1.14
75	20.8	0.7	1.00	-0.3	-1.44	27.9	1.0	1.199	-0.2	-0.86	47.3	1.7	1.5	0.2	0.81
80	19.8	0.6	1.00	-0.4	-1.69	26.6	1.0	1.199	-0.2	-1.15	45.0	1.6	1.5	0.1	0.47
85	18.9	0.6	1.00	-0.4	-1.94	25.4	0.9	1.199	-0.3	-1.44	43.0	1.6	1.5	0.0	0.12
90	18.1	0.6	1.00	-0.4	-2.20	24.3	0.9	1.199	-0.3	-1.74	41.1	1.5	1.5	0.0	-0.23
95	17.4	0.6	1.00	-0.4	-2.46	23.3	0.8	1.199	-0.4	-2.04	39.4	1.4	1.5	-0.1	-0.59
100	16.7	0.5	1.00	-0.5	-2.72	22.4	0.8	1.199	-0.4	-2.34	37.9	1.4	1.5	-0.2	-0.95
105	16.1	0.5	1.00	-0.5	-2.98	21.6	0.8	1.199	-0.4	-2.64	36.5	1.3	1.5	-0.2	-1.32
110	15.6	0.5	1.00	-0.5	-3.24	20.8	0.8	1.199	-0.4	-2.95	35.2	1.3	1.5	-0.3	-1.69
115	15.0	0.5	1.00	-0.5	-3.50	20.1	0.7	1.199	-0.5	-3.26	34.0	1.2	1.5	-0.3	-2.06
120	14.6	0.5	1.00	-0.5	-3.77	19.5	0.7	1.199	-0.5	-3.57	32.9	1.2	1.5	-0.3	-2.44
Max =					**0.91**					**1.64**					**3.36**

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

TABLE D9 P-1 Storage Volumes for 2-year, 5-Year and 100-Year Storms (MRM)

Area No: P-1
C_{AVG} = 0.59 (2-yr)
C_{AVG} = 0.59 (5-yr)
C_{AVG} = 0.73 (100-yr, Max 1.0)
Time Interval = 5.00 (mins)
Drainage Area = 0.1257 (hectares)

Actual Release Rate (L/sec) = 30.00
Percentage of Actual Rate (City of Ottawa requirement) = 100% (Set to 50% when U/G storage used)
Release Rate Used for Estimation of 100-year Storage (L/sec) = 30.00

Intensity Incr (%) = 20% Use 20% for Climate Change

Duration (mins)	Release Rate = 15.78 (L/sec); Return Period = (years); IDF Parameters, A = 733.0, B = 0.810, C = 6.199 (I = A/(T_c+C))					Release Rate = 21.41 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.1, B = 0.814, C = 6.053 (I = A/(T_c+C))					Release Rate = 30.00 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.7, B = 0.820, C = 6.014 (I = A/(T_c+C))					Release Rate = 30.00 (L/sec); Return Period = 100+20% (years); IDF Parameters, A = 1735.7, 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)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	34.4	15.8	18.6	0.0	230.5	47.4	21.4	26.0	0.0	398.6	102.4	30.0	72.4	0.0	478.3	122.9	30.0	92.9	0.0
5	103.6	21.3	15.8	5.5	1.7	141.2	29.0	21.4	7.6	2.3	242.7	62.3	30.0	32.3	9.7	291.2	74.8	30.0	44.8	13.4
10	76.8	15.8	15.8	0.0	0.0	104.2	21.4	21.4	0.0	0.0	178.6	45.9	30.0	15.9	9.5	214.3	55.0	30.0	25.0	15.0
15	61.8	12.7	15.8	-3.1	-2.8	83.6	17.2	21.4	-4.2	-3.8	142.9	36.7	30.0	6.7	6.0	171.5	44.0	30.0	14.0	12.6
20	52.0	10.7	15.8	-5.1	-6.1	70.3	14.4	21.4	-7.0	-8.4	120.0	30.8	30.0	0.8	1.0	143.9	37.0	30.0	7.0	8.4
25	45.2	9.3	15.8	-6.5	-9.8	60.9	12.5	21.4	-8.9	-13.3	103.8	26.7	30.0	-3.3	-5.0	124.6	32.0	30.0	2.0	3.0
30	40.0	8.2	15.8	-7.6	-13.6	53.9	11.1	21.4	-10.3	-18.6	91.9	23.6	30.0	-6.4	-11.5	110.2	28.3	30.0	-1.7	-3.0
35	36.1	7.4	15.8	-8.4	-17.6	48.5	10.0	21.4	-11.4	-24.0	82.6	21.2	30.0	-8.8	-18.5	99.1	25.5	30.0	-4.5	-9.5
40	32.9	6.8	15.8	-9.0	-21.7	44.2	9.1	21.4	-12.3	-29.6	75.1	19.3	30.0	-10.7	-25.7	90.2	23.2	30.0	-6.8	-16.4
45	30.2	6.2	15.8	-9.6	-25.8	40.6	8.3	21.4	-13.1	-35.3	69.1	17.7	30.0	-12.3	-33.1	82.9	21.3	30.0	-8.7	-23.5
50	28.0	5.8	15.8	-10.0	-30.1	37.7	7.7	21.4	-13.7	-41.0	64.0	16.4	30.0	-13.6	-40.7	76.7	19.7	30.0	-10.3	-30.9
55	26.2	5.4	15.8	-10.4	-34.3	35.1	7.2	21.4	-14.2	-46.8	59.6	15.3	30.0	-14.7	-48.5	71.5	18.4	30.0	-11.6	-38.4
60	24.6	5.0	15.8	-10.7	-38.6	32.9	6.8	21.4	-14.6	-52.7	55.9	14.4	30.0	-15.6	-56.3	67.1	17.2	30.0	-12.8	-46.0
65	23.2	4.8	15.8	-11.0	-43.0	31.0	6.4	21.4	-15.0	-58.6	52.6	13.5	30.0	-16.5	-64.3	63.2	16.2	30.0	-13.8	-53.7
70	21.9	4.5	15.8	-11.3	-47.4	29.4	6.0	21.4	-15.4	-64.6	49.8	12.8	30.0	-17.2	-72.3	59.7	15.3	30.0	-14.7	-61.5
75	20.8	4.3	15.8	-11.5	-51.8	27.9	5.7	21.4	-15.7	-70.6	47.3	12.1	30.0	-17.9	-80.4	56.7	14.6	30.0	-15.4	-69.5
80	19.8	4.1	15.8	-11.7	-56.2	26.6	5.5	21.4	-16.0	-76.6	45.0	11.6	30.0	-18.4	-88.5	54.0	13.9	30.0	-16.1	-77.4
85	18.9	3.9	15.8	-11.9	-60.6	25.4	5.2	21.4	-16.2	-82.6	43.0	11.0	30.0	-19.0	-96.7	51.5	13.2	30.0	-16.8	-85.5
90	18.1	3.7	15.8	-12.1	-65.1	24.3	5.0	21.4	-16.4	-88.7	41.1	10.6	30.0	-19.4	-105.0	49.3	12.7	30.0	-17.3	-93.6
95	17.4	3.6	15.8	-12.2	-69.6	23.3	4.8	21.4	-16.6	-94.7	39.4	10.1	30.0	-19.9	-113.3	47.3	12.2	30.0	-17.8	-101.7
100	16.7	3.4	15.8	-12.3	-74.0	22.4	4.6	21.4	-16.8	-100.8	37.9	9.7	30.0	-20.3	-121.6	45.5	11.7	30.0	-18.3	-109.9
Max =					**1.7**					**2.3**					**9.7**					**15.0**

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

City of Ottawa IDF Data (from SDG002)

IDF curve equations (Intensity in mm/hr)

