Stormwater Management & Servicing Report
Ottawa Train Yards, 830 Belfast Road

Client:
Controlex Corporation
100-223 Colonnade Road South
Ottawa, Ontario K2E 7K3

Project Number:
OTT-00251090-A0

Prepared By: Marc Lafleur, M.Eng., P.Eng..

Reviewed By: Alam Ansari, M.Sc., P. Eng.

EXP Services Inc.
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Date Submitted:
April 9, 2019
Revised August 8, 2019

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LICENSED PROFESSIONAL ENGINEER
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August 8, 2019
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Date Submitted:
April 9, 2019
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Legal Notification

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

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1 Introduction

EXP Services Inc. (EXP) was retained by Controlex Corporation to provide Servicing and Stormwater Management report for a commercial development at 830 Belfast Road.

The site is 1.3 hectares in area and is bound by Belfast road to the north, an unnamed local road to the east, Industrial Avenue to the south and a general industrial lot to the west.

This servicing design report will address SWM the quality and quantity control requirements for the proposed drainage areas of the one-storey retail building, determine how the proposed building will be serviced with sanitary, storm and water services, determine the size of the proposed services and identify the locations of the connections to the existing services. Servicing, Grading and Drainage and SWM plans for the development of the proposed building at 830 Belfast road are included with this report.

Refer to Figure 1 in Appendix D for the site location.

2 References

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

- City of Ottawa Sewer Design Guidelines Revision 2, October 2012 (SDG002)
  - Technical Bulletins ISDTB-2012-4, ISDTB-2014-01, PIEDTB-2016-01, ISTB-2018-01 and ISTB-2018-04
- City of Ottawa Water Distribution Design Guidelines, July 2010 (WDG001)
  - Technical Bulletins ISDTB-2014-02 and ISTB-2018-02
- Stormwater Management Planning and Design Manual, Ontario Ministry of the Environment, March 2003 (MOE SMPDM)
- Geotechnical Investigation Report by Paterson Group dated January 17, 2019

3 Sanitary Sewer Design

3.1 Peak Design Flow

There is an existing 250mm diameter sanitary sewer servicing three existing buildings on the south and west side of 830 Belfast, with a drainage area of 4.54ha. Refer to Figure 2 – for the Sanitary Drainage Area plan in Appendix D. The 250mm sanitary is connected to the 375mm municipal sanitary sewer on Belfast Road. A portion of the existing 250mm sanitary sewer is within the footprint of the proposed building. This section of the sewer will be rerouted and will be utilized to service the proposed building at 830 Belfast Road. The anticipated peak sanitary flows from the proposed commercial building site have been calculated as per the City of Ottawa Sewer Design Guidelines (SDG02, 2012) and Technical Bulletin ISTB-2018-01. The anticipated peak sanitary flows are calculated as follows:

Design Flows

Commercial Design Flow:	28,000 L/gross ha/day
Development Area:	1.3 hectares
Peak Factor:	1.5
Extraneous Flow:	0.33 L/s/ha
Peak Design Flow:	=(28000L/ha/day)(1.3ha)(1.5)(1/86400)+(1.3ha)(0.33L/s/ha)
	=**1.06 L/s**

The proposed building at 830 Belfast road will be serviced by a new 200mm diameter sanitary service that will connect to the 250mm sanitary sewer at sanitary manhole SANMH 103. The 200mm diameter sanitary service will be installed at a minimum slope of 1.0%. At this slope, the 200mm diameter sanitary service will have a capacity of 32.8 L/s and a full flow velocity of 1.04 m/s, which will be sufficient to service proposed building. Refer to the Site Servicing plan in Appendix D.

3.2 Capacity of 250mm Sanitary Sewer

Design Flows

Commercial Design Flow:	28,000 L/gross ha/day
Sanitary Drainage Area:	4.54 hectares
Peak Factor:	1.5
Extraneous Flow:	0.33 L/s/ha
Peak Design Flow:	=(28,000L/ha/day)(4.54ha)(1.5)(1/86400)+(4.53ha)(0.33L/s/ha)
	=**3.70 L/sec**

The design sanitary flows for the 4.54ha area, as shown in Figure 2 in Appendix D, is 3.70 L/s. The re-routed 250mm diameter sanitary sewer will be installed at a minimum slope of 0.25% and will have a capacity of 30.2 L/s and a full flow velocity of 0.61 m/s, which will be adequate to service the 4.54ha drainage area and the proposed building at 830 Belfast Road. It has already been demonstrated in the Trainyards East Land Phase 2 report that the 375mm diameter sanitary sewer along Belfast Road has sufficient capacity to service this drainage area. Refer to the excerpts from the Trainyards East Land Phase 2 report and the sanitary sewer design sheet in Appendix C.

4 Watermain Design

4.1 Required Fire Flow

The fire flow demand calculations were prepared based on the Fire Underwriters Survey (FUS, 1999) criteria and Technical Bulletin 2018-02. The proposed building's type of construction is classified as mixed construction – non-combustible as defined in Technical Bulletin 2018-02. The building will have a fully supervised sprinkler system and combustible contents. The required fire flow was determined to be 100 L/s. Refer to Appendix B for detailed fire flow demand calculations and the architect's confirmation email regarding type of construction.

4.2 Watermain Design

There is an existing 200mm diameter watermain connected to the 305mmmm diameter municipal watermain servicing the existing buildings at 197 Trainyards Drive and other buildings on the property. A section of this watermain will be re-aligned as it will be under the footprint of the new building. The proposed building will be serviced by a new 200mm diameter water service lateral connected to the re-aligned 200mm diameter watermain

The domestic water demands for the proposed building were calculated as per the City of Ottawa Water Distribution Guidelines. Commercial average consumption rate and peak factors were used for the demands calculations. The proposed building domestic demands were determined as follows:

Commercial Water Demand

Average daily demand:
=28,000 L/ha/day
=1.3 ha x 28,000 L/ha/day x (1/86,400 s/day)
= 0.42 L/s

Maximum daily demand:
=1.5 x avg. day
=1.5 x 0.42 L/s
=0.63 L/s

Maximum hourly daily demand:
=1.8 x max.day
=1.8 x 0.63 L/s
=1.13 L/s

4.3 Pressure Check

The following boundary conditions were provided by the City of Ottawa (refer to Appendix B):

Peak Hour HGL = 109.3m

Maximum HGL = 118.4m

Max Day (L/s) + Fire Flow (100L/s) = 111.5m

Based on HGL of 111.5.0m under the max day + fire flow conditions, the residual pressure at the proposed building was 55.1 psi (380.2 kPa). Refer to Appendix B for calculation details. The residual water pressures in the are greater than the minimum requirement of 20psi (140kPa) and less than the maximum requirement of 80 psi (552 kPa) as per the City of Ottawa Design Guidelines. Therefore, the existing water supply system will have adequate capacity to meet the domestic and fire demands for the proposed building.

4.4 Fire Hydrants

The proposed building has an existing fire hydrant within 45m of the Siamese connection fronting Belfast Road.

5 Stormwater Management

5.1 Storm Design Criteria

The storm sewer system was designed in conformance with the City of Ottawa Sewer Design Guidelines (SDG02, 2012). The stormwater servicing design criteria for the proposed development is 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.
- Maximum allowable ponding depth is 350 mm.
- Flows from storm events greater than the 100-year return period will be directed overland towards the rear of the property and will ultimately outlet to Industrial Avenue, south of the property as per the existing overland conveyance pattern.
- Average runoff coefficients were calculated for each inlet drainage area using a runoff coefficient of 0.20 for pervious surfaces and 0.90 for impervious surfaces.
- Estimated storage volumes are based on the Modified Rational Method.
- 100-year minor system flows to the municipal sewer must be controlled to the allowable release rate.
- Minimum freeboard of 0.3m between the 100-year overland flow elevation and finished floor.

5.2 Pre-Development Conditions

The 830 Belfast site currently drains towards the existing storm sewer system that services the drainage area of building 197 Trainyards and the site area of 830 Belfast building. The total drainage area is 2.03ha. Refer to Drawing # SWM in Appendix D. The existing storm sewer system is connected to the existing 450mm storm sewer, which outlets to municipal trunk sewer located on Trainyard Drive. An existing stormceptor STC 300 installed on the north east side of building 195 Trainyard during the development of 197 Trainyards provides quality control for the existing development. The site has been graded with slopes ranging between 1.6% to 3.0% with overland flows directed from north to south towards the rear of the property.

5.3 Allowable Release Rate

The allowable release rate for the site is calculated using a runoff coefficient of 0.4 and a time of concentration of 15 minutes. The design criteria was established in the Master Servicing Report for the Ottawa Trainyards development. Refer to the East Lands Phase 2 SWM design criteria confirmation in Appendix A.

The allowable release rate for the drainage area is calculated as follows:

Allowable Runoff Coefficient:	C = 0.40
Rainfall Intensity:	$I_{(5\text{-year, 15 min})}$ = 81.0 mm/hr
Allowable Runoff Rate:	Q = (2.78)(0.4)(81) = 90.1 L/s/ha
Effective Area of Site:	2.03 hectares
Allowable Release Rate:	Q = (2.03ha)(90.1)
	=**182.9 L/s**

Therefore, the allowable release rate for the 2.03 ha drainage area is 182.9 L/s.

Stormwater flows from the drainage area shown in the stormwater management drawing # SWM are currently conveyed via the existing storm sewer system to the Stormceptor STC300 installed north east of the existing building 195 Trainyard Drive before it is discharged via the 450mm storm sewer into the municipal trunk sewer located on Trainyard Drive. The 100-year post-development release rate from the 2.03ha drainage area which includes the area of 830 Belfast Road, following the development of the proposed one-storey retail building will be restricted to or less than the 5-year pre-development flow.

5.4 Post-Development Conditions

Stormwater from the 2.03ha 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.

5.4.1 Storage Requirements and Allocation

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

Surface ponding volumes over catch basins and catch basin manholes were determined by applying the pyramid volume equation of one-third of the depth multiplied by the surface area of the pond. Ponding depths for the subject site must be equal to or less than 350 mm for the 100-year storm event.

Refer to Stormwater Management Plan drawing # SWM for the drainage areas and refer to Appendix A for the detailed stormwater management spreadsheet calculations. The following table 5-1 summarizes the release rates and storage requirements for the 2.03ha drainage area which includes the proposed one-storey development at 830 Belfast Road.

Table 5-1: Summary of SWM Storage Requirements

Area ID	Outlet Location	Area (ha)	Runoff Coefficient 'C'	100 Year Release (L/s)	100 Year storage required (m^3)	100 Year surface storage provided (m^3)	Hydrovex Model
A1	CBMH 204	0.09	0.89	**7.6**	27.7	43.0	**75 VHV-1**
A2	CBMH 203	0.09	0.86	**2.5**	109.4	110.3	**50 VHV-1**
A3		0.10					
A4	CBMH 301	0.09	0.83	35.8	0.0	24.6	
A5	CB 102	0.22	0.90	**37.5**	44.9	45.0	**200 VHV-2**
A6	CB 110	0.05	0.27	**4.8**	1.7	1.8	**75 VHV-1**
A7	CBMH 201	0.05	0.20	**1.0**	3.9	4.0	32 SVHV-1
A8	CB E12	0.08	0.83	**6.0**	26.0	28.8	75 VHV-1
A9	CB E19	0.11	0.90	**3.2**	50.6	72.0	75 VHV-1
A10	BLDG ROOF	0.16	0.90	**3.8**	78.3	80.0	
A11	CBMH 202	0.05	0.90	**4.9**	33.4	33.5	75 VHV-1
A12		0.04					
A13	Ex. CB	0.05	0.63	15.6	0.0	0.9	
A14	CB 112	0.13	0.90	**14.0**	34.6	35.3	**100 VHV-1**
A15	CB 111	0.08	0.90	**3.0**	34.0	34.7	**50 VHV-1**
A16	BLDG ROOF	0.35	0.90	**15.0**	141.8	175.0	
A17	CB 108	0.04	0.20	**1.0**	2.8	5.3	32 SVHV-1
A18	Uncontrolled	0.04	0.20	4.0	0.0	0.0	
A19	Uncontrolled	0.01	0.20	1.0	0.0	0.0	
A20	CB 113-114	0.02	0.90	7.9	0.0	0.0	
E13	CBMH E13	0.09	0.87	**11.8**	61.5	102.0	100 VHV-1
E14		0.09					
	TOTAL	**2.03**					
			Totals:	**180.4**	**650.6**	**796.1**	
			Total Allowable Release L/s:	**182.9**			

Bold flows are controlled.

The 100-year controlled release rate from 2.03ha area is 180.4 L/s, which is less than the total allowable release rate of 182.9 L/s. The available storage volume of 796.1 m^3 is more than the required volume of 635.1 m^3.

5.4.2 Flow Control Device Sizing

Stormwater runoff from the 2.03ha area will be detained using inlet control devices (ICDs) within the storm system as well as flow control roof drains. The existing ICDs, which were installed as part of the 197 Trainyards Drive design will remain, except for the ICD installed in CB102 located in the parking lot area north of the existing building 197 Trainyard Drive, which will be replaced with a new ICD. The new ICD will be a Hydrovex model 200 VHV-2.

There are five additional proposed ICDs. Hydrovex model 75 VHV-1 to be installed in CB110 and CBMH204 located in the landscape area west of the proposed building and in the parking lot area southwest of the proposed building, respectively. Hydrovex model 50 VHV-1 to be installed in CB111 and CBMH203 located in the parking lot area south and southwest of the proposed building, respectively. And Hydrovex model 100 VHV-1 to be installed in CB112 located in the parking lot area south of the proposed building. Refer to the Stormwater Management Plan drawing # SWM for the ICD locations and details and Appendix A for the Hydrovex flow regulator selection curves.

5.4.3 Uncontrolled Flow

Uncontrolled runoff flow from the site will be from designated landscape areas located to the North and the East of the proposed building. The uncontrolled areas are significantly reduced from the existing conditions and thus will generate minimal runoff flow. Refer to the Stormwater Management Plan drawing # SWM, which indicates the uncontrolled areas.

5.4.4 Quality Control

Quality control for the proposed development will be provided by the existing Stormceptor STC 300 unit, which will provide the required level of 80% TSS removal. The existing Stormceptor was designed for the 1.49ha drainage area, which included the gravel/asphalt area where the new building will be located. Following the development of 830 Belfast, the total asphalt and landscape area that will drain towards the stormceptor will be 1.42ha, which is less than the area the current STC300 is designed to treat. Therefore, the existing stormceptor should be adequate to provide the required level of 80% TSS removal. Additional quality control measures are therefore not warranted. Refer to the RVCA Letter dated May 14th, 2019 and Figure 3 for the drainage area the stormceptor is treating in Appendix D.

The remaining area of the 2.03ha site includes the existing building 197 Trainyards Drive and the proposed building 830 Belfast, which do not require treatment as the conveyed storm water from the roofs is considered as clean water. Similarly, the uncontrolled flow from landscape areas do not require treatment.

6 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 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.

7 Conclusions

This report addresses the adequacy of the existing municipal services to service the proposed development at 830 Belfast Road, Ottawa, Ontario. Based on the analysis provided in this report, the conclusions are as follows:

- The proposed one-storey retail building will be serviced by a 200mm diameter watermain, which will adequately service the proposed development.
- The proposed building will be serviced by a 250mm diameter sanitary sewer, which will adequately service the proposed development.
- SWM for the proposed development will be achieved by restricting all storms up to the 100-year post development flow to the allowable release rate. The quantity control criteria for the site is to restrict the 100-year post-development release rate to the 5-year pre-development flow using a runoff coefficient of 0.4 and a time of concentration of 15 minutes.
- Required on-site SWM storage volumes will be achieved using the surface storage in the parking-lots and storage on the roof of the new building for storms up to the 100-year event.
- Quality control will be provided by the existing Stormceptor STC300.
- Temporary erosion and sediment control measures for the subject site have been identified.
- Overland flow routes have been provided for the subject site.
- During all construction activities, erosion and sedimentation shall be controlled.

Appendix A – Stormwater Management Design Sheets

Conservation Partners
Partenaires en conservation

Mississippi Valley Conservation Authority | Rideau Valley Conservation Authority | South Nation Conservation de la Nation Sud

File: 19-OTT-SPC-0235

May 14th, 2019

City of Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West, 4th Floor
Ottawa, ON K1P 1J1

Attention: John Bernier

Subject: Controlex Corporation
Site Plan Control Application D07-12-19-0071
820/830 Belfast Road, City of Ottawa

Dear Mr. Bernier:

The Conservation Partners Planning and Development Review Team has completed a review of the above noted application to construct a one-storey, 3530 square metre grocery store and associated surface parking area within a commercial retail mall.

We have undertaken our review within the context of Sections 1.6.6 Sewage, Water and Stormwater, 2.1 Natural Heritage, 2.2 Water and 3.1 Natural Hazards of the Provincial Policy Statement, 2014 issued under Section 3 of the *Planning Act*, and from the perspective of the Conservation Authority regulations. The following comments are offered for your consideration.

Natural Heritage

We have not identified any natural heritage features on this property which would preclude the approval of this application.

Natural Hazards

We have not identified any natural hazards on the site which would preclude this application.

3889 Rideau Valley Drive, P.O. Box 599
Manotick, Ontario, K4M 1A5

Tel: 613-692-3571
Fax: 613-692-0831

Stormwater Management

We note that stormwater from this site is being directed to an existing storm sewer located on Trainyards Drive. Based on the information provided in the report "Stormwater Management & Servicing Report – Ottawa Train Yards, 830 Belfast Road" dated April 9th, 2019, prepared by EXP Services Inc., quality control for this site will be provided by the existing Stormceptor STC 300 unit, which will provide the required level of 80% TSS removal. The report indicates that the existing Stormceptor model was designed for the 1.49 ha drainage area which included the gravel/asphalt and landscape area where the new building will be located. The RVCA finds the water quality objective acceptable from a watershed management perspective.

Please note that the RVCA did not conduct a technical review of the stormwater management plan. We will rely on the City to ensure that the stormwater management plan is consistent with the overall stormwater management plan for the Train Yards subdivision.

