Stormwater Management & Servicing Report Buildings 100 and 550, 3020 Hawthorne Road

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

Project Number:
OTT-00250557-A0

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Date Submitted:
December 14, 2018

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1 Introduction

EXP Services Inc. (EXP) was retained by Controlex Corporation to provide engineering services for the preparation of site grading, servicing and stormwater management report for a light industrial development at 3020 Hawthorne Road.

The site is 8 hectares in area and is bound by Hawthorne Road to the east, a hydro transmission corridor to the south, the Mather Award Ditch to the west and a railway line to the north. Development of the site is proceeding in a phased manner. The first phase, completed in 2006, involved the construction of Building 700 (Acklands Grainger). The second phase, built in 2008, included Building 200, the third phase, built in 2013, included the development of Building 300, and the fourth phase, constructed in 2017, includes the development of Buildings 500 and 600. The fifth phase, currently proposed, includes the development of Buildings 100 and 550.

This servicing design brief will address SWM the quality and quantity control requirements for the proposed drainage areas of Buildings 100 and 550, determine how the proposed buildings 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 Buildings 100 and 500 are included with this report.

Refer to Figure 1 in Appendix C for the site location and existing conditions.

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)

3 Sanitary Sewer Design

3.1 Peak Design Flow

The site is currently serviced by an existing 250mm diameter municipal sanitary sewer located within an easement along the south side of the site and follows the alignment of the once proposed Russell Road extension. This sewer was designed to service these lands and flows westward and connects to a 375mm diameter sewer on the east bank of the Mather Ditch. The 375mm sewer flows north and connects to the 2,700mm diameter South Ottawa Collector located on the north side of the property. The anticipated peak sanitary flows from the proposed Buildings 100 and 550 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:

Building 100 Design Flows

Light Industrial Design Flow:	35,000 L/gross ha/day
Building Area:	0.22 hectares
Peak Factor:	7.9 as per Sewer Design Guidelines Appendix 4-B
Extraneous Flow:	0.33 L/s/ha
Peak Design Flow:	=(35000L/ha/day)(0.22ha)(7.9)(1/86400)+(0.22ha)(0.33L/s/ha)
	=**0.78 L/s**

Building 500 Design Flows

Light Industrial Design Flow:	35,000 L/gross ha/day
Building Area:	0.069 hectares
Peak Factor:	8.0 as per Sewer Design Guidelines Appendix 4-B
Extraneous Flow:	0.33 L/s/ha
Peak Design Flow:	=(35,000L/ha/day)(0.069ha)(8)(1/86400)+(0.069ha)(0.33L/s/ha)
	=**0.25 L/sec**
Total Peak Design Flow:	=0.78 L/s + 0.25 L/s
	=1.03 L/s

Proposed Building 100 will be serviced by an existing 150mm diameter sanitary service that ties-in to the existing sanitary manhole SANMH 112. The 150mm diameter sanitary service is installed at a slope of 1.0%. At this slope, the 150mm diameter sanitary service has a capacity of 20.7 L/s and a full flow velocity of 1.21 m/s, which will be sufficient to service proposed Building 100.

Proposed Building 550 will be serviced by a new 150mm diameter sanitary service that connects to the existing 250mm diameter sanitary sewer. The new 150mm diameter sanitary service will be installed at a minimum slope of 0.5%. At this slope, the 150mm diameter sanitary service will have a capacity of 14.6 L/s and a full flow velocity of 0.86 m/s, which will be sufficient to service proposed Building 550. The City of Ottawa Sewer Design Guidelines recommends a flow velocity between 0.6m/s to 3m/s. Refer to Appendix C for the Site Servicing plan.

3.2 Downstream Capacity

Design Flows

Light Industrial Design Flow:	35,000 L/gross ha/day
Property Area:	8.9 hectares
Peak Factor:	4.3 as per Sewer Design Guidelines Appendix 4-B
Extraneous Flow:	0.33 L/s/ha
Peak Design Flow:	=(35,000L/ha/day)(8.9ha)(4.3)(1/86400)+(8.9ha)(0.33L/s/ha)
	=**18.4 L/sec**

The design sanitary flows for the 8.9ha property is 18.4 L/s. The existing municipal 250mm diameter sanitary sewer is installed at a minimum slope of 0.4%. At this slope, the existing 250mm diameter sanitary sewer has a capacity of 38.2 L/s which will be sufficient to service the existing and proposed buildings 100 and 550 at the site.

4 Watermain Design

4.1 Required Fire Flow

The fire flow demand calculations were prepared based on the Fire Underwriters Survey (FUS, 1999) criteria. Proposed Buildings 100 and 550 will be similar in construction as the previous buildings on the property. The buildings will be sprinklered with non-combustible construction and with limited combustible contents. The required fire flows were determined to be 67 L/s and 50 L/s for Buildings 100 and 550, respectively. Refer to Appendix B for detailed fire flow demand calculations.

4.2 Watermain Design

Proposed Building 100 will be serviced by an existing 150mm diameter water service lateral connected to the on-site existing 200mm diameter watermain. Building 550 will be serviced by a new 150mm diameter water service lateral to be connected to the on-site existing 200mm diameter watermain installed during phase 4 of development for Buildings 500 and 600.

The domestic water demands for the proposed buildings were calculated as per the City of Ottawa Water Distribution Guidelines and Technical Bulletin 2018-02. Light industrial average consumption rate and peak factors were used for the demands calculations. Buildings 100 and 550 domestic demands were determined as follows:

Building 100 Water Demand

Average daily demand:

=35,000 L/ha/day
=0.22 ha x 35,000 L/ha/day x (1/86,400 s/day)
= 0.089 L/s

Maximum daily demand:

=1.5 x avg. day
=1.5 x 0.089 L/s
=0.13 L/s

Maximum hourly daily demand:
=1.8 x max.day
=1.8 x 0.13 L/s
=0.23 L/s

Building 550 Water Demand

Average daily demand:
=35,000 L/ha/day
=0.069 ha x 35,000 L/ha/day x (1/86,400 s/day)
= 0.028 L/s

Maximum daily demand:
=1.5 x avg. day
=1.5 x 0.028 L/s
=0.042 L/s

Maximum hourly daily demand:
=1.8 x max.day
=1.8 x 0.042 L/s
=0.076 L/s

Total Water Demand

Total Average daily demand:
=0.089 L/s + 0.028 L/s
=0.12 L/s

Total Maximum daily demand:
=0.13 L/s + 0.042 L/s
=0.17 L/s

Total Maximum hourly daily demand:
=0.23 L/s + 0.076 L/s
=0.31 L/s

4.3 Pressure Check

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

Peak Hour HGL = 124.0m

Maximum HGL = 130.8m

Max Day (L/s) + Fire Flow (67L/s) = 126.0m

Building 100 max day and fire flow demands governed the boundary conditions. Based on 126.0m for the max day + fire flow scenario, pressure analyses were performed for both developments. Building 100 and 550 had residual pressures of 63.6 psi (438.3 kPa) and 61.9 psi (426.9 kPa), respectively. Refer to Appendix B for calculation details. The residual water pressures during the scenario 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. The existing water supply system will therefore have adequate capacity to meet the domestic and fire demands for the proposed buildings.

4.4 Fire Hydrants

Each building has a fire hydrant within 45m of the Siamese connections.

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 300 mm.
- Flows from storms events greater than the 100-year return period will be directed overland towards Mather Award drain.
- 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 site is currently fully developed except the area where building # 100 will be located. The site has been graded to with slopes ranging between 1.2% to 3.5% with overland flows directed from east to west towards the Mather Award drain. An existing municipal storm sewer runs along the south property line. The storm sewer diameter is 600 mm at Hawthorne Road and 900 mm at the headwall outlet into the Mather Award drain.

5.3 Allowable Release Rate

The allowable release rate for the site was established in the previous phases of development; 100-year post-development release rate should be equal to or less than the 5-year pre-development flow using a runoff coefficient of 0.65 and a time of concentration of 20 minutes.

Building 550

Building 500 is located in the existing parking lot on the south side of building 500. During the SWM design of building 500 and 600 it was demonstrated that the post development flows from this area was restricted to the allowable release rate. Stormwater flows from 3.54ha drainage area shown in storm water management drawing # SWM is currently conveyed via the existing storm sewer system to the Stormceptor STC3000 located east of building 550 before it is discharged into the municipal trunk sewer along the south property line. The 100-year post-development release rate from 3.54ha drainage area following construction of building 550 will be restricted to or less than the 5-year pre-development flow. In addition, since the total drainage area draining towards STC 3000 will remain unchanged the capacity of STC for treatment of storm water flows will not be affected.

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

Total Drainage Area(A):	3.54 hectares
Allowable Runoff coefficient (C):	0.65
5-year Rainfall Intensity	**I** (5-year, 20 min) = 70.3 mm/hr
Allowable Release Rate	**Q** = 2.78CIA
	Q = 2.78 x 0.65 x 70.3 x 3.54
	Q = 450 L/s

Therefore, the allowable release rate for the 3.54 ha drainage area which now includes building 550 is 450L/s.

Building 100

Building 100 covers an area of 0.24 ha and is located in an area that is currently landscaped. Storm water flows from this area have been accounted for in the SWM design for the entire property. The intent of the current design is to ensure that the post development storm water flows, up to the 100-year event, from the 0.24 ha area are equal to or less than the 5 year pre-development flows calculated using runoff coefficient of 0.65. The allowable release rate is calculated as follows:

Total Drainage Area (A):	0.24 hectares
Allowable Runoff coefficient (C):	0.65
5-year Rainfall Intensity	**I** (5-year, 20 min) = 70.3 mm/hr
Allowable Release Rate	**Q** = 2.78CIA
	Q = 2.78 x 0.65 x 70.3 x0.24
	Q = 30.5 L/s

Therefore, the allowable release rate for Building 100 is 30.5 L/s.

5.4 Post-Development Conditions

Stormwater from the 3.54ha 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 300 mm for the 100-year storm event.

Refer to Stormwater Management Plan SWM in Appendix C 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 3.54ha drainage area which includes the Building 550.

Table 5-1: Building 550 Summary of SWM Storage Requirements

Area ID	Area (ha)	Runoff Coefficient 'C'	100 Year Release (L/s)	100 Year storage required (m^3)	100 Year surface storage provided (m^3)
A301	0.250				
A302	0.090				
A303	0.120	0.90	54.20	187.46	214
A304	0.080				
A305	0.080				
A306	0.200	0.90	62.00	22.37	25.40
A307	0.920	0.90	37.60	379.28	388.20
A308	0.080				
A309	0.080	0.90	10.00	87.34	130.7
A310	0.060				
A601	0.550	0.90	22.10	228.11	229.80
A602	0.060				
A603	0.080	0.90	40.00	104.06	171.5
A604	0.240				
A605	0.580	0.90	150.00	82.75	86
A550	0.070	0.90	3.00	28.4	35
TOTAL	**3.54**				
		Totals:	**378.9**	**1119.7**	**1280.6**
Total Allowable Release L/s:			**450**		

The 100-year controlled release rate from 3.54ha area is 378.9 L/s which is less than the total allowable release rate of 450 L/s. The available storage volume of 1,280.6 m^3 is more than the required volume of 1,119.7 m^3.