100 year Intensity = 1735.688 / (Time in min + 6.014) $^{0.820}$
50 year Intensity = 1569.580 / (Time in min + 6.014) $^{0.820}$
25 year Intensity = 1402.884 / (Time in min + 6.018) $^{0.819}$
10 year Intensity = 1174.184 / (Time in min + 6.014) $^{0.816}$
5 year Intensity = 998.071 / (Time in min + 6.053) $^{0.814}$
2 year Intensity = 732.951 / (Time in min + 6.199) $^{0.810}$

TABLE D10 P-2 Storage Volumes for 2-year, 5-Year and 100-Year Storms (MRM)

Area No: P-2
C_{AVG} = 0.84 (2-yr)
C_{AVG} = 0.84 (5-yr)
C_{AVG} = 1.00 (100-yr, Max 1.0)
Time Interval = 5.00 (mins)
Drainage Area = 0.2032 (hectares)

Actual Release Rate (L/sec) = 78.00
Percentage of Actual Rate (City of Ottawa requirement) = 100% (Set to 50% when U/G storage used)
Release Rate Used for Estimation of 100-year Storage (L/sec) = 78.00

Intensity Incr (%) = 20% Use 20% for Climate Change

Duration (mins)	Release Rate = 36.33 (L/sec), Return Period = (years), IDF Parameters, A = 733.0, B = 0.810, C = 6.199 (I = A/(T_c+C))					Release Rate = 49.28 (L/sec), Return Period = 5 (years), IDF Parameters, A = 998.1, B = 0.814, C = 6.053 (I = A/(T_c+C))					Release Rate = 78.00 (L/sec), Return Period = 100 (years), IDF Parameters, A = 1735.7, B = 0.820, C = 6.014 (I = A/(T_c+C))					Release Rate = 78.00 (L/sec), Return Period = 100+20% (years), IDF Parameters, A = 1735.7, 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)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	79.1	36.3	42.8	0.0	230.5	109.0	49.3	59.7	0.0	398.6	225.2	78.0	147.2	0.0	478.3	270.2	78.0	192.2	0.0
5	103.6	49.0	36.3	12.7	3.8	141.2	66.8	49.3	17.5	5.2	242.7	137.1	78.0	59.1	17.7	291.2	164.5	78.0	86.5	26.0
10	76.8	36.3	36.3	0.0	0.0	104.2	49.3	49.3	0.0	0.0	178.6	100.9	78.0	22.9	13.7	214.3	121.0	78.0	43.0	25.8
15	61.8	29.2	36.3	-7.1	-6.4	83.6	39.5	49.3	-9.8	-8.8	142.9	80.7	78.0	2.7	2.4	171.5	96.9	78.0	18.9	17.0
20	52.0	24.6	36.3	-11.7	-14.1	70.3	33.2	49.3	-16.1	-19.3	120.0	67.8	78.0	-10.2	-12.3	143.9	81.3	78.0	3.3	4.0
25	45.2	21.4	36.3	-15.0	-22.4	60.9	28.8	49.3	-20.5	-30.7	103.8	58.7	78.0	-19.3	-29.0	124.6	70.4	78.0	-7.6	-11.4
30	40.0	18.9	36.3	-17.4	-31.3	53.9	25.5	49.3	-23.8	-42.8	91.9	51.9	78.0	-26.1	-47.0	110.2	62.3	78.0	-15.7	-28.3
35	36.1	17.1	36.3	-19.3	-40.5	48.5	22.9	49.3	-26.3	-55.3	82.6	46.6	78.0	-31.4	-65.8	99.1	56.0	78.0	-22.0	-46.3
40	32.9	15.5	36.3	-20.8	-49.9	44.2	20.9	49.3	-28.4	-68.1	75.1	42.4	78.0	-35.6	-85.3	90.2	50.9	78.0	-27.1	-65.0
45	30.2	14.3	36.3	-22.0	-59.5	40.6	19.2	49.3	-30.1	-81.2	69.1	39.0	78.0	-39.0	-105.3	82.9	46.8	78.0	-31.2	-84.2
50	28.0	13.3	36.3	-23.1	-69.2	37.7	17.8	49.3	-31.5	-94.4	64.0	36.1	78.0	-41.9	-125.6	76.7	43.3	78.0	-34.7	-104.0
55	26.2	12.4	36.3	-23.9	-79.0	35.1	16.6	49.3	-32.7	-107.8	59.6	33.7	78.0	-44.3	-146.3	71.5	40.4	78.0	-37.6	-124.0
60	24.6	11.6	36.3	-24.7	-89.0	32.9	15.6	49.3	-33.7	-121.3	55.9	31.6	78.0	-46.4	-167.1	67.1	37.9	78.0	-40.1	-144.4
65	23.2	10.9	36.3	-25.4	-99.0	31.0	14.7	49.3	-34.6	-134.9	52.6	29.7	78.0	-48.3	-188.2	63.2	35.7	78.0	-42.3	-165.0
70	21.9	10.4	36.3	-26.0	-109.0	29.4	13.9	49.3	-35.4	-148.6	49.8	28.1	78.0	-49.9	-209.5	59.7	33.7	78.0	-44.3	-185.9
75	20.8	9.8	36.3	-26.5	-119.2	27.9	13.2	49.3	-36.1	-162.4	47.3	26.7	78.0	-51.3	-230.9	56.7	32.0	78.0	-46.0	-206.9
80	19.8	9.4	36.3	-26.9	-129.3	26.6	12.6	49.3	-36.7	-176.2	45.0	25.4	78.0	-52.6	-252.4	54.0	30.5	78.0	-47.5	-228.0
85	18.9	9.0	36.3	-27.4	-139.6	25.4	12.0	49.3	-37.3	-190.1	43.0	24.3	78.0	-53.7	-274.1	51.5	29.1	78.0	-48.9	-249.3
90	18.1	8.6	36.3	-27.7	-149.8	24.3	11.5	49.3	-37.8	-204.1	41.1	23.2	78.0	-54.8	-295.8	49.3	27.9	78.0	-50.1	-270.7
95	17.4	8.2	36.3	-28.1	-160.1	23.3	11.0	49.3	-38.3	-218.1	39.4	22.3	78.0	-55.7	-317.6	47.3	26.7	78.0	-51.3	-292.2
100	16.7	7.9	36.3	-28.4	-170.4	22.4	10.6	49.3	-38.7	-232.1	37.9	21.4	78.0	-56.6	-339.5	45.5	25.7	78.0	-52.3	-313.9
Max =					**3.8**					**5.2**					**17.7**					**26.0**

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) Maximum Storage = Max Storage Over Duration
7) Parameters a,b,c are for City of Ottawa

City of Ottawa IDF Data (from SDG002)

IDF curve equations (Intensity in mm/hr)

100 year Intensity = 1735.688 / (Time in min + 6.014) $^{0.820}$
50 year Intensity = 1569.580 / (Time in min + 6.014) $^{0.820}$
25 year Intensity = 1402.884 / (Time in min + 6.018) $^{0.819}$
10 year Intensity = 1174.184 / (Time in min + 6.014) $^{0.816}$
5 year Intensity = 998.071 / (Time in min + 6.053) $^{0.814}$
2 year Intensity = 732.951 / (Time in min + 6.199) $^{0.810}$

TABLE D11 P-3 Storage Volumes for 2-year, 5-Year and 100-Year Storms (MRM)

Area No: P-3
C_{AVG} = 0.84 (2-yr)
C_{AVG} = 0.84 (5-yr)
C_{AVG} = 1.00 (100-yr, Max 1.0)
Time Interval = 5.00 (mins)
Drainage Area = 0.1792 (hectares)

Actual Release Rate (L/sec) = 72.00
Percentage of Actual Rate (City of Ottawa requirement) = 100% (Set to 50% when U/G storage used)
Release Rate Used for Estimation of 100-year Storage (L/sec) = 72.00