Conclusion

In conclusion, the RVCA has no objection to this Site Plan Control application. The Conservation Authority kindly requests a copy of decision related to this file. For any questions regarding the information contained in this letter, please feel free to contact me.

Respectfully,

Jamie Batchelor, MCIP, RPP
Planner, Planning and Watershed Science
Rideau Valley Conservation Authority
613-692-3571 ext. 1191
Jamie.batchelor@rvca.ca

Cc: Mike Green: Controlex Corporation

8.0 STORMWATER MANAGEMENT DESIGN

8.1 Allowable Release Rate

At 2.45 hectares, Phase 2 of this development is larger than the 2.2 hectares anticipated in the *Master Servicing Report*. Due to this increase in drainage area, Phase 2 will need to be over controlled. As outlined in the *Master Servicing Report* the proposed release rate for the site was calculated as follows.

Allowable Runoff Coefficient:	C = 0.40
Rainfall Intensity:	$i_{(5\text{-year, 15 min})} = 81.0$ mm/hr
Allowable Release Rate:	Q = 2.78CiA = 2.78(0.4)81.0
	Q = 90.1 L/s/ha
Effective Area of Site:	A = 2.2 hectares
Allowable release rate	Q = 2.2 ha x 90.1 L/s/ha = 198.2 L/s

The equivalent runoff coefficient for Phase 2 can be determined as follows.

Allowable Release Rate:	Q = 2.78CiA
	198.2 = 2.78(C)(81.0)(2.45)
	C = 198.2 / [2.78(81.0)(2.45)]
Effective Runoff Coefficient:	C = 0.36

8.2 Storage Requirements and Allocation

The site was designed to limit runoff to the allowable release rate up to the 100-year storm event. Orifices in catchbasins will be employed to control runoff from parking, access and landscape areas. Roof drain inserts will be used to control rooftop runoff to 40 L/s/ha. To determine the resulting storage volume a 5-year and 100-year storm was applied at time steps of 10 minutes until a peak storage volume requirement was attained for the sub-area being controlled. The peak storage volume required was then met or exceeded at the ponding location. Ponding volumes were determined by applying the pyramid volume equation of one-third of the depth multiplied by the surface area of the ponding limit.

Ponding depths were limited to 150 mm for the 5-year storm and 300 mm for the 100-year event. In the event of less frequent storms an overland flow route toward Trainyards Drive has been provided that will prevent any negative impact on the buildings.

Table A1
Stormwater Management Summary

Area ID	Outlet Location	Area (ha)	Runoff Coefficient 'C'	100 Year Release (L/s)	100 Year storage required (m^3)	100 Year surface storage provided (m^3)	Hydrovex Model
A1	CBMH 204	0.09	0.89	**7.6**	27.7	43.0	**75 VHV-1**
A2	CBMH 203	0.09	0.86	**2.5**	109.4	110.3	**50 VHV-1**
A3		0.10					
A4	CBMH 301	0.09	0.83	35.8	0.0	24.6	
A5	CB 102	0.22	0.90	**37.5**	44.9	45.0	**200 VHV-2**
A6	CB 110	0.05	0.27	**4.8**	1.7	1.8	**75 VHV-1**
A7	CBMH 201	0.05	0.20	**1.0**	3.9	4.0	32 SVHV-1
A8	CB E12	0.08	0.83	**6.0**	26.0	28.8	75 VHV-1
A9	CB E19	0.11	0.90	**3.2**	50.6	72.0	75 VHV-1
A10	BLDG ROOF	0.16	0.90	**3.8**	78.3	80.0	
A11	CBMH 202	0.05	0.90	**4.9**	33.4	33.5	75 VHV-1
A12		0.04					
A13	Ex. CB	0.05	0.63	15.6	0.0	0.9	
A14	CB 112	0.13	0.90	**14.0**	34.6	35.3	**100 VHV-1**
A15	CB 111	0.08	0.90	**3.0**	34.0	34.7	**50 VHV-1**
A16	BLDG ROOF	0.35	0.90	**15.0**	141.8	175.0	
A17	CB 108	0.04	0.20	**1.0**	2.8	5.3	32 SVHV-1
A18	Uncontrolled	0.04	0.20	4.0	0.0	0.0	
A19	Uncontrolled	0.01	0.20	1.0	0.0	0.0	
A20	CB 113-114	0.02	0.90	7.9	0.0	0.0	
E13	CBMH E13	0.09	0.87	**11.8**	61.5	102.0	100 VHV-1
E14		0.09					
	TOTAL	**2.03**					
			Totals:	**180.4**	**650.6**	**796.1**	
			Total Allowable Release L/s:	**182.9**			

Table A2
SWM POST-DEVELOPMENT RUNOFF (UNCONTROLLED AND CONTROLLED)

Area No	Outlet Location	Area (ha)	Time of Conc. T_c (min)	Storm = 5-year				Storm = 100-year			
				C_{AVG}	I_5 (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	$C_{AVG\text{-}100Yr}$	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)
A1	CBMH 204	0.09	15	0.89	83.56	37.0	**7.6**	1.00	142.89	71.5	**7.6**
A2	CBMH 203	0.09	15	0.86	83.56	37.8	**2.5**	1.00	142.89	75.5	**2.5**
A3		0.10									
A4	CBMH 301	0.09	15	0.83	83.56	17.4	17.4	1.00	142.89	35.8	35.8
A5	CB 102	0.22	15	0.90	83.56	46.0	**37.5**	1.00	142.89	87.4	**37.5**
A6	CB 110	0.05	15	0.27	83.56	3.1	**4.8**	0.34	142.89	6.7	**4.8**
A7	CBMH 201	0.05	15	0.20	83.56	2.3	**1.0**	0.25	142.89	5.0	**1.0**
A8	CB E12	0.08	15	0.83	83.56	15.4	**6.0**	1.00	142.89	31.8	**6.0**
A9	CB E19	0.11	15	0.90	83.56	23.0	**3.2**	1.00	142.89	43.7	**3.2**
A10	BLDG ROOF	0.16	15	0.90	83.56	33.4	**3.8**	1.00	142.89	63.6	**3.8**
A11	CBMH 202	0.05	15	0.90	83.56	18.8	**4.9**	1.00	142.89	35.8	**4.9**
A12		0.04									
A13	Ex. CB	0.05	15	0.63	83.56	7.3	7.3	0.79	142.89	15.6	15.6
A14	CB 112	0.13	15	0.90	83.56	27.2	**14.0**	1.00	142.89	51.6	**14.0**
A15	CB 111	0.08	15	0.90	83.56	16.7	**3.0**	1.00	142.89	31.8	**3.0**
A16	BLDG ROOF	0.35	15	0.90	83.56	73.2	**15.0**	1.00	142.89	139.0	**15.0**
A17	CB 108	0.04	15	0.20	83.56	1.9	**1.0**	0.25	142.89	4.0	**1.0**
A18	Uncontrolled	0.04	15	0.20	83.56	1.9	1.9	0.25	142.89	4.0	4.0
A19	Uncontrolled	0.01	15	0.20	83.56	0.5	0.5	0.25	142.89	1.0	1.0
A20	CB 113-114	0.02	15	0.90	83.56	4.2	4.2	1.00	142.89	7.9	7.9
E13	CBMH E13	0.09	15	0.87	83.56	36.5	**11.8**	1.00	142.89	71.5	**11.8**
E14		0.09									
Total		2.03				403.6	**147.3**			783.1	**180.4**

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 (5.4.5.2, City of Ottawa)
4) Flows under column Q_{CAP} which are **bold**, denotes flows that are controlled.

Table A3
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A1
C_{AVG} = 0.89 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.0900 (hectares)

Duration, T_D (min)	Release Rate = 7.6 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951 , B = 0.810 ($I = A/(T_D+C)^B$) , C = 6.199					Release Rate = 7.6 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688 0.820 ($I = A/(T_D+C)^B$) , C = 6.014				
	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	37.0	7.60	29.4	0	398.6	99.7	7.600	92.1	0.0
15	61.8	13.7	7.60	6.1	**5**	142.9	35.8	7.600	28.2	25.3
30	40.0	8.9	7.60	1.3	2	91.9	23.0	7.600	15.4	**27.7**
45	30.2	6.7	7.60	-0.9	-2	69.1	17.3	7.600	9.7	26.1
60	24.6	5.4	7.60	-2.2	-8	55.9	14.0	7.600	6.4	23.0
75	20.8	4.6	7.60	-3.0	-13	47.3	11.8	7.600	4.2	19.0
90	18.1	4.0	7.60	-3.6	-19	41.1	10.3	7.600	2.7	14.5
105	16.1	3.6	7.60	-4.0	-25	36.5	9.1	7.600	1.5	9.6
120	14.6	3.2	7.60	-4.4	-31	32.9	8.2	7.600	0.6	4.5
135	13.3	2.9	7.60	-4.7	-38	30.0	7.5	7.600	-0.1	-0.8
150	12.3	2.7	7.60	-4.9	-44	27.6	6.9	7.600	-0.7	-6.2
165	11.4	2.5	7.60	-5.1	-50	25.6	6.4	7.600	-1.2	-11.8
180	10.6	2.4	7.60	-5.2	-57	23.9	6.0	7.600	-1.6	-17.5
195	10.0	2.2	7.60	-5.4	-63	22.4	5.6	7.600	-2.0	-23.3
210	9.4	2.1	7.60	-5.5	-69	21.1	5.3	7.600	-2.3	-29.1
225	8.9	2.0	7.60	-5.6	-76	20.0	5.0	7.600	-2.6	-35.0
240	8.5	1.9	7.60	-5.7	-82	19.0	4.8	7.600	-2.8	-41.0
255	8.1	1.8	7.60	-5.8	-89	18.1	4.5	7.600	-3.1	-47.0
270	7.7	1.7	7.60	-5.9	-95	17.3	4.3	7.600	-3.3	-53.0
285	7.4	1.6	7.60	-6.0	-102	16.6	4.1	7.600	-3.5	-59.1
300	7.1	1.6	7.60	-6.0	-108	15.9	4.0	7.600	-3.6	-65.2
315	6.8	1.5	7.60	-6.1	-115	15.3	3.8	7.600	-3.8	-71.4
Maximum Storage Requried =					**5.5**					**27.7**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A4
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A2-A3
C_{AVG} = 0.86 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.1900 (hectares)

Duration, T_D (min)	Release Rate = 2.5 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810; (I = A/(T_D+C)^B , C = 6.199					Release Rate = 2.5 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820; (I = A/(T_D+C)^B , C = 6.014				
	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	75.6	2.50	73.1	0	398.6	210.6	2.500	208.1	0.0
15	61.8	27.9	2.50	25.4	23	142.9	75.5	2.500	73.0	65.7
30	40.0	18.1	2.50	15.6	28	91.9	48.5	2.500	46.0	82.8
45	30.2	13.7	2.50	11.2	30	69.1	36.5	2.500	34.0	91.7
60	24.6	11.1	2.50	8.6	31	55.9	29.5	2.500	27.0	97.3
75	20.8	9.4	2.50	6.9	**31**	47.3	25.0	2.500	22.5	101.1
90	18.1	8.2	2.50	5.7	31	41.1	21.7	2.500	19.2	103.8
105	16.1	7.3	2.50	4.8	30	36.5	19.3	2.500	16.8	105.7
120	14.6	6.6	2.50	4.1	29	32.9	17.4	2.500	14.9	107.1
135	13.3	6.0	2.50	3.5	28	30.0	15.8	2.500	13.3	108.1
150	12.3	5.5	2.50	3.0	27	27.6	14.6	2.500	12.1	108.8
165	11.4	5.1	2.50	2.6	26	25.6	13.5	2.500	11.0	109.2
180	10.6	4.8	2.50	2.3	25	23.9	12.6	2.500	10.1	109.4
195	10.0	4.5	2.50	2.0	24	22.4	11.8	2.500	9.3	**109.4**
210	9.4	4.3	2.50	1.8	22	21.1	11.2	2.500	8.7	109.2
225	8.9	4.0	2.50	1.5	21	20.0	10.6	2.500	8.1	108.9
240	8.5	3.8	2.50	1.3	19	19.0	10.0	2.500	7.5	108.6
255	8.1	3.7	2.50	1.2	18	18.1	9.6	2.500	7.1	108.1
270	7.7	3.5	2.50	1.0	16	17.3	9.1	2.500	6.6	107.5
285	7.4	3.3	2.50	0.8	14	16.6	8.7	2.500	6.2	106.8
300	7.1	3.2	2.50	0.7	13	15.9	8.4	2.500	5.9	106.1
315	6.8	3.1	2.50	0.6	11	15.3	8.1	2.500	5.6	105.3
Maximum Storage Requried =					**31.1**					**109.4**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, I = A/(T_D+C)^B, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A5
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A4
C_{AVG} = 0.83 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.0900 (hectares)

Duration, T_D (min)	Release Rate = 35.8 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951, B = 0.810, C = 6.199 ($I = A/(T_D+C)^B$)					Release Rate = 35.8 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688, 0.820, C = 6.014 ($I = A/(T_D+C)^B$)				
	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	34.9	35.75	-0.9	**0**	398.6	99.7	35.752	64.0	**0.0**
15	61.8	12.9	35.75	-22.9	-21	142.9	35.8	35.752	0.0	**0.0**
30	40.0	8.3	35.75	-27.4	-49	91.9	23.0	35.752	-12.8	-23.0
45	30.2	6.3	35.75	-29.4	-80	69.1	17.3	35.752	-18.5	-49.9
60	24.6	5.1	35.75	-30.6	-110	55.9	14.0	35.752	-21.8	-78.4
75	20.8	4.3	35.75	-31.4	-141	47.3	11.8	35.752	-23.9	-107.7
90	18.1	3.8	35.75	-32.0	-173	41.1	10.3	35.752	-25.5	-137.5
105	16.1	3.4	35.75	-32.4	-204	36.5	9.1	35.752	-26.6	-167.7
120	14.6	3.0	35.75	-32.7	-236	32.9	8.2	35.752	-27.5	-198.2
135	13.3	2.8	35.75	-33.0	-267	30.0	7.5	35.752	-28.2	-228.8
150	12.3	2.6	35.75	-33.2	-299	27.6	6.9	35.752	-28.8	-259.6
165	11.4	2.4	35.75	-33.4	-330	25.6	6.4	35.752	-29.3	-290.5
180	10.6	2.2	35.75	-33.5	-362	23.9	6.0	35.752	-29.8	-321.5
195	10.0	2.1	35.75	-33.7	-394	22.4	5.6	35.752	-30.1	-352.6
210	9.4	2.0	35.75	-33.8	-426	21.1	5.3	35.752	-30.5	-383.8
225	8.9	1.9	35.75	-33.9	-458	20.0	5.0	35.752	-30.7	-415.1
240	8.5	1.8	35.75	-34.0	-489	19.0	4.8	35.752	-31.0	-446.4
255	8.1	1.7	35.75	-34.1	-521	18.1	4.5	35.752	-31.2	-477.7
270	7.7	1.6	35.75	-34.1	-553	17.3	4.3	35.752	-31.4	-509.1
285	7.4	1.5	35.75	-34.2	-585	16.6	4.1	35.752	-31.6	-540.5
300	7.1	1.5	35.75	-34.3	-617	15.9	4.0	35.752	-31.8	-572.0
315	6.8	1.4	35.75	-34.3	-649	15.3	3.8	35.752	-31.9	-603.5
Maximum Storage Requried =					**0.0**					**0.0**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A6

Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A5
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.2200 (hectares)

Duration, T_D (min)	Release Rate = 37.5 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810; ($I = A/(T_D+C)^B$), C = 6.199					Release Rate = 37.5 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820; ($I = A/(T_D+C)^B$), C = 6.014				
	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	92.0	37.50	54.5	**0**	398.6	243.8	37.500	206.3	0.0
15	61.8	34.0	37.50	-3.5	-3	142.9	87.4	37.500	49.9	**44.9**
30	40.0	22.0	37.50	-15.5	-28	91.9	56.2	37.500	18.7	33.6
45	30.2	16.6	37.50	-20.9	-56	69.1	42.2	37.500	4.7	12.8
60	24.6	13.5	37.50	-24.0	-86	55.9	34.2	37.500	-3.3	-11.9
75	20.8	11.5	37.50	-26.0	-117	47.3	28.9	37.500	-8.6	-38.7
90	18.1	10.0	37.50	-27.5	-149	41.1	25.1	37.500	-12.4	-66.7
105	16.1	8.9	37.50	-28.6	-180	36.5	22.3	37.500	-15.2	-95.6
120	14.6	8.0	37.50	-29.5	-212	32.9	20.1	37.500	-17.4	-125.1
135	13.3	7.3	37.50	-30.2	-244	30.0	18.3	37.500	-19.2	-155.1
150	12.3	6.7	37.50	-30.8	-277	27.6	16.9	37.500	-20.6	-185.5
165	11.4	6.3	37.50	-31.2	-309	25.6	15.7	37.500	-21.8	-216.2
180	10.6	5.8	37.50	-31.7	-342	23.9	14.6	37.500	-22.9	-247.1
195	10.0	5.5	37.50	-32.0	-374	22.4	13.7	37.500	-23.8	-278.2
210	9.4	5.2	37.50	-32.3	-407	21.1	12.9	37.500	-24.6	-309.6
225	8.9	4.9	37.50	-32.6	-440	20.0	12.2	37.500	-25.3	-341.0
240	8.5	4.7	37.50	-32.8	-473	19.0	11.6	37.500	-25.9	-372.6
255	8.1	4.4	37.50	-33.1	-506	18.1	11.1	37.500	-26.4	-404.3
270	7.7	4.3	37.50	-33.2	-539	17.3	10.6	37.500	-26.9	-436.1
285	7.4	4.1	37.50	-33.4	-572	16.6	10.1	37.500	-27.4	-468.1
300	7.1	3.9	37.50	-33.6	-605	15.9	9.7	37.500	-27.8	-500.1
315	6.8	3.8	37.50	-33.7	-638	15.3	9.3	37.500	-28.2	-532.1
Maximum Storage Requried =					**0.0**					**44.9**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A7
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A6
C_{AVG} = 0.27 (2-yr, 5-yr)
C_{AVG} = 0.34 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.0500 (hectares)