The following table 5-2 summarizes the storage requirements for the development of Building 100:

Table 5-2: Building 100 Summary of SWM Storage Requirements

Area ID	Area (ha)	Runoff Coefficient 'C'	100 Year Release (L/s)	100 Year storage required (m^3)	100 Year surface storage provided (m^3)
A100	0.220	0.90	9.00	90.67	110.00
A101	0.015	0.90	7.45	0.00	0.00
TOTAL	**0.24**				
		Totals:	**16.4**	**90.7**	**110.0**
Total Allowable Release L/s:			**30.5**		

The 100-year controlled release rate from Building 100 is 16.4 L/s, which is less than the total allowable release rate of 30.5 L/s. The available storage volume is 110 m^3 which is more than the required volume of 90.7 m^3

5.4.2 Flow Control Device Sizing

Stormwater runoff from the 3.54ha 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 Building 300 and Building 600 design will remain, except for ICD installed in CBMH 415 located south west of the proposed Building 550 which will be removed and a new ICD will be installed in the existing CBMH 418, upstream of CBMH 415. The new ICD will be a 215mm diameter plug type orifice. The following Table 5-3 summarizes the ICDs that are existing and proposed.

Table 5-3: ICD Summary Table

Location	Exisiting/Proposed	Controlled Release (L/s)	Outlet Pipe Dia. (mm)	Plug Type Orifice Dia. (mm)	Hydrovex Model
STMMH 402	Existing	54.2	457	128	N/A
CB 44	Existing	62	254	154	N/A
CBMH 407	Existing	10.0	381	N/A	75-VHV-1
CBMH 416	Existing	40.0	305	108	N/A
CBMH 415	**Proposed**	**150.0**	**254**	**215**	**N/A**

The discharge rate for the two ICDs was calculated based on the Orifice Equation, assuming it was fully submerged, as follows:

$Q_{ORF} = C * A * \sqrt{(2gH)}$

where:

Q_{ORF}	=	Flow through orifice, m^3/sec
C	=	Discharge Coefficient [0.61]
A	=	Area of orifice (m^2)
g	=	Acceleration due to gravity, m/sec^2 [9.81]
H	=	Head above centerline of orifice, m

5.4.3 Quality Control

Quality control for building 550 will be provided by the existing Stormceptor STC 3000 unit which will provide the required level of 70% TSS removal. The existing Stormceptor was designed for the 3.54 ha drainage area which included the parking lot where building 550 will be constructed. Construction of building 550 will improve the quality of run off as the parking lot area is being reduced due to construction of building 550. Therefore, additional quality control measure are not warranted.

Building 100 will not require any quality control measures as the landscape area is being replaced by the building which will significantly improve the quality of run off.

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 351 Sandhill Rd, Ottawa, Ontario. Based on the analysis provided in this report, the conclusions are as follows:

- The proposed Building 100 and Building 550 will be serviced by a 150mm diameter watermain, which will adequately service the proposed development.
- The proposed Building 100 and Building 550 will be serviced by a 150mm 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 0.65 and a time of concentration of 20 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 buildings for storms up to the 100-year event.
- Quality control for building 550 will be provided by the existing Stormceptor STC3000. Building 100 will not require any quality control measures as the landscape area is being replaced by the building which will significantly improve the quality of run off.
- 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

Table A1
Stormwater Management Summary
Building 550

Area ID	Area (ha)	Runoff Coefficient 'C'	100 Year Release (L/s)	100 Year storage required (m^3)	100 Year surface storage provided (m^3)
A301	0.250	0.90	54.20	187.46	214.00
A302	0.090				
A303	0.120				
A304	0.080				
A305	0.080				
A306	0.200	0.90	62.00	22.37	25.40
A307	0.920	0.90	37.60	379.28	388.20
A308	0.080	0.90	10.00	87.34	130.70
A309	0.080				
A310	0.060				
A601	0.550	0.90	22.10	228.11	229.80
A602	0.060	0.90	40.00	104.06	171.50
A603	0.080				
A604	0.240				
A605	0.580	0.90	150.00	82.75	86.00
A550	0.070	0.90	3.00	28.4	35.00
TOTAL	**3.54**				
		Totals:	**378.9**	**1119.7**	**1280.6**
Total Allowable Release L/s:			**450**		

Table A2
SUMMARY OF POST DEVELOPMENT RUNOFF (UNCONTROLLED AND CONTROLLED)

Area No	Outlet Location	Area (ha)	Time of Conc. T_c (min)		Storm = 100-year			
				C_{AVG}	$C_{AVG-100Yr}$	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)
A301		0.250						
A302		0.090						
A303	STMMH 402	0.120	10	0.90	1.00	178.56	307.8	**54.2**
A304		0.080						
A305		0.080						
A306	CB44	0.200	10	0.90	1.00	178.56	99.3	**62.0**
A307	BLDG 300	0.920	10	0.90	1.00	178.56	456.7	**37.6**
A308		0.080						
A309	CBMH407	0.080	10	0.90	1.00	178.56	39.7	**10.0**
A310		0.060						
A601	BLDG 600	0.550	10	0.90	1.00	178.56	273.0	**22.1**
A602		0.060						
A603	CBMH416	0.080	10	0.90	1.00	178.56	29.8	**40.0**
A604		0.240						
A605	STMMH 4	0.580	10	0.90	1.00	178.56	287.9	**150.0**
A550	BLDG550	0.070	10	0.90	1.00	178.56	34.7	**3.0**
Total		3.540					1528.9	**378.9**

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: A301-A305
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 10 (mins)
Drainage Area = 0.6200 (hectares)

Duration, T_D (min)	Release Rate = 54.2 (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 = 54.2 (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	259.4	54.20	205.2	0	398.6	687.1	54.200	632.9	0.0
10	76.8	119.1	54.20	64.9	**39**	178.6	307.8	54.200	253.6	152.1
20	52.0	80.7	54.20	26.5	32	120.0	206.7	54.200	152.5	183.1
30	40.0	62.1	54.20	7.9	14	91.9	158.3	54.200	104.1	**187.5**
40	32.9	51.0	54.20	-3.2	-8	75.1	129.5	54.200	75.3	180.8
50	28.0	43.5	54.20	-10.7	-32	64.0	110.2	54.200	56.0	168.1
60	24.6	38.1	54.20	-16.1	-58	55.9	96.3	54.200	42.1	151.7
70	21.9	34.0	54.20	-20.2	-85	49.8	85.8	54.200	31.6	132.8
80	19.8	30.8	54.20	-23.4	-113	45.0	77.5	54.200	23.3	112.1
90	18.1	28.1	54.20	-26.1	-141	41.1	70.9	54.200	16.7	90.0
100	16.7	26.0	54.20	-28.2	-169	37.9	65.3	54.200	11.1	66.8
110	15.6	24.2	54.20	-30.0	-198	35.2	60.7	54.200	6.5	42.7
120	14.6	22.6	54.20	-31.6	-228	32.9	56.7	54.200	2.5	18.0
130	13.7	21.2	54.20	-33.0	-257	30.9	53.3	54.200	-0.9	-7.4
140	12.9	20.1	54.20	-34.1	-287	29.2	50.2	54.200	-4.0	-33.2
150	12.3	19.0	54.20	-35.2	-317	27.6	47.6	54.200	-6.6	-59.5
160	11.7	18.1	54.20	-36.1	-347	26.2	45.2	54.200	-9.0	-86.1
170	11.1	17.2	54.20	-37.0	-377	25.0	43.1	54.200	-11.1	-113.1
180	10.6	16.5	54.20	-37.7	-407	23.9	41.2	54.200	-13.0	-140.4
190	10.2	15.8	54.20	-38.4	-438	22.9	39.5	54.200	-14.7	-168.0
200	9.8	15.2	54.20	-39.0	-468	22.0	37.9	54.200	-16.3	-195.7
210	9.4	14.6	54.20	-39.6	-499	21.1	36.4	54.200	-17.8	-223.7
Maximum Storage Requried =					**39.0**					**187.5**

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.

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

Area No: A306
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 10 (mins)
Drainage Area = 0.2000 (hectares)

Duration, T_D (min)	Release Rate = 62.0 (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 = 62.0 (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	83.7	62.00	21.7	**0**	398.6	221.6	62.000	159.6	0.0
10	76.8	38.4	62.00	-23.6	-14	178.6	99.3	62.000	37.3	**22.4**
20	52.0	26.0	62.00	-36.0	-43	120.0	66.7	62.000	4.7	5.6
30	40.0	20.0	62.00	-42.0	-76	91.9	51.1	62.000	-10.9	-19.7
40	32.9	16.4	62.00	-45.6	-109	75.1	41.8	62.000	-20.2	-48.5
50	28.0	14.0	62.00	-48.0	-144	64.0	35.6	62.000	-26.4	-79.3
60	24.6	12.3	62.00	-49.7	-179	55.9	31.1	62.000	-30.9	-111.3
70	21.9	11.0	62.00	-51.0	-214	49.8	27.7	62.000	-34.3	-144.1
80	19.8	9.9	62.00	-52.1	-250	45.0	25.0	62.000	-37.0	-177.5
90	18.1	9.1	62.00	-52.9	-286	41.1	22.9	62.000	-39.1	-211.4
100	16.7	8.4	62.00	-53.6	-322	37.9	21.1	62.000	-40.9	-245.6
110	15.6	7.8	62.00	-54.2	-358	35.2	19.6	62.000	-42.4	-280.0
120	14.6	7.3	62.00	-54.7	-394	32.9	18.3	62.000	-43.7	-314.7
130	13.7	6.9	62.00	-55.1	-430	30.9	17.2	62.000	-44.8	-349.6
140	12.9	6.5	62.00	-55.5	-466	29.2	16.2	62.000	-45.8	-384.6
150	12.3	6.1	62.00	-55.9	-503	27.6	15.4	62.000	-46.6	-419.8
160	11.7	5.8	62.00	-56.2	-539	26.2	14.6	62.000	-47.4	-455.1
170	11.1	5.6	62.00	-56.4	-576	25.0	13.9	62.000	-48.1	-490.6
180	10.6	5.3	62.00	-56.7	-612	23.9	13.3	62.000	-48.7	-526.1
190	10.2	5.1	62.00	-56.9	-649	22.9	12.7	62.000	-49.3	-561.7
200	9.8	4.9	62.00	-57.1	-685	22.0	12.2	62.000	-49.8	-597.3
210	9.4	4.7	62.00	-57.3	-722	21.1	11.8	62.000	-50.2	-633.1
Maximum Storage Requried =					**0.0**					**22.4**

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: A307
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 10 (mins)
Drainage Area = 0.9200 (hectares)