Intensity Incr (%) = 20% Use 20% for Climate Change

Duration (mins)	Release Rate = 31.96 (L/sec), Return Period = (years), IDF Parameters, A = 733.0, B = 0.810, C = 6.199 (I = A/(T_c+C))					Release Rate = 43.36 (L/sec), Return Period = 5 (years), IDF Parameters, A = 998.1, B = 0.814, C = 6.053 (I = A/(T_c+C))					Release Rate = 72.00 (L/sec), Return Period = 100 (years), IDF Parameters, A = 1735.7, B = 0.820, C = 6.014 (I = A/(T_c+C))					Release Rate = 72.00 (L/sec), Return Period = 100+20% (years), IDF Parameters, A = 1735.7, 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)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	69.6	32.0	37.6	0.0	230.5	95.9	43.4	52.6	0.0	398.6	198.5	72.0	126.5	0.0	478.3	238.2	72.0	166.2	0.0
5	103.6	43.1	32.0	11.1	3.3	141.2	58.8	43.4	15.4	4.6	242.7	120.9	72.0	48.9	14.7	291.2	145.1	72.0	73.1	21.9
10	76.8	32.0	32.0	0.0	0.0	104.2	43.4	43.4	0.0	0.0	178.6	88.9	72.0	16.9	10.2	214.3	106.7	72.0	34.7	20.8
15	61.8	25.7	32.0	-6.3	-5.6	83.6	34.8	43.4	-8.6	-7.7	142.9	71.2	72.0	-0.8	-0.7	171.5	85.4	72.0	13.4	12.1
20	52.0	21.7	32.0	-10.3	-12.4	70.3	29.2	43.4	-14.1	-17.0	120.0	59.7	72.0	-12.3	-14.7	143.9	71.7	72.0	-0.3	-0.4
25	45.2	18.8	32.0	-13.2	-19.8	60.9	25.3	43.4	-18.0	-27.0	103.8	51.7	72.0	-20.3	-30.4	124.6	62.1	72.0	-9.9	-14.9
30	40.0	16.7	32.0	-15.3	-27.5	53.9	22.4	43.4	-20.9	-37.7	91.9	45.8	72.0	-26.2	-47.2	110.2	54.9	72.0	-17.1	-30.8
35	36.1	15.0	32.0	-17.0	-35.6	48.5	20.2	43.4	-23.2	-48.7	82.6	41.1	72.0	-30.9	-64.8	99.1	49.4	72.0	-22.6	-47.6
40	32.9	13.7	32.0	-18.3	-43.9	44.2	18.4	43.4	-25.0	-59.9	75.1	37.4	72.0	-34.6	-83.0	90.2	44.9	72.0	-27.1	-65.0
45	30.2	12.6	32.0	-19.4	-52.3	40.6	16.9	43.4	-26.5	-71.4	69.1	34.4	72.0	-37.6	-101.5	82.9	41.3	72.0	-30.7	-83.0
50	28.0	11.7	32.0	-20.3	-60.9	37.7	15.7	43.4	-27.7	-83.1	64.0	31.9	72.0	-40.1	-120.4	76.7	38.2	72.0	-33.8	-101.3
55	26.2	10.9	32.0	-21.1	-69.5	35.1	14.6	43.4	-28.7	-94.9	59.6	29.7	72.0	-42.3	-139.6	71.5	35.6	72.0	-36.4	-120.0
60	24.6	10.2	32.0	-21.7	-78.3	32.9	13.7	43.4	-29.7	-106.7	55.9	27.8	72.0	-44.2	-159.0	67.1	33.4	72.0	-38.6	-138.9
65	23.2	9.6	32.0	-22.3	-87.1	31.0	12.9	43.4	-30.4	-118.7	52.6	26.2	72.0	-45.8	-178.5	63.2	31.5	72.0	-40.5	-158.1
70	21.9	9.1	32.0	-22.8	-95.9	29.4	12.2	43.4	-31.1	-130.8	49.8	24.8	72.0	-47.2	-198.2	59.7	29.8	72.0	-42.2	-177.4
75	20.8	8.7	32.0	-23.3	-104.9	27.9	11.6	43.4	-31.8	-142.9	47.3	23.5	72.0	-48.5	-218.1	56.7	28.2	72.0	-43.8	-196.9
80	19.8	8.3	32.0	-23.7	-113.8	26.6	11.1	43.4	-32.3	-155.1	45.0	22.4	72.0	-49.6	-238.0	54.0	26.9	72.0	-45.1	-216.5
85	18.9	7.9	32.0	-24.1	-122.8	25.4	10.6	43.4	-32.8	-167.3	43.0	21.4	72.0	-50.6	-258.1	51.5	25.7	72.0	-46.3	-236.3
90	18.1	7.6	32.0	-24.4	-131.8	24.3	10.1	43.4	-33.3	-179.6	41.1	20.5	72.0	-51.5	-278.2	49.3	24.6	72.0	-47.4	-256.1
95	17.4	7.2	32.0	-24.7	-140.9	23.3	9.7	43.4	-33.7	-191.9	39.4	19.6	72.0	-52.4	-298.4	47.3	23.6	72.0	-48.4	-276.1
100	16.7	7.0	32.0	-25.0	-150.0	22.4	9.3	43.4	-34.0	-204.2	37.9	18.9	72.0	-53.1	-318.7	45.5	22.7	72.0	-49.3	-296.1
Max =					3.3					4.6					14.7					21.9

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

City of Ottawa IDF Data (from SDG002)

IDF curve equations (Intensity in mm/hr)

100 year Intensity = 1735.688 / (Time in min + 6.014) $^{0.820}$
50 year Intensity = 1569.580 / (Time in min + 6.014) $^{0.820}$
25 year Intensity = 1402.884 / (Time in min + 6.018) $^{0.819}$
10 year Intensity = 1174.184 / (Time in min + 6.014) $^{0.816}$
5 year Intensity = 998.071 / (Time in min + 6.053) $^{0.814}$
2 year Intensity = 732.951 / (Time in min + 6.199) $^{0.810}$

TABLE D12 P-4 Storage Volumes for 2-year, 5-Year and 100-Year Storms (MRM)

Area No: P-4
C_{AVG} = 0.24 (2-yr)
C_{AVG} = 0.24 (5-yr)
C_{AVG} = 0.31 (100-yr, Max 1.0)
Time Interval = 5.00 (mins)
Drainage Area = 1.9029 (hectares)

Actual Release Rate (L/sec) = 177.00
Percentage of Actual Rate (City of Ottawa requirement) = 100% (Set to 50% when U/G storage used)
Release Rate Used for Estimation of 100-year Storage (L/sec) = 177.00