Duration, T_D (min)	Release Rate = 4.8 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810; ($I = A/(T_D+C)^B$), C = 6.199					Release Rate = 4.8 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820; ($I = A/(T_D+C)^B$), C = 6.014				
	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	6.3	4.80	1.5	**0**	398.6	18.7	4.800	13.9	0.0
15	61.8	2.3	4.80	-2.5	-2	142.9	6.7	4.800	1.9	**1.7**
30	40.0	1.5	4.80	-3.3	-6	91.9	4.3	4.800	-0.5	-0.9
45	30.2	1.1	4.80	-3.7	-10	69.1	3.2	4.800	-1.6	-4.2
60	24.6	0.9	4.80	-3.9	-14	55.9	2.6	4.800	-2.2	-7.8
75	20.8	0.8	4.80	-4.0	-18	47.3	2.2	4.800	-2.6	-11.6
90	18.1	0.7	4.80	-4.1	-22	41.1	1.9	4.800	-2.9	-15.5
105	16.1	0.6	4.80	-4.2	-26	36.5	1.7	4.800	-3.1	-19.5
120	14.6	0.5	4.80	-4.3	-31	32.9	1.5	4.800	-3.3	-23.4
135	13.3	0.5	4.80	-4.3	-35	30.0	1.4	4.800	-3.4	-27.5
150	12.3	0.5	4.80	-4.3	-39	27.6	1.3	4.800	-3.5	-31.5
165	11.4	0.4	4.80	-4.4	-43	25.6	1.2	4.800	-3.6	-35.6
180	10.6	0.4	4.80	-4.4	-48	23.9	1.1	4.800	-3.7	-39.7
195	10.0	0.4	4.80	-4.4	-52	22.4	1.1	4.800	-3.7	-43.8
210	9.4	0.4	4.80	-4.4	-56	21.1	1.0	4.800	-3.8	-48.0
225	8.9	0.3	4.80	-4.5	-60	20.0	0.9	4.800	-3.9	-52.1
240	8.5	0.3	4.80	-4.5	-65	19.0	0.9	4.800	-3.9	-56.3
255	8.1	0.3	4.80	-4.5	-69	18.1	0.8	4.800	-4.0	-60.4
270	7.7	0.3	4.80	-4.5	-73	17.3	0.8	4.800	-4.0	-64.6
285	7.4	0.3	4.80	-4.5	-77	16.6	0.8	4.800	-4.0	-68.8
300	7.1	0.3	4.80	-4.5	-82	15.9	0.7	4.800	-4.1	-73.0
315	6.8	0.3	4.80	-4.5	-86	15.3	0.7	4.800	-4.1	-77.2
Maximum Storage Requried =					**0.0**					**1.7**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A8
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A7
C_{AVG} = 0.20 (2-yr, 5-yr)
C_{AVG} = 0.25 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.0500 (hectares)

Duration, T_D (min)	Release Rate = 1.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 ($I = A/(T_D+C)^B$)					Release Rate = 1.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820, C = 6.014 ($I = A/(T_D+C)^B$)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	4.6	1.00	3.6	0	398.6	13.9	1.000	12.9	0.0
15	61.8	1.7	1.00	0.7	**1**	142.9	5.0	1.000	4.0	3.6
30	40.0	1.1	1.00	0.1	0	91.9	3.2	1.000	2.2	**3.9**
45	30.2	0.8	1.00	-0.2	0	69.1	2.4	1.000	1.4	3.8
60	24.6	0.7	1.00	-0.3	-1	55.9	1.9	1.000	0.9	3.4
75	20.8	0.6	1.00	-0.4	-2	47.3	1.6	1.000	0.6	2.9
90	18.1	0.5	1.00	-0.5	-3	41.1	1.4	1.000	0.4	2.3
105	16.1	0.4	1.00	-0.6	-3	36.5	1.3	1.000	0.3	1.7
120	14.6	0.4	1.00	-0.6	-4	32.9	1.1	1.000	0.1	1.0
135	13.3	0.4	1.00	-0.6	-5	30.0	1.0	1.000	0.0	0.3
150	12.3	0.3	1.00	-0.7	-6	27.6	1.0	1.000	0.0	-0.4
165	11.4	0.3	1.00	-0.7	-7	25.6	0.9	1.000	-0.1	-1.1
180	10.6	0.3	1.00	-0.7	-8	23.9	0.8	1.000	-0.2	-1.8
195	10.0	0.3	1.00	-0.7	-8	22.4	0.8	1.000	-0.2	-2.6
210	9.4	0.3	1.00	-0.7	-9	21.1	0.7	1.000	-0.3	-3.3
225	8.9	0.2	1.00	-0.8	-10	20.0	0.7	1.000	-0.3	-4.1
240	8.5	0.2	1.00	-0.8	-11	19.0	0.7	1.000	-0.3	-4.9
255	8.1	0.2	1.00	-0.8	-12	18.1	0.6	1.000	-0.4	-5.7
270	7.7	0.2	1.00	-0.8	-13	17.3	0.6	1.000	-0.4	-6.5
285	7.4	0.2	1.00	-0.8	-14	16.6	0.6	1.000	-0.4	-7.3
300	7.1	0.2	1.00	-0.8	-14	15.9	0.6	1.000	-0.4	-8.1
315	6.8	0.2	1.00	-0.8	-15	15.3	0.5	1.000	-0.5	-8.9
Maximum Storage Requried =					**0.6**					**3.9**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A9
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A8
C_{AVG} = 0.83 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.0800 (hectares)

Duration, T_D (min)	Release Rate = 6.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 ($I = A/(T_D+C)^B$)					Release Rate = 6.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820, C = 6.014 ($I = A/(T_D+C)^B$)				
	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	30.8	6.00	24.8	0	398.6	88.7	6.000	82.7	0.0
15	61.8	11.4	6.00	5.4	**5**	142.9	31.8	6.000	25.8	23.2
30	40.0	7.4	6.00	1.4	2	91.9	20.4	6.000	14.4	**26.0**
45	30.2	5.6	6.00	-0.4	-1	69.1	15.4	6.000	9.4	25.3
60	24.6	4.5	6.00	-1.5	-5	55.9	12.4	6.000	6.4	23.2
75	20.8	3.8	6.00	-2.2	-10	47.3	10.5	6.000	4.5	20.3
90	18.1	3.3	6.00	-2.7	-14	41.1	9.1	6.000	3.1	17.0
105	16.1	3.0	6.00	-3.0	-19	36.5	8.1	6.000	2.1	13.3
120	14.6	2.7	6.00	-3.3	-24	32.9	7.3	6.000	1.3	9.5
135	13.3	2.5	6.00	-3.5	-29	30.0	6.7	6.000	0.7	5.4
150	12.3	2.3	6.00	-3.7	-34	27.6	6.1	6.000	0.1	1.3
165	11.4	2.1	6.00	-3.9	-39	25.6	5.7	6.000	-0.3	-3.0
180	10.6	2.0	6.00	-4.0	-44	23.9	5.3	6.000	-0.7	-7.4
195	10.0	1.8	6.00	-4.2	-49	22.4	5.0	6.000	-1.0	-11.8
210	9.4	1.7	6.00	-4.3	-54	21.1	4.7	6.000	-1.3	-16.3
225	8.9	1.6	6.00	-4.4	-59	20.0	4.5	6.000	-1.5	-20.9
240	8.5	1.6	6.00	-4.4	-64	19.0	4.2	6.000	-1.8	-25.5
255	8.1	1.5	6.00	-4.5	-69	18.1	4.0	6.000	-2.0	-30.2
270	7.7	1.4	6.00	-4.6	-74	17.3	3.8	6.000	-2.2	-34.9
285	7.4	1.4	6.00	-4.6	-79	16.6	3.7	6.000	-2.3	-39.6
300	7.1	1.3	6.00	-4.7	-84	15.9	3.5	6.000	-2.5	-44.4
315	6.8	1.3	6.00	-4.7	-90	15.3	3.4	6.000	-2.6	-49.2
Maximum Storage Requried =					**4.8**					**26.0**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A10
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A9
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.1100 (hectares)

Duration, T_D (min)	Release Rate = 3.2 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, ($I = A/(T_D+C)^B$), C = 6.199					Release Rate = 3.2 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820, ($I = A/(T_D+C)^B$), C = 6.014				
	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	46.0	3.20	42.8	0	398.6	121.9	3.200	118.7	0.0
15	61.8	17.0	3.20	13.8	12	142.9	43.7	3.200	40.5	36.4
30	40.0	11.0	3.20	7.8	**14**	91.9	28.1	3.200	24.9	44.8
45	30.2	8.3	3.20	5.1	14	69.1	21.1	3.200	17.9	48.4
60	24.6	6.8	3.20	3.6	13	55.9	17.1	3.200	13.9	50.0
75	20.8	5.7	3.20	2.5	11	47.3	14.5	3.200	11.3	**50.6**
90	18.1	5.0	3.20	1.8	10	41.1	12.6	3.200	9.4	50.6
105	16.1	4.4	3.20	1.2	8	36.5	11.2	3.200	8.0	50.2
120	14.6	4.0	3.20	0.8	6	32.9	10.1	3.200	6.9	49.4
135	13.3	3.7	3.20	0.5	4	30.0	9.2	3.200	6.0	48.4
150	12.3	3.4	3.20	0.2	2	27.6	8.4	3.200	5.2	47.2
165	11.4	3.1	3.20	-0.1	-1	25.6	7.8	3.200	4.6	45.8
180	10.6	2.9	3.20	-0.3	-3	23.9	7.3	3.200	4.1	44.4
195	10.0	2.7	3.20	-0.5	-5	22.4	6.9	3.200	3.7	42.8
210	9.4	2.6	3.20	-0.6	-8	21.1	6.5	3.200	3.3	41.2
225	8.9	2.5	3.20	-0.7	-10	20.0	6.1	3.200	2.9	39.4
240	8.5	2.3	3.20	-0.9	-12	19.0	5.8	3.200	2.6	37.6
255	8.1	2.2	3.20	-1.0	-15	18.1	5.5	3.200	2.3	35.8
270	7.7	2.1	3.20	-1.1	-17	17.3	5.3	3.200	2.1	33.8
285	7.4	2.0	3.20	-1.2	-20	16.6	5.1	3.200	1.9	31.9
300	7.1	2.0	3.20	-1.2	-22	15.9	4.9	3.200	1.7	29.9
315	6.8	1.9	3.20	-1.3	-25	15.3	4.7	3.200	1.5	27.8
Maximum Storage Requried =					**14.1**					**50.6**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A11

Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A10

C_{AVG} = 0.90 (2-yr, 5-yr)

C_{AVG} = 1.00 (100-yr +25%)

Time Interval = 15 (mins)

Drainage Area = 0.1600 (hectares)

Duration, T_D (min)	Release Rate = 3.8 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 ($I = A/(T_D+C)^B$)					Release Rate = 3.8 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 ($I = A/(T_D+C)^B$)				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	66.9	3.80	63.1	0	398.6	177.3	3.800	173.5	0.0
15	61.8	24.7	3.80	20.9	19	142.9	63.6	3.800	59.8	53.8
30	40.0	16.0	3.80	12.2	22	91.9	40.9	3.800	37.1	66.7
45	30.2	12.1	3.80	8.3	**22**	69.1	30.7	3.800	26.9	72.7
60	24.6	9.8	3.80	6.0	22	55.9	24.9	3.800	21.1	75.8
75	20.8	8.3	3.80	4.5	20	47.3	21.0	3.800	17.2	77.5
90	18.1	7.3	3.80	3.5	19	41.1	18.3	3.800	14.5	78.2
105	16.1	6.5	3.80	2.7	17	36.5	16.2	3.800	12.4	**78.3**
120	14.6	5.8	3.80	2.0	15	32.9	14.6	3.800	10.8	78.0
135	13.3	5.3	3.80	1.5	12	30.0	13.3	3.800	9.5	77.3
150	12.3	4.9	3.80	1.1	10	27.6	12.3	3.800	8.5	76.3
165	11.4	4.6	3.80	0.8	7	25.6	11.4	3.800	7.6	75.1
180	10.6	4.3	3.80	0.5	5	23.9	10.6	3.800	6.8	73.8
195	10.0	4.0	3.80	0.2	2	22.4	10.0	3.800	6.2	72.3
210	9.4	3.8	3.80	0.0	0	21.1	9.4	3.800	5.6	70.6
225	8.9	3.6	3.80	-0.2	-3	20.0	8.9	3.800	5.1	68.9
240	8.5	3.4	3.80	-0.4	-6	19.0	8.5	3.800	4.7	67.0
255	8.1	3.2	3.80	-0.6	-9	18.1	8.1	3.800	4.3	65.1
270	7.7	3.1	3.80	-0.7	-11	17.3	7.7	3.800	3.9	63.1
285	7.4	3.0	3.80	-0.8	-14	16.6	7.4	3.800	3.6	61.0
300	7.1	2.8	3.80	-1.0	-17	15.9	7.1	3.800	3.3	58.8
315	6.8	2.7	3.80	-1.1	-20	15.3	6.8	3.800	3.0	56.6
Maximum Storage Requried =					**22.4**					**78.3**

Notes

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

2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)

3) Release Rate = Desired Capture (Release) Rate

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A12
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A11-A12
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.0900 (hectares)

Duration, T_D (min)	Release Rate = 4.9 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951, B = 0.810 ($I = A/(T_D+C)^B$, C = 6.199					Release Rate = 4.9 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688 0.820 ($I = A/(T_D+C)^B$, C = 6.014				
	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	37.7	4.90	32.8	0	398.6	99.7	4.900	94.8	0.0
15	61.8	13.9	4.90	9.0	**8**	142.9	35.8	4.900	30.9	27.8
30	40.0	9.0	4.90	4.1	7	91.9	23.0	4.900	18.1	32.6
45	30.2	6.8	4.90	1.9	5	69.1	17.3	4.900	12.4	**33.4**
60	24.6	5.5	4.90	0.6	2	55.9	14.0	4.900	9.1	32.7
75	20.8	4.7	4.90	-0.2	-1	47.3	11.8	4.900	6.9	31.2
90	18.1	4.1	4.90	-0.8	-4	41.1	10.3	4.900	5.4	29.1
105	16.1	3.6	4.90	-1.3	-8	36.5	9.1	4.900	4.2	26.7
120	14.6	3.3	4.90	-1.6	-12	32.9	8.2	4.900	3.3	24.0
135	13.3	3.0	4.90	-1.9	-15	30.0	7.5	4.900	2.6	21.1
150	12.3	2.8	4.90	-2.1	-19	27.6	6.9	4.900	2.0	18.1
165	11.4	2.6	4.90	-2.3	-23	25.6	6.4	4.900	1.5	14.9
180	10.6	2.4	4.90	-2.5	-27	23.9	6.0	4.900	1.1	11.7
195	10.0	2.2	4.90	-2.7	-31	22.4	5.6	4.900	0.7	8.3
210	9.4	2.1	4.90	-2.8	-35	21.1	5.3	4.900	0.4	4.9
225	8.9	2.0	4.90	-2.9	-39	20.0	5.0	4.900	0.1	1.4
240	8.5	1.9	4.90	-3.0	-43	19.0	4.8	4.900	-0.1	-2.1
255	8.1	1.8	4.90	-3.1	-47	18.1	4.5	4.900	-0.4	-5.7
270	7.7	1.7	4.90	-3.2	-51	17.3	4.3	4.900	-0.6	-9.3
285	7.4	1.7	4.90	-3.2	-55	16.6	4.1	4.900	-0.8	-12.9
300	7.1	1.6	4.90	-3.3	-59	15.9	4.0	4.900	-0.9	-16.6
315	6.8	1.5	4.90	-3.4	-64	15.3	3.8	4.900	-1.1	-20.4
Maximum Storage Requried =					**8.1**					**33.4**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A13
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A14
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.1300 (hectares)

Duration, T_D (min)	Release Rate = 14.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, ($I = A/(T_D+C)^B$), C = 6.199					Release Rate = 14.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820, ($I = A/(T_D+C)^B$), C = 6.014				
	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	54.4	14.00	40.4	0	398.6	144.1	14.000	130.1	0.0
15	61.8	20.1	14.00	6.1	**5**	142.9	51.6	14.000	37.6	33.9
30	40.0	13.0	14.00	-1.0	-2	91.9	33.2	14.000	19.2	**34.6**
45	30.2	9.8	14.00	-4.2	-11	69.1	25.0	14.000	11.0	29.6
60	24.6	8.0	14.00	-6.0	-22	55.9	20.2	14.000	6.2	22.3
75	20.8	6.8	14.00	-7.2	-33	47.3	17.1	14.000	3.1	13.9
90	18.1	5.9	14.00	-8.1	-44	41.1	14.9	14.000	0.9	4.6
105	16.1	5.2	14.00	-8.8	-55	36.5	13.2	14.000	-0.8	-5.1
120	14.6	4.7	14.00	-9.3	-67	32.9	11.9	14.000	-2.1	-15.2
135	13.3	4.3	14.00	-9.7	-78	30.0	10.8	14.000	-3.2	-25.6
150	12.3	4.0	14.00	-10.0	-90	27.6	10.0	14.000	-4.0	-36.2
165	11.4	3.7	14.00	-10.3	-102	25.6	9.3	14.000	-4.7	-47.0
180	10.6	3.5	14.00	-10.5	-114	23.9	8.6	14.000	-5.4	-57.9
195	10.0	3.2	14.00	-10.8	-126	22.4	8.1	14.000	-5.9	-69.0
210	9.4	3.1	14.00	-10.9	-138	21.1	7.6	14.000	-6.4	-80.1
225	8.9	2.9	14.00	-11.1	-150	20.0	7.2	14.000	-6.8	-91.4
240	8.5	2.8	14.00	-11.2	-162	19.0	6.9	14.000	-7.1	-102.7
255	8.1	2.6	14.00	-11.4	-174	18.1	6.5	14.000	-7.5	-114.1
270	7.7	2.5	14.00	-11.5	-186	17.3	6.3	14.000	-7.7	-125.5
285	7.4	2.4	14.00	-11.6	-198	16.6	6.0	14.000	-8.0	-137.1
300	7.1	2.3	14.00	-11.7	-210	15.9	5.7	14.000	-8.3	-148.6
315	6.8	2.2	14.00	-11.8	-223	15.3	5.5	14.000	-8.5	-160.2
Maximum Storage Requried =					**5.5**					**34.6**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A14
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A15
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.0800 (hectares)