Duration, T_D (min)	Release Rate = 37.6 (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 = 37.6 (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	384.9	37.60	347.3	0	398.6	1019.5	37.600	981.9	0.0
10	76.8	176.8	37.60	139.2	84	178.6	456.7	37.600	419.1	251.4
20	52.0	119.8	37.60	82.2	**99**	120.0	306.8	37.600	269.2	323.0
30	40.0	92.2	37.60	54.6	98	91.9	235.0	37.600	197.4	355.3
40	32.9	75.6	37.60	38.0	91	75.1	192.2	37.600	154.6	371.0
50	28.0	64.5	37.60	26.9	81	64.0	163.6	37.600	126.0	377.9
60	24.6	56.5	37.60	18.9	68	55.9	143.0	37.600	105.4	**379.3**
70	21.9	50.4	37.60	12.8	54	49.8	127.3	37.600	89.7	376.9
80	19.8	45.6	37.60	8.0	39	45.0	115.1	37.600	77.5	371.9
90	18.1	41.8	37.60	4.2	22	41.1	105.1	37.600	67.5	364.7
100	16.7	38.5	37.60	0.9	6	37.9	96.9	37.600	59.3	356.0
110	15.6	35.8	37.60	-1.8	-12	35.2	90.0	37.600	52.4	346.1
120	14.6	33.5	37.60	-4.1	-29	32.9	84.1	37.600	46.5	335.0
130	13.7	31.5	37.60	-6.1	-47	30.9	79.0	37.600	41.4	323.1
140	12.9	29.8	37.60	-7.8	-66	29.2	74.6	37.600	37.0	310.5
150	12.3	28.2	37.60	-9.4	-85	27.6	70.6	37.600	33.0	297.2
160	11.7	26.8	37.60	-10.8	-103	26.2	67.1	37.600	29.5	283.3
170	11.1	25.6	37.60	-12.0	-123	25.0	64.0	37.600	26.4	268.9
180	10.6	24.5	37.60	-13.1	-142	23.9	61.1	37.600	23.5	254.2
190	10.2	23.4	37.60	-14.2	-161	22.9	58.6	37.600	21.0	239.0
200	9.8	22.5	37.60	-15.1	-181	22.0	56.2	37.600	18.6	223.5
210	9.4	21.7	37.60	-15.9	-201	21.1	54.1	37.600	16.5	207.6
Maximum Storage Requried =					**98.6**					**379.3**

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 A6

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

Area No: A308-310
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 10 (mins)
Drainage Area = 0.2200 (hectares)

Duration, T_D (min)	Release Rate = 10.0 (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 = 10.0 (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	92.0	10.00	82.0	0	398.6	243.8	10.000	233.8	0.0
10	76.8	42.3	10.00	32.3	19	178.6	109.2	10.000	99.2	59.5
20	52.0	28.6	10.00	18.6	**22**	120.0	73.4	10.000	63.4	76.0
30	40.0	22.0	10.00	12.0	22	91.9	56.2	10.000	46.2	83.1
40	32.9	18.1	10.00	8.1	19	75.1	46.0	10.000	36.0	86.3
50	28.0	15.4	10.00	5.4	16	64.0	39.1	10.000	29.1	**87.3**
60	24.6	13.5	10.00	3.5	13	55.9	34.2	10.000	24.2	87.1
70	21.9	12.1	10.00	2.1	9	49.8	30.5	10.000	20.5	85.9
80	19.8	10.9	10.00	0.9	4	45.0	27.5	10.000	17.5	84.1
90	18.1	10.0	10.00	0.0	0	41.1	25.1	10.000	15.1	81.8
100	16.7	9.2	10.00	-0.8	-5	37.9	23.2	10.000	13.2	79.1
110	15.6	8.6	10.00	-1.4	-9	35.2	21.5	10.000	11.5	76.1
120	14.6	8.0	10.00	-2.0	-14	32.9	20.1	10.000	10.1	72.9
130	13.7	7.5	10.00	-2.5	-19	30.9	18.9	10.000	8.9	69.4
140	12.9	7.1	10.00	-2.9	-24	29.2	17.8	10.000	7.8	65.8
150	12.3	6.7	10.00	-3.3	-29	27.6	16.9	10.000	6.9	62.0
160	11.7	6.4	10.00	-3.6	-34	26.2	16.0	10.000	6.0	58.1
170	11.1	6.1	10.00	-3.9	-40	25.0	15.3	10.000	5.3	54.0
180	10.6	5.8	10.00	-4.2	-45	23.9	14.6	10.000	4.6	49.9
190	10.2	5.6	10.00	-4.4	-50	22.9	14.0	10.000	4.0	45.6
200	9.8	5.4	10.00	-4.6	-55	22.0	13.4	10.000	3.4	41.3
210	9.4	5.2	10.00	-4.8	-61	21.1	12.9	10.000	2.9	36.9
Maximum Storage Requried =					**22.4**					**87.3**

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 A7

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

Area No: A601

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

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

Time Interval = 10 (mins)

Drainage Area = 0.5500 (hectares)

Duration, T_D (min)	Release Rate = 22.1 (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 = 22.1 (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	230.1	22.10	208.0	0	398.6	609.5	22.100	587.4	0.0
10	76.8	105.7	22.10	83.6	50	178.6	273.0	22.100	250.9	150.6
20	52.0	71.6	22.10	49.5	59	120.0	183.4	22.100	161.3	193.6
30	40.0	55.1	22.10	33.0	**59**	91.9	140.5	22.100	118.4	213.1
40	32.9	45.2	22.10	23.1	55	75.1	114.9	22.100	92.8	222.7
50	28.0	38.6	22.10	16.5	49	64.0	97.8	22.100	75.7	227.1
60	24.6	33.8	22.10	11.7	42	55.9	85.5	22.100	63.4	**228.1**
70	21.9	30.2	22.10	8.1	34	49.8	76.1	22.100	54.0	226.9
80	19.8	27.3	22.10	5.2	25	45.0	68.8	22.100	46.7	224.1
90	18.1	25.0	22.10	2.9	15	41.1	62.9	22.100	40.8	220.1
100	16.7	23.0	22.10	0.9	6	37.9	58.0	22.100	35.9	215.1
110	15.6	21.4	22.10	-0.7	-4	35.2	53.8	22.100	31.7	209.4
120	14.6	20.0	22.10	-2.1	-15	32.9	50.3	22.100	28.2	203.0
130	13.7	18.8	22.10	-3.3	-25	30.9	47.2	22.100	25.1	196.1
140	12.9	17.8	22.10	-4.3	-36	29.2	44.6	22.100	22.5	188.8
150	12.3	16.9	22.10	-5.2	-47	27.6	42.2	22.100	20.1	181.1
160	11.7	16.0	22.10	-6.1	-58	26.2	40.1	22.100	18.0	173.0
170	11.1	15.3	22.10	-6.8	-69	25.0	38.2	22.100	16.1	164.6
180	10.6	14.6	22.10	-7.5	-81	23.9	36.5	22.100	14.4	156.0
190	10.2	14.0	22.10	-8.1	-92	22.9	35.0	22.100	12.9	147.2
200	9.8	13.5	22.10	-8.6	-104	22.0	33.6	22.100	11.5	138.1
210	9.4	13.0	22.10	-9.1	-115	21.1	32.3	22.100	10.2	128.9
Maximum Storage Requried =					**59.4**					**228.1**

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: A602-604
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 10 (mins)
Drainage Area = 0.3800 (hectares)

Duration, T_D (min)	Release Rate = 40.0 (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 = 40.0 (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	159.0	40.00	119.0	0	398.6	421.1	40.000	381.1	0.0
10	76.8	73.0	40.00	33.0	**20**	178.6	188.6	40.000	148.6	89.2
20	52.0	49.5	40.00	9.5	11	120.0	126.7	40.000	86.7	**104.1**
30	40.0	38.1	40.00	-1.9	-3	91.9	97.0	40.000	57.0	102.7
40	32.9	31.2	40.00	-8.8	-21	75.1	79.4	40.000	39.4	94.5
50	28.0	26.7	40.00	-13.3	-40	64.0	67.6	40.000	27.6	82.7
60	24.6	23.3	40.00	-16.7	-60	55.9	59.0	40.000	19.0	68.6
70	21.9	20.8	40.00	-19.2	-80	49.8	52.6	40.000	12.6	52.9
80	19.8	18.9	40.00	-21.1	-102	45.0	47.5	40.000	7.5	36.1
90	18.1	17.2	40.00	-22.8	-123	41.1	43.4	40.000	3.4	18.5
100	16.7	15.9	40.00	-24.1	-144	37.9	40.0	40.000	0.0	0.2
110	15.6	14.8	40.00	-25.2	-166	35.2	37.2	40.000	-2.8	-18.6
120	14.6	13.8	40.00	-26.2	-188	32.9	34.8	40.000	-5.2	-37.8
130	13.7	13.0	40.00	-27.0	-210	30.9	32.6	40.000	-7.4	-57.4
140	12.9	12.3	40.00	-27.7	-233	29.2	30.8	40.000	-9.2	-77.3
150	12.3	11.6	40.00	-28.4	-255	27.6	29.2	40.000	-10.8	-97.5
160	11.7	11.1	40.00	-28.9	-278	26.2	27.7	40.000	-12.3	-117.9
170	11.1	10.6	40.00	-29.4	-300	25.0	26.4	40.000	-13.6	-138.5
180	10.6	10.1	40.00	-29.9	-323	23.9	25.3	40.000	-14.7	-159.3
190	10.2	9.7	40.00	-30.3	-346	22.9	24.2	40.000	-15.8	-180.2
200	9.8	9.3	40.00	-30.7	-368	22.0	23.2	40.000	-16.8	-201.3
210	9.4	9.0	40.00	-31.0	-391	21.1	22.3	40.000	-17.7	-222.6
Maximum Storage Requried =					**19.8**					**104.1**

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: A605

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

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

Time Interval = 10 (mins)

Drainage Area = 0.5800 (hectares)

Duration, T_D (min)	Release Rate = 150.0 (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 = 150.0 (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	242.7	150.00	92.7	**0**	398.6	642.7	150.000	492.7	0.0
10	76.8	111.5	150.00	-38.5	-23	178.6	287.9	150.000	137.9	**82.7**
20	52.0	75.5	150.00	-74.5	-89	120.0	193.4	150.000	43.4	52.1
30	40.0	58.1	150.00	-91.9	-165	91.9	148.1	150.000	-1.9	-3.4
40	32.9	47.7	150.00	-102.3	-246	75.1	121.2	150.000	-28.8	-69.2
50	28.0	40.7	150.00	-109.3	-328	64.0	103.1	150.000	-46.9	-140.6
60	24.6	35.6	150.00	-114.4	-412	55.9	90.1	150.000	-59.9	-215.6
70	21.9	31.8	150.00	-118.2	-496	49.8	80.3	150.000	-69.7	-292.8
80	19.8	28.8	150.00	-121.2	-582	45.0	72.5	150.000	-77.5	-371.8
90	18.1	26.3	150.00	-123.7	-668	41.1	66.3	150.000	-83.7	-452.0
100	16.7	24.3	150.00	-125.7	-754	37.9	61.1	150.000	-88.9	-533.3
110	15.6	22.6	150.00	-127.4	-841	35.2	56.8	150.000	-93.2	-615.4
120	14.6	21.1	150.00	-128.9	-928	32.9	53.0	150.000	-97.0	-698.1
130	13.7	19.9	150.00	-130.1	-1015	30.9	49.8	150.000	-100.2	-781.4
140	12.9	18.8	150.00	-131.2	-1102	29.2	47.0	150.000	-103.0	-865.2
150	12.3	17.8	150.00	-132.2	-1190	27.6	44.5	150.000	-105.5	-949.3
160	11.7	16.9	150.00	-133.1	-1278	26.2	42.3	150.000	-107.7	-1033.8
170	11.1	16.1	150.00	-133.9	-1366	25.0	40.3	150.000	-109.7	-1118.7
180	10.6	15.4	150.00	-134.6	-1453	23.9	38.5	150.000	-111.5	-1203.8
190	10.2	14.8	150.00	-135.2	-1541	22.9	36.9	150.000	-113.1	-1289.1
200	9.8	14.2	150.00	-135.8	-1630	22.0	35.4	150.000	-114.6	-1374.7
210	9.4	13.7	150.00	-136.3	-1718	21.1	34.1	150.000	-115.9	-1460.4
Maximum Storage Requried =					**0.0**					**82.7**