Intensity Incr (%) = 20% Use 20% for Climate Change

Duration (mins)	Release Rate = 99.29 (L/sec); Return Period = (years); IDF Parameters, A = 733.0, B = 0.810, C = 6.199 (I = A/(T_c+C))					Release Rate = 134.69 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.1, B = 0.814, C = 6.053 (I = A/(T_c+C))					Release Rate = 177.00 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.7, B = 0.820, C = 6.014 (I = A/(T_c+C))					Release Rate = 177.00 (L/sec); Return Period = 100+20% (years); IDF Parameters, A = 1735.7, 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)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	216.2	99.3	116.9	0.0	230.5	297.9	134.7	163.3	0.0	398.6	644.1	177.0	467.1	0.0	478.3	773.0	177.0	596.0	0.0
5	103.6	133.9	99.3	34.6	10.4	141.2	182.5	134.7	47.8	14.3	242.7	392.2	177.0	215.2	64.6	291.2	470.6	177.0	293.6	88.1
10	76.8	99.3	99.3	0.0	0.0	104.2	134.7	134.7	0.0	0.0	178.6	288.5	177.0	111.5	66.9	214.3	346.2	177.0	169.2	101.5
15	61.8	79.8	99.3	-19.4	-17.5	83.6	108.0	134.7	-26.7	-24.0	142.9	230.9	177.0	53.9	48.5	171.5	277.1	177.0	100.1	90.1
20	52.0	67.3	99.3	-32.0	-38.4	70.3	90.8	134.7	-43.9	-52.7	120.0	193.8	177.0	16.8	20.2	143.9	232.6	177.0	55.6	66.7
25	45.2	58.4	99.3	-40.9	-61.3	60.9	78.7	134.7	-56.0	-84.0	103.8	167.8	177.0	-9.2	-13.8	124.6	201.4	177.0	24.4	36.6
30	40.0	51.8	99.3	-47.5	-85.5	53.9	69.7	134.7	-65.0	-117.0	91.9	148.4	177.0	-28.6	-51.4	110.2	178.1	177.0	1.1	2.1
35	36.1	46.6	99.3	-52.7	-110.6	48.5	62.7	134.7	-72.0	-151.1	82.6	133.4	177.0	-43.6	-91.5	99.1	160.1	177.0	-16.9	-35.4
40	32.9	42.5	99.3	-56.8	-136.3	44.2	57.1	134.7	-77.6	-186.2	75.1	121.4	177.0	-55.6	-133.4	90.2	145.7	177.0	-31.3	-75.1
45	30.2	39.1	99.3	-60.2	-162.5	40.6	52.5	134.7	-82.2	-221.9	69.1	111.6	177.0	-65.4	-176.6	82.9	133.9	177.0	-43.1	-116.4
50	28.0	36.2	99.3	-63.0	-189.1	37.7	48.7	134.7	-86.0	-258.1	64.0	103.3	177.0	-73.7	-221.0	76.7	124.0	177.0	-53.0	-159.0
55	26.2	33.8	99.3	-65.5	-216.0	35.1	45.4	134.7	-89.3	-294.6	59.6	96.3	177.0	-80.7	-266.2	71.5	115.6	177.0	-61.4	-202.6
60	24.6	31.7	99.3	-67.5	-243.1	32.9	42.6	134.7	-92.1	-331.6	55.9	90.3	177.0	-86.7	-312.0	67.1	108.4	177.0	-68.6	-247.0
65	23.2	29.9	99.3	-69.4	-270.5	31.0	40.1	134.7	-94.6	-368.8	52.6	85.1	177.0	-91.9	-358.5	63.2	102.1	177.0	-74.9	-292.2
70	21.9	28.3	99.3	-71.0	-298.0	29.4	38.0	134.7	-96.7	-406.2	49.8	80.5	177.0	-96.5	-405.5	59.7	96.5	177.0	-80.5	-337.9
75	20.8	26.9	99.3	-72.4	-325.7	27.9	36.1	134.7	-98.6	-443.9	47.3	76.4	177.0	-100.6	-452.9	56.7	91.6	177.0	-85.4	-384.2
80	19.8	25.6	99.3	-73.7	-353.5	26.6	34.3	134.7	-100.4	-481.7	45.0	72.7	177.0	-104.3	-500.6	54.0	87.2	177.0	-89.8	-430.8
85	18.9	24.5	99.3	-74.8	-381.5	25.4	32.8	134.7	-101.9	-519.7	43.0	69.4	177.0	-107.6	-548.7	51.5	83.3	177.0	-93.7	-477.9
90	18.1	23.5	99.3	-75.8	-409.5	24.3	31.4	134.7	-103.3	-557.8	41.1	66.4	177.0	-110.6	-597.1	49.3	79.7	177.0	-97.3	-525.3
95	17.4	22.5	99.3	-76.8	-437.6	23.3	30.1	134.7	-104.6	-596.0	39.4	63.7	177.0	-113.3	-645.7	47.3	76.5	177.0	-100.5	-573.0
100	16.7	21.6	99.3	-77.6	-465.8	22.4	29.0	134.7	-105.7	-634.4	37.9	61.2	177.0	-115.8	-694.5	45.5	73.5	177.0	-103.5	-621.0
Max =					10.4					14.3					66.9					101.5

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) Maximum Storage = Max Storage Over Duration
7) Parameters a,b,c are for City of Ottawa

City of Ottawa IDF Data (from SDG002)

IDF curve equations (Intensity in mm/hr)

100 year Intensity	= 1735.688 / (Time in min + 6.014) $^{0.820}$
50 year Intensity	= 1569.580 / (Time in min + 6.014) $^{0.820}$
25 year Intensity	= 1402.884 / (Time in min + 6.018) $^{0.819}$
10 year Intensity	= 1174.184 / (Time in min + 6.014) $^{0.816}$
5 year Intensity	= 998.071 / (Time in min + 6.053) $^{0.814}$
2 year Intensity	= 732.951 / (Time in min + 6.199) $^{0.810}$

Table D13 - 5-YEAR STORM SEWER CALCULATION SHEET

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

LOCATION			AREA (hectares)				FLOW (UNRESTRICTED - RATIONAL METHOD)							SEWER DATA									
Location	From Node	To Node	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 (L/sec)	Return Period	Q (L/sec)	Dia (mm) Actual	Dia (mm) Nominal	Type	Slope (%)	Length (m)	Capacity (L/sec)	Velocity (m/s)		Time in Pipe, Tt (min)	Hydraulic Ratios	
																				Vf	Va		Qa/Qf	Va/Vf
675 Borbridge Ave.	CB 301	CB 302	P-8	0.15	0.150	0.65	0.27	0.27	10.00	104.19	28.06	5.00	28.1	299.36	300	PVC	0.35	33.09	56.9	0.81	0.57	0.96	0.49	0.71
	CB 302	STMMH 101			0.150			0.27	10.96	99.36		5.00	26.8	299.36	300	PVC	0.50	30.57	68.0	0.97	0.68	0.74	0.39	0.71
	DCB 308	STMMH 101	P-7	0.7302	0.730	0.21	0.43	0.43	10.00	104.19	44.38	5.00	44.4	299.36	300	PVC	1.00	29.77	96.2	1.37	0.97	0.51	0.46	0.71
	DCB 303	STMMH 101	P-6	0.8592	0.859	0.25	0.59	0.59	10.00	104.19	61.84	5.00	61.8	299.36	300	PVC	1.00	2.72	96.2	1.37	1.26	0.04	0.64	0.92
	STMMH 101	STMMH 102			1.739			1.29	11.71	95.96		5.00	123.7	533	525	CONC	0.30	88.53	245.2	1.09	0.77	1.92	0.50	0.71
	DCB 309	STMMH 102	P-5	0.804	0.804	0.28	0.62	0.62	10.00	104.19	64.75	5.00	64.8	299.36	300	PVC	1.00	2.43	96.2	1.37	1.15	0.04	0.67	0.84
	STMMH 102	STMMH 103			2.543			1.91	13.63	88.27		5.00	168.6	533	525	CONC	0.30	37.79	245.2	1.09	1.02	0.62	0.69	0.94
	CB 304	STMMH 103	P-3	0.179	0.179	0.84	0.42	0.42	10.00	104.19	43.36	5.00	43.4	299.36	300	PVC	1.00	12.13	96.2	1.37	0.97	0.21	0.45	0.71
	CB 305	STMMH 103	P-2	0.2032	0.203	0.84	0.47	0.47	10.00	104.19	49.28	5.00	49.3	299.36	300	PVC	1.00	11.88	96.2	1.37	0.97	0.20	0.51	0.71
	STMMH 103	STMMH 104			2.925			2.80	14.24	86.09		5.00	241.0	610	600	CONC	0.30	55.67	351.5	1.19	1.12	0.83	0.69	0.94
	DCB 306	STMMH 104	P-4	1.903	1.903	0.24	1.29	1.29	10.00	104.19	134.69	5.00	134.7	366.42	375	PVC	1.00	24.98	164.8	1.59	1.56	0.27	0.82	0.98
	CB 307	STMMH 104	P-1	0.126	0.126	0.59	0.21	0.21	10.00	104.19	21.41	5.00	21.4	251.46	250	PVC	1.00	3.65	60.4	1.21	0.85	0.07	0.35	0.70
	STMMH 104	STMMH 105			4.954			4.30	15.07	83.32		5.00	358.1	610	600	CONC	0.50	37.93	453.7	1.54	1.50	0.42	0.79	0.98
	STMMH 105	STMMH 107			4.954			4.30	15.49	82.00		5.00	352.4	610	600	CONC	0.50	86.80	453.7	1.54	1.50	0.96	0.78	0.98
	BLDG	STMMH 106	P-R	0.634	0.634	0.90	1.59	1.59	10.00	104.19	165.17	5.00	165.2	366.42	375	PVC	3.50	3.80	308.4	2.97	2.10	0.03	0.54	0.71
	STMMH 106	STMMH 107			0.634			1.59	10.03	104.03		5.00	164.9	366.42	375	PVC	3.00	9.50	285.5	2.75	1.95	0.08	0.58	0.71
	STMMH 107	MUNI STM			5.587			5.88	16.45	79.14		5.00	465.5	533	525	CONC	2.50	21.32	708.0	3.14	2.89	0.12	0.66	0.92

