Kollaard Associates
Engineers
210 Prescott Street, Unit 1
P.O. Box 189
Kemptville, Ontario K0G 1J0

Civil • Geotechnical •
Structural • Environmental •
Hydrogeology •

(613) 860-0923
FAX: (613) 258-0475

SITE SERVICING AND STORMWATER MANAGEMENT
PROPOSED RESIDENTIAL DEVELOPMENT
KING STREET WEST
GANANOQUE, ONTARIO

Project # 201052

Submitted to:

9695443 Canada Inc.
15 Lillico Drive
Ottawa, Ontario
K1V 9L5

PROJECT #: 201052

DISTRIBUTION
2 copies – Town of Gananoque
1 copy – 9685443 Canada Inc.
1 copy – Kollaard Associates Inc.

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1 INTRODUCTION

Kollaard Associates was retained by Mr. Stefano Ferrante of 9695443 Canada Inc to complete a Site Servicing and Stormwater Management Report for a new residential development in the Town of Gananoque, Ontario.

1.1 Purpose

This report will address the serviceability of the proposed site, specifically relating to the adequacy of the existing municipal storm sewer, sanitary sewer, and watermains to hydraulically convey the necessary storm runoff, sanitary sewage and water demands that will be placed on the existing system as a result of the proposed development located at King Street West, Gananoque, Ontario. The report shall summarize the stormwater management (SWM) design requirements and proposed works that will address stormwater flows arising from the site under post-development conditions. The report and will identify and address any stormwater servicing concerns and also describe any measures to be taken during construction to minimize erosion and sedimentation.

1.2 Proposed Development

The development being proposed by 9695443 Canada Inc. is located on the south side of King Street West, approximately 120 metres west of Garfield Street in Gananoque Ontario.

The site has a total area of 0.4896 hectares. The property is legally described as Part of Lot 11, Concession 1, Parts 1-5 Plan 28R-5002, Parts 1-3 Plan 28R 9972 Town of Gananoque, Counties of Leeds & Grenville. The site is currently unoccupied but is subject to both servicing and access easements.

The proposed development is to consist of a total of 22 micro-rowhouse units divided between three 6 unit blocks and one 4 unit block. The units are slab on grade construction and each block has been designed with a single roof slope from north to south.

1.3 Referenced Documents

The following documents have been referenced during the preparation of this Servicing and Stormwater management Report. These documents are publicly available or have been provided as part of the Site Plan Control Application and are not included with this report.

- Geotechnical Investigation Report Prepared by Kollaard Associates Inc.
- Site Plan prepared by ZanderPlan Inc.

- Preliminary Architectural drawings of the Proposed Building
- City of Ottawa Sewer Design Guidelines
- City of Ottawa Design Guidelines Water Distribution
- Ministry of Environment Stormwater Management Planning and Design Manual

2 STORMWATER DESIGN

2.1 Stormwater Management Design Criteria

Design of the proposed stormwater management works was completed in conformance to the following SWM design criteria:

2.1.1 Quantity Control

- Post-development peak runoff rates will be restricted for all design storm events (2 year to 100 year inclusive) to less than or equal to the pre-development peak runoff rate for the respective storm event.
- Post-development peak runoff rates for all storm events from the 5-Year storm event to and including the 100-Year storm event will be restricted to less than or equal to the peak runoff from the 5-year pre-development storm event.
- Pre-development conditions for the site are to be considered to be the existing conditions.
- A time of concentration is to be calculated and to be no less than 10 minutes.
- The storm sewers have been designed and sized based on the rational formula and the Manning's Equation under free flow conditions for the 5-year storm using a 10-minute inlet time.
- The major system has been designed to accommodate on-site detention with sufficient capacity to attenuate the runoff generated onsite during a 100-year design storm to 2 year pre-development conditions.

2.1.2 Quality Control

Quality control requirements for the site have been provided by the Cataraqui Region Conservation Authority. Communication with CRCA is included in Appendix F.

- Provide a normal level of protection with 70 percent removal of total suspended solids for the downstream water body receiving runoff from the site

The following additional quality control measures are also implemented in the design:

- Implement Erosion Control Measures as required to mitigate the potential for offsite transport of sediment during construction.

- Best management practices will be incorporated at the site to reduce potential suspended solid contamination. Snow and Ice control management practices will be incorporated to reduce contamination from winter snow and ice removal.

2.1.3 Approval Authorities

The approval authorities for the proposed stormwater management facility consist of the Cataraqui Region Conservation Authority (CRCA), the Town of Gananoque and the United Counties of Leeds and Grenville.

2.1.4 Consideration for ECA from MECP

The requirement for Environmental Compliance Approval from the Ministry of Environment Conservation and Parks is governed by the Water Resources Act Section 53 - Sewage Works and Ontario Regulation 25/98.

The water Resources Act provides the following:
Section 1 – Interpretation:
"sewage" includes drainage, storm water, commercial wastes and industrial wastes and such other matter or substance as is specified by the regulations;
"sewage works" means any works for the collection, transmission, treatment and disposal of sewage or any part of such works, but does not include plumbing to which the *Building Code Act, 1992* applies;

Approval, sewage works
53 (1) Subject to section 47.3 of the *Environmental Protection Act*, no person shall use, operate, establish, alter, extend or replace new or existing sewage works except under and in accordance with an environmental compliance approval. 2010, c. 16, Sched. 7, s. 3 (9).

Ontario Regulation 525/98: Approvals Exemptions - Current Update March 6, 2015 provides the following:
Subsection 3 - Subsections 53 (1) and (3) of the Act do not apply to the use, operation, establishment, alteration, extension or replacement of or a change in a storm water management facility that,

(a) is designed to service one lot or parcel of land;
(b) discharges into a storm sewer that is not a combined sewer;
(c) does not service industrial land or a structure located on industrial land; and
(d) is not located on industrial land. O. Reg. 525/98, s. 3; O. Reg. 40/15, s. 4.

It is acknowledged that under Section 53 of the Water Resources Act approval is required by the Ministry. It is considered however that Subsection 3 of O.Reg. 525/98 as quoted above provides approvals exemption for the proposed works for the following reasons:

The proposed stormwater management works consists of the establishment of a stormwater management facility that is:

a) designed to service one lot which is the subject lot in question. Ownership of all portions of the development is retained by one owner;
b) discharges into an existing storm sewer that is not a combined sewer;
c) the site consists of residential land and will be occupied by a residential use;
d) the site is within an area that has residential zoning.

Based on the above rational, the undersigned of Kollaard Associates considers that an ECA is not required for the construction of the stormwater management facility for the proposed development.

2.2 Site Conditions

2.2.1 Pre-Development

As previously indicated, the site is located along the south side of King Street West within the Town of Gananoque. The site has a total area of about 0.4896 hectares and is currently undeveloped. The some mixed forest cover, which extends over about 40 percent of the lot and is located along the west and south sides of the site. The northeast 60 percent of the lot is grass covered and has been maintained by periodic mowing.

Current drainage patterns for about 0.4016 hectares of the site direct the surface runoff by a combination of sheet flow and shallow concentrated flow to storm sewer inlets located at about the northwest corner of the site, about the middle of the north side the site and at about the north east corner of the site.

Runoff from the remaining about 0.0884 hectares of the site is directed to an existing low area which begins at about the southwest corner of the site and extends west along the rear of the adjacent property.

2.2.2 Post-Development

As previously indicated, the proposed development will consist of a total of 22 micro-rowhouse units divided between three 6 unit blocks and one 4 unit block. These row house blocks will be serviced with an asphaltic concrete surfaced parking area and roadway. having a combined area 1128 square metres, accessed from King Street West. The site will have a total roof area of 704 square metres and will have 233 square metres of sidewalk. The remaining surface area of the site will be divided between grass surfaced and landscaped or treed areas. There will be about 82 square metres of the landscaped area that gets covered with riprap during the post-development conditions. This riprap will be used to ensure the stability of a landscaped slope to avoid the use of a retaining wall.

2.3 Storm Analysis Variables

2.3.1 Runoff Coefficients

The Runoff coefficient for the development was calculated as a weighted average by area. Runoff coefficients for impervious surfaces (roofs, asphalt, and concrete) were taken as 0.90, whereas pervious surfaces (grass) were taken as 0.25. Riprap covered surfaces were assumed to have a runoff coefficient of 0.40 during the 2 year and 5 year storm events.

A 10 % increase and a 25% increase for the post development 25-year and 100-year runoff coefficients was used as per City of Ottawa guidelines.

Pre-development Runoff Coefficients

The pre-development runoff coefficient for the site was considered to be equal to 0.25 as there are no impervious surfaces considered on the site during pre-development conditions.

Post-development Runoff Coefficients

The post-development runoff coefficient for each catchment area is calculated using a weighted average based on the proposed ground surface conditions as follows:

$$C = \frac{\left(A_{imp}\ x\ 0.9 + A_{rip}\ x\ 0.4 + A_{soft}\ x\ 0.25\right)}{A_{total}}$$

The calculated post-development time of concentrations will be summarized in a following section.

2.3.2 Impervious Ratio

The impervious ratio for the developed portion of the site is equal the total impervious area divided by the total developed area.

Uncontrolled Area

The total uncontrolled area of the site is 0.0909 hectares. Of this area, 0.0066 hectares will be occupied by pavement and sidewalk and the remainder by landscaped grass surface.
Uncontrolled Area Impervious Ratio = 0.0066/0.0909 = 0.07

Controlled Area

The total controlled area of the site is 0.3987 hectares. Of this area, 0.2065 hectares will be occupied by pavement, roof and sidewalk and the remainder by landscaped grass surface.
Impervious Ratio = 0.2065/0.3987 = 0.52

2.3.3 Time of Concentration

Pre-Development – Catchment Area to King Street West.

The time of concentration for the portion of the site out letting to King Street West during pre-development conditions was calculated assuming that the time of concentration is the sum of the travel times for segments along the hydraulically most distant flow path. The segments for this site consist of sheet flow followed by shallow concentrated flow. The most hydraulically distance point for the site was determined to be 69 metres over an elevation change of 0.8 metres.

The airport formula, developed by the U.S. Department of Transportation's Federal Aviation Administration (FAA), commonly used for rural development where the runoff coefficient is less than 0.40 was used to determine the travel time for sheet flow. The Uplands Method was used to calculate the travel time for shallow concentrated flow. It is considered that runoff changes from sheet flow to shallow concentrated flow after 15 metres of travel over a surface with the cover and slope present at the site.

Airport Formula:

$$t_{ca} = \frac{3.26\ x\ (1.1 - C)\ x\ {l_c}^{0.5}}{S^{0.33}}$$

Where C = Runoff Coefficient = 0.25
lc = length of flow path = 16 m
S = Slope of flow path percent = 1.16 for this site.
For this site, tca = 10.22 min

Upland Formula:

$$t_{cu} = \frac{L}{60V} \text{ where } V = K \times \sqrt{S}$$

Where L = length of flow path = 54 m
K = Coefficient for the relation between V and S depending on ground cover = 2.3
S = Slope = 1.16
For this site, t_{cu} = 3.63 min

Total tc = 10.22 + 3.63 = 13.85 which was rounded to 14 minutes.

Calculations are presented in Appendix A.

Pre-Development – Catchment Area to Adjacent Site to the West.

The most hydraulically distance point for runoff from the portion of the site out letting to the low area on the adjacent property west is about 25 metres from the outlet. The slope over this distance is about 4 percent. Using the Airport formula for this distance would result in a time of

concentration of 8.77 minutes. Since this is less than the minimum recommended time of concentration of 10 minutes, a time of concentration of 10 minutes was used for calculations for the pre-development runoff to the adjacent site.

Post-Development
During post-development conditions, runoff will be directed by means of catch basins and storm sewer. In keeping with City of Ottawa sewer design guidelines, a post development time of concentration of 10 minutes was used.