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 A10

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

Area No: A550

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

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

Time Interval = 10 (mins)

Drainage Area = 0.0700 (hectares)

Duration, T_D (min)	Release Rate = 3.0 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951 ($I = A/(T_D+C)^B$			, B = 0.810 , C = 6.199		Release Rate = 3.0 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688 ($I = A/(T_D+C)^B$			, C =	0.820 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	29.3	3.00	26.3	0	398.6	77.6	3.000	74.6	0.0
10	76.8	13.5	3.00	10.5	6	178.6	34.7	3.000	31.7	19.0
20	52.0	9.1	3.00	6.1	**7**	120.0	23.3	3.000	20.3	24.4
30	40.0	7.0	3.00	4.0	7	91.9	17.9	3.000	14.9	26.8
40	32.9	5.8	3.00	2.8	7	75.1	14.6	3.000	11.6	27.9
50	28.0	4.9	3.00	1.9	6	64.0	12.4	3.000	9.4	28.3
60	24.6	4.3	3.00	1.3	5	55.9	10.9	3.000	7.9	**28.4**
70	21.9	3.8	3.00	0.8	4	49.8	9.7	3.000	6.7	28.1
80	19.8	3.5	3.00	0.5	2	45.0	8.8	3.000	5.8	27.6
90	18.1	3.2	3.00	0.2	1	41.1	8.0	3.000	5.0	27.0
100	16.7	2.9	3.00	-0.1	0	37.9	7.4	3.000	4.4	26.3
110	15.6	2.7	3.00	-0.3	-2	35.2	6.9	3.000	3.9	25.4
120	14.6	2.6	3.00	-0.4	-3	32.9	6.4	3.000	3.4	24.5
130	13.7	2.4	3.00	-0.6	-5	30.9	6.0	3.000	3.0	23.5
140	12.9	2.3	3.00	-0.7	-6	29.2	5.7	3.000	2.7	22.5
150	12.3	2.1	3.00	-0.9	-8	27.6	5.4	3.000	2.4	21.4
160	11.7	2.0	3.00	-1.0	-9	26.2	5.1	3.000	2.1	20.2
170	11.1	1.9	3.00	-1.1	-11	25.0	4.9	3.000	1.9	19.0
180	10.6	1.9	3.00	-1.1	-12	23.9	4.7	3.000	1.7	17.8
190	10.2	1.8	3.00	-1.2	-14	22.9	4.5	3.000	1.5	16.6
200	9.8	1.7	3.00	-1.3	-15	22.0	4.3	3.000	1.3	15.3
210	9.4	1.6	3.00	-1.4	-17	21.1	4.1	3.000	1.1	14.0
Maximum Storage Requried =					**7.3**					**28.4**

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 A11
Orifice Sizing

Event	Flow (L/s)	Head (m)	ORIFICE AREA(m^2)	SQUARE (1-side mm)	CIRC (mmØ)
100 Year	149.5	2.40	0.036	191	215

Orifice Control Sizing
Q = 0.6 x A x (2gh)1/2
Where:
Q is the release rate in m^3/s
A is the orifice area in m^2
g is the acceleration due to gravity, $9.81 m/s^2$
h is the head of water above the orifice centre in m
d is the diameter of the orifice in m

Orifice Invert =	72.45	m
Ponding Elevation =	74.95	m
Top of CB Elevation =	74.65	m

Note: Orifice is located on the downstream invert of CBMH418

Table A12
Stormwater Management Summary
Building 100

Area ID	Area (ha)	Runoff Coefficient 'C'	100 Year Release (L/s)	100 Year storage required (m^3)	100 Year surface storage provided (m^3)
A100	0.220	0.90	9.00	90.67	110.00
A101	0.015	0.90	7.45	0.00	0.00
TOTAL	**0.24**				
		Totals:	**16.4**	**90.7**	**110.0**
Total Allowable Release L/s:			**30.5**		

Table A13
SUMMARY OF POST DEVELOPMENT RUNOFF (UNCONTROLLED AND CONTROLLED)

Area No	Outlet Location	Area (ha)	Time of Conc. T_c (min)		Storm = 100-year			
				C_{AVG}	$C_{AVG\text{-}100Yr}$	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)
A100	BLDG 100	0.200	10	0.90	1.00	178.56	99.3	**9.0**
A101	CB 101	0.015	10	0.90	1.00	178.56	7.4	**7.4**
Total		0.215					106.7	**16.4**

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

Area No: A100
C_{AVG} = 0.90 (2-yr, 5-yr)
C_{AVG} = 1.00 (100-yr +25%)
Time Interval = 10 (mins)
Drainage Area = 0.2200 (hectares)

Duration, T_D (min)	Release Rate = 9.0 (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 = 9.0 (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	92.0	9.00	83.0	0	398.6	243.8	9.000	234.8	0.0
10	76.8	42.3	9.00	33.3	20	178.6	109.2	9.000	100.2	60.1
20	52.0	28.6	9.00	19.6	**24**	120.0	73.4	9.000	64.4	77.2
30	40.0	22.0	9.00	13.0	23	91.9	56.2	9.000	47.2	84.9
40	32.9	18.1	9.00	9.1	22	75.1	46.0	9.000	37.0	88.7
50	28.0	15.4	9.00	6.4	19	64.0	39.1	9.000	30.1	90.3
60	24.6	13.5	9.00	4.5	16	55.9	34.2	9.000	25.2	**90.7**
70	21.9	12.1	9.00	3.1	13	49.8	30.5	9.000	21.5	90.1
80	19.8	10.9	9.00	1.9	9	45.0	27.5	9.000	18.5	88.9
90	18.1	10.0	9.00	1.0	5	41.1	25.1	9.000	16.1	87.2
100	16.7	9.2	9.00	0.2	1	37.9	23.2	9.000	14.2	85.1
110	15.6	8.6	9.00	-0.4	-3	35.2	21.5	9.000	12.5	82.7
120	14.6	8.0	9.00	-1.0	-7	32.9	20.1	9.000	11.1	80.1
130	13.7	7.5	9.00	-1.5	-11	30.9	18.9	9.000	9.9	77.2
140	12.9	7.1	9.00	-1.9	-16	29.2	17.8	9.000	8.8	74.2
150	12.3	6.7	9.00	-2.3	-20	27.6	16.9	9.000	7.9	71.0
160	11.7	6.4	9.00	-2.6	-25	26.2	16.0	9.000	7.0	67.7
170	11.1	6.1	9.00	-2.9	-29	25.0	15.3	9.000	6.3	64.2
180	10.6	5.8	9.00	-3.2	-34	23.9	14.6	9.000	5.6	60.7
190	10.2	5.6	9.00	-3.4	-39	22.9	14.0	9.000	5.0	57.0
200	9.8	5.4	9.00	-3.6	-43	22.0	13.4	9.000	4.4	53.3
210	9.4	5.2	9.00	-3.8	-48	21.1	12.9	9.000	3.9	49.5
Maximum Storage Requried =					**23.6**					**90.7**

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.

Appendix B – Water

From: Sharif, Sharif <sharif.sharif@ottawa.ca>
Sent: Friday, November 30, 2018 2:03 PM
To: Aly Elgayar
Subject: RE: 3020 Hawthorne Road – Boundary Conditions Request
Attachments: 3020 Hawthorne Nov 2018.pdf

Hi Aly,

Here are the boundary condition for the proposed development. If you have any question, let me know. Thanks.

Sharif

The following are boundary conditions, HGL, for hydraulic analysis at 3020 Hawthorne (zone 2C) assumed to be connected to the 406mm on Russell (see attached PDF for location).

Minimum HGL = 124.0m

Maximum HGL = 130.8m

MaxDay + FireFlow (67 L/s) = 126.0m

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.

From: Aly Elgayar <Aly.ElGayar@exp.com>
Sent: Wednesday, November 28, 2018 11:39 AM
To: Sharif, Sharif <sharif.sharif@ottawa.ca>
Cc: Marc Alain Lafleur <MarcAlain.Lafleur@exp.com>; Alam Ansari <alam.ansari@exp.com>
Subject: RE: 3020 Hawthorne Road – Boundary Conditions Request

Hi Sharif,

Please find the requested information in the attached files and the following:

i. Proposed light industrial Buildings 100 and 550 at 3020 Hawthorne Road.
ii. Location of services and hydrants are highlighted on the attached aerial figure.
iii. Fire hydrants servicing the buildings are on-site. Distance between FH-1 to Building 100 is 31.5m and FH-2 to Building 550 is 22.7m. Spacing meets the City guideline requirements.

iv. Water demands & Fire flows required are as follows:

Building 100

- Fire Flow Required: 67 L/sec (FF calculation sheet attached)
- Average Daily Demand: 0.089 L/sec
- Maximum Daily Demand: 0.13 L/sec
- Maximum Hourly Demand: 0.23 L/sec

Building 550

- Fire Flow Required: 50 L/sec (FF calculation sheet attached)
- Average Daily Demand: 0.028 L/sec
- Maximum Daily Demand: 0.042 L/sec
- Maximum Hourly Demand: 0.076 L/sec

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: Wednesday, November 28, 2018 9:47 AM
To: Aly Elgayar <Aly.ElGayar@exp.com>
Cc: Marc Alain Lafleur <MarcAlain.Lafleur@exp.com>; Alam Ansari <alam.ansari@exp.com>
Subject: RE: 3020 Hawthorne Road – Boundary Conditions Request

Good Morning Aly,

Please send the FUS calculation sheet and a figure showing the connection. Here are the steps we need to request the boundary condition:

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

   i. Location of service

   ii. Type of development and the amount of fire flow required (as per FUS, 1999).