Duration, T_D (min)	Release Rate = 3.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 ($I = A/(T_D+C)^B$)					Release Rate = 3.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820, C = 6.014 ($I = A/(T_D+C)^B$)				
	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	33.5	3.00	30.5	0	398.6	88.7	3.000	85.7	0.0
15	61.8	12.4	3.00	9.4	8	142.9	31.8	3.000	28.8	25.9
30	40.0	8.0	3.00	5.0	**9**	91.9	20.4	3.000	17.4	31.4
45	30.2	6.1	3.00	3.1	8	69.1	15.4	3.000	12.4	33.4
60	24.6	4.9	3.00	1.9	7	55.9	12.4	3.000	9.4	**34.0**
75	20.8	4.2	3.00	1.2	5	47.3	10.5	3.000	7.5	33.8
90	18.1	3.6	3.00	0.6	3	41.1	9.1	3.000	6.1	33.2
105	16.1	3.2	3.00	0.2	1	36.5	8.1	3.000	5.1	32.2
120	14.6	2.9	3.00	-0.1	-1	32.9	7.3	3.000	4.3	31.1
135	13.3	2.7	3.00	-0.3	-3	30.0	6.7	3.000	3.7	29.7
150	12.3	2.5	3.00	-0.5	-5	27.6	6.1	3.000	3.1	28.3
165	11.4	2.3	3.00	-0.7	-7	25.6	5.7	3.000	2.7	26.7
180	10.6	2.1	3.00	-0.9	-9	23.9	5.3	3.000	2.3	25.0
195	10.0	2.0	3.00	-1.0	-12	22.4	5.0	3.000	2.0	23.3
210	9.4	1.9	3.00	-1.1	-14	21.1	4.7	3.000	1.7	21.5
225	8.9	1.8	3.00	-1.2	-16	20.0	4.5	3.000	1.5	19.6
240	8.5	1.7	3.00	-1.3	-19	19.0	4.2	3.000	1.2	17.7
255	8.1	1.6	3.00	-1.4	-21	18.1	4.0	3.000	1.0	15.7
270	7.7	1.5	3.00	-1.5	-24	17.3	3.8	3.000	0.8	13.7
285	7.4	1.5	3.00	-1.5	-26	16.6	3.7	3.000	0.7	11.7
300	7.1	1.4	3.00	-1.6	-28	15.9	3.5	3.000	0.5	9.6
315	6.8	1.4	3.00	-1.6	-31	15.3	3.4	3.000	0.4	7.5
Maximum Storage Requried =					**9.0**					**34.0**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A15
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A16
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.3500 (hectares)

Duration, T_D (min)	Release Rate = 15.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 ($I = A/(T_D+C)^B$)					Release Rate = 15.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 ($I = A/(T_D+C)^B$)				
	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	146.4	15.00	131.4	0	398.6	387.9	15.000	372.9	0.0
15	61.8	54.1	15.00	39.1	35	142.9	139.0	15.000	124.0	111.6
30	40.0	35.1	15.00	20.1	**36**	91.9	89.4	15.000	74.4	133.9
45	30.2	26.5	15.00	11.5	31	69.1	67.2	15.000	52.2	140.9
60	24.6	21.5	15.00	6.5	23	55.9	54.4	15.000	39.4	**141.8**
75	20.8	18.2	15.00	3.2	15	47.3	46.0	15.000	31.0	139.4
90	18.1	15.9	15.00	0.9	5	41.1	40.0	15.000	25.0	135.0
105	16.1	14.1	15.00	-0.9	-5	36.5	35.5	15.000	20.5	129.2
120	14.6	12.8	15.00	-2.2	-16	32.9	32.0	15.000	17.0	122.4
135	13.3	11.6	15.00	-3.4	-27	30.0	29.2	15.000	14.2	114.9
150	12.3	10.7	15.00	-4.3	-38	27.6	26.9	15.000	11.9	106.8
165	11.4	10.0	15.00	-5.0	-50	25.6	24.9	15.000	9.9	98.2
180	10.6	9.3	15.00	-5.7	-61	23.9	23.3	15.000	8.3	89.2
195	10.0	8.7	15.00	-6.3	-73	22.4	21.8	15.000	6.8	79.8
210	9.4	8.2	15.00	-6.8	-85	21.1	20.6	15.000	5.6	70.2
225	8.9	7.8	15.00	-7.2	-97	20.0	19.5	15.000	4.5	60.4
240	8.5	7.4	15.00	-7.6	-109	19.0	18.5	15.000	3.5	50.3
255	8.1	7.1	15.00	-7.9	-121	18.1	17.6	15.000	2.6	40.0
270	7.7	6.8	15.00	-8.2	-133	17.3	16.8	15.000	1.8	29.6
285	7.4	6.5	15.00	-8.5	-146	16.6	16.1	15.000	1.1	19.0
300	7.1	6.2	15.00	-8.8	-158	15.9	15.5	15.000	0.5	8.3
315	6.8	6.0	15.00	-9.0	-170	15.3	14.9	15.000	-0.1	-2.5
Maximum Storage Requried =					**36.1**					**141.8**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A16
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: A17
C_{AVG} = 0.20 (2-yr, 5-yr)
C_{AVG} = 0.25 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.0400 (hectares)

Duration, T_D (min)	Release Rate = 1.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; ($I = A/(T_D+C)^B$)					Release Rate = 1.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820, C = 6.014; ($I = A/(T_D+C)^B$)				
	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	3.7	1.00	2.7	0	398.6	11.1	1.000	10.1	0.0
15	61.8	1.4	1.00	0.4	**0**	142.9	4.0	1.000	3.0	2.7
30	40.0	0.9	1.00	-0.1	0	91.9	2.6	1.000	1.6	**2.8**
45	30.2	0.7	1.00	-0.3	-1	69.1	1.9	1.000	0.9	2.5
60	24.6	0.5	1.00	-0.5	-2	55.9	1.6	1.000	0.6	2.0
75	20.8	0.5	1.00	-0.5	-2	47.3	1.3	1.000	0.3	1.4
90	18.1	0.4	1.00	-0.6	-3	41.1	1.1	1.000	0.1	0.8
105	16.1	0.4	1.00	-0.6	-4	36.5	1.0	1.000	0.0	0.1
120	14.6	0.3	1.00	-0.7	-5	32.9	0.9	1.000	-0.1	-0.6
135	13.3	0.3	1.00	-0.7	-6	30.0	0.8	1.000	-0.2	-1.3
150	12.3	0.3	1.00	-0.7	-7	27.6	0.8	1.000	-0.2	-2.1
165	11.4	0.3	1.00	-0.7	-7	25.6	0.7	1.000	-0.3	-2.9
180	10.6	0.2	1.00	-0.8	-8	23.9	0.7	1.000	-0.3	-3.6
195	10.0	0.2	1.00	-0.8	-9	22.4	0.6	1.000	-0.4	-4.4
210	9.4	0.2	1.00	-0.8	-10	21.1	0.6	1.000	-0.4	-5.2
225	8.9	0.2	1.00	-0.8	-11	20.0	0.6	1.000	-0.4	-6.0
240	8.5	0.2	1.00	-0.8	-12	19.0	0.5	1.000	-0.5	-6.8
255	8.1	0.2	1.00	-0.8	-13	18.1	0.5	1.000	-0.5	-7.6
270	7.7	0.2	1.00	-0.8	-13	17.3	0.5	1.000	-0.5	-8.4
285	7.4	0.2	1.00	-0.8	-14	16.6	0.5	1.000	-0.5	-9.2
300	7.1	0.2	1.00	-0.8	-15	15.9	0.4	1.000	-0.6	-10.0
315	6.8	0.2	1.00	-0.8	-16	15.3	0.4	1.000	-0.6	-10.9
Maximum Storage Requried =					**0.3**					**2.8**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Table A17
Estimate of Storage Required for 2-yr and 100-yr Storms (Modified Rational Method)

Area No: E13-E14
C_{AVG} = 0.87 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 15 (mins)
Drainage Area = 0.1800 (hectares)

Duration, T_D (min)	Release Rate = 11.8 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951 , B = 0.810 ($I = A/(T_D+C)^B$, C = 6.199					Release Rate = 11.8 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688 0.820 ($I = A/(T_D+C)^B$, C = 6.014				
	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	73.1	11.80	61.3	0	398.6	199.5	11.800	187.7	0.0
15	61.8	27.0	11.80	15.2	**14**	142.9	71.5	11.800	59.7	53.7
30	40.0	17.5	11.80	5.7	10	91.9	46.0	11.800	34.2	**61.5**
45	30.2	13.2	11.80	1.4	4	69.1	34.6	11.800	22.8	61.4
60	24.6	10.7	11.80	-1.1	-4	55.9	28.0	11.800	16.2	58.2
75	20.8	9.1	11.80	-2.7	-12	47.3	23.6	11.800	11.8	53.3
90	18.1	7.9	11.80	-3.9	-21	41.1	20.6	11.800	8.8	47.4
105	16.1	7.1	11.80	-4.7	-30	36.5	18.3	11.800	6.5	40.7
120	14.6	6.4	11.80	-5.4	-39	32.9	16.5	11.800	4.7	33.6
135	13.3	5.8	11.80	-6.0	-48	30.0	15.0	11.800	3.2	26.0
150	12.3	5.4	11.80	-6.4	-58	27.6	13.8	11.800	2.0	18.1
165	11.4	5.0	11.80	-6.8	-68	25.6	12.8	11.800	1.0	10.0
180	10.6	4.6	11.80	-7.2	-77	23.9	12.0	11.800	0.2	1.7
195	10.0	4.4	11.80	-7.4	-87	22.4	11.2	11.800	-0.6	-6.7
210	9.4	4.1	11.80	-7.7	-97	21.1	10.6	11.800	-1.2	-15.4
225	8.9	3.9	11.80	-7.9	-107	20.0	10.0	11.800	-1.8	-24.1
240	8.5	3.7	11.80	-8.1	-117	19.0	9.5	11.800	-2.3	-33.0
255	8.1	3.5	11.80	-8.3	-126	18.1	9.1	11.800	-2.7	-41.9
270	7.7	3.4	11.80	-8.4	-136	17.3	8.7	11.800	-3.1	-51.0
285	7.4	3.2	11.80	-8.6	-146	16.6	8.3	11.800	-3.5	-60.1
300	7.1	3.1	11.80	-8.7	-156	15.9	8.0	11.800	-3.8	-69.3
315	6.8	3.0	11.80	-8.8	-167	15.3	7.6	11.800	-4.2	-78.5
Maximum Storage Requried =					**13.7**					**61.5**

Notes
1) Peak flow is equal to the product of 2.78 x C x I x A
2) Rainfall Intensity, $I = A/(T_D+C)^B$, where T_D = storm duration (mins)
3) Release Rate = Desired Capture (Release) Rate
4) Storage Rate = Peak Flow - Release Rate
5) Storage = Duration x Storage Rate
6) Maximium Storage = Max Storage Over Duration
7) A,B,C are IDF Parameters for City of Ottawa. From Ottawa Sewer Design Guidelines, Section 5.4.2.

Stormceptor Design Summary

PCSWMM for Stormceptor

Project Information

Date	3/11/2015
Project Name	197 Train Yards Drive
Project Number	OTT-00219462-A0
Location	Ottawa, Ontario

Designer Information

Company	the exp Services Inc.
Contact	Winston Yang

Notes

N/A

Drainage Area

Total Area (ha)	1.49
Imperviousness (%)	80

The Stormceptor System model STC 300 achieves the water quality objective removing 81% TSS for a Fine (organics, silts and sand) particle size distribution.

Rainfall

Name	OTTAWA MACDONALD-CARTIER INT'L A
State	ON
ID	6000
Years of Records	1967 to 2003
Latitude	45°19'N
Longitude	75°40'W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0.000	00.000
0.074	49.900

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 300	**81**
STC 750	86
STC 1000	86
STC 1500	85
STC 2000	88
STC 3000	88
STC 4000	90
STC 5000	91
STC 6000	92
STC 9000	94
STC 10000	94
STC 14000	95

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

Fine (organics, silts and sand)								
Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
20	20	1.3	0.0004					
60	20	1.8	0.0016					
150	20	2.2	0.0108					
400	20	2.65	0.0647					
2000	20	2.65	0.2870					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

® HYDROVEX®

VHV/SVHV Vortex Flow Regulator

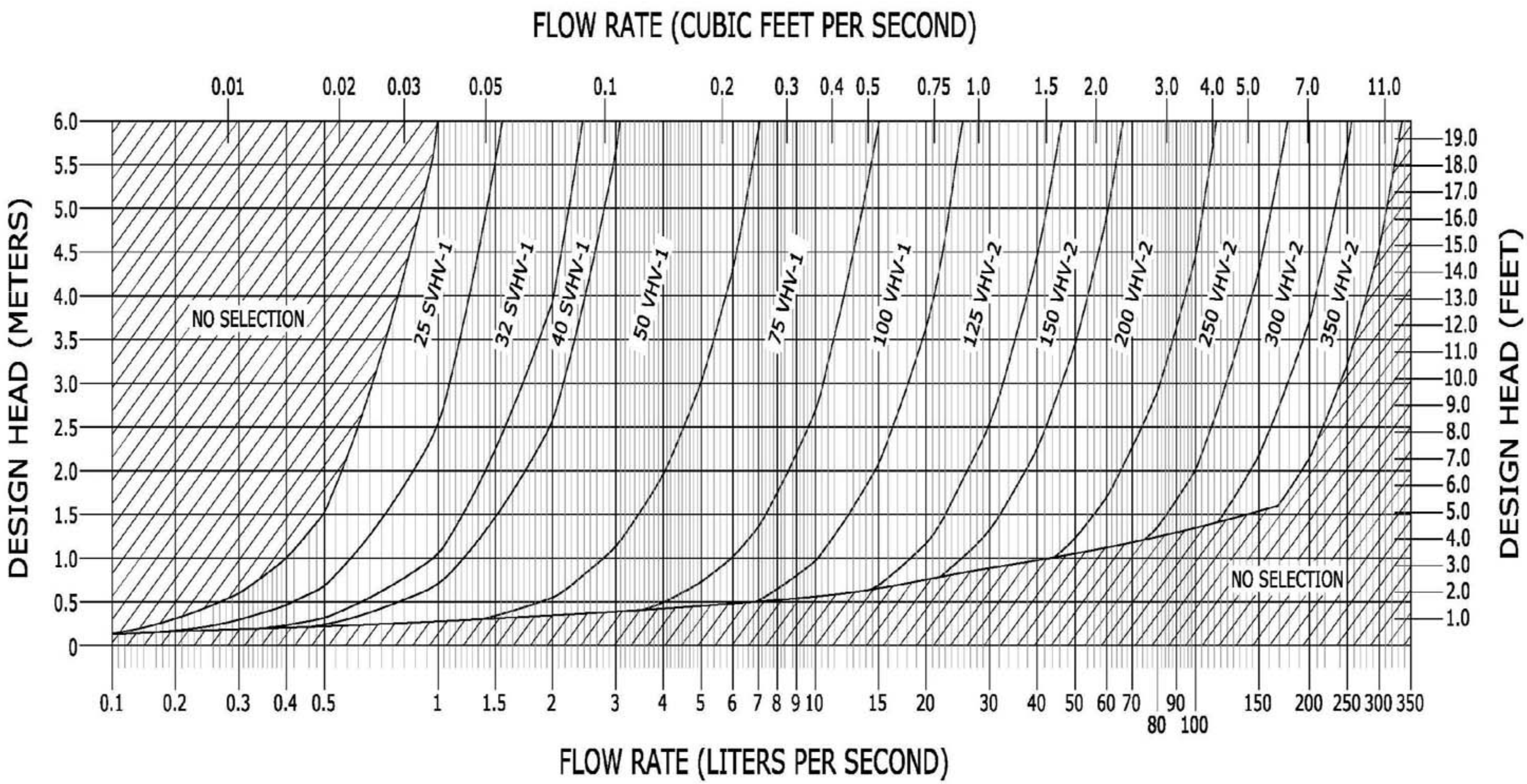


FIGURE 3

JOHN MEUNIER

Appendix B – Water

Aly Elgayar

From:	James Salem <salem@mcrobie.com>
Sent:	Wednesday, March 20, 2019 7:38 PM
To:	Aly Elgayar
Cc:	Alam Ansari; Marc Alain Lafleur; Mike Green; Eric Malboeuf
Subject:	RE: 830 Belfast Road – Building Construction Confirmation

Aly,

Further to our conversation, on the basis of the definitions provided for Classification of Mixed Construction, we believe the proposed building qualifies under d, noncombustible.

James Salem
Vice President

MCROBIE
ARCHITECTS + INTERIOR DESIGNERS

Suite 100, 66 Queen Street
Ottawa ON K1P 5C6
T. 613-238-2072 ext. 224
salem@mcrobie.com
www.mcrobie.com

From: Aly Elgayar [mailto:Aly.ElGayar@exp.com]
Sent: Thursday, March 14, 2019 3:13 PM
To: James Salem
Cc: Alam Ansari; Marc Alain Lafleur; Mike Green; Eric Malboeuf
Subject: RE: 830 Belfast Road — Building Construction Confirmation

Hi James,

As discussed on the phone, please find attached the classifications of mixed construction and associated definitions as per the City of Ottawa's interpretation of the Fire Underwriters methodology.
Please re-send your email with more details supporting one of the classification choices you think best suits the building type of construction and I will base my fire flow calculations on that.

I do need the sprinkler system information reiterated however as the email will serve as supporting documentation for the Site Servicing report.