2.4 Stormwater Quantity Control

Peak Flow for runoff quantities for the Pre-Development and Post-Development stages of the project were calculated using the rational method. The rational method is a common and straightforward calculation, which assumes that the entire drainage area is subject to uniformly distributed rainfall. The formula is:

$$Q = \frac{CiA}{360}$$

Where
Q is the Peak runoff measured in ***m^3/s***
C is the Runoff Coefficient, **Dimensionless**
A is the runoff area in ***hectares***
i is the storm intensity measure in ***mm/hr***

All values for intensity, i, for this project were derived from IDF curves provided by the Ontario Ministry of Transportation (MTO) IDF Curve Lookup web-based application. An IDF curve was obtained from the website for the coordinates 44° 14' 15" N, 76° 33' 14" W (44.237500, -76.554167). For this project four return periods were considered, 2, 5, 25 and 100-year events. The formulas for each are:

2-Year Event
$$i = 20.5 \times (t_c)^{-0.699}$$
5-Year Event
$$i = 27.3 \times (t_c)^{-0.699}$$
25-Year Event
$$i = 37.3 \times (t_c)^{-0.699}$$
100-Year Event
$$i = 45.6 \times (t_c)^{-0.699}$$

Where
t_c is time of concentration in ***hrs***
i is the storm intensity measure in ***mm/hr***

2.4.1 Pre-development Runoff Rate

Using the MTO IDF curves for the 2-year, 5-year, 25-year and 100-year storm events, the storm intensities at a 14 minute time of concentration are 71.73, 95.52, 130.51 and 159.55 mm/hr respectively. Using the Rational Method with a time of concentration of 14 minutes, and the previously indicated runoff coefficients, the pre-development runoff rates for the 2-year, 5-year, 25-year and 100-year design storms for the portion of the site out letting to King Street West is:

2 year = 0.25 x 71.73 x 0.4012 / 360 = 15.8 L/s
5 year = 0.25 x 95.52 x 0.4012 / 360 = 21.1 L/s
25 year = 0.28 x 130.51 x 0.4012 / 360 = 32.2 L/s
100 year = 0.31 x 159.55 x 0.4012 / 360 = 43.6 L/s

The pre-development runoff rate during the 2-year, 5-year, 25-year and 100-year design storms for the portion of the site out letting to the adjacent site to the west was calculated as follows:

2 year = 0.25 x 71.73 x 0.0884 / 360 = 4.4 L/s
5 year = 0.25 x 95.52 x 0.0884 / 360 = 5.9 L/s
25 year = 0.28 x 130.51 x 0.0884 / 360 = 9.0 L/s
100 year = 0.31 x 159.55 x 0.0884 / 360 = 12.2 L/s

2.4.2 Controlled and Uncontrolled Areas

For the purposes of this storm water management design, the site has been divided into uncontrolled and controlled areas as outlined on drawing 201052-POST. The controlled areas are defined as areas CA1, CA2, CA3, CA4 and CA5 and uncontrolled areas are defined as UC1 and UC2. In general: CA1 consists of southern 2 rowhouse blocks and the majority of the landscaped area between these blocks and the south property line; CA2 consists of the west end of the parking area, then northwest rowhouse block and the landscaped area between the southwest and northwest rowhouse blocks; CA3 consists of the middle portion of the parking area and the adjacent landscaping; CA4 consists of the northeast rowhouse block, the east end of the parking area, the adjacent landscaping and the south half of the entrance road; CA5 consists of the majority of the landscaped site area between the rowhouse blocks and King Street West.

UA1 consists of narrow strips of landscaped area along the south, east and north sides of the site. UA2 consists of a relative small section of the site between the parking area and the west

property line.

Post-development site conditions are summarised for the proposed development in the following Table 2.1

Table 2.1 - Post Development Site Conditions

Catchment Area Label	Area ha.	Runoff Coefficient			Impervious Ratio
		2, 5 year	25 year	100 year	
CA1	0.1009	0.49	0.54	0.56	0.37
CA2	0.1127	0.75	0.82	0.84	0.77
CA3	0.0392	0.79	0.87	0.88	0.83
CA4	0.0784	0.78	0.86	0.88	0.82
CA5	0.0761	0.27	0.30	0.33	0.03
UC1	0.0665	0.31	0.35	0.38	0.10
UC2	0.0188	0.32	0.36	0.39	0.00

2.4.3 Uncontrolled Area Runoff

The runoff from the uncontrolled area UC1 directed to King Street was determined using the rational method for a time of concentration of 10 minutes using the above calculated runoff coefficients.

2 year = 0.31 x 71.73 x 0.0665 / 360 = 4.1 L/s
5 year = 0.31 x 95.52 x 0.0665 / 360 = 5.5 L/s
25 year = 0.35 x 130.51 x 0.0665 / 360 = 8.4 L/s
100 year = 0.39 x 159.55 x 0.0665 / 360 = 11.2 L/s

The uncontrolled runoff from UC2 directed to the low area on the adjacent property to the west was calculated as follows:

2 year = 0.32 x 71.73 x 0.0188 / 360 = 1.2 L/s
5 year = 0.32 x 95.52 x 0.0188 / 360 = 1.6 L/s
25 year = 0.35 x 130.51 x 0.0188 / 360 = 2.4 L/s
100 year = 0.39 x 159.55 x 0.0188 / 360 = 3.3 L/s

2.4.4 Allowable Release Rate to King Street West

As previously indicated, the post-development runoff rate from the site must be equal to or less

than the pre-development runoff rate from the site for each design storm event up to and including a 100 year design storm event.

As such, the allowable release rate from the controlled areas of the site to King Street West is equal to the pre-development runoff rate to King Street West less the runoff rate from the uncontrolled areas directing flow to King Street West for each design storm event.

$$Q_{allowable\ controlled} = Q_{pre\text{-}development} - Q_{uncontrolled}$$

For the 2-year Storm event; $Q_{controlled} = 15.8 - 4.1 = 11.7$ L/s
For the 5-year Storm event; $Q_{controlled} = 21.1 - 5.5 = 15.6$ L/s
For the 25-year Storm event; $Q_{controlled} = 32.2 - 8.4 = 23.8$ L/s
For the 100-year Storm event; $Q_{controlled} = 43.6 - 11.2 = 32.4$ L/s

2.4.5 Runoff to the low area on the Adjacent Property to the West

Due to the physical constraints of the site, runoff from a small portion of the site (known as UC2) during post-development conditions will be allowed to flow in accordance with the existing pre-development drainage patterns to the low area on the adjacent site to the west with the following justification:

The pre-development runoff rate directed to the adjacent site as calculated above is 4.4 L/s, 5.9 L/s, 9.0 L/s and 12.2 L/s during the 2-year, 5-year, 25-year and 100-year storm events respectively.

The uncontrolled flow rate directed to the adjacent site as calculated above is 1.2 L/s, 1.6 L/s, 2.4 L/s and 3.3 L/s during the 2-year, 5-year, 25-year and 100-year storm events respectively..

The post-development runoff rates directed to the adjacent site have been compared to the runoff rates directed to the park during pre-development conditions in the following Table 2.2

Table 2.2 Comparison of Flows to the Adjacent Site

Storm Event	Runoff During Pre-Development Conditions	Runoff During Post-Development Conditions	Difference in Runoff Rate	Percent Decrease in Runoff Rate
2 – year	4.4 L/s	1.2 L/s	-3.2 L/s	73 %
5 – year	5.9 L/s	1.6 L/s	-4.3 L/s	73 %
25 – year	9.0 L/s	2.4 L/s	-6.6 L/s	73 %
100 – year	12.2 L/s	3.3 L/s	-8.9 L/s	73 %

From the above table, the proposed development will result in a reduction in flow to the adjacent property of 70 percent for all storm events. The 100 year post-development flow rate to the adjacent property will be less than the 2 year pre-development rate.

2.4.6 Post Development Restricted Flow and Storage

In order to meet the stormwater quantity control restriction, the post development runoff rate from the controlled areas of the site cannot exceed the allowable release rate to North Russell Road for each design storm event. Runoff in excess of the allowable release rate will be detained and temporarily stored on the site to be released a controlled rate during and following a storm event.

The stormwater management calculation sheets included in Appendix A were generated to determine the maximum storage requirement for each catchment area:
On the required storage vs release rate calculation sheet: For each catchment area, the storage requirement for a series of design storms was determined as a function of the release rate from the catchment area for each return period. For example: For the purposes of this sheet, each duration of the 100 year storm is considered to be an individual design storm. When considering a storm event with a 100 year return period for catchment CA1, the maximum storage requirement for a release rate of 2 L/s will occur for a design storm with a duration of 70 minutes and for a release rate of 4 L/s will occur for a design storm with a duration of 30 minutes.

On the outlet control design sheet: The available storage volume in the pond is calculated with respect to the ponding level elevation in the storage pond. Since the discharge rate from the storage pond is a function of the head on the outlet control device, the discharge rate from the storm pond is also calculated with respect to the ponding elevation.
The storage discharge curve chart was generated to overlay the maximum storage requirement vs discharge rate curve for each return period (calculated on the required storage vs release rate sheet) on the available storage volume vs discharge rate curve (calculated on the outlet control design sheet). The point where the curves cross provides the maximum storage volume and discharge rate for each return period considered.

Catchments CA1 to CA4
Stormwater collected on surface area of catchment CA1 will be detained, temporarily stored on the landscaped surface between the south rowhouse blocks and the south property line and released at a controlled rate into the storm sewer. Sormwater collected on the surface area of catchment areas CA2 to CA4 will be detained, temporarily stored on the parking area surface and released at a controlled rate into the storm sewer.

The release rate from each of the catchment areas will be controlled by an inlet control devise (ICD) placed in the inlet of the outlet pipe from the catchbasin in each catchment area. The catch basins are independently controlled. The controlled discharge from each catch basin is conveyed by 250 mm diameter PVC storm sewer leads to a manhole within catchment area CA3. The combined flow is then conveyed by means of a 300 mm storm sewer to a proposed catchbasin manhole within Catchment CA5.

Since the discharge from each of the catchments CA1 to CA4 is directed to the catchbasin manhole within Catchment CA5 there is no direct discharge from catchments CA1 to CA4 to King Street West. Storage will be provided on the ground surface or parking area in each of catchment areas CA1 to CA4 as summarized in the following Table 2.3. The release rate from each of the catchments CA1 to CA4 will be controlled by a Hydrovex 75SVHV-1 ICD placed in the outlet of the storm pipe from the catchbasin in the catchment area. The Hydrovex 75VHV-1 should be sized for a release rate of 5 L/s at a head of 1.0 m.

Table 2.3 – Summary of Maximum Discharge Rate, Storage Requirement and Ponding Depth

Catchment Area	Release rate	Required Storage Volume	Available Storage Volume	Required Storage Depth	Available Storage Depth	Storage Elevation
	(L/s)	(m^3)	(m^3)	(m)	(m)	(m)
2 Year Return Period						
CA1	5.3	3.2	36.9	0.16	0.40	92.76
CA2	5.9	6.5	52.6	0.11	0.25	92.91
CA3	6.4	1.0	39.6	0.05	0.25	92.85
CA4	5.1	4.2	21.8	0.09	0.25	92.64
5 Year Return Period						
CA1	5.5	4.8	36.9	0.19	0.40	92.79
CA2	6.0	9.8	52.6	0.13	0.25	92.93
CA3	6.5	2.0	39.6	0.07	0.25	92.87
CA4	5.2	6.2	21.8	0.11	0.25	92.66
25 Year Return Period						
CA1	5.7	8.4	36.9	0.24	0.40	92.84
CA2	6.1	17.3	52.6	0.16	0.25	92.96
CA3	6.6	4.0	39.6	0.10	0.25	92.90
CA4	5.3	11.3	21.8	0.15	0.25	92.70
100 Year Return Period						
CA1	5.9	11.6	36.9	0.27	0.40	92.87
CA2	6.2	23.8	52.6	0.18	0.25	92.98
CA3	6.7	5.4	39.6	0.11	0.25	92.91
CA4	5.4	15.5	21.8	0.17	0.25	92.72

Catchments CA5

As previously indicated, stormwater collected on the surface area of catchments CA1 to CA4 is directed to the catchment CA5. Outflow from Catchment CA5 will be controlled by means of an ICD within the inlet of the outlet storm sewer from the catchbasin manhole in CA5. As such the discharge from catchments CA1 to CA4 as well as the runoff originating on catchment CA5 will be detained, temporarily stored in a landscaped storage swale between the north rowhouse blocks and the north property line and discharged to the storm sewer along King Street West.