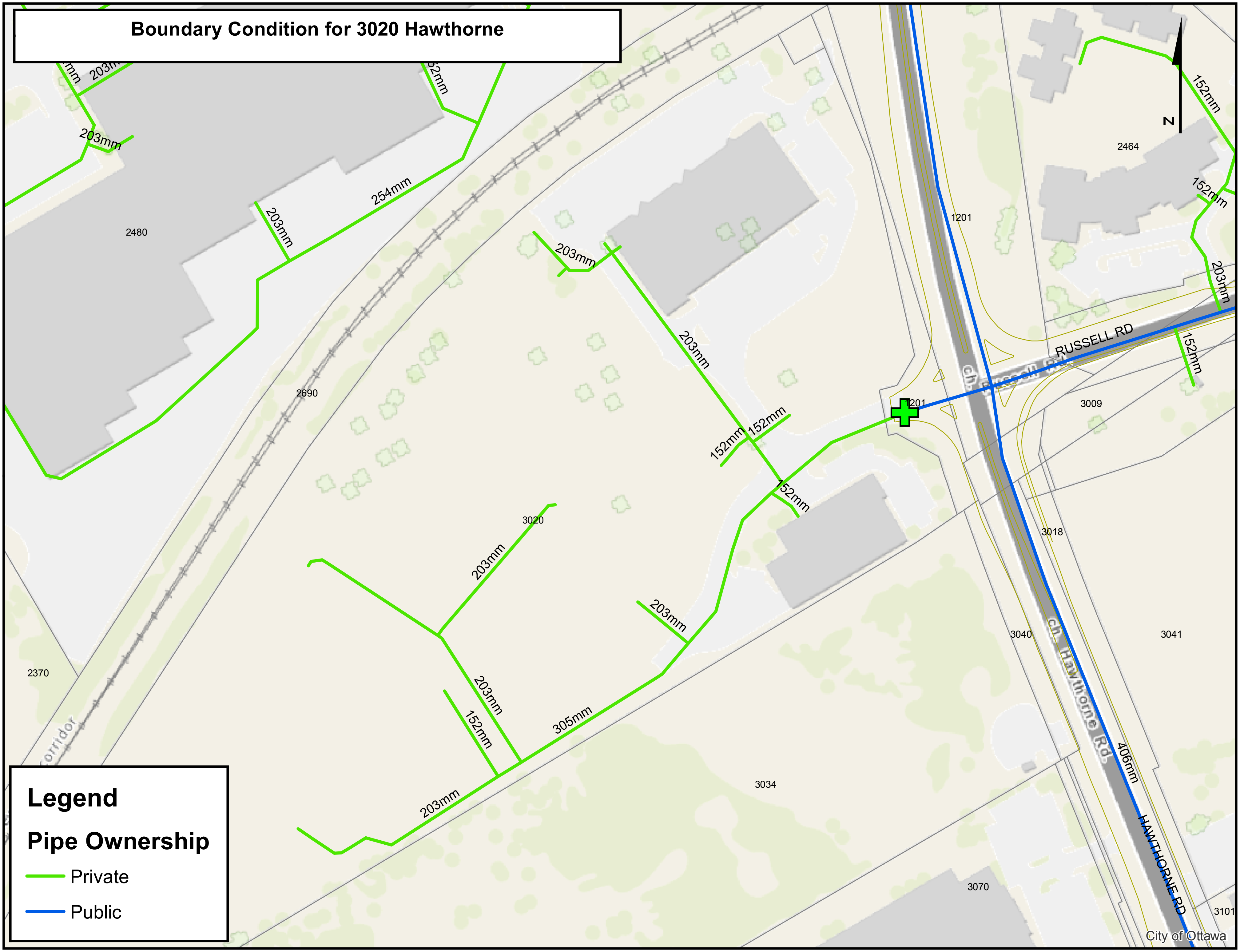
   iii. Average daily demand: ___ l/s.

   iv. Maximum daily demand: ___l/s.

   v. Maximum hourly daily demand: ___ l/s.

   vi. Hydrant location and spacing to meet City's Water Design guidelines.

Boundary Condition for 3020 Hawthorne



3020 Hawthorne Road — Building 100
Client: Controlex Corportion
Project: OTT-00250557-A0
Prepared By: A. Elgayar
Date: December 2018

Max day(0.13L/s) + FireFlow(67L/s) HGL= 126.0 m
Max HGL= 130.8 m
Peak Hour= 124.0 m

Table 3 - Building 100 Pressure Analysis

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 hf (m)	Equivalent Pipe Length of Fittings (m)	Minor Loss of Fittings hb (m)	Total Losses (m) hb + hf	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	406 to 203 reducer	67.1	406	0.406	0.06713	0.129461782	120	0.5185	0.0008	124.27	0.101317717	24.8	0.02019	0.12151	77.68	75.60	2.08	473.9	(68.7)	493.1	(71.5)	-2.8
	406 to 203 reducer	203 to 150 reducer	67.1	203	0.203	0.06713	0.032365446	110	2.0741	0.0280	22.88	0.640878367	13.0	0.36391	1.00479	75.60	76.00	-0.40	493.1	(71.5)	479.3	(69.5)	2.0
	203 to 150 reducer	Building	67.1	150	0.150	0.06713	0.017671444	100	3.7988	0.1459	16.86	2.459108483	5.3	0.76982	3.22893	76.00	76.95	-0.95	479.3	(69.5)	438.3	(63.6)	5.9

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 406mm WM

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)
Standard 90⁰ Elbow	32	12.99	1	12.992
11.25 Degree Elbow	8	3.25	2	6.496
45 Degree Elbow	16	6.50	0	0
Gate Valve Full -Open	13	5.28	1	5.278
		Total:	**4**	**24.766**

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 90⁰ Elbow	32	12.99	1	12.992
11.25 Degree Elbow	8	3.25	0	0
45 Degree Elbow	16	6.50	0	0
Gate Valve Full -Open	13	5.28	0	0
		Total:	**1**	**12.992**

Resistance of Fittings and Valves for 150mm WM

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)
Standard 90⁰ Elbow	32	12.99	0	0
11.25 Degree Elbow	8	3.25	0	0
45 Degree Elbow	16	6.50	0	0
Gate Valve Full -Op	13	5.28	1	5.278
		Total:	**1**	**5.278**

3020 Hawthorne Road — Building 550
Client: Controlex Corportion
Project: OTT-00250557-A0
Prepared By: A. Elgayar
Date: December 2018

Max day(0.042L/s) + FireFlow(67L/s) HGL= 126.0 m
Max HGL= 130.8 m
Peak Hour= 124.0 m

Table 3 - Building 550 Pressure Analysis

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 hf (m)	Equivalent Pipe Length of Fittings (m)	Minor Loss of Fittings hb (m)	Total Losses (m) hb + hf	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	406 to 305 reducer	67.0	406	0.406	0.067042	0.129461782	120	0.5179	0.0008	239.13	0.194490371	39.8	0.03236	0.22685	77.68	74.80	2.88	473.9	(68.7)	499.9	(72.5)	-3.8
	406 to 305 reducer	305 to 203 reducer	67.0	305	0.305	0.067042	0.073061602	120	0.9176	0.0033	60.91	0.199496006	13.0	0.04255	0.24205	74.80	75.02	-0.22	499.9	(72.5)	495.4	(71.8)	0.7
	305 to 203 reducer	203 to 150 reducer	67.0	203	0.203	0.067042	0.032365446	110	2.0714	0.0279	40.51	1.131948785	18.3	0.51051	1.64246	75.02	75.65	-0.63	495.4	(71.8)	473.1	(68.6)	3.2
	203 to 150 reducer	Building	67.0	150	0.150	0.067042	0.017671444	100	3.7938	0.1455	5.5	0.800253809	24.8	3.60347	4.40372	75.65	75.95	-0.30	473.1	(68.6)	426.9	(61.9)	6.7

V=Q/A

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

hf = Slope of HGL * Pipe Length

Resistance of Fittings and Valves for 406mm WM

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)
Standard 90⁰ Elbow	32	12.99	0	0
11.25 Degree Elbow	8	3.25	9	29.232
45 Degree Elbow	16	6.50	0	0
Gate Valve Full -Open	13	5.28	2	10.556
		Total:	**11**	**39.788**

Resistance of Fittings and Valves for 305mm WM

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)
Standard 90⁰ Elbow	32	12.99	1	12.992
11.25 Degree Elbow	8	3.25	0	0
45 Degree Elbow	16	6.50	0	0
Gate Valve Full -Open	13	5.28	0	0
		Total:	**1**	**12.992**

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 90⁰ Elbow	32	12.99	1	12.992
11.25 Degree Elbow	8	3.25	0	0
45 Degree Elbow	16	6.50	0	0
Gate Valve Full -Oper	13	5.28	1	5.278
		Total:	**2**	**18.27**

Resistance of Fittings and Valves for 150mm WM

Fittings	Loss in Equiv. Length in Pipe Diameters	Equiv. Length (metres)	Quantity (each)	Total Equiv. Length (m)
Standard 90⁰ Elbow	32	12.99	1	12.992
11.25 Degree Elbow	8	3.25	2	6.496
45 Degree Elbow	16	6.50	0	0
Gate Valve Full -Opei	13	5.28	1	5.278
		Total:	**4**	**24.766**

TABLE 1: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: 3020 Hawthorne Road
Building No: **Building 100**

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)	3rd Floor		0	2195.0 m²	
	2nd Floor		0		
	1st Floor		2195		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				8,246
Fire Flow (F)	Rounded to nearest 1,000				**8,000**

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier			Input						Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%			Limited Combustible						-15%	-1,200	6,800
	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%	-2,040	4,760
	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%	-680	4,080
	Not Standard Water Supply or Unavailable	0%											
	Fully Supervised Sprinkler System	-10%			Fully Supervised Sprinkler System						-10%	-680	3,400
	Not Fully Supervised or N/A	0%											
Choose Structure Exposure Distance						Exposed Wall Length							
	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposed Wall type	Length (m)	No of Storeys	Lenth-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
	North	35.3	5	30.1 to 45	Type B	66.5	1	66.5	5C	5%	15%	1,020	4,420
	East	100	6	> 45.1	Type B	0	0	0	6	0%			
	West	43.3	5	30.1 to 45	Type B	34.8	1	34.8	5B	5%			
	South	41.1	5	30.1 to 45	Type B	12	1	12	5A	5%			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =												**4,000**
	Total Required Fire Flow, L/s =												**67**

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 2: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: 3020 Hawthorne Road
Building No: **Building 550**

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)	3rd Floor		0	687.0 m²	
	2nd Floor		0		
	1st Floor		687		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				4,613
Fire Flow (F)	Rounded to nearest 1,000				5,000

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-750	4,250
	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%	-1,275	2,975
	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%	-425	2,550
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Fully Supervised Sprinkler System	-10%	-425	2,125
	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)	Fire Flow Total (L/min)
Choose Structure Exposure Distance	North	21.5	4	20.1 to 30	Type B	33.6	1	33.6	4B	7%	17%	723	2,848
	East	17.9	3	10.1 to 20	Type B	23.8	1	23.8	3A	10%			
	West	100	6	> 45.1	Type B	0	0	0	6	0%			
	South	100	6	> 45.1	Type B	0	0	0	6	0%			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =												3,000
	Total Required Fire Flow, L/s =												50