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)

Notes:
Ottawa Rainfall Intensity Values:
From Sewer Desing Guidelines, 2004

	5yr	100yr
a =	998.071	1735.688
b=	0.814	0.820
c =	6.053	6.014

Designed: **Aaditya Jariwala, M.Eng, P.Eng.**
Checked: **Aaditya Jariwala, M.Eng, P.Eng.**
Dwg Reference: **C100**

Project: **675 Borbridge Ave**
Location: **Ottawa, Ontario**
File Ref: **24005530 - STM Design Sheet**
Sheet No: **1 of 1**

TABLE D14 - Flow Through Inlet Control Device - CB 307 (Catchment P-1)

Elev (m)	Head Over Orifice (m)	Orifice Flow (l/s)
88.48	0.00	0.0
91.30	2.82	28.9
91.35	2.87	29.1
91.40	2.92	29.4
91.45	2.97	29.6
91.50	3.02	29.9
91.54	3.06	30.1
91.59	3.11	30.3

$Q_{ORIFICE} = C\ A\ (2\ g\ H)^{0.5}$

Size (mm) =	90.00
C/L Orifice Elev =	88.48
Max. Ponding Elev=	91.50
C = Discharge Coeff =	0.61
A = Orifice Area (mm^2) =	6,359
A = Orifice Area (m^2) =	0.0064
Max head over Orifice =	3.02

TABLE D15 - Flow Through Inlet Control Device - CB 305 (Catchment P-2)

Elev (m)	Head Over Orifice (m)	Orifice Flow (l/s)
88.74	0.00	0.0
91.25	2.51	75.6
91.30	2.56	76.4
91.35	2.61	77.1
91.40	2.66	77.8
91.45	2.71	78.6
91.50	2.76	79.3
91.55	2.81	80.0
91.60	2.86	80.7

$Q_{ORIFICE} = C\ A\ (2\ g\ H)^{0.5}$

Size (mm) =	150.00
C/L Orifice Elev =	88.74
Max. Ponding Elev=	91.50
C = Discharge Coeff =	0.61
A = Orifice Area (mm^2) =	17,663
A = Orifice Area (m^2) =	0.0177
Max head over Orifice =	2.76

TABLE D16 - Flow Through Inlet Control Device - CB 304 (Catchment P-3)

Elev (m)	Head Over Orifice (m)	Orifice Flow (l/s)
88.81	0.00	0.0
91.25	2.44	69.7
91.30	2.49	70.4
91.35	2.54	71.1
91.40	2.59	71.8
91.45	2.64	72.5
91.50	2.69	73.1
91.55	2.74	73.8
91.60	2.79	74.5

$Q_{ORIFICE} = C\ A\ (2\ g\ H)^{0.5}$

Size (mm) =	145.00
C/L Orifice Elev =	88.81
Max. Ponding Elev=	91.50
C = Discharge Coeff =	0.61
A = Orifice Area (mm^2) =	16,505
A = Orifice Area (m^2) =	0.0165
Max head over Orifice =	2.69

TABLE D17 - Flow Through Inlet Control Device - DCB 306 (Catchment P-4)

Elev (m)	Head Over Orifice (m)	Orifice Flow (l/s)
88.78	0.00	0.0
91.05	2.27	166.1
91.10	2.32	167.9
91.15	2.37	169.7
91.20	2.42	171.5
91.25	2.47	173.3
91.30	2.52	175.0
91.35	2.57	176.8
91.40	2.62	178.5