For the purposes of determining the maximum storage requirement within the storm water storage swale in CA5, the lesser of the runoff rate generated on each of catchments CA1 to CA4 or the maximum release rate from the storage in each of these catchments was added to each design storm for the return period considered. As an example: For the design storms with a return period of 5 years, the runoff rate generated on the surface area of CA1 was greater than the maximum release rate of 5.5 L/s (for a return period of 5 years) from the CA1 storage for each 5 yr design storm with a duration of less than 40 minutes. As such, the contribution from CA1 to CA5 was restricted to a maximum of 5.5 L/s for the design storms with a duration of less than 40 minutes and then decreased for the design storms with a duration of greater than 40 minutes. For the 100 year design storm, the maximum contribution to CA5 from the combined areas of CA1 to CA4 was restricted to a total of 24.0 L/s. As such, the contribution to CA5 from CA1 to CA4 was restricted to 24.0 L/s for design storms with a return period of 100 years and a duration of less than 40 minutes.

Stormwater Storage within catchment CA5 will be provided within a shallow storage swale located along the north side of the site. Due to the limited slope along the bottom, the swale will be subdrained. The release rate from the stormwater storage swale in CA5 will be controlled with a Hydrovex 100SVHV-2 ICD placed in the inlet of the outlet storm sewer from the catchbasin manhole CBMH100 in CA5. The Hydrovex ICD should be sized for a release rate of 11.4 L/s at a head of 1.5 m.

The calculation tables provided in Appendix A include calculations for the ground surface storage in catchments CA1 to CA4 and for the stormwater storage swale in catchment CA5. The maximum discharge rates, storage requirements and ponding depths for the design storms for CA5 are as summarized in the following Table 2.4.

Table 2.4 – Summary of Maximum Discharge Rate, Storage Requirement and Ponding Depth

Return period	Allowable Release Rate	Actual Release rate	Required Storage	Available Storage	Required Storage Depth	Available Storage Depth	Storage Elevation
(years)	(L/s)	(L/s)	(m3)	(m3)	(m)	(m)	
Catchment Area CA5 – Stormwater Storage Swale							
2	11.7	11.2	16.8	106.5	0.08	0.30	92.58
5	15.6	11.4	25.5	106.5	0.11	0.30	92.61
25	23.8	11.8	44.0	106.5	0.17	0.30	92.67
100	32.4	12.1	60.7	106.5	0.21	0.30	92.71

The Hydrovex Flow Regulators can be order using the following specifications:

CA1 to CA4

Model	75-SVHV-1
Pipe Outlet	250 mm PVC SDR 35
Discharge	5.0 L/s
Upstream Head	1.0 m
Catchbasin Dimensions	0.6 x 0.6 metres
Minimum Clearance	0.45 m

CA5

Model	100-SVHV-2
Pipe Outlet	250 mm PVC SDR 35
Discharge	11.4 L/s
Upstream Head	1.5 m
Maintenance Hole Diameter	1.2 metres
Minimum Clearance	0.45 m

2.4.7 Summary of Post Development Runoff Rates

Calculations for the post development runoff rates are provided in Appendix A. The following Table 2.5 provides a summary of the post development runoff rates from the site.

Table 2.5 – Summary of Post Development Runoff Rates

Area (ha)	Outlet Location	Runoff Rate (L/s)			
		2 year	5 year	25 year	100 year
Pre-Development Runoff Rate to King Street West					
0.4012	King Street	15.8	21.1	32.2	43.6
Post-Development Uncontrolled Runoff Rate to King Street West					
0.0665	King Street	4.1	5.5	8.4	11.2
Allowable Release Rate to King Street West					
	King Street	11.7	15.6	23.8	32.4
Actual Release Rate to King Street West					
	King Street	11.2	11.4	11.8	12.1
Pre-Development Runoff Rate to Adjacent Properties					
0.0884	Adjacent Prop.	4.4	5.9	9.0	12.2
Post-Development Uncontrolled Runoff Rate to Adjacent Properties					
0.0188	Adjacent Prop.	1.2	1.6	2.4	3.3
Total Pre-Development Runoff Rate From Site					
0.4896	Off Site	20.2	26.9	41.2	55.8
Total Post-Development Runoff Rate From Site					
0.4896	Off Site	16.5	18.5	22.6	26.6

From the table above, the total runoff rate from the site including all controlled and uncontrolled flows generated during a 100 year storm event is less than the pre-development runoff rate from the site during a 5 year storm event. As such the runoff rate from all storm events up to and including the 100 year storm event is controlled on site to less than the 5 year pre-development runoff rate.

2.5 Stormwater Quality Control

As previously indicated in the report, quality control requirements for the site have been provided by the Cataraqui Region Conservation Authority. Communication with CRCA is included in Appendix F.

2.5.1 Primary Quality Control

The quality control requirement for the site is considered to be the equivalent of an enhanced level of treatment or 70% removal of total suspended soils and will be met with the use of a hydrodynamic vortex separator. The selected hydrodynamic vortex separator will consist of a Continuous Deflective System (CDS) Unit such as the CDS Model PMSU20-_15_4m or approved alternative. The CDS is a patented system designed by Contech Engineered Solutions to provide stormwater treatment. The CDS technology uses a combination of swirl concentration and indirect screening to screen, separate and trap debris, sediment, and hydrocarbons from stormwater runoff. The performance of the CDS Hydrodynamic Separator has been tested and verified using the procedure prepared for Environment Canada's Environmental Technology Verification Program. The CDS unit has been certified to meet the ETV protocol.

A CDS unit will be placed in a manhole downstream of CNMH100 in catchment area CA5. The ICD and stormwater storage provide upstream attenuation for the CDS treatment unit. The location of the unit is shown on Kollaard Associates Inc. Drawing #201052-SER. The preliminary design and sizing information of the CDS unit is attached in Appendix B.

The CDS treatment unit will discharge to the existing storm sewer system by means of a 250 mm diameter PVC storm pipe.

It should be noted that the CDS Unit has an average annual total suspended solids removal rate of 87.6 percent which is in excess of the CRCA's normal protection requirement rate of 70 percent total suspended solids removal.

2.5.2 Best Management Practices

The surface areas at the site consist of the roof of the buildings, the landscaped areas, the walkways, the parking areas and the stormwater storage swale.

The roof of a building is typically not considered to be a major source of suspended solids contamination. In addition, the landscaped areas are not considered to be a source of suspended contamination as the landscaped areas provide vegetative filtration of the surface runoff and the vegetation and landscaping protects the ground surface reducing the potential for erosion and eliminating the landscaped ground surface area as a source of suspended solids.

The major source of stormwater contamination from a development site is the onsite surface parking areas. The walkways and amenity area can also be a source of suspended solids especially during winter snow and ice removal.

The use of best management practices will be incorporated at the site to reduce potential suspended solid contamination. These practices include:

Sumps on the catch basins and catch basin manholes in combination with proper maintenance to remove coarse sediment prior to its entry into the storm sewer;
Snow and Ice control management practices which include:

- Clearing snow prior to the application of salt and sand to reduce the quantity of salt and sand required;
- Sourcing clean coarse grained sand for application to reduce fine suspended solids not easily settled or filtered by vegetation;
- Proper timing of the application of the salt and sand will be incorporated to reduce contamination from winter snow and ice removal;
- Directing runoff from impervious surfaces to the adjacent landscaped surface where possible.

2.6 Stormwater System Operation and Maintenance

2.6.1 Inlet Control Device (ICD) - Orifices

The orifices should be inspected on a semi-annual basis and following major storm events. Any blockages, trash or debris should be removed. If surface ponding on the parking area does not recede in a normal manner, the orifices should be inspected for blockage and cleaned.

2.6.2 Catchbasin / Catchbasin Manhole

The catchbasin and manholes should be cleaned with a hydrovac excavation truck following completion of construction, paving of the asphaltic concrete surface and establishment of adequate grass cover on the landscaped areas.
Following the initial cleaning these structures should be inspected on a semi-annual basis and following major storm events. Any blockages, trash or debris should be removed. Once the sediment accumulation in the catchbasin and/or manhole has reached a level equal to 0.2 metres below the outlet invert of the structure, the sediment should be removed by hydro excavation.

2.6.3 Storm Sewers

Due to site constraints, the storm sewers have been installed at less than normally recommended slopes. At the proposed slopes, the storm sewers may not be self cleaning and local sumps are expected within the storm sewers.

Following the initial cleaning the storm sewers should be inspected on a semi-annual basis and following major storm events for accumulated sediment. Due to the relatively shallow depth and limited length of the storm sewers, it is considered that each length of storm sewer can be inspected from the surface using a mirror and light. Each length can be inspected from both ends of the length.

Any accumulated sediment, blockages, trash or debris should be removed by means of flushing in combination with hydro excavation at the downstream end.

2.6.4 CDS Treatment Unit

The CDS hydrodynamic separator should be inspected and cleaned in accordance with the manufacturers recommendations. At minimum:

Inspection:

- The treatment unit should be inspected at regular intervals. At minimum inspections should be performed twice per year.
- Inspections should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen.
- Inspections should also quantify the accumulation of hydrocarbons, trash and sediment in the system.

Maintenance:

The CDS system should be cleaned when the level of sediment has reached 75% of capacity or when an appreciable level of hydrocarbons and trash have accumulated.

2.7 Storm Sewer Design

The on-site storm sewers were designed to be in general conformance with the City of Ottawa Sewer Design Guidelines (October 2012). Specifically, storm sewers were sized using Manning's Equation, assuming a roughness coefficient N = 0.013, to accommodate the uncontrolled runoff from the 5-year storm, under 'open-channel' conditions. The uncontrolled runoff was determined using the rational method and the City of Ottawa IDF curve for a 10-minute time of concentration. Refer to Storm Sewer Design Sheet in Appendix A.

The storage volume within the storm pipes and structures (catch basins and maintenance holes) has not been utilized in the calculations for available storage in the proposed stormwater management facility. Since these unaccounted volumes are small, this will have no significant impact to the stormwater management facility and any impact that does occur will not have a negative effect to the design.

3 SANITARY SEWER DESIGN

The existing residential sanitary service is connected to the existing sanitary manhole located on the south side of the east bound lane of King Street West immediately adjacent the northeast corner of the site. The sanitary sewer system along King Street West consists of a 200 mm diameter pipe at 0.55 percent.

As previously indicated, the proposed development consist of a total of 22 micro-rowhouse units divided between three 6 unit blocks and one 4 unit block. Each unit will have a foot print of about 360 square feet. As such a maximum occupancy of 1.4 persons per unit, which corresponds to a bachelor or 1 bedroom apartment occupancy, was used. Sewage discharges will be domestic in type and in compliance with the Gananoque Sewer Use By-law. The anticipated peak sanitary flow from the development will be a total of approximately 0.53 L/s.

The sanitary sewage flow for the proposed development was calculated based on the City of Ottawa Sewer Design Guidelines (Section 4.4.1.2) and incorporated Technical Bulletin ISTB-2018-01.