Thanks,

Aly Elgayar, M.A.Sc.
EXP | Engineering Designer
t : +1.613.688.1899, 3225 | m : +1.613.282.0561 | e : aly.elgayar@exp.com

From: James Salem <salem@mcrobie.com>
Sent: Wednesday, March 13, 2019 5:43 PM
To: Aly Elgayar <Aly.ElGayar@exp.com>
Cc: Alam Ansari <alam.ansari@exp.com>; Marc Alain Lafleur <MarcAlain.Lafleur@exp.com>; Mike Green <MGreen@controlex.ca>; Eric Malboeuf <malboeuf@mcrobie.com>
Subject: RE: 830 Belfast Road – Building Construction Confirmation

Aly,

- Construction will be a combination of combustible and non-combustible as permitted under OBC 3.2.2.60
- The building will be sprinklered.
- The sprinkler system will be fully supervised.

James Salem
Vice President

MCROBIE
ARCHITECTS + INTERIOR DESIGNERS

Suite 100, 66 Queen Street
Ottawa ON K1P 5C6
T. 613-238-2072 ext. 224
salem@mcrobie.com
www.mcrobie.com

From: Aly Elgayar [mailto:Aly.ElGayar@exp.com]
Sent: Wednesday, March 13, 2019 2:41 PM
To: James Salem
Cc: Alam Ansari; Marc Alain Lafleur; Mike Green
Subject: 830 Belfast Road — Building Construction Confirmation

Hi James,

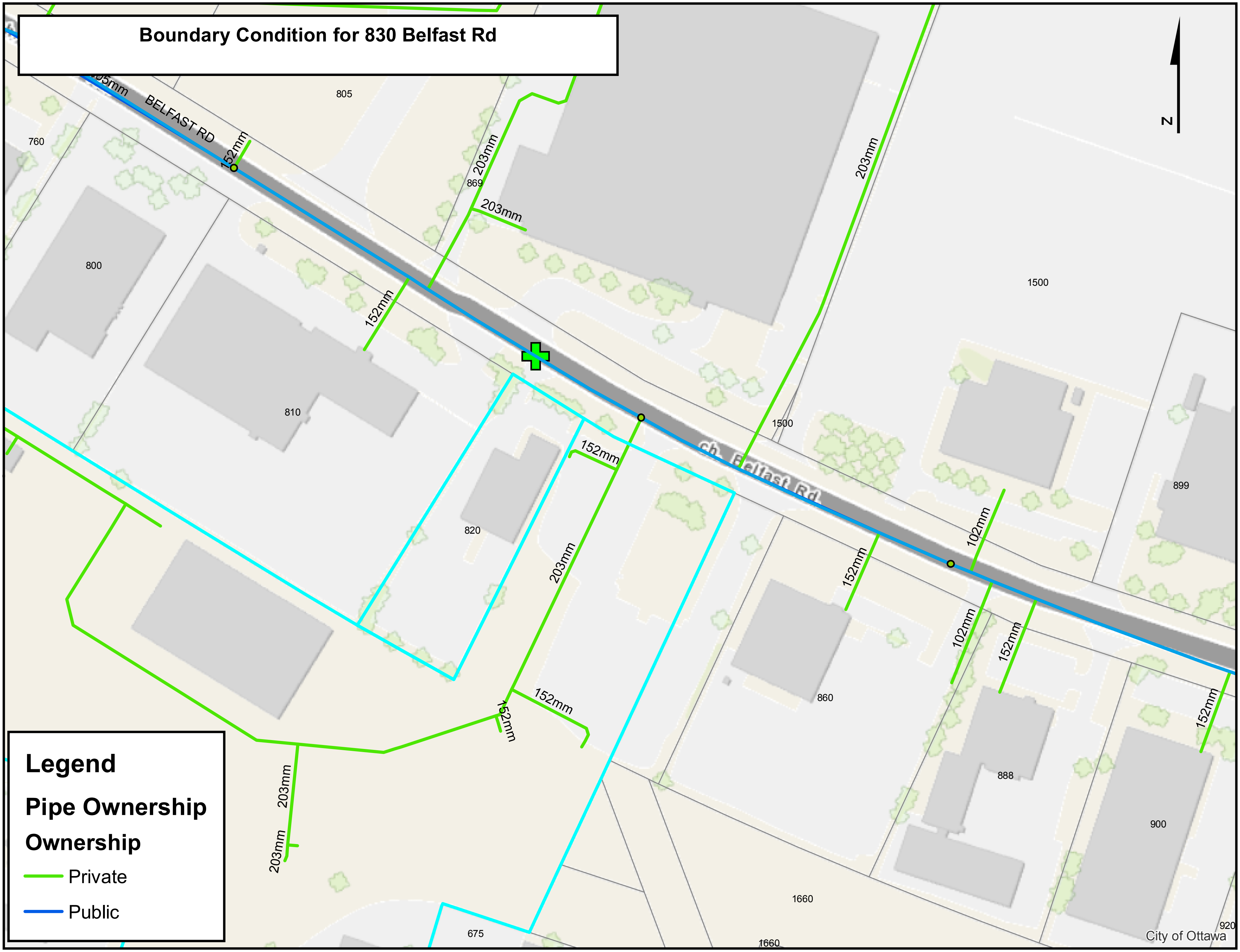
Can you please confirm the following information regarding the proposed building's construction:

- Type of construction?
- Will a sprinkler system be installed?
- If a sprinkler system is install, will it be fully supervised?

Thanks,

exp.

Aly Elgayar, M.A.Sc.
EXP | Engineering Designer
t : +1.613.688.1899, 3225 | m : +1.613.282.0561 | e : aly.elgayar@exp.com
2650 Queensview Drive
Suite 100
Ottawa, ON K2B 8H6
CANADA



Boundary Condition for 830 Belfast Rd
N
BELFAST RD
ch. Belfast Rd
805
760
869
800
810
820
1500
899
860
888
900
1660
675
920
152mm
203mm
102mm
Legend
Pipe Ownership
Ownership
Private
Public
City of Ottawa

Aly Elgayar

From: Sharif, Sharif <sharif.sharif@ottawa.ca>
Sent: Tuesday, March 26, 2019 3:57 PM
To: Aly Elgayar
Cc: Alam Ansari; Marc Alain Lafleur
Subject: RE: 830 Belfast Road – Boundary Conditions Request
Attachments: 830 Belfast March 2019.pdf

Good Afternoon Aly,

Here is the water boundary condition for the above site. If you have any question, please let me know. Thanks.

The following are boundary conditions, HGL, for hydraulic analysis at 830 Belfast (zone 1E) assumed to be connected to the 305mm on Belfast (see attached PDF for location).

Minimum HGL = 109.3m

Maximum HGL = 118.4 m

MaxDay + FireFlow (100L/s) = 111.5m

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

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

Sharif.

From: Aly Elgayar <Aly.ElGayar@exp.com>
Sent: March 21, 2019 11:38 AM
To: Sharif, Sharif <sharif.sharif@ottawa.ca>
Cc: Alam Ansari <alam.ansari@exp.com>; Marc Alain Lafleur <MarcAlain.Lafleur@exp.com>
Subject: RE: 830 Belfast Road – Boundary Conditions Request

Hi Sharif,

Please find attached the FUS calculation sheet as requested.

Regards,

Aly Elgayar, M.A.Sc.
EXP | Engineering Designer
t : +1.613.688.1899, 3225 | m : +1.613.282.0561 | e : aly.elgayar@exp.com

From: Sharif, Sharif <sharif.sharif@ottawa.ca>
Sent: Thursday, March 21, 2019 11:36 AM
To: Aly Elgayar <Aly.ElGayar@exp.com>
Cc: Alam Ansari <alam.ansari@exp.com>; Marc Alain Lafleur <MarcAlain.Lafleur@exp.com>
Subject: RE: 830 Belfast Road – Boundary Conditions Request

Hello Aly,

Please provide the FUS calculation sheet. Thanks.

Sharif

From: Aly Elgayar <Aly.ElGayar@exp.com>
Sent: March 21, 2019 11:19 AM
To: Sharif, Sharif <sharif.sharif@ottawa.ca>
Cc: Alam Ansari <alam.ansari@exp.com>; Marc Alain Lafleur <MarcAlain.Lafleur@exp.com>
Subject: 830 Belfast Road – Boundary Conditions Request

Hello Sharif,

Can you please provide the water boundary conditions for 830 Belfast road given the below information?

The attached map identifies the anticipated location of the connection to the existing 300mm diameter watermain on Belfast road. The proposed development consists of a one-storey retail building.

Required fire flow (as per FUS, 1999 & Technical Bulletin 2018-02): **100L/s**
Average daily demand: **0.42L/s**
Max Day Demand: **0.63L/S**
Max hourly daily demand: **1.13L/s**

Thank you,

Aly Elgayar, M.A.Sc.
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2650 Queensview Drive
Suite 100
Ottawa, ON K2B 8H6
CANADA

TABLE B1: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: 830 BELFAST ROAD
PROJECT NO.: OTT-00251090-A0

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

F = 220 * C * SQRT(A)

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

Task	Options	Multiplier	Input	Value Used	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Non-combustible Construction	0.8	
	Ordinary Construction	1			
	Non-combustible Construction	0.8			
	Fire Resistive Construction	0.6			
Input Building Floor Areas (A)	50% Second floor area		0	3531.4 m²	
	Second Floor		0		
	First Floor		3531.4		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				10,459
Fire Flow (F)	Rounded to nearest 1,000				**10,000**

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%	Combustible	0%	0	10,000
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	Adequate Sprinkler Conforms to NFPA13	-30%	-3,000	7,000
	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%	-1,000	6,000
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Fully Supervised Sprinkler System	-10%	-1,000	5,000
	Not Fully Supervised or N/A	0%				

Task	Exposures	Separation Dist (m)	Cond	Separation Conditon	Exposed Wall type	Exposed Wall Length: Length (m)	No of Storeys	Lenth-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
Choose Structure Exposure Distance	North	71.9	6	> 45.1	Type B	67.8	2	135.6	6	0%	5%	500	5,500
	South	71.7	6	> 45.1	Type B	21.9	2	43.8	6	0%			
	East	36	5	30.1 to 45	Type C	30.1	1	30.1	5A	5%			
	West	43.8	5	30.1 to 45	Type D	21	1	21	5A	0%			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =												**6,000**
	Total Required Fire Flow, L/s =												**100**

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

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

Conditons for Separation

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

Table B2: Estimated Water Pressure at Building (through single water service connection)
830 Belfast Road
Client: Controlex Corportion
Project: OTT-00251090-A0
Prepared By: A. Elgayar
Date: March 2019

Max day(0.63L/s) + FireFlow(100L/s) HGL= 111.5 m
Max HGL= 118.4 m
Peak Hour= 109.3 m

Description	From	To	Flow (L/sec)	Pipe Dia (mm)	Dia (m)	Q (m³/sec)	Area (m2)	C	Velocity V (m/s)	Slope of HGL (m/m)	Pipe Length (m)	Frictional Head Loss h_f (m)	Equivalent Pipe Length of Fittings (m)	Minor Loss of Fittings h_b (m)	Total Losses (m) $h_b + h_f$	Start Ground Elev(m)	End Ground Elev (m)	Static Head (m)	Pressure From kPa	(psi)	Pressure To kPa	(psi)	Pressure Drop (psi)
Max Day + Fire Flow	Main	Service Connection	100.6	203	0.203	0.10063	0.032365446	110	3.1092	0.0593	30.8	1.825878846	9.1	0.54154	2.36742	69.19	69.07	0.12	414.9	(60.2)	392.9	(57.0)	3.2
	Service Connection	Proposed Building	100.6	203	0.203	0.10063	0.032365446	110	3.1092	0.0593	7.9	0.468326068	9.1	0.54154	1.00987	69.07	69.35	-0.28	392.9	(57.0)	380.2	(55.1)	1.8
	Service Connection	203x203 Tee	100.6	203	0.203	0.10063	0.032365446	110	3.1092	0.0593	92.6	5.489492895	15.6	0.92663	6.41613	69.35	69.25	0.10	380.2	(55.1)	318.3	(46.2)	9.0

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

hf = Slope of HGL * Pipe Length

Resistance of Fittings and Valves for 203mm WM

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)
Standard 90^0 Elbow	32	6.50	1	6.496
11.25 Degree Elbow	8	1.62	0	0
45 Degree Elbow	16	3.25	0	0
Gate Valve Full -Open	13	2.64	1	2.639
		Total:	**2**	**9.135**

Resistance of Fittings and Valves for 203mm Service

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)
Standard 90^0 Elbow	32	6.50	1	6.496
11.25 Degree Elbow	8	1.62	0	0
45 Degree Elbow	16	3.25	0	0
Gate Valve Full -Open	13	2.64	1	2.639
		Total:	**2**	**9.135**

Resistance of Fittings and Valves for 203mm WM

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)
Standard 90^0 Elbow	32	6.50	1	6.496
11.25 Degree Elbow	8	1.62	0	0
45 Degree Elbow	16	3.25	2	6.496
Gate Valve Full -Oper	13	2.64	1	2.639
		Total:	**4**	**15.631**

Appendix C – Sewer Design Sheets

4.1 Sanitary Sewer

The sanitary sewer outlet for the site is to the Tremblay Road trunk sewer system. The sanitary design flow estimated in the *Master Servicing Report* and in this report are conservative since they are calculated using average commercial flow of 50 000 L/ha/day as per the City of Ottawa Sewer Design Guidelines. The sanitary sewer system is discussed in more detail below.

4.1.1 Tremblay Road Trunk Sewer

The overall outlet for the Trainyards development is to the Tremblay Road trunk sanitary sewer system. The *Master Servicing Report* allowed for 2.2 hectares of land from the Eastlands Phase 2 development to drain to the Tremblay Road trunk sewer. The current proposal consists of an area of 2.45 hectares as the Phase 2 portion of the development. Although there is now an increase in the area of Phase 2, the additional 0.25 ha was accounted for in the drainage area of the Tremblay Road trunk sewer (*see Table 2-5 and Sketch SAN-SK3 in Appendix A).*

The *Master Servicing Report* shows the outlet for all of the Eastlands development to a sanitary sewer along Trainyards Drive which is part of the Tremblay Road sewer system. It is proposed that the sanitary drainage from Phase 2 of the Eastlands development drain to the sanitary sewer along Belfast Road which is also part of the Tremblay Road sanitary sewer system. (*Sketch SAN-SK3 in Appendix A*).

4.1.3 Belfast Road Sewer

As indicated above the Belfast Road sanitary sewer (375mm diameter) is part of the Tremblay Road trunk sanitary sewer system and is the proposed outlet for the Phase 2 Eastlands development. The analysis of this sanitary sewer is as follows:

- **375mm diameter sewer east of Trainyards Drive**
  - This 375 mm diameter section of the Belfast sewer is assumed to have a minimum slope of 0.14% (minimum required by MOE and City standards), which has an estimated capacity of 68.51 L/s.
  - Using the entire sanitary drainage area tributary to the Belfast Road sewer outlet (*refer to Sketch SAN-SK3 in Appendix A*) less the flow from East Lands Phase 1, the peak design flow is 54.84 L/s.
  - This is a conservative analysis since the sewer slope may be greater than the minimum required.

- **450mm diameter sewer west of Trainyards Drive**
  - This 450 mm diameter sewer is assumed to have a minimum slope of 0.11% (minimum required by MOE and City standards), which has an estimated capacity of 98.63 L/s.

- Using the entire sanitary drainage area tributary to the Belfast Road sewer outlet the peak design flow is 71.07 L/s (*Sketch SAN-SK3 and Sketch 2168-EAST PH2-SAN-SK1 in Appendix A*).
- This is a conservative analysis since the sewer slope may be greater than the minimum required.

Therefore, given the above analysis, there is sufficient capacity within the Belfast sanitary sewer for Phase 2 of the Eastlands development.

4.2 Watermain Distribution System

The *Master Servicing Report* included a watermain analysis that demonstrated that there is adequate pressure and flow in the water network along Trainyards Drive to service the subject lands. The model created for the analysis had a 300 mm diameter watermain followed by a 200 mm diameter watermain dead-ending in the East Lands development.

4.3 Stormwater Management

The design criteria for the Ottawa Trainyards development was based on a time of concentration of 15 minutes, an allowable runoff coefficient of 0.4 and a 5 year rainfall intensity of 81 mm/hr. This criteria is used to calculate the allowable runoff from the development. Post-development runoff in excess of the allowable must be stored on-site. Surface ponding depths for the 5 year event are limited to 0.15 m in parking areas. The East Lands – Phase 2 drainage area included in the *Master Servicing Report* accounted for 2.2 hectares.

Quality control of stormwater is not required for the site as a “cash-in-lieu” contribution will be made to the City of Ottawa’s Rideau River Stormwater Quality Fund.