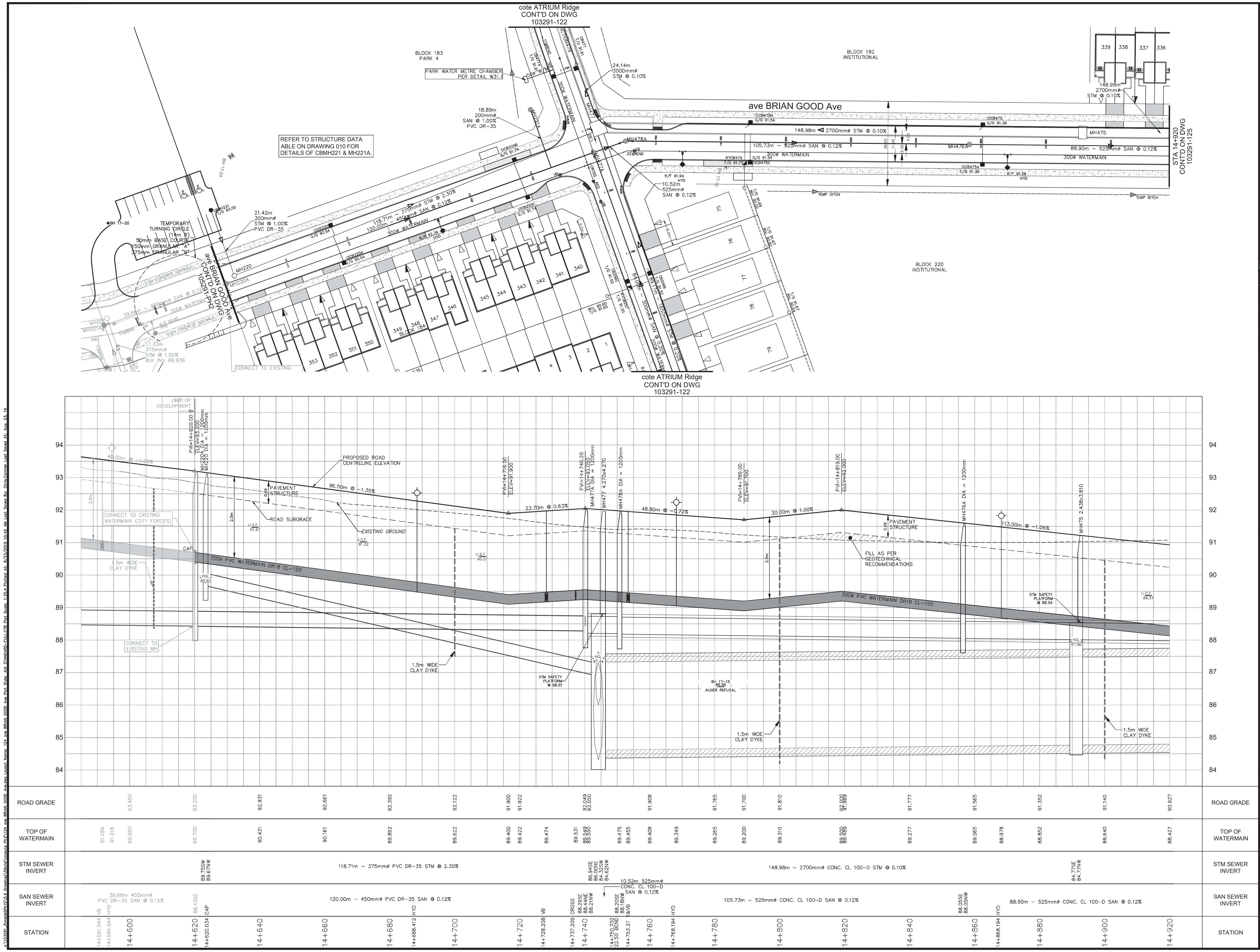
$Q_{ORIFICE} = C\ A\ (2\ g\ H)^{0.5}$

Size (mm) =	228.00
C/L Orifice Elev =	88.78
Max. Ponding Elev=	91.40
C = Discharge Coeff =	0.61
A = Orifice Area (mm^2) =	40,807
A = Orifice Area (m^2) =	0.0408
Max head over Orifice =	2.62

Appendix E – Additional Information

City of Ottawa UCC Drawings

Boundary/Topographic Survey



SEE 010, 011, 012 FOR NOTES, LEGEND, CB TABLE, STREET SECTIONS AND DETAILS

KEY PLAN NTS

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6	ISSUED FOR CONSTRUCTION	L.M.E.	2019:08:23
5	ISSUED FOR CONSTRUCTION CONTRACT 1	L.M.E.	2019:07:30
4	REVISED PER CITY COMMENTS	L.M.E.	2019:07:18
3	REVISED PER CITY COMMENTS	L.M.E.	2019:06:28
2	ISSUED FOR TENDER	L.M.E.	2019:05:24
1	SUBMISSION 1 FOR CITY REVIEW	L.M.E.	2019:05:16