Design Flows
Residential
Total domestic pop:
22 units (22) x 1.4 ppu: 30.8
Total: 31

$Q_{Domestic}$ = 31 x 280 L/person/day x (1/86,400 sec/day) = 0.10 L/sec

Peaking Factor ..... $= 1 + \frac{14}{4 + (31/1000)^{0.5}} = 4.35$ - maximum 4.0

$Q_{Peak\ Domestic}$ = 0.10 L/sec x 4 = 0.4 L/sec

Infiltration

$Q_{Infiltration}$ = 0.33 L/ha/sec x 0.3987 ha = 0.13 L/sec

Total Peak Sanitary Flow = 0.40 + 0.13 = 0.53 L/sec

3.1 Sanitary Service Lateral

The Ontario Building Code specifies minimum pipe size and maximum hydraulic loading for sanitary sewer pipe. OBC 7.4.10.8 (2) states "Horizontal sanitary drainage pipe shall be designed to carry no more than 65% of its full capacity." A 135 mm diameter sanitary service with a minimum slope of 1.0% has a capacity of 11.51 Litres per second.

The maximum peak sanitary flow for each unit is less than 0.1 L/sec. Since 0.1 L/sec is much less than 0.65 x 11.51 = 7.48 L/s, the sanitary service would be properly sized if greater than or equal to 135 mm in diameter. As such each sanitary service lateral will be 135 mm in diameter.

4 WATERMAIN DESIGN

4.1 Water Demand

The water demand for the proposed development was calculated based on the City of Ottawa Water Distribution Design Guidelines as follows:

Residential

Residential
Total domestic pop:
22 units (22) x 1.4 ppu:.....30.8
Total:.....31

Residential Average Daily Demand = 350 L/c/d.

Average daily demand of 350 L/c/day x 31 persons = 10850 Litres/day or 0.13 L/s
Maximum daily demand (factor of 2.5) is 0.13 L/s x 2.5 = 0.31 L/s
Peak hourly demand (factor of 2.2) = 0.31 L/s x 2.2 = 0.69 L/s

4.2 Fire Flow

Fire flow protection requirements were calculated as per the Fire Underwriter's Survey (FUS). Calculations of the fire flow required are provided in Appendix D. Based on the FUS, the fire flow requirements for the site are 82.5 L/s (4,950 L/min or 1,308 US gpm).

4.3 Sufficiency of Existing Infrastructure

There is an existing fire hydrant located at the northeast corner of the site. This fire hydrant has been painted with a light blue top indicating that it is a maintained Class AA hydrant with a flow capacity equal to 5,700 L/min (1500 US gpm) or greater at a minimum residual pressure of 138 kPa (20 psi). As such there is a sufficient water supply within the existing municipal systme at the existing fire hydrant to meet the fire fighting requirements of the site.

4.3.1 Existing Water Service

The site is currently unoccupied. There are no existing water services for the site.

4.4 Proposed Water Main and Service

The proposed development will be supplied by a 150 mm PVC DR18 (Class 150) watermain. The watermain will be extended from the existing watermain to the front of the south row house units. The proposed main will then be extended along the front of both the north and south row house unit blocks to the west side of the proposed development. These extensions will be connected completing the loop.

A minimum water service size of 20 mm is required for peak flows of less than 0.4 L/s. As such, a 20 mm diameter water service will be extended from the 150 mm diameter main to service each unit. The services are to be Type K copper or other approved material.

5 EROSION AND SEDIMENT CONTROL

The owner (and/or contractor) agrees to prepare and implement an erosion and sediment control plan at least equal to the stated minimum requirements and to the satisfaction of the City of Ottawa, appropriate to the site conditions, prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and during all phases of site preparation and construction in accordance with the current best management practices for erosion and sediment control. It is considered to be the owners and/or contractors responsibility to ensure that the erosion control measures are implemented and maintained.

In order to limit the amount of sediment carried in stormwater runoff from the site during construction, it is recommended to install a silt fence along the property, as shown in Kollaard Associates Inc. Drawing #201052-ECP Erosion Control Plan. The silt fence may be polypropylene, nylon, and polyester or ethylene yarn.

If a standard filter fabric is used, it must be backed by a wire fence supported on posts not over 2.0 m apart. Extra strength filter fabric may be used without a wire fence backing if posts are

not over 1.0 m apart. Fabric joints should be lapped at least 150 mm (6") and stapled. The bottom edge of the filter fabric should be anchored in a 300 mm (1 ft) deep trench, to prevent flow under the fence. Sections of fence should be cleaned, if blocked with sediment and replaced if torn.

Filter socks should be installed across existing storm manhole and catch basin lids. As well, filter socks should be installed across the proposed catch basin lids immediately after the catch basins are placed. The filter socks should only be removed once the asphaltic concrete is installed and the site is cleaned.

The proposed landscaping works should be completed as soon as possible. The proposed granular and asphaltic concrete surfaced areas should be surfaced as soon as possible.

The silt fences should only be removed once the site is stabilized and landscaping is completed. These measures will reduce the amount of sediment carried from the site during storm events that may occur during construction.

6 CONCLUSIONS

This report addresses the storm, sanitary and water demands to service the proposed development of micro unit rowhouse buildings at the site along King Street West. Based on the analysis provided in this report, the conclusions are as follows:

SWM for the proposed development will be achieved by:

- Restricting the post-development flow rate from the site to King Street West to less than or equal to the pre-development runoff rate to King Street West for each design storm event.
- Restricting the post-development uncontrolled runoff to the adjacent property to the west to less than the 2 year pre-development flow rate for all design storms up to and including the 100 year storm event.
- Restricting the total post-development runoff rate from the site for all storm events from the 5 year event up to and including the 100 year event to less than or equal to the runoff rate from the 5-year pre-development runoff rate.

Uncontrolled runoff directed off site to adjacent properties will be reduced during post development condition such that the runoff generated during a 100 year post-development storm event will be less than the runoff being directed to the adjacent properties during pre-development conditions for a 2 year storm event.

The peak sewage flow rate from the proposed development will be 0.53 L/sec. The existing municipal sanitary sewer will have adequate capacity to accommodate the minimal increase in peak flow. The Town has not identified any capacity issues in the existing sanitary sewer system.

The existing municipal watermain along King Street West will have adequate capacity to service the proposed development for both domestic and fire protection.

During all construction activities, erosion and sedimentation shall be controlled.

We trust that this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we can be of any further assistance to you on this project, please do not hesitate to contact our office.

Sincerely,
Kollaard Associates, Inc.

Steven deWit, P.Eng.

Appendix A: Storm Design Information

- Sheet 1 – Pre-Development Flows and Allowable Release Rate – King Street West
- Sheet 2 – Pre-Development Flows and Allowable Release Rate – Adjacent Properties
- Sheet 3 – Uncontrolled Area Runoff Calculation to King Street West
- Sheet 4 – Uncontrolled Area Runoff Calculation to Adjacent Properties
- Sheet 5 – Required Storage Vs. Release Rate CA1
- Sheet 6 – Required Storage Vs. Release Rate CA2
- Sheet 7 – Required Storage Vs. Release Rate CA3
- Sheet 8 – Required Storage Vs. Release Rate CA4
- Sheet 9 – Required Storage Vs. Release Rate CA5
- Sheet 10 – Catchment Area Outlet Control Design Sheet
- Figure 1 - CA1 Discharge-Storage Curve
- Figure 2 - CA2 Discharge-Storage Curve
- Figure 3 - CA3 Discharge-Storage Curve
- Figure 4 - CA4 Discharge-Storage Curve
- Figure 5 - CA5 Discharge-Storage Curve

APPENDIX A: SPREADSHEET 1

PRE DEVELOPMENT FLOWS & ALLOWABLE RELEASE RATE

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

PRE DEVELOPMENT FLOW TO KING STREET WEST

Runoff Coefficient Equation

$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$

Rainfall Intensity

$I = A*T^B$ Where T = time in hours

	2 yr	5 yr	25 yr	100 yr
A =	20.5	27.3	37.3	45.6
B =	-0.699	-0.699	-0.699	-0.699

Pre Dev run-off Coefficient "C"

Total Site Area 0.4896 hectares
Site Area to King Street West 0.4012 hectares
Site Area to Adjacent Property 0.0884 hectares

			2,5 Year Event		25 Year Event		100 Year Event	
Area (Ha)	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C" x 1.25**	**$C_{100\ avg}$**	**"C" x 1.25**	**$C_{100\ avg}$**
Total	Asphalt/Roof	0.0000	0.90	**0.25**	0.99	**0.28**	1.00	**0.31**
0.4012	Gravel	0.0000	0.70		0.77		0.88	
	Grass/Trees	0.4012	0.25		0.28		0.31	

*C value multiplied by 1.1 for 25 year and 1.25 to a max. of 1.00 for 100 year event

2 Year Event

Post Dev.	C	Intensity	Area
2 Year	0.25	56.69	0.40
2.78CIA=	15.81		
15.8	L/S		

**Use a 14 minute time of concentration

5 Year Event

Pre Dev.	C	Intensity	Area
5 Year	0.25	75.50	0.401
2.78CIA=	21.05		
21.1	**L/s**		

**Use a 14 minute time of concentration

25 Year Event

Pre Dev.	C	Intensity	Area
5 Year	0.28	103.16	0.401
2.78CIA=	32.21		
32.2	**L/s**		

**Use a 14 minute time of concentration

100 Year Event

Pre Dev.	C	Intensity	Area
100 Year	0.31	126.11	0.401
2.78CIA=	43.60		
43.6	**L/s**		

**Use a 14 minute time of concentration

Pre Dev Time of Concentration "t_c"

$$t_{ca} = \frac{3.26\ x\ (1.1 - C)\ x\ l_c^{0.5}}{S^{0.33}}$$

C = Runoff Coefficient 0.25
lc = length of flow path 15
S = Slope of flow path 1.16

t_c = **10.22**

$t_c =$ L/(60V) $V = K\ x\ \sqrt{S}$ *S = Slope of flow path* 0.01

	L(m)	V(m/s)	t_c
Grass /Field	54	0.25	**3.63**

Runoff Coefficient Equation

$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$

Total t_c **13.85**

APPENDIX A: SPREADSHEET 2

PRE DEVELOPMENT FLOWS & ALLOWABLE RELEASE RATE

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

PRE DEVELOPMENT FLOW TO ADJACENT PROPERTY

Runoff Coefficient Equation

$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$

Rainfall Intensity

$I = A*T^{B}$ Where T = time in hours

	2 yr	5 yr	25 yr	100 yr
A =	20.5	27.3	37.3	45.6
B =	-0.699	-0.699	-0.699	-0.699

Pre Dev run-off Coefficient "C"

Total Site Area 0.4896 hectares
Site Area to King Street West 0.4012 hectares
Site Area to Adjacent Property 0.0884 hectares

			2,5 Year Event		25 Year Event		100 Year Event	
Area (Ha)	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C" x 1.25**	**$C_{100\ avg}$**	**"C" x 1.25**	**$C_{100\ avg}$**
Total	Asphalt/Roof	0.0000	0.90	**0.25**	0.99	**0.28**	1.00	**0.31**
0.0884	Gravel	0.0000	0.70		0.77		0.88	
	Scrub/woodland	0.0884	0.25		0.28		0.31	

*C value multiplied by 1.1 for 25 year and 1.25 to a max. of 1.00 for 100 year event