5.0 SANITARY SEWER DESIGN

A 250mm diameter sanitary sewer will be constructed to service Phase 2 of the East Lands development. As proposed in the *Phase 1 Report*, the Phase 2 sanitary sewer will outlet to the existing 375mm diameter sanitary sewer along Belfast Road. This connection to the existing municipal sanitary sewer system is upstream of the connection point outlined in the *Master Servicing Report* for this development. However, the connection to the Belfast Road sanitary sewer is at a lower elevation than the extension of a sanitary sewer from Phase 1 of the East Lands development. The design flow has been determined as follows:

Design Flow for Commercial Use:	50,000 L/day/ha (0.578 L/s/ha)
Peaking Factor:	1.5
Site Area:	2.45 hectares
Extraneous Flow:	0.28 L/s/ha

SANITARY SEWER CALCULATION SHEET

LOCATION				RESEDENTIAL AREAS AND POPULAITONS												COMMERCIAL			INDUSTRIAL			INSTITUTIONAL		INFILTRATION				SEWER DATA						
					NUMBER OF UNITS							POPULATION				AREA (ha)			AREA (ha)		Peak			AREA (ha)										
Street	U/S MH	D/S MH	Desc	Area (ha)	Singles	Semis	Towns	1-Bed Apt.	2-Bed Apt.	3-Bed Apt.	4-Bed Apt.	INDIV	ACCU	Peak Factor	Peak Flow (L/sec)	INDIV	ACCU	Peak Flow (L/sec)	INDIV	ACCU	Factor (per MOE)	AREA (Ha)	ACCU AREA (Ha)	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)
Private	111	105	Existing	4.5300												4.530	4.53	2.202083						4.530	4.530	1.49	3.70	250	251.46	0.25	105.00	30.2	12%	0.61
	105	104															4.53	2.202083							4.530	1.49	3.70	250	251.46	0.25	48.30	30.2	12%	0.61
	104	103															4.53	2.202083							4.530	1.49	3.70	250	251.46	0.25	30.40	30.2	12%	0.61
	103	102															4.53	2.202083							4.530	1.49	3.70	250	251.46	0.25	24.90	30.2	12%	0.61
	102	101															4.53	2.202083							4.530	1.49	3.70	250	251.46	0.50	12.40	42.7	9%	0.86
				4.530																				**4.530**			**11.09**							

Residential Avg. Daily Flow, q (L/p/day) =	280	Commercial Peak Factor =	1.5	(when area >20%)	Peak Population Flow, (L/sec) =	P*q*M/86.4	Unti Type	Persons/Unit
Commercial Avg. Daily Flow (L/gross ha/day) =	28,000		1.0	(when area <20%)	Peak Extraneous Flow, (L/sec) =	I*Ac	Singles	3.4
or L/gross ha/sec =	0.324				Residential Peaking Factor, M =	1 + (14/(4+P^0.5)) * K	Semi-Detached	5.7
Institutianal Avg. Daily Flow (L/s/ha) =	35,000	Institutional Peak Factor =	1.5	(when area >20%)	A_c = Cumulative Area (hectares)		Townhomes	2.7
or L/gross ha/sec =	0.405		1.0	(when area <20%)	P = Population (thousands)		Single Apt. Unit	1.4
Light Industrial Flow (L/gross ha/day) =	35,000						2-bed Apt. Unit	2.1
or L/gross ha/sec =	0.40509	Residential Correction Factor, K =	0.80		Sewer Capacity, Qcap (L/sec) =	$1/N \; S^{1/2} R^{2/3} A_c$	3-bed Apt. Unit	3.1
Light Industrial Flow (L/gross ha/day) =	55,000	Manning N =	0.013		(Manning's Equation)		4-bed Apt. Unit	3.8
or L/gross ha/sec =	0.637	Peak extraneous flow, I (L/s/ha) =	0.33	(Total I/I)				

Designed:	Project:
A. Elgayar	830 Belfast Road
Checked:	Location:
A. Ansari, P.Eng.	Ottawa, Ontario
File Reference:	Page No:
251090 - SAN Design Sheet.xlsx	**1 of 1**

5-YEAR STORM SEWER CALCULATION SHEET

Return Period Storm =	**5**	(5-years, 100-years)
Default Inlet Time=	15	(minutes)
Manning Coefficient =	0.013	(dimensionless)

LOCATION			AREA (hectares)				FLOW (UNRESTRICTED)							SEWER DATA										
																				Velocity (m/s)			Hydraulic Ratios	
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)	Vf	Va	Time in Pipe, Tt (min)	Qa/Qf	Va/Vf
830 Belfast Rd.	CB111	STMMH207	A15	0.080	0.080	0.90	0.20	0.20	15.00	83.56	16.72	5.00	16.7	251.46	250	PVC	0.50	11.60	42.7	0.86	0.61	0.32	0.39	0.71
	CB112	CB112 Lead	A14	0.130	0.130	0.90	0.33	0.33	15.00	83.56	27.18	5.00	27.2	251.46	250	PVC	0.50	11.90	42.7	0.86	0.79	0.25	0.64	0.92
	STMMH207	STMMH208	A14					0.53	15.57	81.76		5.00	43.0	299.36	300	PVC	0.50	35.20	68.0	0.97	0.89	0.66	0.63	0.92
	CB113	CB114	A20	0.020	0.020	0.90	0.05	0.05	15.00	83.56	4.18	5.00	4.2	251.46	250	PVC	0.50	3.70	42.7	0.86	0.45	0.14	0.10	0.53
	CB114	STMMH208	A14		0.020			0.05	15.10	83.24		5.00	4.2	251.46	250	PVC	0.50	26.20	42.7	0.86	0.45	0.96	0.10	0.53
	STMMH208	STMMH209	A1					0.58	16.86	78.01		5.00	44.9	299.36	300	PVC	0.50	46.50	68.0	0.97	0.89	0.87	0.66	0.92
	CBMH204	STMMH209	A1	0.09	0.090	0.89	0.22	0.22	15.00	83.56	18.61	5.00	18.6	251.46	250	PVC	0.50	4.00	42.7	0.86	0.61	0.11	0.44	0.71
	CB E5	CBMH203	A3	0.1	0.100	0.88	0.24	0.24	15.00	83.56	20.44	5.00	20.4	251.46	250	PVC	0.50	18.60	42.7	0.86	0.61	0.51	0.48	0.71
	CBMH203	STMMH209	A2	0.09	0.19	0.88	0.22	0.46	15.51	81.94	18.04	5.00	38.1	251.46	250	PVC	0.50	18.60	42.7	0.86	0.86	0.36	0.89	1.00
	STMMH209	STMMH403	E13					1.26	18.20	74.47		5.00	94.1	299.36	300	PVC	1.00	21.40	96.2	1.37	1.42	0.25	0.98	1.04
	CB110	STMMH205	A6	0.0500	0.050	0.27	0.04	0.04	15.00	83.56	3.14	5.00	3.1	251.46	250	PVC	0.25	22.60	30.2	0.61	0.33	1.13	0.10	0.55
	STMMH205	STMMH206	A15					0.04	16.13	80.07		5.00	3.0	299.36	300	PVC	0.20	39.40	43.0	0.61	0.29	2.24	0.07	0.48
	Roof	STMMH206	A16	0.350	0.350	0.90	0.88	0.88	15.00	83.56	73.17	5.00	73.2	299.36	300	PVC	1.00	6.50	96.2	1.37	1.34	0.08	0.76	0.98
	CB102	CB102 Lead	A5	0.220	0.22	0.90	0.55	0.55	15.00	83.56	45.99	5.00	46.0	251.46	250	PVC	0.50	19.00	42.7	0.86	0.89	0.36	1.08	1.04
	STMMH206	CBMH301	A15					0.59	17.01	77.58		5.00	60.6	299.36	300	PVC	0.35	90.00	56.9	0.81	0.84	1.78	1.07	1.04
TOTALS =							**2.73**											**375.20**						

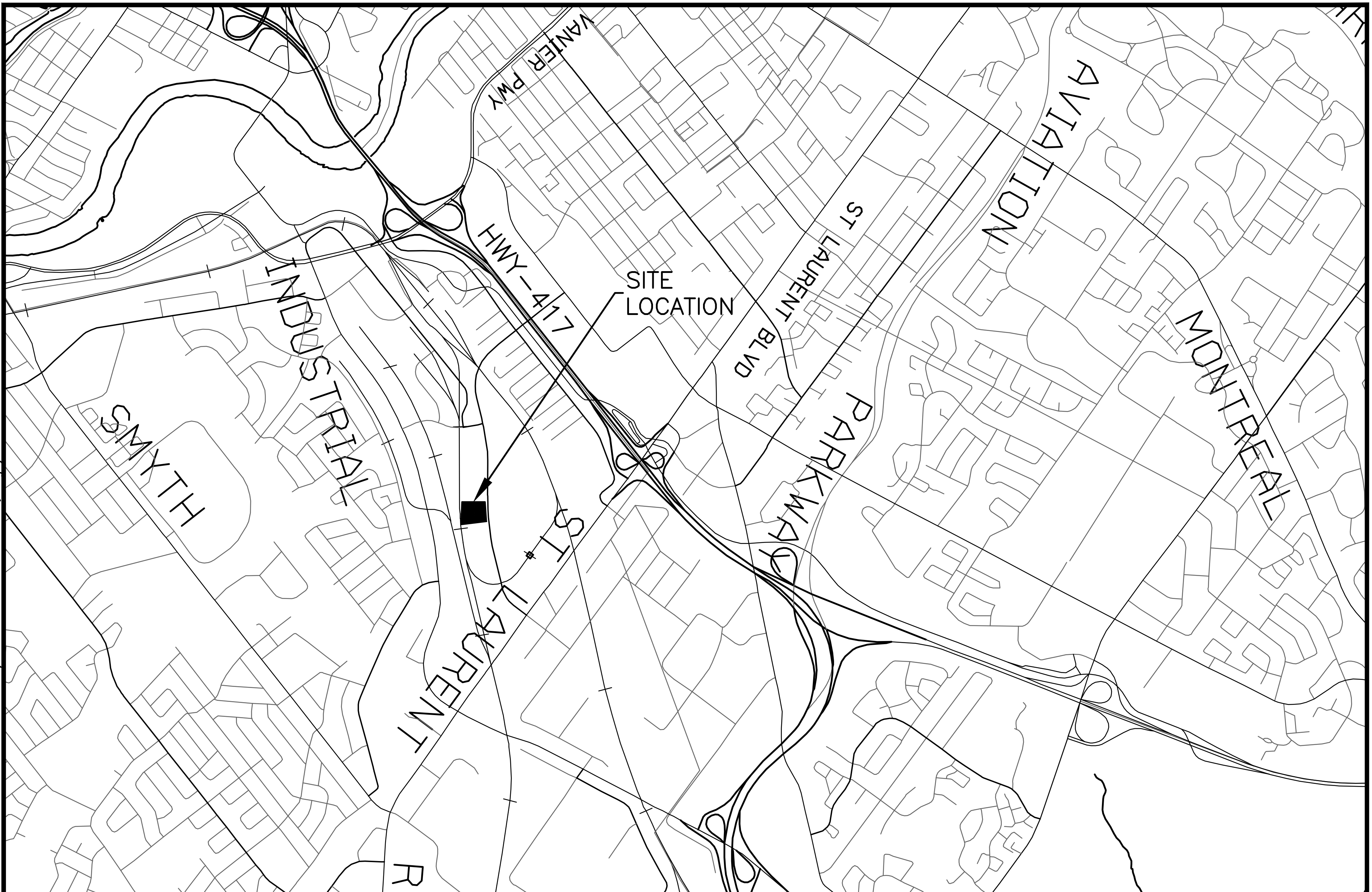
Definitions:
Q = 2.78*AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Watershed Area (hectares)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficients (dimensionless)

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: **A. Elgayar**	Project: **830 Belfast Road**	
Checked: **A. Ansari, PEng.**	Location: **Ottawa, Ontario**	
Dwg Reference: **SS**	File Ref: SWM& Servicing Report Ottawa Train Yards	Sheet No: **1 of 1**

Appendix D – Drawings and Figures



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

www.exp.com

DESIGN AE	OTTAWA TRAIN YARDS 830 BELFAST ROAD, OTTAWA, ON.	SCALE N.T.S	
DRAWN AE		SKETCH NO	
DATE MARCH 2019	SITE LOCATION	FIG-1	
FILE NO OTT-00251090-A0			

Filename: P:\Projects\Civil\251000\OTT-00251090-A0 - 830 Belfast - Controlex\60-EXECUTION\64-DWG\Figures & Sketches\251090 - Site Loc FIG-1.dwg
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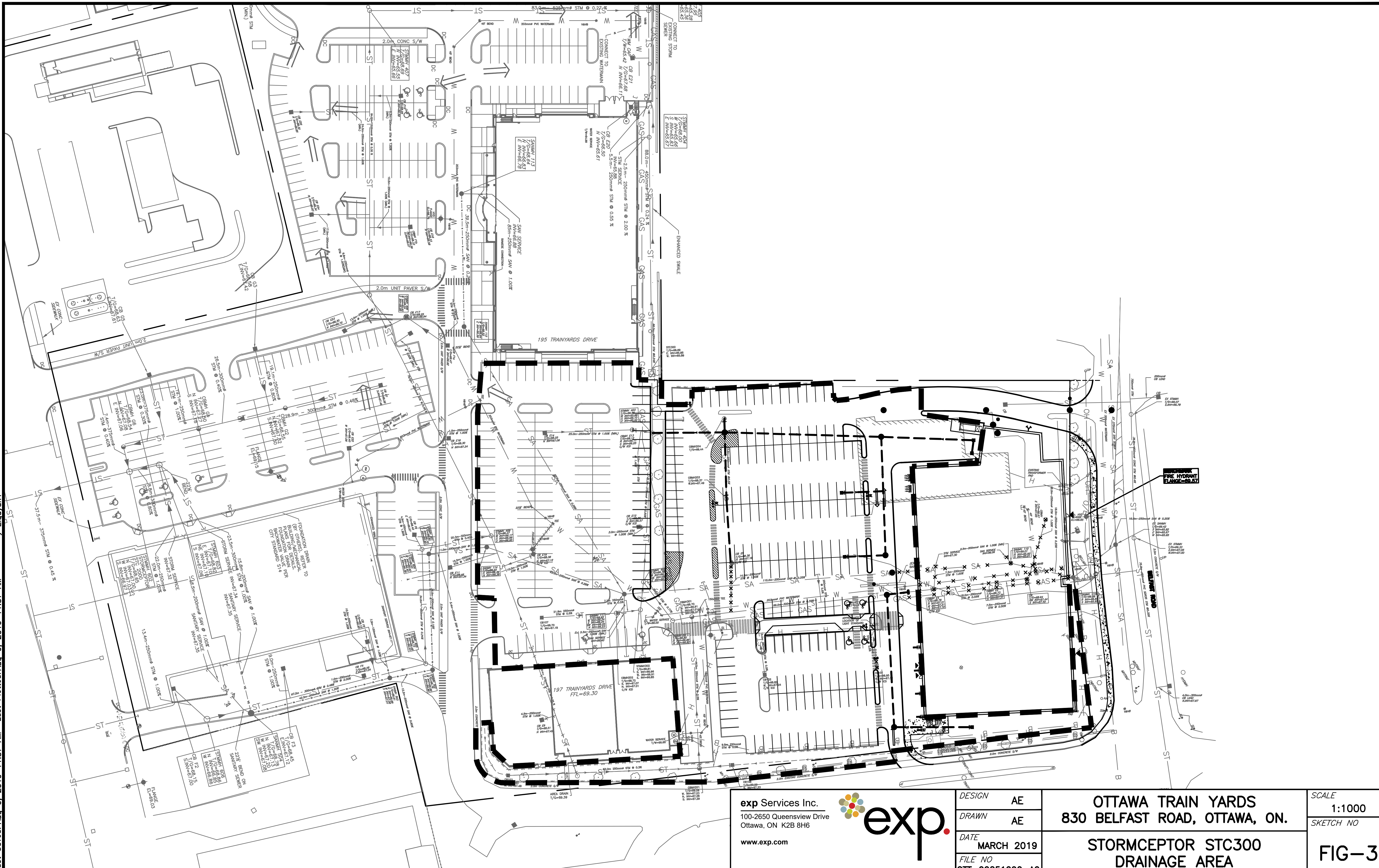
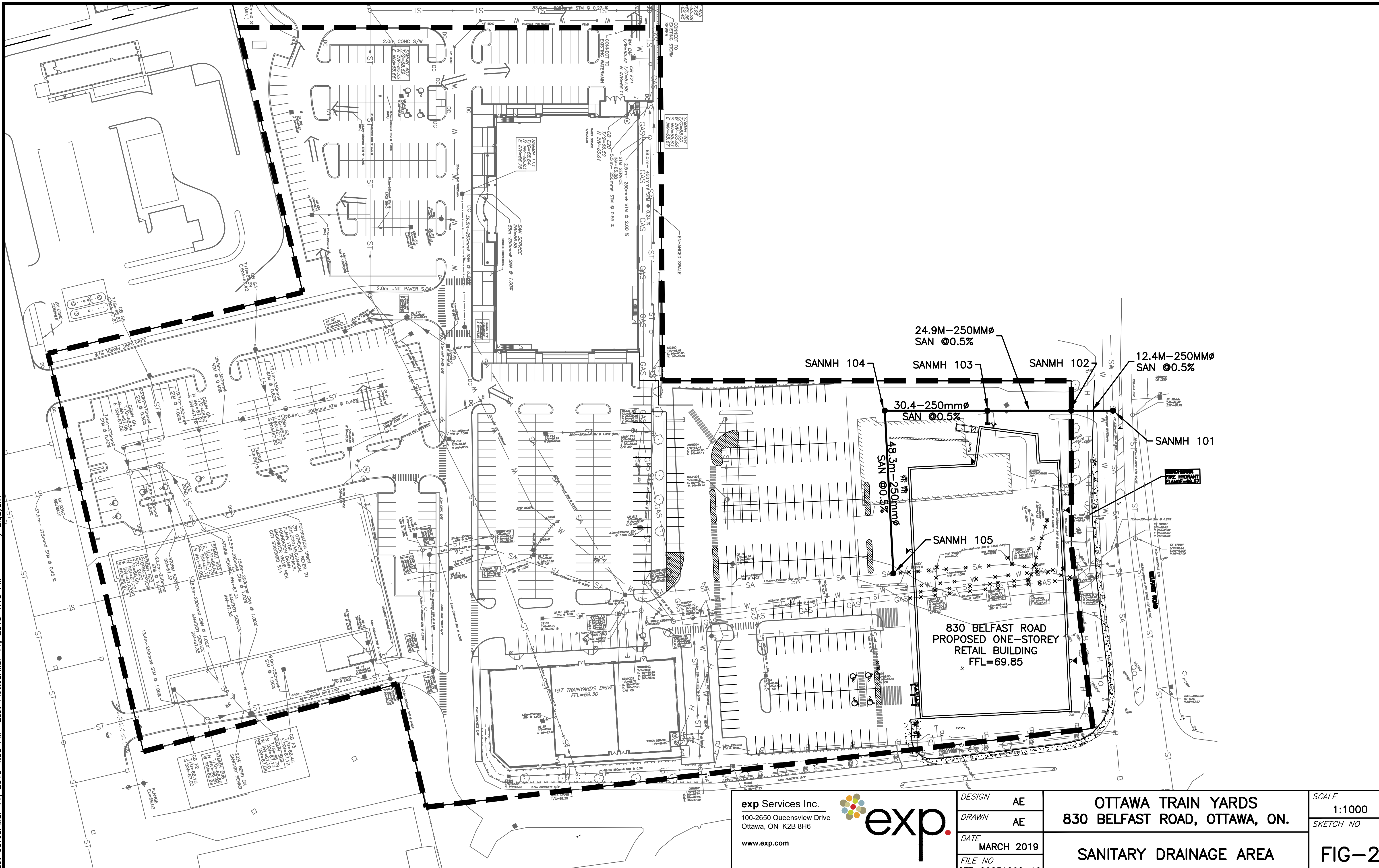


exp Services Inc. 100-2650 Queensview Drive Ottawa, ON K2B 8H6 www.exp.com	DESIGN AE DRAWN AE DATE MARCH 2019 FILE NO OTT-00251090-A0	OTTAWA TRAIN YARDS 830 BELFAST ROAD, OTTAWA, ON. STORMCEPTOR STC300 DRAINAGE AREA