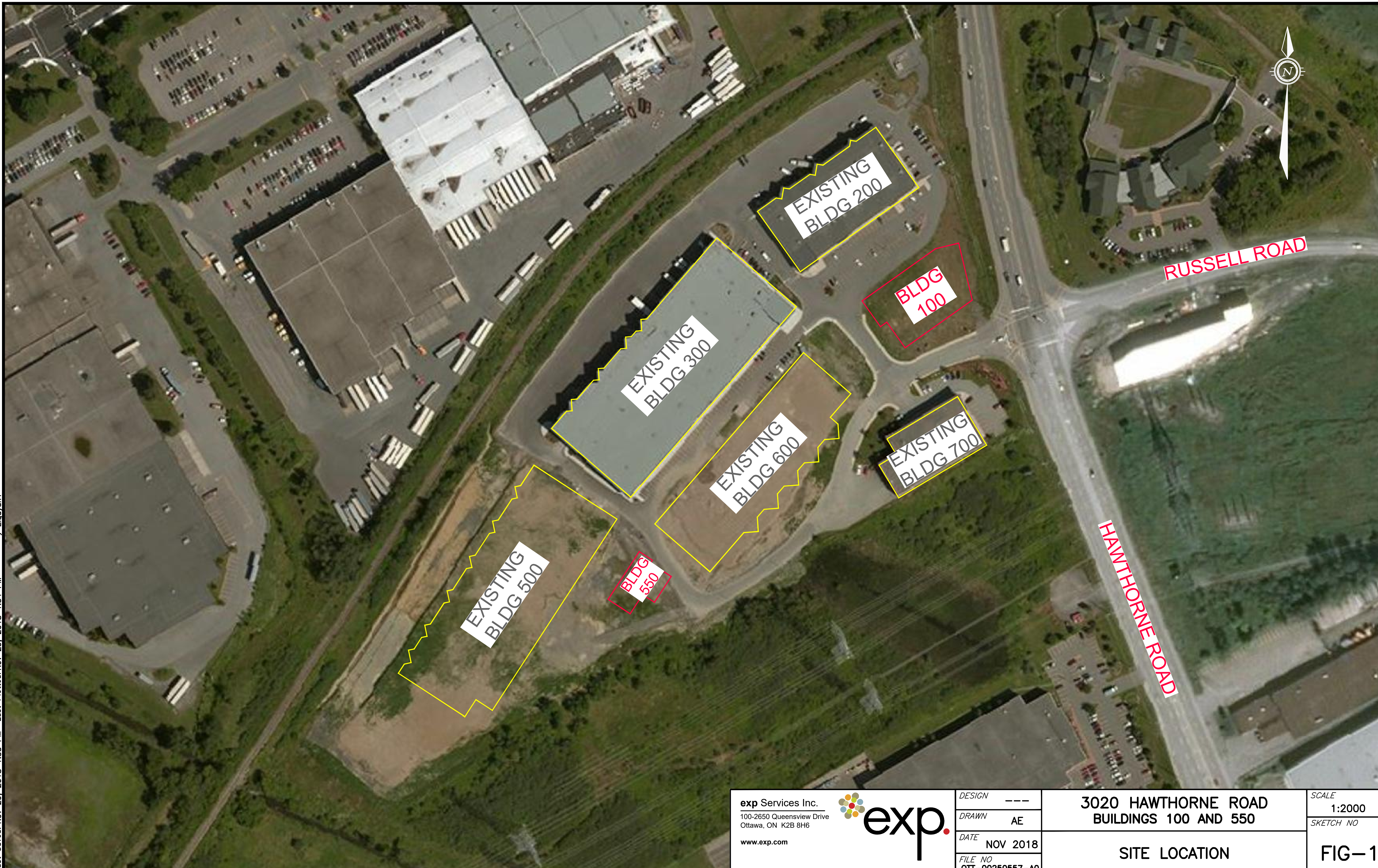
Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

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

Appendix C – Drawings and Figures



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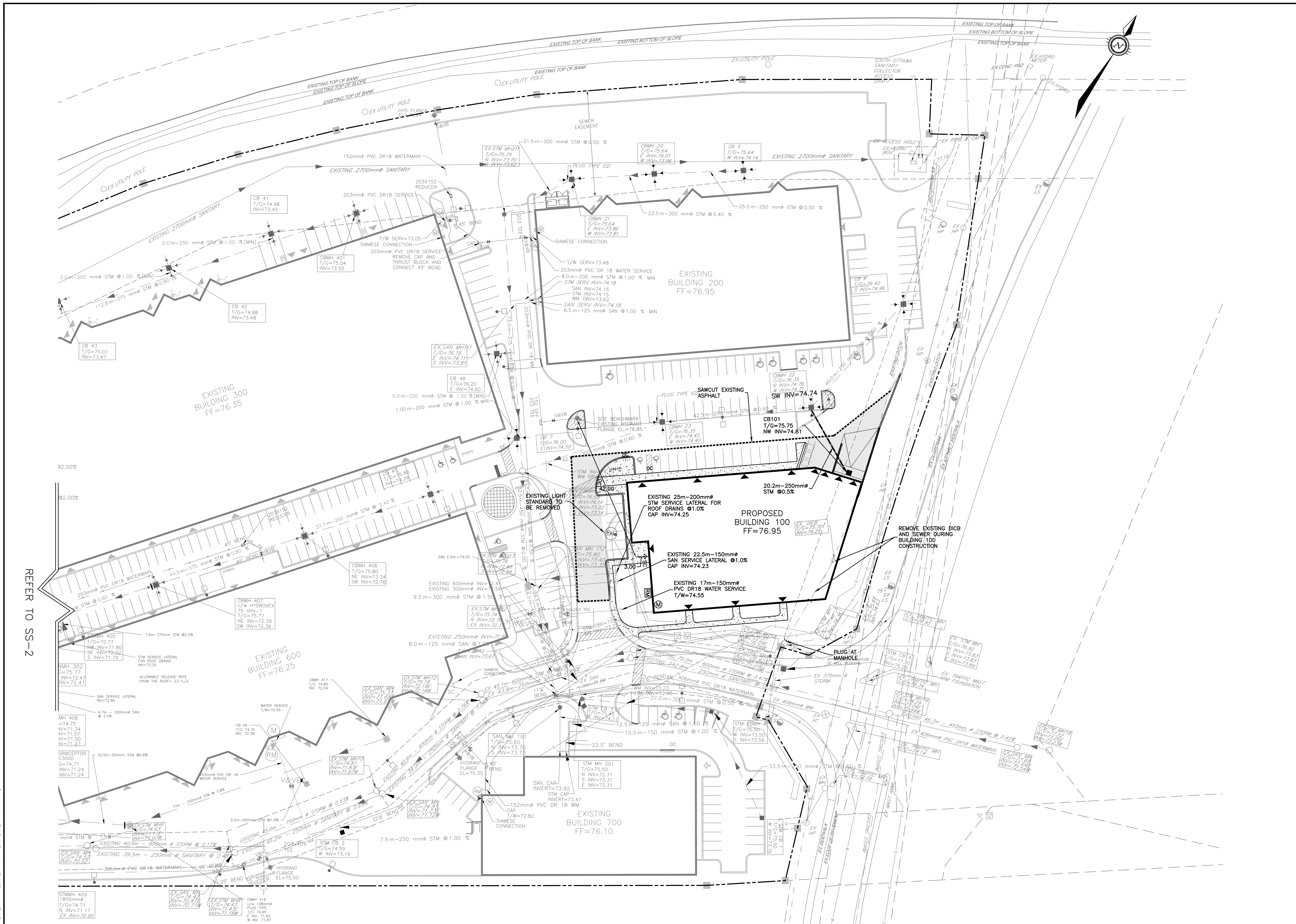
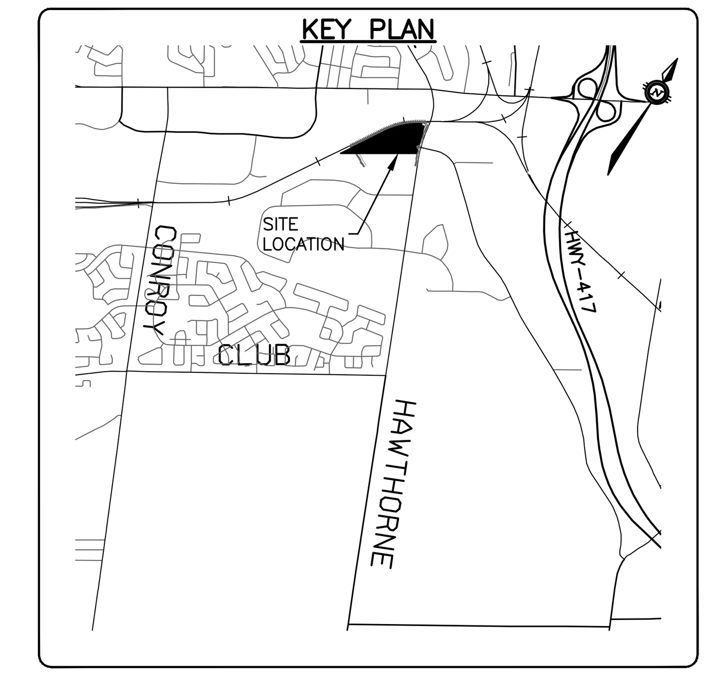
DESIGN ---	3020 HAWTHORNE ROAD BUILDINGS 100 AND 550	SCALE 1:2000
DRAWN AE		SKETCH NO
DATE NOV 2018	SITE LOCATION	FIG-1
FILE NO OTT-00250557-A0		

Filename: P:\Projects\Civil\250000\OTT-00250557-A0 - Bldgs 100 & 550, 3020 Hawthorne - Controlex\60-EXECUTION\64-DWG\Sketches & Figures\250557 - Site Location - FIG-1.dwg
Last Saved: Nov 29, 2018 1:53 PM Last Plotted: Nov 29, 2018 1:54 PM Plotted by: ElgayarA





LEGEND

- EXISTING TRANSFORMER PAD
- EXISTING REMOTE WATER METER
- EXISTING WATER METER
- EXISTING LIGHT STANDARD
- EXISTING FIRE HYDRANT
- EXISTING HYDRO POLE
- EXISTING CATCHBASIN
- EXISTING VALVE & VALVE BOX
- EXISTING SANITARY MANHOLE
- EXISTING STORM MANHOLE
- EXISTING WATERMAIN
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING UNDERGROUND HYDRO
- EXISTING OVERHEAD HYDRO
- EXISTING GAS
- EXISTING UNDERGROUND BELL
- PROPERTY LINE
- PROPOSED SANITARY SEWER
- PROPOSED STORM SEWER
- PROPOSED WATERMAIN
- PROPOSED REMOTE WATER METER
- PROPOSED WATER METER
- PROPOSED VALVE & VALVE BOX
- PROPOSED SIAMESE CONNECTION
- PROPOSED CATCHBASIN
- PROPOSED THRUSTBLOCK
- PROPOSED RETAINING WALL
- PROPOSED 50mm HI-40 RIGID INSULATION
- PROPOSED HEAVY DUTY ASPHALT
- PROPOSED LIGHT DUTY ASPHALT
- PROPOSED CONCRETE

CAUTION

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE	BY	APPD
1	SUBMITTED FOR SITE APPLICATION	17/12/18	AE	AA

SCALE: HORIZONTAL 1:500

REVIEWED BY: LICENSED PROFESSIONAL ENGINEER — M.A. ANSARI — 14/12/2018 — PROVINCE OF ONTARIO

CLIENT: CONTROLEX CORPORATION
100–223 COLONNADE ROAD SOUTH
OTTAWA, ON. K2E 7K3
613.723.7490

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BASEPLAN: SAB
DESIGN: AA/AE
CHECKED: AA
CAD: AE
PROJECT MANAGER: AA
APPROVED: AA

PROJECT: 3020 HAWTHORNE ROAD
BUILDING 100 AND 550
OTTAWA, ONTARIO.