2 Year Event

Post Dev.	C	Intensity	Area
2 Year	0.25	71.73	0.09
2.78CIA= 4.41			
4.4 L/S			

**Use a 10 minute time of concentration

5 Year Event

Pre Dev.	C	Intensity	Area
5 Year	0.25	95.52	0.088
2.78CIA= 5.87			
5.9 L/s			

**Use a 10 minute time of concentration

25 Year Event

Pre Dev.	C	Intensity	Area
5 Year	0.28	130.51	0.088
2.78CIA= 8.98			
9.0 L/s			

**Use a 10 minute time of concentration

100 Year Event

Pre Dev.	C	Intensity	Area
100 Year	0.31	159.55	0.088
2.78CIA= 12.15			
12.2 L/s			

**Use a 10 minute time of concentration

Pre Dev Time of Concentration "t_c"

$$t_{ca} = \frac{3.26\ x\ (1.1 - C)\ x\ l_c^{0.5}}{S^{0.33}}$$

C = Runoff Coefficient	0.25
lc = length of flow path	25
S = Slope of flow path	4.00

t_c = **8.77**

Pre Dev Time of Concentration "t_c"
Use minimum time of 10 minutes

APPENDIX A: SPREADSHEET 3

UNCONTROLLED AREA FLOW AND SITE DISCHARGE RATE SUMMARY to KING STREET WEST

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - UC1

			2,5 Year Event		25 Year Event		100 Year Event	
Area	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C" x 1.1**	**$C_{100\ avg}$**	**"C" x 1.25**	**$C_{100\ avg}$**
Total	Asphalt/Roof	0.0066	0.90	**0.31**	0.99	**0.35**	1.00	**0.38**
0.0665	Riprap	0.0000	0.40		0.44		1.00	
	Sidewalk	0.0000	0.90		0.99		1.00	
	Grass	0.0599	0.25		0.28		0.31	

Impervious Ratio 0.10

Post Dev Free Flow
2 Year Event

Post Dev.	C	Intensity	Area
2 Year	0.31	71.73	0.07
2.78CIA= 4.11			
4.1 L/S			

**Use a 10 minute time of concentration for 5 year

Post Dev Free Flow
5 Year Event

Post Dev.	C	Intensity	Area
5 Year	0.31	95.52	0.07
2.78CIA= 5.48			
5.5 L/S			

**Use a 10 minute time of concentration for 5 year

Post Dev Free Flow
25 Year Event

Post Dev.	C	Intensity	Area
5 Year	0.35	130.51	0.07
2.78CIA= 8.45			
8.4 L/S			

**Use a 10 minute time of concentration for 5 year

100 Year Event

Post Dev.	C*	Intensity	Area
5 Year	0.38	159.55	0.07
2.78CIA= 11.21			
11.2 L/S			

**Use a 10 minute time of concentration for 100 year

Sub Area I.D.	Sub Area (ha)	2,5 year C	25 year C	100 year C	Outlet Location	2 Year Runoff Rate (L/s)	5 Year Runoff Rate (L/s)	25 Year Runoff Rate (L/s)	100 Year Runoff Rate (L/s)
Pre-Development Runoff Rate to King Street West									
	0.4012	0.25	0.28	0.31	King Street	15.8	21.1	32.2	43.6
Post-Development Uncontrolled Runoff Rate to King Street West									
	0.0665	0.31	0.35	0.38	King Street	4.1	5.5	8.4	11.2
Allowable Release Rate to King Street West									
						11.7	15.6	23.8	32.4
Actual Release Rate to King Street West									
						11.2	11.4	11.8	12.1
Pre-Development Runoff Rate to Adjacent Properties									
	0.0884	0.25	0.28	0.31	Adjacent	4.4	5.9	9.0	12.2
Post-Development Uncontrolled Runoff Rate to Adjacent Properties									
	0.0188	0.32	0.35	0.39	Adjacent	1.2	1.6	2.4	3.3
Total Pre-Development Runoff Rate From Site									
	0.4896					20.2	26.9	41.2	55.8
Total Post-Development Runoff Rate From Site									
	0.4896					16.5	18.5	22.6	26.6

APPENDIX A: SPREADSHEET 4

UNCONTROLLED AREA FLOW AND SITE DISCHARGE RATE SUMMARY to ADJACENT PROPERTIES

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - UC2

			2,5 Year Event		25 Year Event		100 Year Event	
Area	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C" x 1.1**	**$C_{100\ avg}$**	**"C" x 1.25**	**$C_{100\ avg}$**
Total	Asphalt/Roof	0.0000	0.90	**0.32**	0.99	**0.35**	1.00	**0.39**
0.0188	Riprap	0.0082	0.40		0.44		0.50	
	Sidewalk	0.0000	0.90		0.99		1.00	
	Grass	0.0106	0.25		0.28		0.31	

Impervious Ratio 0.00

Post Dev Free Flow
2 Year Event

Post Dev.	C	Intensity	Area
2 Year	0.32	71.73	0.02
2.78CIA= 1.20			
1.2 L/S			

**Use a 10 minute time of concentration for 5 year

Post Dev Free Flow
5 Year Event

Post Dev.	C	Intensity	Area
5 Year	0.32	95.52	0.02
2.78CIA= 1.60			
1.6 L/S			

**Use a 10 minute time of concentration for 5 year

Post Dev Free Flow
25 Year Event

Post Dev.	C	Intensity	Area
25 Year	0.35	130.51	0.02
2.78CIA= 2.39			
2.4 L/S			

**Use a 10 minute time of concentration for 5 year

100 Year Event

Post Dev.	C*	Intensity	Area
100 Year	0.39	159.55	0.02
2.78CIA= 3.25			
3.3 L/S			

**Use a 10 minute time of concentration for 100 year

Sub Area I.D.	Sub Area (ha)	2, 5 year C	25 year C	100 year C	Outlet Location	2 Year Runoff Rate (L/s)	5 Year Runoff Rate (L/s)	25 Year Runoff Rate (L/s)	100 Year Runoff Rate (L/s)
Pre-Development Runoff Rate to Adjacent Site to the West									
	0.0884	0.25	0.28	0.31	Low Area	4.4	5.9	9.0	12.2
Post-Development Uncontrolled Runoff Rate to Adjacent Site									
	0.0188	0.32	0.35	0.39	Low Area	1.2	1.6	2.4	3.3
Controlled Runoff Released to the Adjacent Site									
					Low Area	0.0	0.0	0.0	0.0
Total Post-Development Runoff Rate to Adjacent Site to the West									
					Low Area	1.2	1.6	2.4	3.3
Difference in Runoff Rate Post- to Pre- Development									
					Adjacent	-3.2	-4.3	-6.6	-8.9

APPENDIX A: SPREADSHEET 5a
REQUIRED STORAGE VS. RELEASE RATE CA1

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA1

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0369	0.90	**0.49**	0.99	**0.54**	1.00	**0.56**
	Asphalt	0.0000	0.90		0.99		1.00	
0.1009	Sidewalk	0.0000	0.90		0.99		1.00	
	Grass	0.0640	0.25		0.28		0.31	

Impervious Ratio 0.37

REQUIRED STORAGE VERSUS RELEASE RATE FOR 2 YEAR STORM

Runoff Coeffcient, C = **0.49**
Drainage Area (ha) = **0.101**
Return Period (yrs) = **2**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	116.4	16.0	4.8	4.2	3.6	3.0	2.4	1.8	1.2	0.6	0.0	-0.6
10	71.7	9.9	5.9	4.7	3.5	2.3	1.1	-0.1	-1.3	-2.5	-3.7	-4.9
20	44.2	6.1	7.3	4.9	2.5	0.1	-2.3	-4.7	-7.1	-9.5	-11.9	-14.3
30	33.3	4.6	8.2	4.6	1.0	-2.6	-6.2	-9.8	-13.4	-17.0	-20.6	-24.2
40	27.2	3.7	9.0	4.2	-0.6	-5.4	-10.2	-15.0	-19.8	-24.6	-29.4	-34.2
50	23.3	3.2	9.6	3.6	-2.4	-8.4	-14.4	-20.4	-26.4	-32.4	-38.4	-44.4
60	20.5	2.8	10.1	2.9	-4.3	-11.5	-18.7	-25.9	-33.1	-40.3	-47.5	-54.7
70	18.4	2.5	10.6	2.2	-6.2	-14.6	-23.0	-31.4	-39.8	-48.2	-56.6	-65.0
80	16.8	2.3	11.1	1.5	-8.1	-17.7	-27.3	-36.9	-46.5	-56.1	-65.7	-75.3
90	15.4	2.1	11.5	0.7	-10.1	-20.9	-31.7	-42.5	-53.3	-64.1	-74.9	-85.7
100	14.3	2.0	11.8	-0.2	-12.2	-24.2	-36.2	-48.2	-60.2	-72.2	-84.2	-96.2
110	13.4	1.8	12.2	-1.0	-14.2	-27.4	-40.6	-53.8	-67.0	-80.2	-93.4	-106.6
120	12.6	1.7	12.5	-1.9	-16.3	-30.7	-45.1	-59.5	-73.9	-88.3	-102.7	-117.1
130	11.9	1.6	12.8	-2.8	-18.4	-34.0	-49.6	-65.2	-80.8	-96.4	-112.0	-127.6
140	11.3	1.6	13.1	-3.7	-20.5	-37.3	-54.1	-70.9	-87.7	-104.5	-121.3	-138.1
150	10.8	1.5	13.4	-4.6	-22.6	-40.6	-58.6	-76.6	-94.6	-112.6	-130.6	-148.6
160	10.3	1.4	13.6	-5.6	-24.8	-44.0	-63.2	-82.4	-101.6	-120.8	-140.0	-159.2
170	9.9	1.4	13.9	-6.5	-26.9	-47.3	-67.7	-88.1	-108.5	-128.9	-149.3	-169.7
180	9.5	1.3	14.1	-7.5	-29.1	-50.7	-72.3	-93.9	-115.5	-137.1	-158.7	-180.3
190	9.2	1.3	14.4	-8.4	-31.2	-54.0	-76.8	-99.6	-122.4	-145.2	-168.0	-190.8
Maximum Storage Rate =			14.4	4.9	3.6	3.0	2.4	1.8	1.2	0.6	0.0	-0.6

REQUIRED STORAGE VERSUS RELEASE RATE FOR 100 YEAR STORM

Runoff Coeffcient, C = **0.56**
Drainage Area (ha) = **0.101**
Return Period (yrs) = **100**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	259.0	40.7	12.2	11.6	11.0	10.4	9.8	9.2	8.6	8.0	7.4	6.8
10	159.5	25.1	15.0	13.8	12.6	11.4	10.2	9.0	7.8	6.6	5.4	4.2
20	98.3	15.4	18.5	16.1	13.7	11.3	8.9	6.5	4.1	1.7	-0.7	-3.1
30	74.0	11.6	20.9	17.3	13.7	10.1	6.5	2.9	-0.7	-4.3	-7.9	-11.5
40	60.5	9.5	22.8	18.0	13.2	8.4	3.6	-1.2	-6.0	-10.8	-15.6	-20.4
50	51.8	8.1	24.4	18.4	12.4	6.4	0.4	-5.6	-11.6	-17.6	-23.6	-29.6
60	45.6	7.2	25.8	18.6	11.4	4.2	-3.0	-10.2	-17.4	-24.6	-31.8	-39.0
70	40.9	6.4	27.0	18.6	10.2	1.8	-6.6	-15.0	-23.4	-31.8	-40.2	-48.6
80	37.3	5.9	28.1	18.5	8.9	-0.7	-10.3	-19.9	-29.5	-39.1	-48.7	-58.3
90	34.3	5.4	29.1	18.3	7.5	-3.3	-14.1	-24.9	-35.7	-46.5	-57.3	-68.1
100	31.9	5.0	30.1	18.1	6.1	-5.9	-17.9	-29.9	-41.9	-53.9	-65.9	-77.9
110	29.9	4.7	30.9	17.7	4.5	-8.7	-21.9	-35.1	-48.3	-61.5	-74.7	-87.9
120	28.1	4.4	31.8	17.4	3.0	-11.4	-25.8	-40.2	-54.6	-69.0	-83.4	-97.8
130	26.6	4.2	32.5	16.9	1.3	-14.3	-29.9	-45.5	-61.1	-76.7	-92.3	-107.9
140	25.2	4.0	33.3	16.5	-0.3	-17.1	-33.9	-50.7	-67.5	-84.3	-101.1	-117.9
150	24.0	3.8	34.0	16.0	-2.0	-20.0	-38.0	-56.0	-74.0	-92.0	-110.0	-128.0
160	23.0	3.6	34.6	15.4	-3.8	-23.0	-42.2	-61.4	-80.6	-99.8	-119.0	-138.2
170	22.0	3.5	35.3	14.9	-5.5	-25.9	-46.3	-66.7	-87.1	-107.5	-127.9	-148.3
180	21.2	3.3	35.9	14.3	-7.3	-28.9	-50.5	-72.1	-93.7	-115.3	-136.9	-158.5
190	20.4	3.2	36.5	13.7	-9.1	-31.9	-54.7	-77.5	-100.3	-123.1	-145.9	-168.7
200	19.7	3.1	37.0	13.0	-11.0	-35.0	-59.0	-83.0	-107.0	-131.0	-155.0	-179.0
Maximum Storage Rate =			37.0	18.6	13.7	11.4	10.2	9.2	8.6	8.0	7.4	6.8