Riverside South

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Project Title

RIVERSIDE SOUTH

PHASE 15-2, 4 & SPRATT ROAD

LICENSED PROFESSIONAL ENGINEER
L. M. ERION
13379508
2019/08/23
PROVINCE OF ONTARIO

Drawing Title

ave BRIAN GOOD Ave

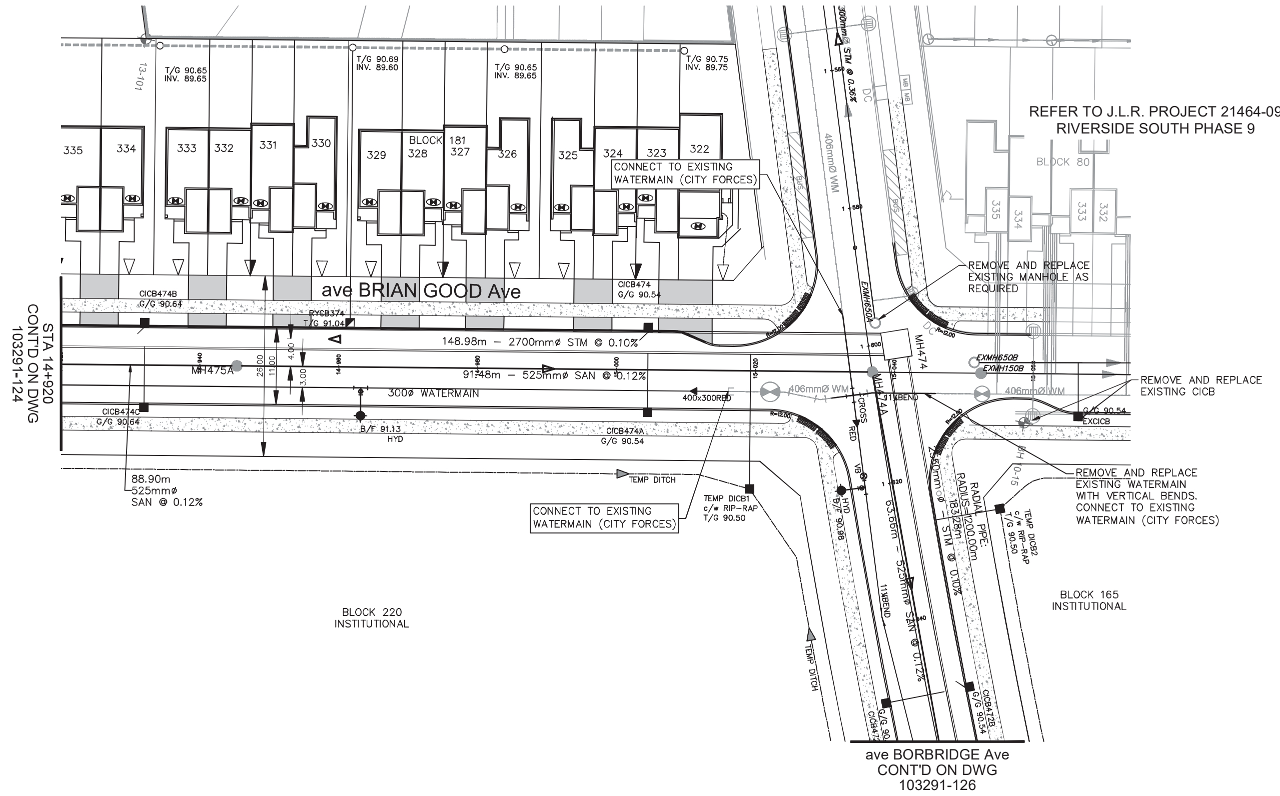
STA 14+620 TO STA 14+920

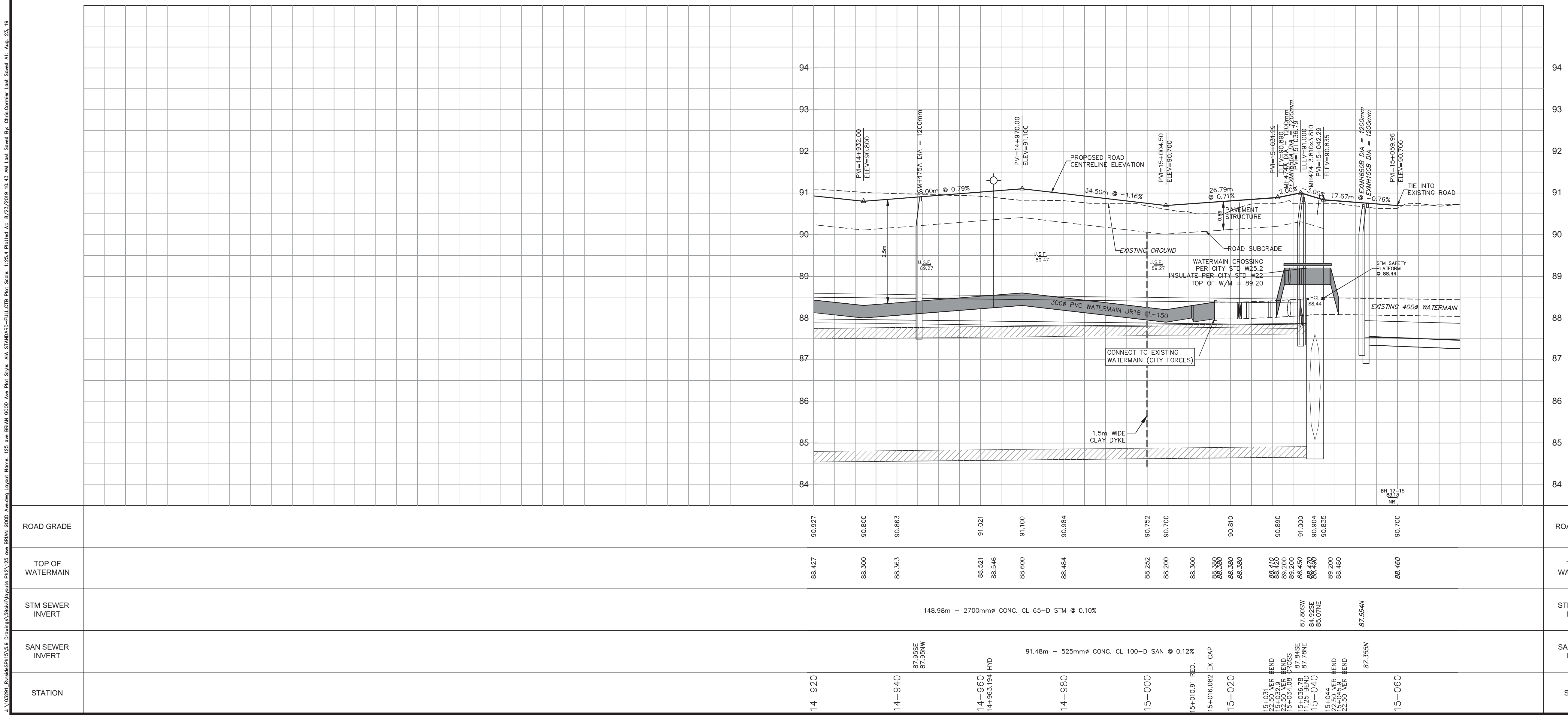
Scale
HORIZ. SCALE 1 : 500
VERT. SCALE 1 : 50

Design	Date
L.E.	JANUARY 2019
Drawn	Checked
C.C.	L.E.
Project No.	Drawing No.
103291	124

D07-16-17-0023 PH2

#17743





SEE 010, 011, 012 FOR NOTES, LEGEND, CB TABLE, STREET SECTIONS AND DETAILS

KEY PLAN
NTS

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	ISSUED FOR CONSTRUCTION	L.M.E.	2019:08:23
6	REVISED CICB LOCATION	L.M.E.	2019:08:08
5	ISSUED FOR CONSTRUCTION CONTRACT 1	L.M.E.	2019:07:30
4	REVISED PER CITY COMMENTS	L.M.E.	2019:07:18
3	REVISED PER CITY COMMENTS	L.M.E.	2019:06:28
2	ISSUED FOR TENDER	L.M.E.	2019:05:24
1	SUBMISSION 1 FOR CITY REVIEW	L.M.E.	2019:05:16

Riverside South

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

Project Title

RIVERSIDE SOUTH

PHASE 15-2, 4 & SPRATT ROAD

LICENSED PROFESSIONAL ENGINEER
L.M. ERION
13379508
2019/08/23
PROVINCE OF ONTARIO

Drawing Title

ave BRIAN GOOD Ave

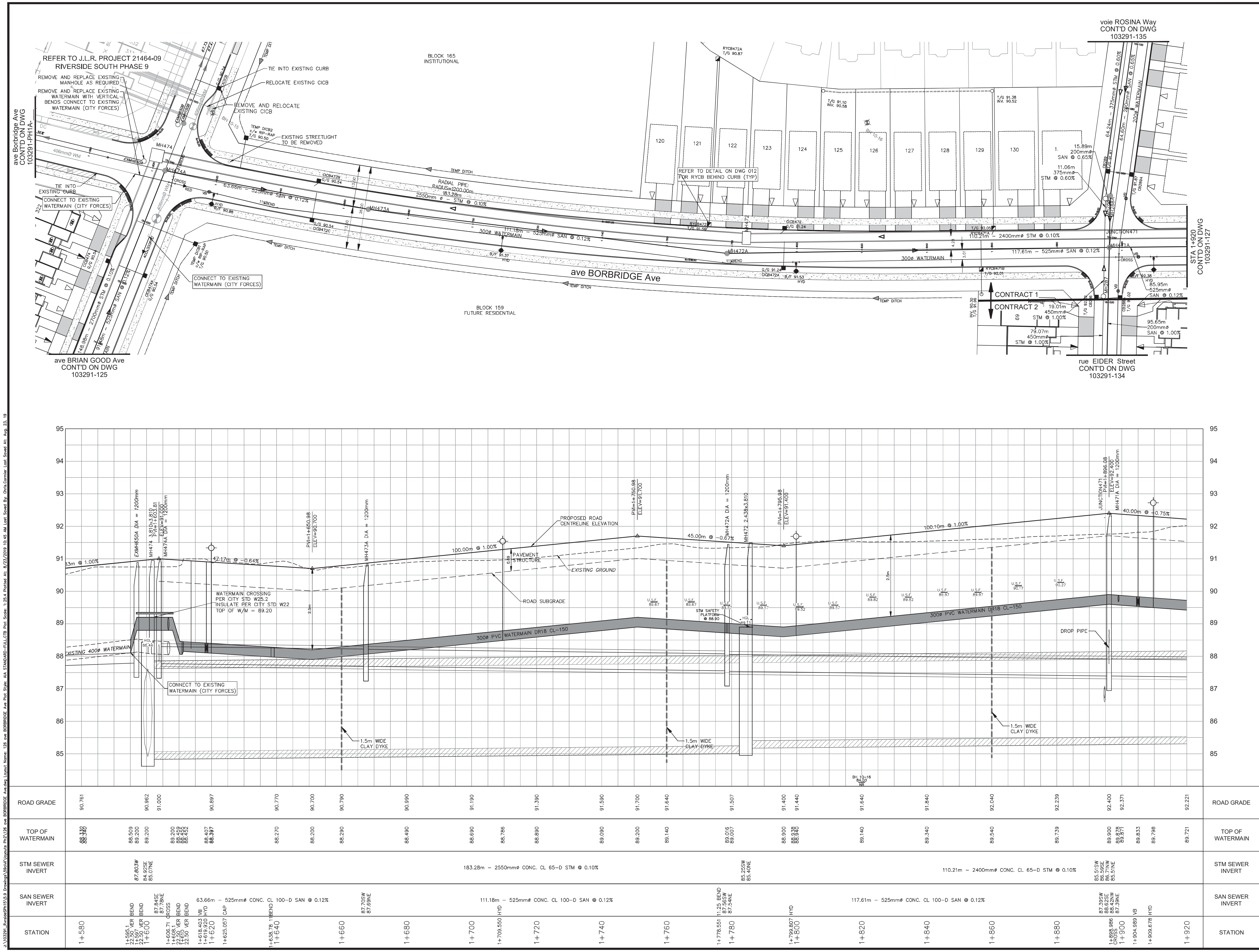
STA 14+920 TO BORBRIDGE

Scale	
HORIZ. SCALE	1 : 500
VERT. SCALE	1 : 50

Design	Date
L.E.	JANUARY 2019
Drawn	**Checked**
C.C.	L.E.
Project No.	**Drawing No.**
103291	125

D07-16-17-0023 PH2

#17743



SEE 010, 011, 012 FOR NOTES, LEGEND, CB TABLE, STREET SECTIONS AND DETAILS

KEY PLAN
NTS

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6	ISSUED FOR CONSTRUCTION	L.M.E.	2019:08:23
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RIVERSIDE SOUTH
PHASE 15-2, 4 & SPRATT ROAD

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L. M. ERION
13379508
2019/08/23
PROVINCE OF ONTARIO