SCALE 1:1000

SKETCH NO FIG-3

Filename: P:\Projects\Civil\251000\OTT-00251090-A0 - 830 Belfast - Controlex\60-EXECUTION\64-DWG\Figures & Sketches\251090 - OGS Drainage Area FIG-3.dwg
Last Saved: Aug 6, 2019 11:57 AM Last Plotted: Aug 6, 2019 11:57 AM Plotted by: ElgayarA

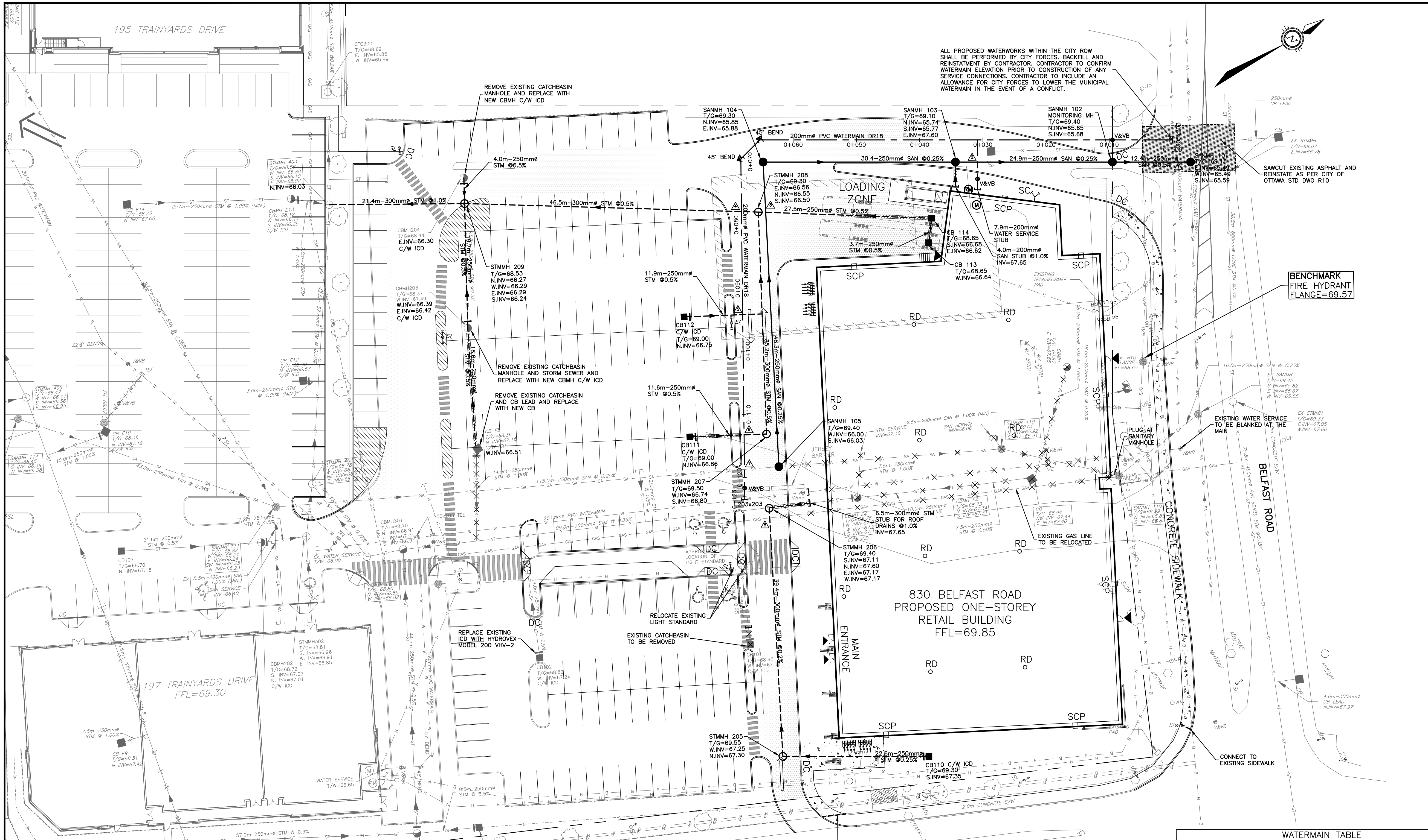


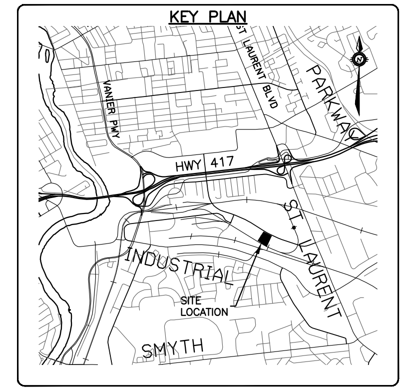
exp Services Inc. 100-2650 Queensview Drive Ottawa, ON K2B 8H6 www.exp.com	DESIGN: AE DRAWN: AE DATE: MARCH 2019 FILE NO: OTT-00251090-A0	OTTAWA TRAIN YARDS 830 BELFAST ROAD, OTTAWA, ON. SANITARY DRAINAGE AREA

SCALE 1:1000

SKETCH NO FIG–2

Filename: P:\Projects\Civil\251000\OTT-00251090-A0 – 830 Belfast – Controlex\60-EXECUTION\64-DWG\Figures & Sketches\251090 – SAN Areas FIG-2.dwg
Last Saved: Mar 11, 2019 4:09 PM Last Plotted: Mar 11, 2019 4:10 PM Plotted by: ElgayarA





LEGEND

UP	EXISTING HYDRO POLE
AN	EXISTING ANCHOR
B	EXISTING BOLLARD
Ex.FH	EXISTING FIRE HYDRANT
SL	EXISTING LIGHT STANDARD
SL	PROPOSED LIGHT STANDARD
TEE	EXISTING THRUST BLOCK
V&VB	EXISTING VALVE AND VALVE BOX
CBMH	EXISTING CATCH BASIN MANHOLE
CB	EXISTING CATCH BASIN
STMMH	EXISTING STORM MANHOLE
SANMH	EXISTING SANITARY MANHOLE
	PROPERTY LINE
GAS	EXISTING GAS LINE
O/B	EXISTING BELL CABLE
ST	EXISTING STORM SEWER
W	EXISTING WATERMAIN
SA	EXISTING SANITARY SEWER
H	EXISTING UNDERGROUND HYDRO
OH	EXISTING OVERHEAD HYDRO
	PROPOSED CURB
RD	PROPOSED ROOF DRAIN
SCP	PROPOSED SCUPPER
SC	PROPOSED SIAMESE CONNECTION
M	PROPOSED WATER METER
RM	PROPOSED REMOTE WATER METER
200mmø SAN	PROPOSED SANITARY SEWER
200mmø STM	PROPOSED STORM SEWER
200mmø WATERMAIN	PROPOSED WATERMAIN
V&VB	PROPOSED VALVE & VALVE BOX
203x152	PROPOSED TEE CONNECTION
	PROPOSED THRUST BLOCK
STMMH 200	PROPOSED STORM MANHOLE
CB1	PROPOSED CATCH BASIN
SANMH 100	PROPOSED SANITARY MANHOLE
	PROPOSED HI40 INSULATION
	PROPOSED HEAVY DUTY PAVEMENT
	PROPOSED LIGHT DUTY PAVEMENT

STRUCTURE TABLE

STRUCTURE LABEL	SIZE	STRUCTURE OPSD No. OR CITY STD DWG	FRAME OPSD No. OR CITY STD DWG
SANMH 101	1200mmø	701.010	401.010–A
SANMH 102	1200mmø	701.010	401.010–A
SANMH 103	1200mmø	701.010	401.010–A
SANMH 104	1200mmø	701.010	401.010–A
SANMH 105	1200mmø	701.010	401.010–A
CBs	600mm x 600mm	705.010	400.020
CBMH 203	1200mmø	701.010	401.010–B
CBMH 204	1200mmø	701.010	401.010–B
STMMH 205	1200mmø	701.010	401.010–B
STMMH 206	1200mmø	701.010	401.010–B
STMMH 207	1200mmø	701.010	401.010–B
STMMH 208	1200mmø	701.010	401.010–B
STMMH 209	1200mmø	701.010	401.010–B

ICD SUMMARY TABLE

ICD LOCATION	HYDROVEX MODEL	HEAD	FLOW RATE (L/s)	100-YR STORAGE VOLUME PROVIDED (m³)
CBMH204	**75 VHV-1**	2.58	7.60	43.0
CBMH203	**50 VHV-1**	2.12	2.50	110.3
CB102	**200 VHV-2**	1.74	37.50	45.0
CB110	**75 VHV-1**	2.13	4.80	1.8
CBMH201	32 SVHV-1	1.85	1.00	4.0
CB E12	75 VHV-1	5.80	6.00	28.8
CB E19	75 VHV-1	3.10	3.20	72.0
CBMH202	75 VHV-1	1.77	4.90	33.5
CB112	**100 VHV-1**	2.38	14.00	35.3
CB111	**50 VHV-1**	2.27	3.00	34.7
CB108	32 SVHV-1	1.95	1.00	5.3
CBMH E13	100 VHV-1	2.22	11.80	102.0

CROSSING TABLE

LOCATION	SANITARY SEWER			STORM SEWER			WATERMAIN			Gas		CLEARANCES (mm)
	Invert Elev	Dia. (mm)	Obvert Elev	Invert Elev	Dia. (mm)	Obvert Elev	Invert Elev	Dia. (mm)	Obvert Elev	Depth (mm)	Elev	
1	65.60	250	65.85				67.19	300	67.49			1340mm (SAN Below)
2	65.75	250	66.00				66.50	200	66.70			500mm (SAN Below)
3	65.90	250	66.15	66.56	250	66.81						410mm (SAN Below)
4				66.49	300	66.79	65.79	200	65.99			500mm (WM Below)
5				66.71	250	66.96	66.01	200	66.21			500mm (WM Below)
6				66.82	250	67.07	66.12	200	66.32			500mm (WM Below)
7	66.04	250	66.29				66.58	200	66.78			290mm (SAN Below)
8				67.17	300	67.47				±450	±68.34	870mm (STM Below)

WATERMAIN TABLE

STATION	FIN/GRADE	T/W GRADE	COMMENT
0+000	69.19	67.19	TIE INTO EXISTING WATERMAIN ON BELFAST RD
0+009.5	69.30	66.90	VALVE AND VALVE BOX
0+020	69.20	66.80	TOP OF WATERMAIN
0+030.8	69.05	66.65	WATER SERVICE CONNECTION
0+040	69.26	66.86	TOP OF WATERMAIN
0+050	69.44	67.04	TOP OF WATERMAIN
0+065.3	69.30	66.90	THRUST BLOCK AND 45° BEND
0+069.5	69.28	66.88	THRUST BLOCK AND 45° BEND
0+077.8	69.25	65.99	STM CROSSING
0+094.2	69.28	66.21	STM CROSSING
0+100	69.36	66.24	TOP OF WATERMAIN
0+0113.2	69.34	66.32	STM CROSSING
0+0118.7	69.18	66.78	SAN CROSSING
0+0121.7	69.22	66.82	VALVE AND VALVE BOX
0+0123	69.25	66.85	TIE INTO EXISTING WATERMAIN ON-SITE

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ANNIS O'SULLIVAN VOLLEBEKK TD.
14 CONCOURSE GATE, SUITE 500
OTTAWA, ON. K2E 7S6
613.727.0850

REV	REVISION DESCRIPTION	DATE	BY	APPD
2	REVISED AS PER CITY COMMENTS	08/08/19	AE	AA
1	ISSUED FOR SITE APPLICATION	09/04/19	AE	AA

SCALE
0 3m 6m 12m
HORIZONTAL 1:300

NORTH

DESIGNED BY

REVIEWED BY

CLIENT
CONTROLEX CORPORATION
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BASEPLAN AE
DESIGN AE
CHECKED AA
CAD AE
PROJECT MANAGER AA
APPROVED AA

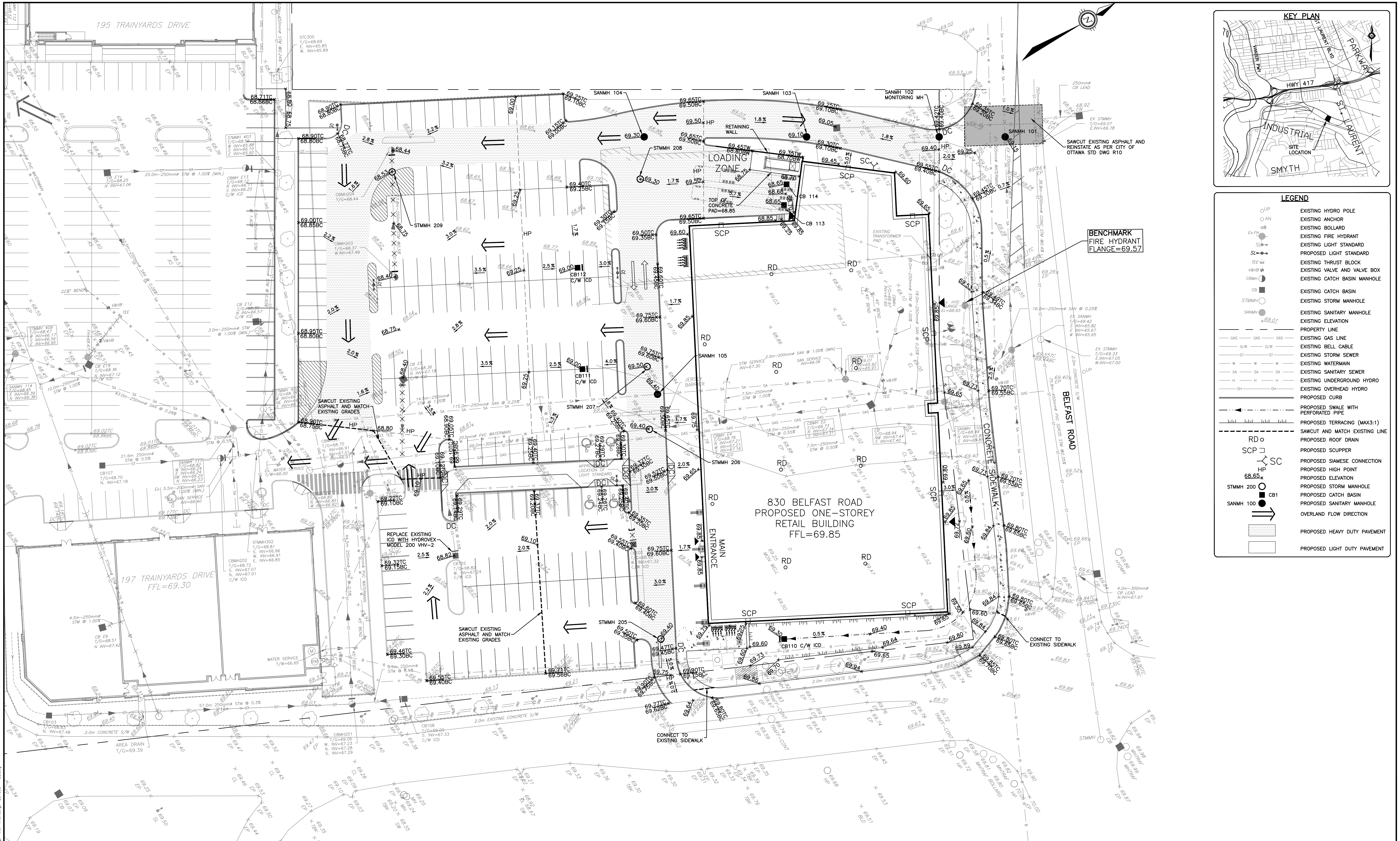
PROJECT
OTTAWA TRAIN YARDS
830 BELFAST ROAD
OTTAWA, ONTARIO.