TITLE: BUILDING 100 SITE SERVICING PLAN

PROJECT No.: OTT-250557-A0
SURVEY: ---
DATE: DECEMBER 2018
DRAWING No.: SS-1

WATERMAIN

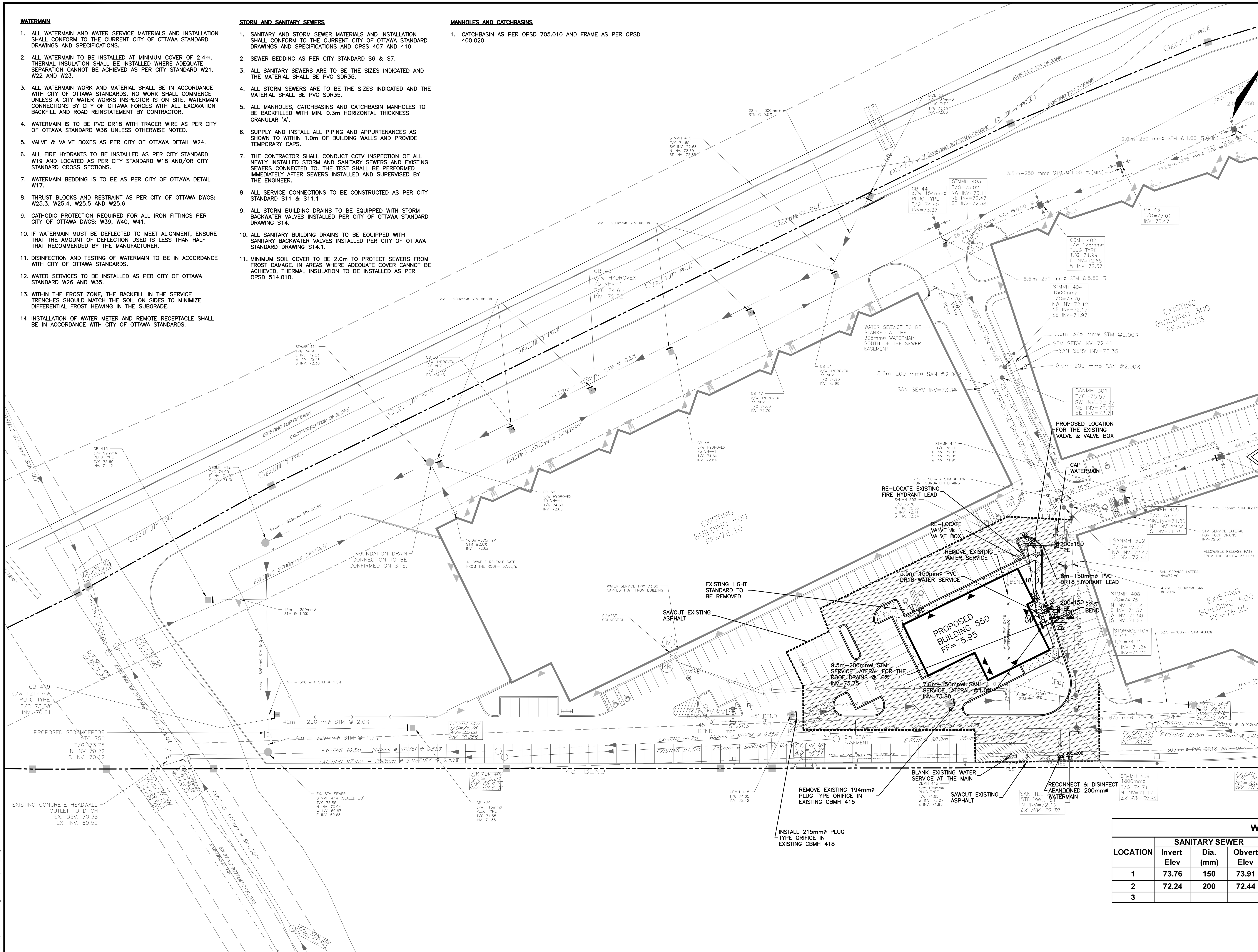
1. ALL WATERMAIN AND WATER SERVICE MATERIALS AND INSTALLATION SHALL CONFORM TO THE CURRENT CITY OF OTTAWA STANDARD DRAWINGS AND SPECIFICATIONS.
2. ALL WATERMAIN TO BE INSTALLED AT MINIMUM COVER OF 2.4m. THERMAL INSULATION SHALL BE INSTALLED WHERE ADEQUATE SEPARATION CANNOT BE ACHIEVED AS PER CITY STANDARD W21, W22 AND W23.
3. ALL WATERMAIN WORK AND MATERIAL SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA STANDARDS. NO WORK SHALL COMMENCE UNLESS A CITY WATER WORKS INSPECTOR IS ON SITE. WATERMAIN CONNECTIONS BY CITY OF OTTAWA FORCES WITH ALL EXCAVATION BACKFILL AND ROAD REINSTATEMENT BY CONTRACTOR.
4. WATERMAIN IS TO BE PVC DR18 WITH TRACER WIRE AS PER CITY OF OTTAWA STANDARD W36 UNLESS OTHERWISE NOTED.
5. VALVE & VALVE BOXES AS PER CITY OF OTTAWA DETAIL W24.
6. ALL FIRE HYDRANTS TO BE INSTALLED AS PER CITY STANDARD W19 AND LOCATED AS PER CITY STANDARD W18 AND/OR CITY STANDARD CROSS SECTIONS.
7. WATERMAIN BEDDING IS TO BE AS PER CITY OF OTTAWA DETAIL W17.
8. THRUST BLOCKS AND RESTRAINT AS PER CITY OF OTTAWA DWGS: W25.3, W25.4, W25.5 AND W25.6.
9. CATHODIC PROTECTION REQUIRED FOR ALL IRON FITTINGS PER CITY OF OTTAWA DWGS: W39, W40, W41.
10. IF WATERMAIN MUST BE DEFLECTED TO MEET ALIGNMENT, ENSURE THAT THE AMOUNT OF DEFLECTION USED IS LESS THAN HALF THAT RECOMMENDED BY THE MANUFACTURER.
11. DISINFECTION AND TESTING OF WATERMAIN TO BE IN ACCORDANCE WITH CITY OF OTTAWA STANDARDS.
12. WATER SERVICES TO BE INSTALLED AS PER CITY OF OTTAWA STANDARD W26 AND W35.
13. WITHIN THE FROST ZONE, THE BACKFILL IN THE SERVICE TRENCHES SHOULD MATCH THE SOIL ON SIDES TO MINIMIZE DIFFERENTIAL FROST HEAVING IN THE SUBGRADE.
14. INSTALLATION OF WATER METER AND REMOTE RECEPTACLE SHALL BE IN ACCORDANCE WITH CITY OF OTTAWA STANDARDS.

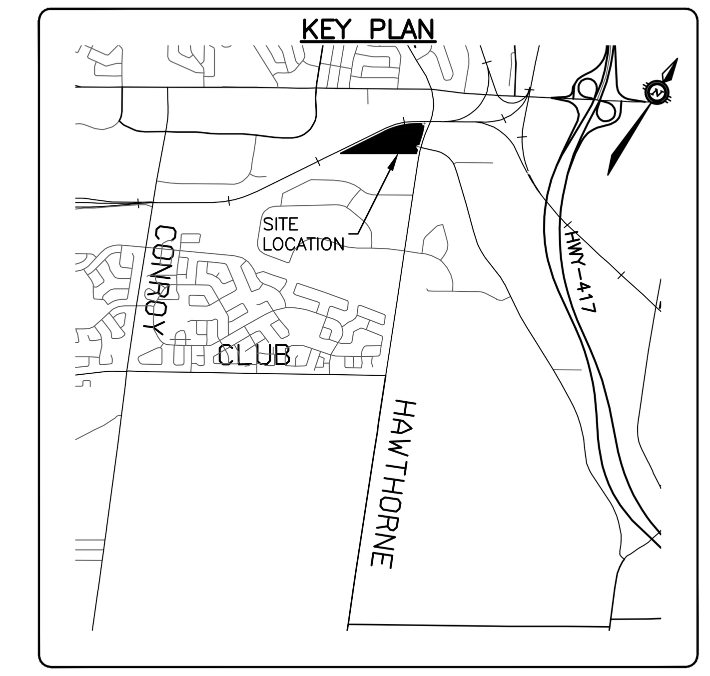
STORM AND SANITARY SEWERS

1. SANITARY AND STORM SEWER MATERIALS AND INSTALLATION SHALL CONFORM TO THE CURRENT CITY OF OTTAWA STANDARD DRAWINGS AND SPECIFICATIONS AND OPSS 407 AND 410.
2. SEWER BEDDING AS PER CITY STANDARD S6 & S7.
3. ALL SANITARY SEWERS ARE TO BE THE SIZES INDICATED AND THE MATERIAL SHALL BE PVC SDR35.
4. ALL STORM SEWERS ARE TO BE THE SIZES INDICATED AND THE MATERIAL SHALL BE PVC SDR35.
5. ALL MANHOLES, CATCHBASINS AND CATCHBASIN MANHOLES TO BE BACKFILLED WITH MIN. 0.3m HORIZONTAL THICKNESS GRANULAR 'A'.
6. SUPPLY AND INSTALL ALL PIPING AND APPURTENANCES AS SHOWN TO WITHIN 1.0m OF BUILDING WALLS AND PROVIDE TEMPORARY CAPS.
7. THE CONTRACTOR SHALL CONDUCT CCTV INSPECTION OF ALL NEWLY INSTALLED STORM AND SANITARY SEWERS AND EXISTING SEWERS CONNECTED TO. THE TEST SHALL BE PERFORMED IMMEDIATELY AFTER SEWERS INSTALLED AND SUPERVISED BY THE ENGINEER.
8. ALL SERVICE CONNECTIONS TO BE CONSTRUCTED AS PER CITY STANDARD S11 & S11.1.
9. ALL STORM BUILDING DRAINS TO BE EQUIPPED WITH STORM BACKWATER VALVES INSTALLED PER CITY OF OTTAWA STANDARD DRAWING S14.
10. ALL SANITARY BUILDING DRAINS TO BE EQUIPPED WITH SANITARY BACKWATER VALVES INSTALLED PER CITY OF OTTAWA STANDARD DRAWING S14.1.
11. MINIMUM SOIL COVER TO BE 2.0m TO PROTECT SEWERS FROM FROST DAMAGE. IN AREAS WHERE ADEQUATE COVER CANNOT BE ACHIEVED, THERMAL INSULATION TO BE INSTALLED AS PER OPSD 514.010.

MANHOLES AND CATCHBASINS

1. CATCHBASIN AS PER OPSD 705.010 AND FRAME AS PER OPSD 400.020.





LEGEND

- EXISTING TRANSFORMER PAD
- EXISTING REMOTE WATER METER
- EXISTING WATER METER
- EXISTING LIGHT STANDARD
- EXISTING FIRE HYDRANT
- EXISTING HYDRO POLE
- EXISTING CATCHBASIN
- EXISTING VALVE & VALVE BOX
- EXISTING SANITARY MANHOLE
- EXISTING STORM MANHOLE
- EXISTING WATERMAIN (EXISTING PVC DR18 WATERMAIN)
- EXISTING SANITARY SEWER (EXISTING 250mmø SANITARY)
- EXISTING STORM SEWER (EXISTING 600mmø STORM)
- EXISTING UNDERGROUND HYDRO
- EXISTING OVERHEAD HYDRO
- EXISTING GAS
- EXISTING UNDERGROUND BELL
- PROPERTY LINE
- PROPOSED SANITARY SEWER
- PROPOSED STORM SEWER
- PROPOSED WATERMAIN (200mmø WATERMAIN)
- PROPOSED REMOTE WATER METER
- PROPOSED WATER METER
- PROPOSED VALVE & VALVE BOX
- PROPOSED SIAMESE CONNECTION
- PROPOSED CATCHBASIN
- PROPOSED THRUSTBLOCK (200x150 TEE)
- PROPOSED RETAINING WALL
- PROPOSED 50mm HI-40 RIGID INSULATION
- PROPOSED HEAVY DUTY ASPHALT
- PROPOSED LIGHT DUTY ASPHALT
- PROPOSED CONCRETE

WATERMAIN / SEWER CROSSING TABLE

LOCATION	SANITARY SEWER Invert Elev	SANITARY SEWER Dia. (mm)	SANITARY SEWER Obvert Elev	STORM SEWER Invert Elev	STORM SEWER Dia. (mm)	STORM SEWER Obvert Elev	WATERMAIN Invert Elev	WATERMAIN Dia. (mm)	WATERMAIN Obvert Elev	CLEARANCES (mm)
1	73.76	150	73.91				73.03	200	73.23	530mm (WM Below)
2	72.24	200	72.44	73.68	200	73.88				1240mm (SAN Below)
3				73.73	200	73.93	73.03	200	73.23	500mm (WM Below)