Drawing Title

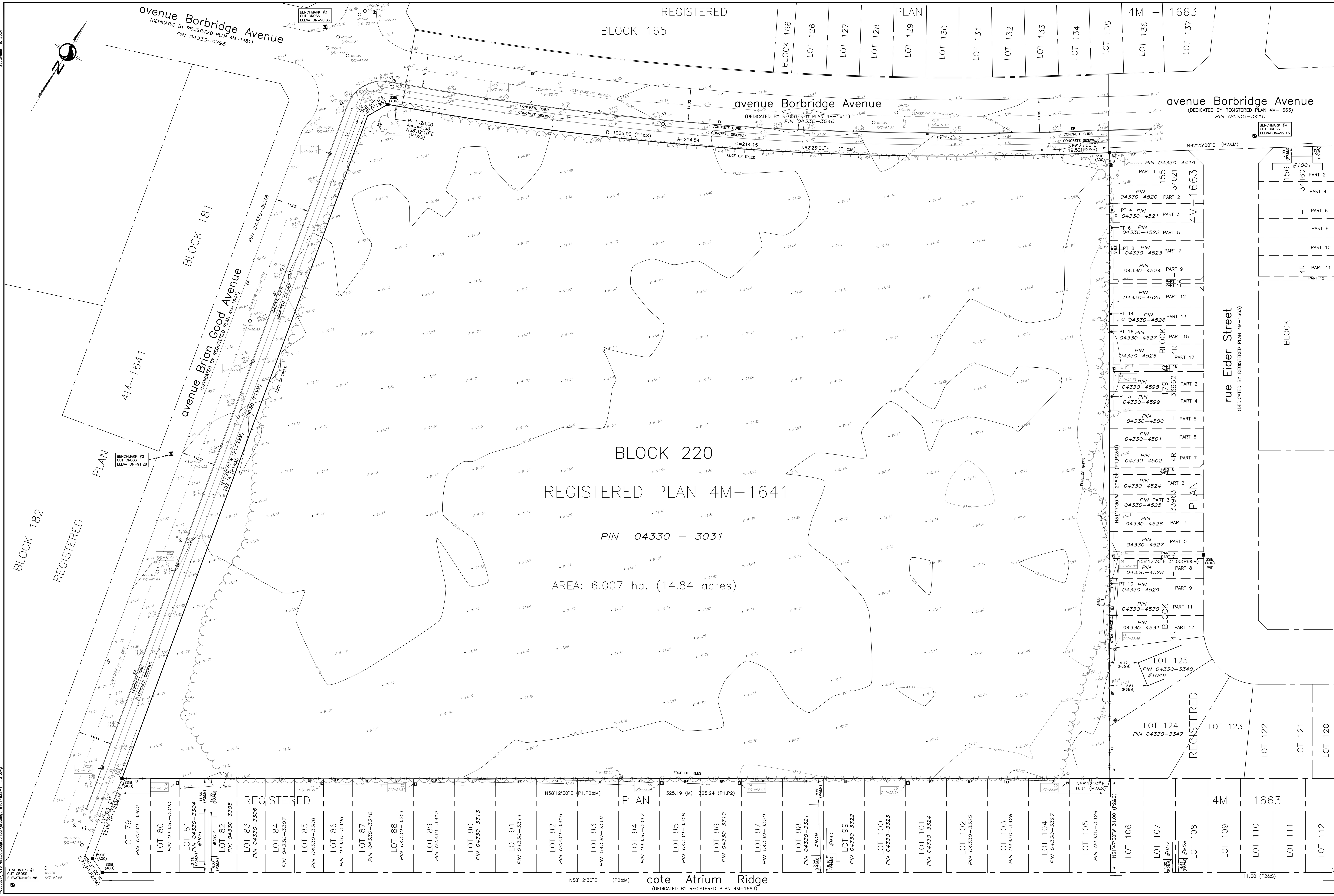
AVE BORBRIDGE AVE
Ph1A to STA 1+920

Scale
HORIZ. SCALE 1 : 500
VERT. SCALE 1 : 50

Design	Date
L.E.	JANUARY 2019
Drawn	Checked
C.C.	L.E.
Project No.	Drawing No.
103291	126

D07-16-17-0023 PH2

#17743



TOPOGRAPHIC PLAN OF SURVEY OF

BLOCK 220
REGISTERED PLAN 4M-1641
CITY OF OTTAWA

Scale 1:500

10 0 10 20 30 METRES

METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING NOTE

BEARINGS ARE GRID, DERIVED FROM CAN-NET VRS NETWORK GPS OBSERVATIONS ON NCC HORIZONTAL CONTROL MONUMENTS 19773035 AND 19680191, CENTRAL MERIDIAN, 76° 30' WEST LONGITUDE MTM ZONE 9, NAD83 (ORIGINAL).

19773035 N:5006060.42 E:324888.04
19680191 N:5033564.26 E:388064.94

ELEVATION NOTE

ELEVATIONS SHOWN HEREON ARE GEODETIC (CGVD-1928:1978) AND ARE DERIVED FROM VERTICAL CONTROL MONUMENT No.001196530101 HAVING AN ELEVATION OF 115.813.

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
PB	"	PLASTIC BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS, M	"	MEASURED
INST	"	INSTRUMENT
S	"	SET
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
AOG/AOV	"	ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
P1	"	REGISTERED PLAN 4M-1641
P2	"	REGISTERED PLAN 4M-1663
P3	"	SRPR BY AOV DATED DECEMBER 9, 2020
P4	"	SRPR BY AOV DATED DECEMBER 1, 2020
P5	"	SRPR BY AOV DATED MARCH 24, 2021
P6	"	SRPR BY AOV DATED JUNE 29, 2021
P7	"	SRPR BY AOV DATED MARCH 16, 2022
P8	"	PLAN 4R-33963
EP	"	EDGE OF PAVEMENT
AN	"	ANCHOR
BF	"	BOARD FENCE
CLF	"	CHAIN LINK FENCE
CB	"	CATCH BASIN
CMB	"	COMMUNITY MAIL BOXES
SICB	"	SIDE INLET CB
DRN	"	DRAIN
FP	"	FLAG POLE
HYD	"	FIRE HYDRANT
LS	"	LIGHT STANDARD
MHSAN	"	MAINTENANCE HOLE SANITARY
MHSTM	"	MAINTENANCE HOLE STORM
SN	"	SIGN
PLBX	"	PULL BOX
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
TB BELL	"	TERMINAL BOX - BELL
	"	TREE STUMP
	"	TREE CONIFEROUS (D.B.H. SHOWN)
	"	TREE DECIDUOUS (D.B.H. SHOWN)

SURVEYOR'S CERTIFICATE

I CERTIFY THAT :

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON THE DAY OF , 2024.

DATE

FRANCIS LAU
ONTARIO LAND SURVEYOR

THIS PLAN OF SURVEY RELATES TO AOLS PLAN SUBMISSION FORM NUMBER V-75687.

Stantec Geomatics Ltd.
CANADA LANDS SURVEYORS
ONTARIO LAND SURVEYORS
1331 CLYDE AVENUE, SUITE 300
OTTAWA, ONTARIO, K2C 3G4
TEL. 613.722.4420
stantec.com

DRAWN: ME	CHECKED: CK	PM: FL	FIELD: CA	PROJECT No.: 161614822-111

Appendix F – Drawings

C000 - Notes & Details (Provided Separately)

C001 - Existing Conditions and Removals Plan (Provided Separately)

C100 - Site Servicing Plan (Provided Separately)

C200-1 - Site Grading Plan – Interim (Provided Separately)

C200-2 - Site Grading Plan – Ultimate (Provided Separately)

C300 - Erosion and Sediment Control Plan (Provided Separately)

C500 - Post-Development Site Catchments (Provided Separately)