APPENDIX A: SPREADSHEET 5b
REQUIRED STORAGE VS. RELEASE RATE CA1

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA1

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0369	0.90	**0.49**	0.99	**0.54**	1.00	**0.56**
	Asphalt& Sidewalk	0.0000	0.90		0.99		1.00	
0.1009	Gravel	0.0000	0.70		0.77		0.88	
	Grass	0.0640	0.25		0.28		0.31	

REQUIRED STORAGE VERSUS RELEASE RATE FOR 5 YEAR STORM

Runoff Coeffcient, C = **0.49**
Drainage Area (ha) = **0.101**
Return Period (yrs) = **5**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

			Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)		Storage Required (m^3)									
5	155.1	21.3		6.4	5.8	5.2	4.6	4.0	3.4	2.8	2.2	1.6	1.0
10	95.5	13.1		7.9	6.7	5.5	4.3	3.1	1.9	0.7	-0.5	-1.7	-2.9
20	58.8	8.1		9.7	7.3	4.9	2.5	0.1	-2.3	-4.7	-7.1	-9.5	-11.9
30	44.3	6.1		11.0	7.4	3.8	0.2	-3.4	-7.0	-10.6	-14.2	-17.8	-21.4
40	36.2	5.0		12.0	7.2	2.4	-2.4	-7.2	-12.0	-16.8	-21.6	-26.4	-31.2
50	31.0	4.3		12.8	6.8	0.8	-5.2	-11.2	-17.2	-23.2	-29.2	-35.2	-41.2
60	27.3	3.8		13.5	6.3	-0.9	-8.1	-15.3	-22.5	-29.7	-36.9	-44.1	-51.3
70	24.5	3.4		14.1	5.7	-2.7	-11.1	-19.5	-27.9	-36.3	-44.7	-53.1	-61.5
80	22.3	3.1		14.7	5.1	-4.5	-14.1	-23.7	-33.3	-42.9	-52.5	-62.1	-71.7
90	20.6	2.8		15.3	4.5	-6.3	-17.1	-27.9	-38.7	-49.5	-60.3	-71.1	-81.9
100	19.1	2.6		15.8	3.8	-8.2	-20.2	-32.2	-44.2	-56.2	-68.2	-80.2	-92.2
110	17.9	2.5		16.2	3.0	-10.2	-23.4	-36.6	-49.8	-63.0	-76.2	-89.4	-102.6
120	16.8	2.3		16.6	2.2	-12.2	-26.6	-41.0	-55.4	-69.8	-84.2	-98.6	-113.0
130	15.9	2.2		17.0	1.4	-14.2	-29.8	-45.4	-61.0	-76.6	-92.2	-107.8	-123.4
140	15.1	2.1		17.4	0.6	-16.2	-33.0	-49.8	-66.6	-83.4	-100.2	-117.0	-133.8
150	14.4	2.0		17.8	-0.2	-18.2	-36.2	-54.2	-72.2	-90.2	-108.2	-126.2	-144.2
160	13.8	1.9		18.1	-1.1	-20.3	-39.5	-58.7	-77.9	-97.1	-116.3	-135.5	-154.7
170	13.2	1.8		18.5	-1.9	-22.3	-42.7	-63.1	-83.5	-103.9	-124.3	-144.7	-165.1
180	12.7	1.7		18.8	-2.8	-24.4	-46.0	-67.6	-89.2	-110.8	-132.4	-154.0	-175.6
190	12.2	1.7		19.1	-3.7	-26.5	-49.3	-72.1	-94.9	-117.7	-140.5	-163.3	-186.1
Maximum Storage Rate =				19.1	7.4	5.5	4.6	4.0	3.4	2.8	2.2	1.6	1.0

REQUIRED STORAGE VERSUS RELEASE RATE FOR 25 YEAR STORM

Runoff Coeffcient, C = **0.54**
Drainage Area (ha) = **0.101**
Return Period (yrs) = **25**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

			Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)		Storage Required (m^3)									
5	211.9	32.1		9.6	9.0	8.4	7.8	7.2	6.6	6.0	5.4	4.8	4.2
10	130.5	19.8		11.9	10.7	9.5	8.3	7.1	5.9	4.7	3.5	2.3	1.1
20	80.4	12.2		14.6	12.2	9.8	7.4	5.0	2.6	0.2	-2.2	-4.6	-7.0
30	60.6	9.2		16.5	12.9	9.3	5.7	2.1	-1.5	-5.1	-8.7	-12.3	-15.9
40	49.5	7.5		18.0	13.2	8.4	3.6	-1.2	-6.0	-10.8	-15.6	-20.4	-25.2
50	42.4	6.4		19.3	13.3	7.3	1.3	-4.7	-10.7	-16.7	-22.7	-28.7	-34.7
60	37.3	5.6		20.3	13.1	5.9	-1.3	-8.5	-15.7	-22.9	-30.1	-37.3	-44.5
70	33.5	5.1		21.3	12.9	4.5	-3.9	-12.3	-20.7	-29.1	-37.5	-45.9	-54.3
80	30.5	4.6		22.2	12.6	3.0	-6.6	-16.2	-25.8	-35.4	-45.0	-54.6	-64.2
90	28.1	4.3		23.0	12.2	1.4	-9.4	-20.2	-31.0	-41.8	-52.6	-63.4	-74.2
100	26.1	4.0		23.7	11.7	-0.3	-12.3	-24.3	-36.3	-48.3	-60.3	-72.3	-84.3
110	24.4	3.7		24.4	11.2	-2.0	-15.2	-28.4	-41.6	-54.8	-68.0	-81.2	-94.4
120	23.0	3.5		25.1	10.7	-3.7	-18.1	-32.5	-46.9	-61.3	-75.7	-90.1	-104.5
130	21.7	3.3		25.7	10.1	-5.5	-21.1	-36.7	-52.3	-67.9	-83.5	-99.1	-114.7
140	20.6	3.1		26.2	9.4	-7.4	-24.2	-41.0	-57.8	-74.6	-91.4	-108.2	-125.0
150	19.7	3.0		26.8	8.8	-9.2	-27.2	-45.2	-63.2	-81.2	-99.2	-117.2	-135.2
160	18.8	2.8		27.3	8.1	-11.1	-30.3	-49.5	-68.7	-87.9	-107.1	-126.3	-145.5
170	18.0	2.7		27.8	7.4	-13.0	-33.4	-53.8	-74.2	-94.6	-115.0	-135.4	-155.8
180	17.3	2.6		28.3	6.7	-14.9	-36.5	-58.1	-79.7	-101.3	-122.9	-144.5	-166.1
190	16.7	2.5		28.8	6.0	-16.8	-39.6	-62.4	-85.2	-108.0	-130.8	-153.6	-176.4
200	16.1	2.4		29.2	5.2	-18.8	-42.8	-66.8	-90.8	-114.8	-138.8	-162.8	-186.8
Maximum Storage Rate =				29.2	13.3	9.8	8.3	7.2	6.6	6.0	5.4	4.8	4.2

APPENDIX A: SPREADSHEET 6a
REQUIRED STORAGE VS. RELEASE RATE CA2

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA2

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0201	0.90	**0.75**	0.99	**0.82**	1.00	**0.84**
	Asphalt	0.0540	0.90		0.99		1.00	
0.1127	Sidewalk	0.0121	0.90		0.99		1.00	
	Grass	0.0265	0.25		0.28		0.31	

Impervious Ratio 0.77

REQUIRED STORAGE VERSUS RELEASE RATE FOR 2 YEAR STORM

Runoff Coeffcient, C = **0.75**
Drainage Area (ha) = **0.113**
Return Period (yrs) = **2**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	116.4	27.4	8.2	7.6	7.0	6.4	5.8	5.2	4.6	4.0	3.4	2.8
10	71.7	16.8	10.1	8.9	7.7	6.5	5.3	4.1	2.9	1.7	0.5	-0.7
20	44.2	10.4	12.5	10.1	7.7	5.3	2.9	0.5	-1.9	-4.3	-6.7	-9.1
30	33.3	7.8	14.1	10.5	6.9	3.3	-0.3	-3.9	-7.5	-11.1	-14.7	-18.3
40	27.2	6.4	15.3	10.5	5.7	0.9	-3.9	-8.7	-13.5	-18.3	-23.1	-27.9
50	23.3	5.5	16.4	10.4	4.4	-1.6	-7.6	-13.6	-19.6	-25.6	-31.6	-37.6
60	20.5	4.8	17.3	10.1	2.9	-4.3	-11.5	-18.7	-25.9	-33.1	-40.3	-47.5
70	18.4	4.3	18.2	9.8	1.4	-7.0	-15.4	-23.8	-32.2	-40.6	-49.0	-57.4
80	16.8	3.9	18.9	9.3	-0.3	-9.9	-19.5	-29.1	-38.7	-48.3	-57.9	-67.5
90	15.4	3.6	19.6	8.8	-2.0	-12.8	-23.6	-34.4	-45.2	-56.0	-66.8	-77.6
100	14.3	3.4	20.2	8.2	-3.8	-15.8	-27.8	-39.8	-51.8	-63.8	-75.8	-87.8
110	13.4	3.2	20.8	7.6	-5.6	-18.8	-32.0	-45.2	-58.4	-71.6	-84.8	-98.0
120	12.6	3.0	21.4	7.0	-7.4	-21.8	-36.2	-50.6	-65.0	-79.4	-93.8	-108.2
130	11.9	2.8	21.9	6.3	-9.3	-24.9	-40.5	-56.1	-71.7	-87.3	-102.9	-118.5
140	11.3	2.7	22.4	5.6	-11.2	-28.0	-44.8	-61.6	-78.4	-95.2	-112.0	-128.8
150	10.8	2.5	22.8	4.8	-13.2	-31.2	-49.2	-67.2	-85.2	-103.2	-121.2	-139.2
160	10.3	2.4	23.3	4.1	-15.1	-34.3	-53.5	-72.7	-91.9	-111.1	-130.3	-149.5
170	9.9	2.3	23.7	3.3	-17.1	-37.5	-57.9	-78.3	-98.7	-119.1	-139.5	-159.9
180	9.5	2.2	24.1	2.5	-19.1	-40.7	-62.3	-83.9	-105.5	-127.1	-148.7	-170.3
190	9.2	2.2	24.5	1.7	-21.1	-43.9	-66.7	-89.5	-112.3	-135.1	-157.9	-180.7
Maximum Storage Rate =			24.5	10.5	7.7	6.5	5.8	5.2	4.6	4.0	3.4	2.8