TITLE
SITE SERVICING PLAN

PROJECT No. OTT–00251090–A0
SURVEY ---
DATE JAN 2019
DRAWING No. SS

D07–12–19–0071

#17920



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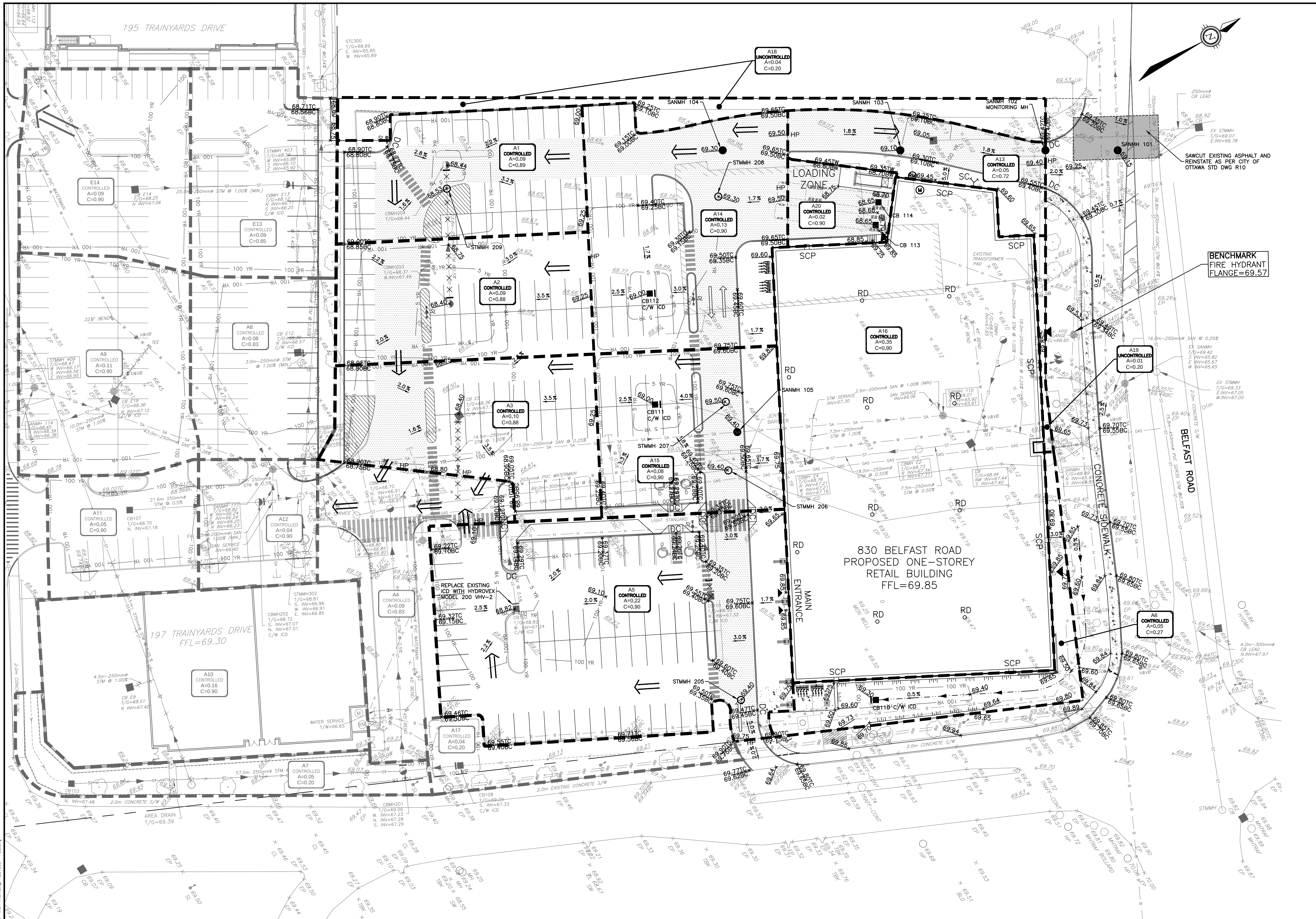
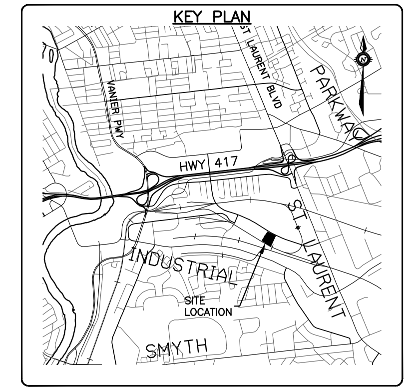
BASEPLAN	AE
DESIGN	AE
CHECKED	AA
CAD	AE
PROJECT MANAGER	AA
APPROVED	AA

PROJECT
OTTAWA TRAIN YARDS
830 BELFAST ROAD
OTTAWA, ONTARIO.

TITLE
GRADING AND DRAINAGE PLAN

PROJECT No. OTT-00251090-A0
SURVEY ---
DATE JAN 2019
DRAWING No. GP





LEGEND

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AN	EXISTING ANCHOR
B	EXISTING BOLLARD
Ex.FH	EXISTING FIRE HYDRANT
SL	EXISTING LIGHT STANDARD
TEE	EXISTING THRUST BLOCK
V&VB	EXISTING VALVE AND VALVE BOX
CBMH	EXISTING CATCH BASIN MANHOLE
CB	EXISTING CATCH BASIN
STMMH	EXISTING STORM MANHOLE
SANMH	EXISTING SANITARY MANHOLE
69.01	EXISTING ELEVATION
	PROPERTY LINE
GAS GAS GAS	EXISTING GAS LINE
O/B O/B	EXISTING BELL CABLE
ST ST	EXISTING STORM SEWER
W W W	EXISTING WATERMAIN
SA SA SA	EXISTING SANITARY SEWER
H H H	EXISTING UNDERGROUND HYDRO
OH OH	EXISTING OVERHEAD HYDRO
	PROPOSED CURB
	PROPOSED SWALE WITH PERFORATED PIPE
	PROPOSED TERRACING (MAX3:1)
5 YR	PONDING AREA 5–YEAR LIMIT
100 YR	PONDING AREA 100–YEAR LIMIT
	DRAINAGE BOUNDARY
RD	PROPOSED ROOF DRAIN
SCP	PROPOSED SCUPPER
SC	PROPOSED SIAMESE CONNECTION
68.65	PROPOSED ELEVATION
STMMH 200	PROPOSED STORM MANHOLE
CBMH 200	PROPOSED CATCH BASIN MANHOLE
CB1	PROPOSED CATCH BASIN
SANMH 100	PROPOSED SANITARY MANHOLE

ICD SUMMARY TABLE

AREA ID	OUTLET LOCATION	AREA (ha)	HEAD (m)	FLOW RATE (L/s)	HYDROVEX MODEL
A1	CBMH 204	0.09	2.58	7.60	**75 VHV-1**
A2	CBMH 203	0.09	2.12	2.50	**50 VHV-1**
A3		0.10			
A4	CBMH 301	0.09			
A5	CB 102	0.22	1.74	37.50	**200 VHV-2**
A6	CB 110	0.05	2.13	4.80	**75 VHV-1**
A7	CBMH 201	0.05	1.85	1.00	32 SVHV-1
A8	CB E12	0.08	5.80	6.00	75 VHV-1
A9	CB E19	0.11	3.10	3.20	75 VHV-1
A10	BLDG ROOF	0.16			
A11	CBMH 202	0.05	1.77	4.90	75 VHV-1
A12		0.04			
A13	Ex. CB	0.05			
A14	CB 112	0.13	2.38	14.00	**100 VHV-1**
A15	CB 111	0.08	2.27	3.00	**50 VHV-1**
A16	BLDG ROOF	0.35			
A17	CB 108	0.04	1.95	1.00	32 SVHV-1
A18	Uncontrolled	0.04			
A19	Uncontrolled	0.01			
A20	CB 113-114	0.02			
E13	CBMH E13	0.09	2.22	11.80	100 VHV-1
E14		0.09			

TOTAL AREA= 2.03

*BOLD DENOTES PROPOSED ICD

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BASEPLAN AE
DESIGN AE
CHECKED AA
CAD AE
PROJECT MANAGER AA
APPROVED AA

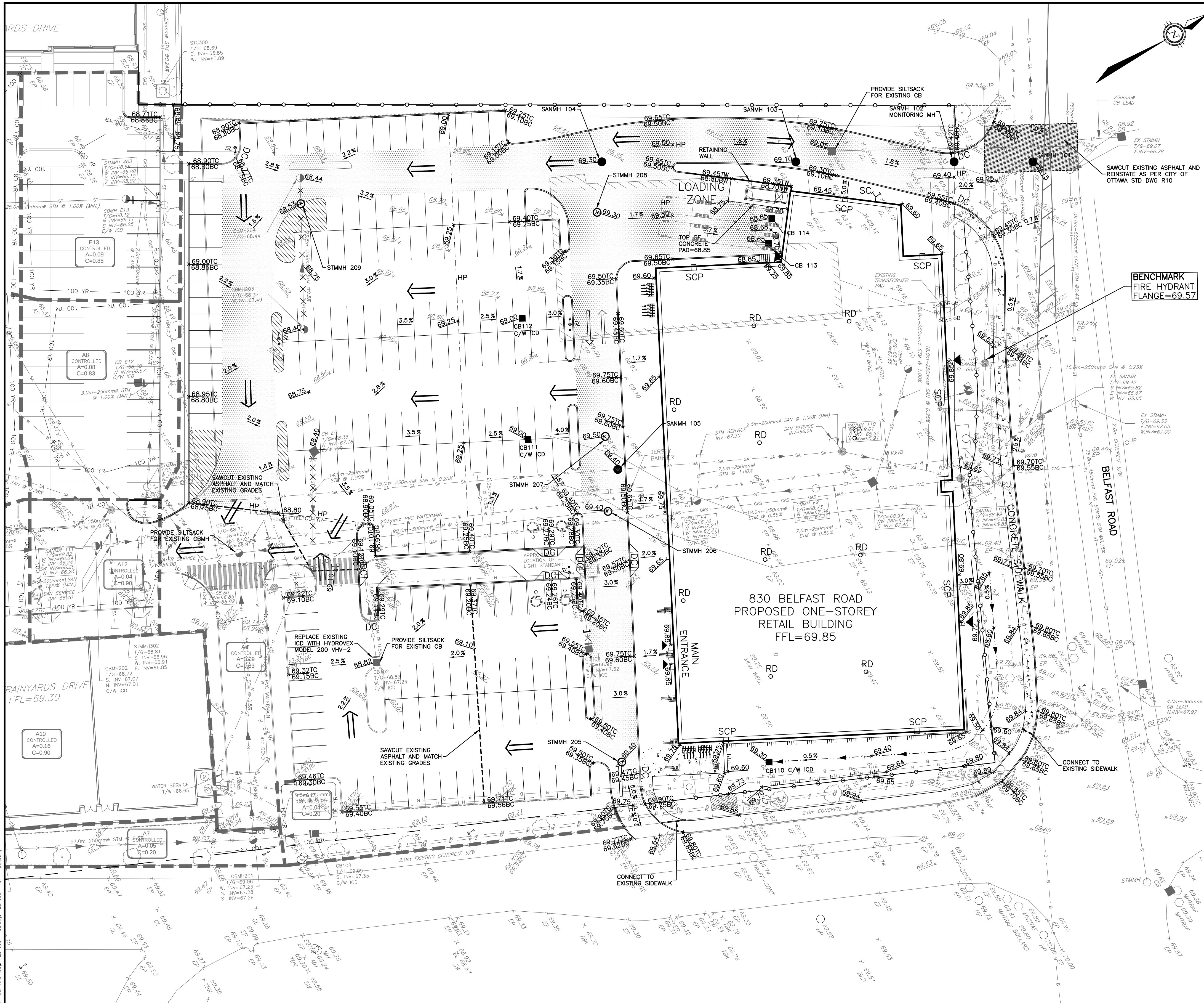
PROJECT
OTTAWA TRAIN YARDS
830 BELFAST ROAD
OTTAWA, ONTARIO.

TITLE
STORMWATER
MANAGEMENT PLAN

PROJECT No. OTT–00251090–A0
SURVEY ---
DATE FEB 2019
DRAWING No. SWM

D07–12–19–0071

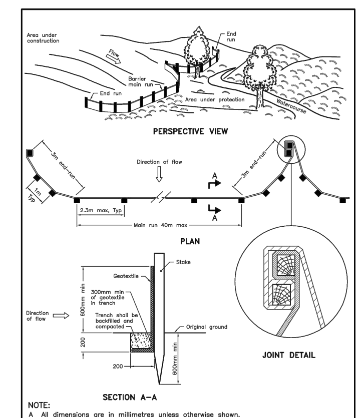
#17920



EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION.

THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY. DURING ALL CONSTRUCTION ACTIVITIES, EROSION AND SEDIMENTATION SHALL BE CONTROLLED BY THE FOLLOWING TECHNIQUES:

1. LIMITING THE EXTENT OF EXPOSED SOILS AT ANY GIVEN TIME.
2. RE-VEGETATION OF EXPOSED AREAS AS SOON AS POSSIBLE.
3. MINIMIZING THE AREA TO BE CLEARED AND DISRUPTION TO ADJACENT AREAS.
4. A SILT FENCE BARRIER (OPSD 219.110) TO BE INSTALLED AS SHOWN ON THIS DRAWING.
5. A VISUAL INSPECTION SHALL BE COMPLETED DAILY ON SEDIMENT CONTROL BARRIERS AND ANY DAMAGE REPAIRED IMMEDIATELY. CARE WILL BE TAKEN TO PREVENT DAMAGE DURING CONSTRUCTION OPERATIONS.
6. IN SOME CASES SOME BARRIERS MAY BE REMOVED TEMPORARILY TO ACCOMMODATE THE CONSTRUCTION OPERATIONS. THE AFFECTED BARRIERS WILL BE REINSTATED AT NIGHT WHEN CONSTRUCTION IS COMPLETED.
7. THE SEDIMENT CONTROL DEVICES WILL BE CLEANED OF ACCUMULATED SILT AS REQUIRED. THE DEPOSITS WILL BE DISPOSED OF AS PER THE REQUIREMENTS OF THE CONTRACT.
8. DURING THE COURSE OF CONSTRUCTION IF THE ENGINEER BELIEVES THAT ADDITIONAL PREVENTION METHODS ARE REQUIRED TO CONTROL EROSION AND SEDIMENTATION, THE CONTRACTOR WILL INSTALL ADDITIONAL SILT FENCES OR OTHER METHODS AS REQUIRED TO THE SATISFACTION OF THE ENGINEER.
9. CONSTRUCTION AND MAINTENANCE REQUIREMENTS FOR EROSION AND SEDIMENT CONTROLS TO COMPLY WITH ONTARIO PROVINCIAL STANDARD SPECIFICATION (OPSS) OPSS 805, AND CITY OF OTTAWA SPECIFICATIONS.
10. EROSION AND SEDIMENT CONTROL MEASURES MAY BE MODIFIED ON-SITE AT THE DISCRETION OF THE CITY OF OTTAWA INSPECTOR OR THE RIDEAU VALLEY CONSERVATION AUTHORITY. CONTRACTOR IS RESPONSIBLE TO INSTALL MODIFICATIONS AS REQUIRED TO THE SATISFACTION OF THE APPROPRIATE AUTHORITIES.
11. IN ACCORDANCE WITH BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL, GEOSYNTHETIC SYSTEMS SILTSACK OR APPROVED EQUIVALENT IS TO BE PLACED INSIDE ALL STORM MANHOLE CATCHBASINS AND CATCHBASINS. INSTALLATION, INSPECTION AND CLEANOUT ARE AS PER MANUFACTURER'S RECOMMENDATIONS.



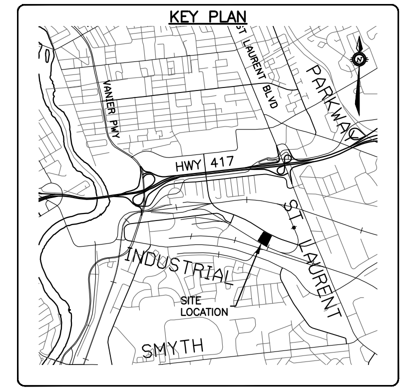
NOTE:
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 2
LIGHT-DUTY SILT FENCE BARRIER	OPSD 219.110	

SILT FENCE NOTES:

1. POSTS TO BE SPACED AT 2.3 METRES CENTRE TO CENTRE.
2. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY A MINIMUM OF 500mm.
3. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.
4. WOOD POSTS TO BE HARDWOOD TYPE (50mm x 50mm).
5. GEOTEXTILE TO BE EMBEDED 200 mm INTO GROUND.
6. GEOTEXTILE TO CONFORM TO OPSS 805 STANDARDS.
7. SILT FENCE MUST BE INSTALLED BEFORE COMMENCEMENT OF CONSTRUCTION AND IN ACCORDANCE WITH DETAIL. SILT FENCE CAN BE REMOVED AFTER LANDSCAPING IS COMPLETE.
8. SEDIMENTS MUST BE CLEARED AWAY WHEN THEY REACH HALF THE HEIGHT OF THE FENCE.

KEY PLAN



LEGEND

- EXISTING HYDRO POLE
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- EXISTING BOLLARD
- EXISTING FIRE HYDRANT
- EXISTING LIGHT STANDARD
- PROPOSED LIGHT STANDARD
- EXISTING THRUST BLOCK
- EXISTING VALVE AND VALVE BOX
- EXISTING CATCH BASIN MANHOLE
- EXISTING CATCH BASIN
- EXISTING STORM MANHOLE
- EXISTING SANITARY MANHOLE
- EXISTING ELEVATION
- PROPERTY LINE
- EXISTING GAS LINE
- EXISTING BELL CABLE
- EXISTING STORM SEWER
- EXISTING WATERMAIN
- EXISTING SANITARY SEWER
- EXISTING UNDERGROUND HYDRO
- EXISTING OVERHEAD HYDRO
- PROPOSED CURB
- PROPOSED SWALE WITH PERFORATED PIPE
- PROPOSED TERRACING (MAX3:1)
- SAWCUT AND MATCH EXISTING LINE
- PROPOSED SILT FENCE
- RD PROPOSED ROOF DRAIN
- SCP PROPOSED SCUPPER
- SC PROPOSED SIAMESE CONNECTION
- HP PROPOSED HIGH POINT
- 68.65 PROPOSED ELEVATION
- STMMH 200 PROPOSED STORM MANHOLE
- CB1 PROPOSED CATCH BASIN
- SANMH 100 PROPOSED SANITARY MANHOLE
- OVERLAND FLOW DIRECTION
- PROPOSED HEAVY DUTY PAVEMENT
- PROPOSED LIGHT DUTY PAVEMENT

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BASEPLAN	DESIGN	CHECKED	CAD	PROJECT MANAGER	APPROVED
AE	AE	AA	AE	AA	AA

PROJECT
OTTAWA TRAIN YARDS
830 BELFAST ROAD
OTTAWA, ONTARIO.

TITLE
EROSION AND SEDIMENT CONTROL PLAN

PROJECT No. OTT-00251090-A0
SURVEY ---
DATE APRIL 2019
DRAWING No. ESC

D07-12-19-0071

#17920