CAUTION
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PRELIMINARY
NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE	BY	APP'D
1	SUBMITTED FOR SITE APPLICATION	17/12/18	AE	AA

SCALE: HORIZONTAL 1:500

REVIEWED BY: M.A. ANSARI, LICENSED PROFESSIONAL ENGINEER, PROVINCE OF ONTARIO, 14/12/2018

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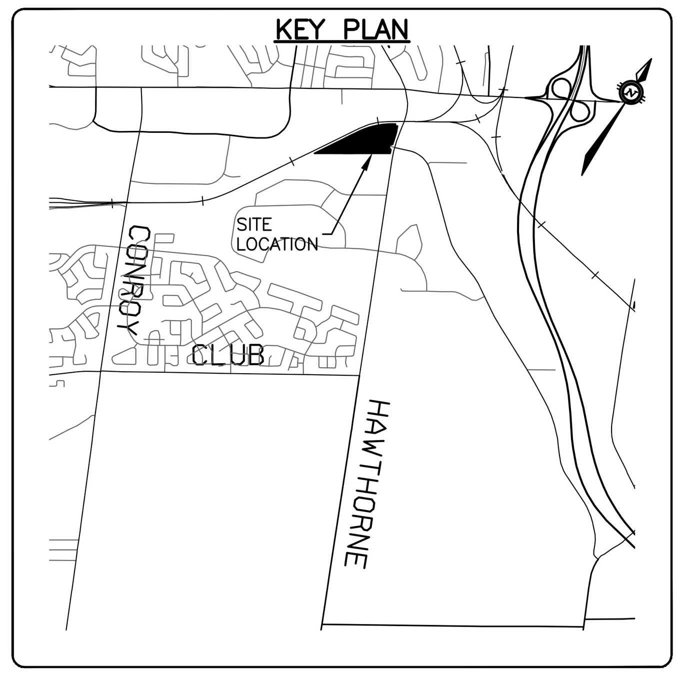
BASEPLAN	DESIGN	CHECKED	CAD	PROJECT MANAGER	APPROVED
SAB	AA/AE	AA	AE	AA	AA

PROJECT: 3020 HAWTHORNE ROAD
BUILDING 100 AND 550
OTTAWA, ONTARIO.

TITLE: BUILDING 550 SITE SERVICING PLAN

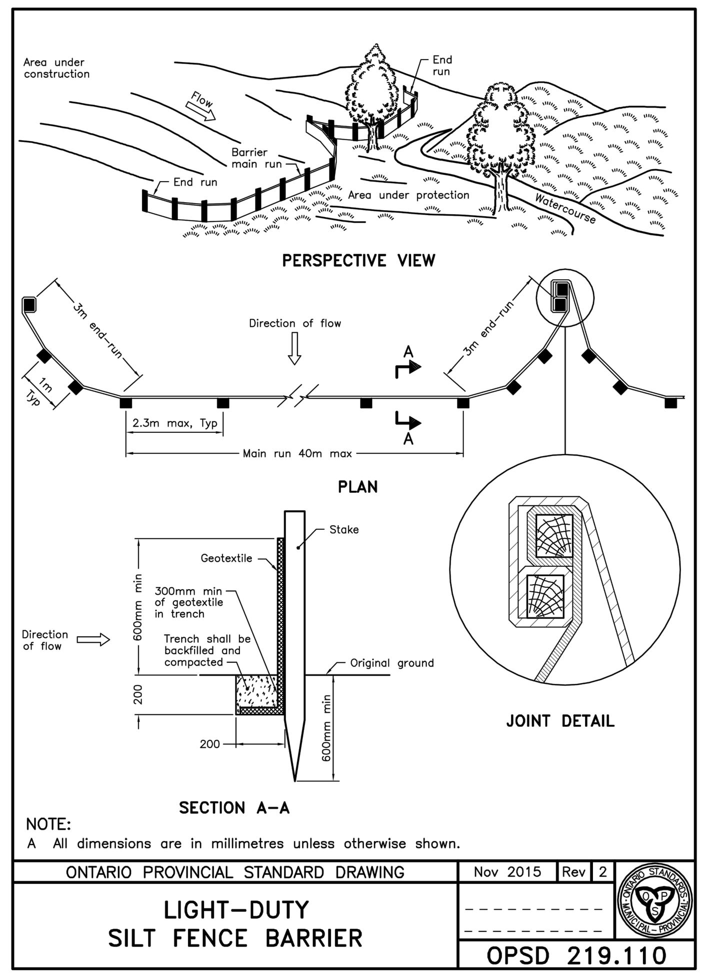
PROJECT No. OTT-250557-A0
SURVEY ---
DATE DECEMBER 2018
DRAWING No. SS-2

KEY PLAN



LEGEND

- EXISTING TRANSFORMER PAD
- EXISTING REMOTE WATER METER
- EXISTING WATER METER
- EXISTING LIGHT STANDARD
- EXISTING HYDRO POLE
- EXISTING FIRE HYDRANT
- EXISTING CATCHBASIN
- EXISTING VALVE & VALVE BOX
- EXISTING SANITARY MANHOLE
- EXISTING STORM MANHOLE
- PROPERTY LINE
- PROPOSED SWALE
- PROPOSED SIAMESE CONNECTION
- PROPOSED CATCHBASIN
- EXISTING ELEVATION
- PROPOSED ELEVATION
- OVERLAND FLOW DIRECTION
- PROPOSED RETAINING WALL
- PROPOSED HEAVY DUTY ASPHALT
- PROPOSED LIGHT DUTY ASPHALT
- PROPOSED SILT FENCE
- PROPOSED CONCRETE



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.

EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION.

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 MISSISSIPPI 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.

CAUTION
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE	BY	APPD	REV	REVISION DESCRIPTION	DATE	BY	APPD
					1	SUBMITTED FOR SITE APPLICATION	17/12/18	AE	AA

SCALE: 0 5m 10m 30m HORIZONTAL 1:750

NORTH

DESIGNED BY

REVIEWED BY: LICENSED PROFESSIONAL ENGINEER M.A. ANSARI 14/12/2018 PROVINCE OF ONTARIO

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

PROJECT: 3020 HAWTHORNE ROAD
BUILDING 100 AND 550
OTTAWA, ONTARIO.

TITLE: EROSION AND SEDIMENT CONTROL PLAN

PROJECT No.: OTT-250557-A0
SURVEY: ---
DATE: DECEMBER 2018
DRAWING No.: ESC

LEGEND

RM	EXISTING REMOTE WATER METER
M	EXISTING WATER METER
	EXISTING LIGHT STANDARD
	EXISTING FIRE HYDRANT
EX HP	EXISTING HYDRO POLE
	EXISTING CATCHBASIN
V&VB	EXISTING VALVE & VALVE BOX
	EXISTING SANITARY MANHOLE
	EXISTING STORM MANHOLE
EXISTING 600mmø STORM	EXISTING STORM SEWER
H	EXISTING UNDERGROUND HYDRO
OH	EXISTING OVERHEAD HYDRO
	PROPERTY LINE
	PROPOSED CATCHBASIN
	PROPOSED RETAINING WALL
	PROPOSED HEAVY DUTY ASPHALT
	PROPOSED LIGHT DUTY ASPHALT
100 YR	100-YEAR PONDING LIMIT
	PROPOSED WATERMAIN
0.90 / 0.22 / A100	AREA (ha) / RUNOFF COEFFICIENT / DRAINAGE AREA ID
	OVERLAND FLOW DIRECTION
	PROPOSED CONCRETE

100 YEAR SURFACE STORAGE VOLUMES

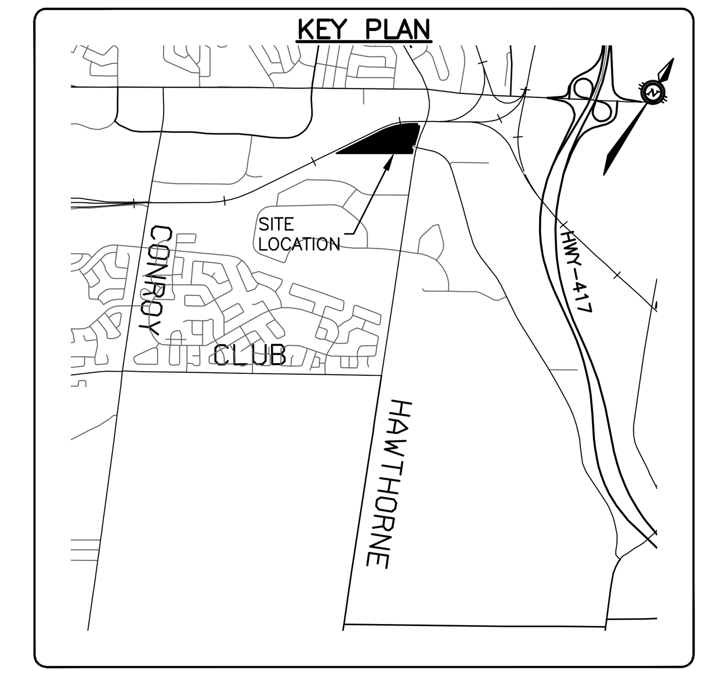
DRAINAGE AREA ID	100 YEAR		
	AREA (sq.m)	DEPTH (m)	VOLUME (cub.m)
A301	492	0.26	42.6
A302	475	0.26	41.2
A303	626	0.26	54.3
A304	451	0.26	39.1
A305	424	0.26	36.8
A306	254	0.3	25.4
A307*	9400	0.12	388
A308	492	0.25	41.0
A309	476	0.25	39.7
A310	600	0.25	50.0
A601*	5500	0.125	229.8
A602	155	0.20	10.3
A603	518	0.25	43.2
A604	1188	0.30	118
A605	860	0.30	86
A550*	700	0.15	35
A100*	2200	0.15	110
TOTAL			1390.6

* – BUILDING ROOFTOP STORAGE

ICD SUMMARY TABLE

Location	Exisiting/Proposed	Controlled Release (L/s)	Outlet Pipe Dia. (mm)	Plug Type Orifice Dia. (mm)	Hydrovex Model
STMMH 402	Existing	54.2	457	128	N/A
CB 44	Existing	62	254	154	N/A
CBMH 407	Existing	10.0	381	N/A	75-VHV-1
CBMH 416	Existing	40.0	305	108	N/A
CBMH 415	**Proposed**	**150.0**	**254**	**215**	**N/A**

KEY PLAN



CAUTION
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE	BY	APP'D
1	SUBMITTED FOR SITE APPLICATION	17/12/18	AE	AA

SCALE: HORIZONTAL 1:750 (0, 5m, 10m, 30m)

NORTH

LICENSED PROFESSIONAL ENGINEER – M.A. ANSARI – 14/12/2018 – PROVINCE OF ONTARIO

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BASEPLAN: SAB
DESIGN: AA/ML
CHECKED: AA
CAD: AE
PROJECT MANAGER: AA
APPROVED: AA

PROJECT: 3020 HAWTHORNE ROAD
BUILDING 100 AND 550
OTTAWA, ONTARIO.

TITLE: STORMWATER MANAGEMENT PLAN

PROJECT No.: OTT-250557-A0
SURVEY: ---
DATE: DECEMBER 2018
DRAWING No.: SWM