REQUIRED STORAGE VERSUS RELEASE RATE FOR 100 YEAR STORM

Runoff Coeffcient, C = **0.84**
Drainage Area (ha) = **0.113**
Return Period (yrs) = **100**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	259.0	68.1	20.4	19.8	19.2	18.6	18.0	17.4	16.8	16.2	15.6	15.0
10	159.5	42.0	25.2	24.0	22.8	21.6	20.4	19.2	18.0	16.8	15.6	14.4
20	98.3	25.9	31.0	28.6	26.2	23.8	21.4	19.0	16.6	14.2	11.8	9.4
30	74.0	19.5	35.1	31.5	27.9	24.3	20.7	17.1	13.5	9.9	6.3	2.7
40	60.5	15.9	38.2	33.4	28.6	23.8	19.0	14.2	9.4	4.6	-0.2	-5.0
50	51.8	13.6	40.9	34.9	28.9	22.9	16.9	10.9	4.9	-1.1	-7.1	-13.1
60	45.6	12.0	43.2	36.0	28.8	21.6	14.4	7.2	0.0	-7.2	-14.4	-21.6
70	40.9	10.8	45.2	36.8	28.4	20.0	11.6	3.2	-5.2	-13.6	-22.0	-30.4
80	37.3	9.8	47.1	37.5	27.9	18.3	8.7	-0.9	-10.5	-20.1	-29.7	-39.3
90	34.3	9.0	48.8	38.0	27.2	16.4	5.6	-5.2	-16.0	-26.8	-37.6	-48.4
100	31.9	8.4	50.4	38.4	26.4	14.4	2.4	-9.6	-21.6	-33.6	-45.6	-57.6
110	29.9	7.9	51.8	38.6	25.4	12.2	-1.0	-14.2	-27.4	-40.6	-53.8	-67.0
120	28.1	7.4	53.2	38.8	24.4	10.0	-4.4	-18.8	-33.2	-47.6	-62.0	-76.4
130	26.6	7.0	54.5	38.9	23.3	7.7	-7.9	-23.5	-39.1	-54.7	-70.3	-85.9
140	25.2	6.6	55.7	38.9	22.1	5.3	-11.5	-28.3	-45.1	-61.9	-78.7	-95.5
150	24.0	6.3	56.9	38.9	20.9	2.9	-15.1	-33.1	-51.1	-69.1	-87.1	-105.1
160	23.0	6.0	58.0	38.8	19.6	0.4	-18.8	-38.0	-57.2	-76.4	-95.6	-114.8
170	22.0	5.8	59.1	38.7	18.3	-2.1	-22.5	-42.9	-63.3	-83.7	-104.1	-124.5
180	21.2	5.6	60.1	38.5	16.9	-4.7	-26.3	-47.9	-69.5	-91.1	-112.7	-134.3
190	20.4	5.4	61.1	38.3	15.5	-7.3	-30.1	-52.9	-75.7	-98.5	-121.3	-144.1
200	19.7	5.2	62.1	38.1	14.1	-9.9	-33.9	-57.9	-81.9	-105.9	-129.9	-153.9
Maximum Storage Rate =			62.1	38.9	28.9	24.3	21.4	19.2	18.0	16.8	15.6	15.0

APPENDIX A: SPREADSHEET 6b
REQUIRED STORAGE VS. RELEASE RATE CA2

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA2

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0201	0.90	**0.73**	0.99	**0.80**	1.00	**0.83**
	Asphalt& Sidewalk	0.0540	0.90		0.99		1.00	
0.1127	Gravel	0.0121	0.70		0.77		0.88	
	Grass	0.0265	0.25		0.28		0.31	

REQUIRED STORAGE VERSUS RELEASE RATE FOR 5 YEAR STORM

Runoff Coeffcient, C = **0.75** Duration Interval (min) = **10**
Drainage Area (ha) = **0.113** Release Rate Start (L/s) = **0**
Return Period (yrs) = **5** Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	155.1	36.4	10.9	10.3	9.7	9.1	8.5	7.9	7.3	6.7	6.1	5.5
10	95.5	22.4	13.5	12.3	11.1	9.9	8.7	7.5	6.3	5.1	3.9	2.7
20	58.8	13.8	16.6	14.2	11.8	9.4	7.0	4.6	2.2	-0.2	-2.6	-5.0
30	44.3	10.4	18.7	15.1	11.5	7.9	4.3	0.7	-2.9	-6.5	-10.1	-13.7
40	36.2	8.5	20.4	15.6	10.8	6.0	1.2	-3.6	-8.4	-13.2	-18.0	-22.8
50	31.0	7.3	21.9	15.9	9.9	3.9	-2.1	-8.1	-14.1	-20.1	-26.1	-32.1
60	27.3	6.4	23.1	15.9	8.7	1.5	-5.7	-12.9	-20.1	-27.3	-34.5	-41.7
70	24.5	5.8	24.2	15.8	7.4	-1.0	-9.4	-17.8	-26.2	-34.6	-43.0	-51.4
80	22.3	5.2	25.2	15.6	6.0	-3.6	-13.2	-22.8	-32.4	-42.0	-51.6	-61.2
90	20.6	4.8	26.1	15.3	4.5	-6.3	-17.1	-27.9	-38.7	-49.5	-60.3	-71.1
100	19.1	4.5	26.9	14.9	2.9	-9.1	-21.1	-33.1	-45.1	-57.1	-69.1	-81.1
110	17.9	4.2	27.7	14.5	1.3	-11.9	-25.1	-38.3	-51.5	-64.7	-77.9	-91.1
120	16.8	4.0	28.4	14.0	-0.4	-14.8	-29.2	-43.6	-58.0	-72.4	-86.8	-101.2
130	15.9	3.7	29.1	13.5	-2.1	-17.7	-33.3	-48.9	-64.5	-80.1	-95.7	-111.3
140	15.1	3.5	29.8	13.0	-3.8	-20.6	-37.4	-54.2	-71.0	-87.8	-104.6	-121.4
150	14.4	3.4	30.4	12.4	-5.6	-23.6	-41.6	-59.6	-77.6	-95.6	-113.6	-131.6
160	13.8	3.2	31.0	11.8	-7.4	-26.6	-45.8	-65.0	-84.2	-103.4	-122.6	-141.8
170	13.2	3.1	31.6	11.2	-9.2	-29.6	-50.0	-70.4	-90.8	-111.2	-131.6	-152.0
180	12.7	3.0	32.1	10.5	-11.1	-32.7	-54.3	-75.9	-97.5	-119.1	-140.7	-162.3
190	12.2	2.9	32.7	9.9	-12.9	-35.7	-58.5	-81.3	-104.1	-126.9	-149.7	-172.5
Maximum Storage Rate =			32.7	15.9	11.8	9.9	8.7	7.9	7.3	6.7	6.1	5.5

REQUIRED STORAGE VERSUS RELEASE RATE FOR 25 YEAR STORM

Runoff Coeffcient, C = **0.82** Duration Interval (min) = **10**
Drainage Area (ha) = **0.113** Release Rate Start (L/s) = **0**
Return Period (yrs) = **25** Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	211.9	54.4	16.3	15.7	15.1	14.5	13.9	13.3	12.7	12.1	11.5	10.9
10	130.5	33.5	20.1	18.9	17.7	16.5	15.3	14.1	12.9	11.7	10.5	9.3
20	80.4	20.6	24.8	22.4	20.0	17.6	15.2	12.8	10.4	8.0	5.6	3.2
30	60.6	15.6	28.0	24.4	20.8	17.2	13.6	10.0	6.4	2.8	-0.8	-4.4
40	49.5	12.7	30.5	25.7	20.9	16.1	11.3	6.5	1.7	-3.1	-7.9	-12.7
50	42.4	10.9	32.6	26.6	20.6	14.6	8.6	2.6	-3.4	-9.4	-15.4	-21.4
60	37.3	9.6	34.5	27.3	20.1	12.9	5.7	-1.5	-8.7	-15.9	-23.1	-30.3
70	33.5	8.6	36.1	27.7	19.3	10.9	2.5	-5.9	-14.3	-22.7	-31.1	-39.5
80	30.5	7.8	37.6	28.0	18.4	8.8	-0.8	-10.4	-20.0	-29.6	-39.2	-48.8
90	28.1	7.2	39.0	28.2	17.4	6.6	-4.2	-15.0	-25.8	-36.6	-47.4	-58.2
100	26.1	6.7	40.2	28.2	16.2	4.2	-7.8	-19.8	-31.8	-43.8	-55.8	-67.8
110	24.4	6.3	41.4	28.2	15.0	1.8	-11.4	-24.6	-37.8	-51.0	-64.2	-77.4
120	23.0	5.9	42.5	28.1	13.7	-0.7	-15.1	-29.5	-43.9	-58.3	-72.7	-87.1
130	21.7	5.6	43.5	27.9	12.3	-3.3	-18.9	-34.5	-50.1	-65.7	-81.3	-96.9
140	20.6	5.3	44.5	27.7	10.9	-5.9	-22.7	-39.5	-56.3	-73.1	-89.9	-106.7
150	19.7	5.0	45.4	27.4	9.4	-8.6	-26.6	-44.6	-62.6	-80.6	-98.6	-116.6
160	18.8	4.8	46.3	27.1	7.9	-11.3	-30.5	-49.7	-68.9	-88.1	-107.3	-126.5
170	18.0	4.6	47.2	26.8	6.4	-14.0	-34.4	-54.8	-75.2	-95.6	-116.0	-136.4
180	17.3	4.4	48.0	26.4	4.8	-16.8	-38.4	-60.0	-81.6	-103.2	-124.8	-146.4
190	16.7	4.3	48.8	26.0	3.2	-19.6	-42.4	-65.2	-88.0	-110.8	-133.6	-156.4
200	16.1	4.1	49.6	25.6	1.6	-22.4	-46.4	-70.4	-94.4	-118.4	-142.4	-166.4
Maximum Storage Rate =			49.6	28.2	20.9	17.6	15.3	14.1	12.9	12.1	11.5	10.9

APPENDIX A: SPREADSHEET 7a
REQUIRED STORAGE VS. RELEASE RATE CA3

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA3

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0000	0.90	**0.79**	0.99	**0.87**	1.00	**0.88**
	Asphalt	0.0290	0.90		0.99		1.00	
0.0392	Sidewalk	0.0036	0.90		0.99		1.00	
	Grass	0.0066	0.25		0.28		0.31	
Impervious Ratio		0.83						

REQUIRED STORAGE VERSUS RELEASE RATE FOR 2 YEAR STORM

Runoff Coeffcient, C = **0.79**
Drainage Area (ha) = **0.039**
Return Period (yrs) = **2**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	116.4	10.0	3.0	2.4	1.8	1.2	0.6	0.0	-0.6	-1.2	-1.8	-2.4
10	71.7	6.2	3.7	2.5	1.3	0.1	-1.1	-2.3	-3.5	-4.7	-5.9	-7.1
20	44.2	3.8	4.6	2.2	-0.2	-2.6	-5.0	-7.4	-9.8	-12.2	-14.6	-17.0
30	33.3	2.9	5.2	1.6	-2.0	-5.6	-9.2	-12.8	-16.4	-20.0	-23.6	-27.2
40	27.2	2.3	5.6	0.8	-4.0	-8.8	-13.6	-18.4	-23.2	-28.0	-32.8	-37.6
50	23.3	2.0	6.0	0.0	-6.0	-12.0	-18.0	-24.0	-30.0	-36.0	-42.0	-48.0
60	20.5	1.8	6.4	-0.8	-8.0	-15.2	-22.4	-29.6	-36.8	-44.0	-51.2	-58.4
70	18.4	1.6	6.7	-1.7	-10.1	-18.5	-26.9	-35.3	-43.7	-52.1	-60.5	-68.9
80	16.8	1.4	6.9	-2.7	-12.3	-21.9	-31.5	-41.1	-50.7	-60.3	-69.9	-79.5
90	15.4	1.3	7.2	-3.6	-14.4	-25.2	-36.0	-46.8	-57.6	-68.4	-79.2	-90.0
100	14.3	1.2	7.4	-4.6	-16.6	-28.6	-40.6	-52.6	-64.6	-76.6	-88.6	-100.6
110	13.4	1.2	7.6	-5.6	-18.8	-32.0	-45.2	-58.4	-71.6	-84.8	-98.0	-111.2
120	12.6	1.1	7.8	-6.6	-21.0	-35.4	-49.8	-64.2	-78.6	-93.0	-107.4	-121.8
130	11.9	1.0	8.0	-7.6	-23.2	-38.8	-54.4	-70.0	-85.6	-101.2	-116.8	-132.4
140	11.3	1.0	8.2	-8.6	-25.4	-42.2	-59.0	-75.8	-92.6	-109.4	-126.2	-143.0
150	10.8	0.9	8.4	-9.6	-27.6	-45.6	-63.6	-81.6	-99.6	-117.6	-135.6	-153.6
160	10.3	0.9	8.5	-10.7	-29.9	-49.1	-68.3	-87.5	-106.7	-125.9	-145.1	-164.3
170	9.9	0.9	8.7	-11.7	-32.1	-52.5	-72.9	-93.3	-113.7	-134.1	-154.5	-174.9
180	9.5	0.8	8.8	-12.8	-34.4	-56.0	-77.6	-99.2	-120.8	-142.4	-164.0	-185.6
190	9.2	0.8	9.0	-13.8	-36.6	-59.4	-82.2	-105.0	-127.8	-150.6	-173.4	-196.2
Maximum Storage Rate =			9.0	2.5	1.8	1.2	0.6	0.0	-0.6	-1.2	-1.8	-2.4

REQUIRED STORAGE VERSUS RELEASE RATE FOR 100 YEAR STORM

Runoff Coeffcient, C = **0.88**
Drainage Area (ha) = **0.039**
Return Period (yrs) = **100**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	259.0	24.8	7.5	6.9	6.3	5.7	5.1	4.5	3.9	3.3	2.7	2.1
10	159.5	15.3	9.2	8.0	6.8	5.6	4.4	3.2	2.0	0.8	-0.4	-1.6
20	98.3	9.4	11.3	8.9	6.5	4.1	1.7	-0.7	-3.1	-5.5	-7.9	-10.3
30	74.0	7.1	12.8	9.2	5.6	2.0	-1.6	-5.2	-8.8	-12.4	-16.0	-19.6
40	60.5	5.8	13.9	9.1	4.3	-0.5	-5.3	-10.1	-14.9	-19.7	-24.5	-29.3
50	51.8	5.0	14.9	8.9	2.9	-3.1	-9.1	-15.1	-21.1	-27.1	-33.1	-39.1
60	45.6	4.4	15.7	8.5	1.3	-5.9	-13.1	-20.3	-27.5	-34.7	-41.9	-49.1
70	40.9	3.9	16.5	8.1	-0.3	-8.7	-17.1	-25.5	-33.9	-42.3	-50.7	-59.1
80	37.3	3.6	17.2	7.6	-2.0	-11.6	-21.2	-30.8	-40.4	-50.0	-59.6	-69.2
90	34.3	3.3	17.8	7.0	-3.8	-14.6	-25.4	-36.2	-47.0	-57.8	-68.6	-79.4
100	31.9	3.1	18.4	6.4	-5.6	-17.6	-29.6	-41.6	-53.6	-65.6	-77.6	-89.6
110	29.9	2.9	18.9	5.7	-7.5	-20.7	-33.9	-47.1	-60.3	-73.5	-86.7	-99.9
120	28.1	2.7	19.4	5.0	-9.4	-23.8	-38.2	-52.6	-67.0	-81.4	-95.8	-110.2
130	26.6	2.5	19.9	4.3	-11.3	-26.9	-42.5	-58.1	-73.7	-89.3	-104.9	-120.5
140	25.2	2.4	20.3	3.5	-13.3	-30.1	-46.9	-63.7	-80.5	-97.3	-114.1	-130.9
150	24.0	2.3	20.7	2.7	-15.3	-33.3	-51.3	-69.3	-87.3	-105.3	-123.3	-141.3
160	23.0	2.2	21.1	1.9	-17.3	-36.5	-55.7	-74.9	-94.1	-113.3	-132.5	-151.7
170	22.0	2.1	21.5	1.1	-19.3	-39.7	-60.1	-80.5	-100.9	-121.3	-141.7	-162.1
180	21.2	2.0	21.9	0.3	-21.3	-42.9	-64.5	-86.1	-107.7	-129.3	-150.9	-172.5
190	20.4	2.0	22.3	-0.5	-23.3	-46.1	-68.9	-91.7	-114.5	-137.3	-160.1	-182.9
200	19.7	1.9	22.6	-1.4	-25.4	-49.4	-73.4	-97.4	-121.4	-145.4	-169.4	-193.4
Maximum Storage Rate =			22.6	9.2	6.8	5.7	5.1	4.5	3.9	3.3	2.7	2.1

APPENDIX A: SPREADSHEET 7b
REQUIRED STORAGE VS. RELEASE RATE CA3

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA3

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0000	0.90	**0.77**	0.99	**0.85**	1.00	**0.87**
	Asphalt& Sidewalk	0.0290	0.90		0.99		1.00	
0.0392	Gravel	0.0036	0.70		0.77		0.88	
	Grass	0.0066	0.25		0.28		0.31	

REQUIRED STORAGE VERSUS RELEASE RATE FOR 5 YEAR STORM

Runoff Coeffcient, C = **0.79**
Drainage Area (ha) = **0.039**
Return Period (yrs) = **5**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	155.1	13.3	4.0	3.4	2.8	2.2	1.6	1.0	0.4	-0.2	-0.8	-1.4
10	95.5	8.2	4.9	3.7	2.5	1.3	0.1	-1.1	-2.3	-3.5	-4.7	-5.9
20	58.8	5.1	6.1	3.7	1.3	-1.1	-3.5	-5.9	-8.3	-10.7	-13.1	-15.5
30	44.3	3.8	6.9	3.3	-0.3	-3.9	-7.5	-11.1	-14.7	-18.3	-21.9	-25.5
40	36.2	3.1	7.5	2.7	-2.1	-6.9	-11.7	-16.5	-21.3	-26.1	-30.9	-35.7
50	31.0	2.7	8.0	2.0	-4.0	-10.0	-16.0	-22.0	-28.0	-34.0	-40.0	-46.0
60	27.3	2.4	8.5	1.3	-5.9	-13.1	-20.3	-27.5	-34.7	-41.9	-49.1	-56.3
70	24.5	2.1	8.9	0.5	-7.9	-16.3	-24.7	-33.1	-41.5	-49.9	-58.3	-66.7
80	22.3	1.9	9.2	-0.4	-10.0	-19.6	-29.2	-38.8	-48.4	-58.0	-67.6	-77.2
90	20.6	1.8	9.6	-1.2	-12.0	-22.8	-33.6	-44.4	-55.2	-66.0	-76.8	-87.6
100	19.1	1.6	9.9	-2.1	-14.1	-26.1	-38.1	-50.1	-62.1	-74.1	-86.1	-98.1
110	17.9	1.5	10.2	-3.0	-16.2	-29.4	-42.6	-55.8	-69.0	-82.2	-95.4	-108.6
120	16.8	1.4	10.4	-4.0	-18.4	-32.8	-47.2	-61.6	-76.0	-90.4	-104.8	-119.2
130	15.9	1.4	10.7	-4.9	-20.5	-36.1	-51.7	-67.3	-82.9	-98.5	-114.1	-129.7
140	15.1	1.3	10.9	-5.9	-22.7	-39.5	-56.3	-73.1	-89.9	-106.7	-123.5	-140.3
150	14.4	1.2	11.1	-6.9	-24.9	-42.9	-60.9	-78.9	-96.9	-114.9	-132.9	-150.9
160	13.8	1.2	11.4	-7.8	-27.0	-46.2	-65.4	-84.6	-103.8	-123.0	-142.2	-161.4
170	13.2	1.1	11.6	-8.8	-29.2	-49.6	-70.0	-90.4	-110.8	-131.2	-151.6	-172.0
180	12.7	1.1	11.8	-9.8	-31.4	-53.0	-74.6	-96.2	-117.8	-139.4	-161.0	-182.6
190	12.2	1.1	12.0	-10.8	-33.6	-56.4	-79.2	-102.0	-124.8	-147.6	-170.4	-193.2
Maximum Storage Rate =			12.0	3.7	2.8	2.2	1.6	1.0	0.4	-0.2	-0.8	-1.4

REQUIRED STORAGE VERSUS RELEASE RATE FOR 25 YEAR STORM

Runoff Coeffcient, C = **0.87**
Drainage Area (ha) = **0.039**
Return Period (yrs) = **25**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	211.9	20.1	6.0	5.4	4.8	4.2	3.6	3.0	2.4	1.8	1.2	0.6
10	130.5	12.4	7.4	6.2	5.0	3.8	2.6	1.4	0.2	-1.0	-2.2	-3.4
20	80.4	7.6	9.1	6.7	4.3	1.9	-0.5	-2.9	-5.3	-7.7	-10.1	-12.5
30	60.6	5.7	10.3	6.7	3.1	-0.5	-4.1	-7.7	-11.3	-14.9	-18.5	-22.1
40	49.5	4.7	11.3	6.5	1.7	-3.1	-7.9	-12.7	-17.5	-22.3	-27.1	-31.9
50	42.4	4.0	12.1	6.1	0.1	-5.9	-11.9	-17.9	-23.9	-29.9	-35.9	-41.9
60	37.3	3.5	12.7	5.5	-1.7	-8.9	-16.1	-23.3	-30.5	-37.7	-44.9	-52.1
70	33.5	3.2	13.3	4.9	-3.5	-11.9	-20.3	-28.7	-37.1	-45.5	-53.9	-62.3
80	30.5	2.9	13.9	4.3	-5.3	-14.9	-24.5	-34.1	-43.7	-53.3	-62.9	-72.5
90	28.1	2.7	14.4	3.6	-7.2	-18.0	-28.8	-39.6	-50.4	-61.2	-72.0	-82.8
100	26.1	2.5	14.8	2.8	-9.2	-21.2	-33.2	-45.2	-57.2	-69.2	-81.2	-93.2
110	24.4	2.3	15.3	2.1	-11.1	-24.3	-37.5	-50.7	-63.9	-77.1	-90.3	-103.5
120	23.0	2.2	15.7	1.3	-13.1	-27.5	-41.9	-56.3	-70.7	-85.1	-99.5	-113.9
130	21.7	2.1	16.1	0.5	-15.1	-30.7	-46.3	-61.9	-77.5	-93.1	-108.7	-124.3
140	20.6	2.0	16.4	-0.4	-17.2	-34.0	-50.8	-67.6	-84.4	-101.2	-118.0	-134.8
150	19.7	1.9	16.8	-1.2	-19.2	-37.2	-55.2	-73.2	-91.2	-109.2	-127.2	-145.2
160	18.8	1.8	17.1	-2.1	-21.3	-40.5	-59.7	-78.9	-98.1	-117.3	-136.5	-155.7
170	18.0	1.7	17.4	-3.0	-23.4	-43.8	-64.2	-84.6	-105.0	-125.4	-145.8	-166.2
180	17.3	1.6	17.7	-3.9	-25.5	-47.1	-68.7	-90.3	-111.9	-133.5	-155.1	-176.7
190	16.7	1.6	18.0	-4.8	-27.6	-50.4	-73.2	-96.0	-118.8	-141.6	-164.4	-187.2
200	16.1	1.5	18.3	-5.7	-29.7	-53.7	-77.7	-101.7	-125.7	-149.7	-173.7	-197.7
Maximum Storage Rate =			18.3	6.7	5.0	4.2	3.6	3.0	2.4	1.8	1.2	0.6

APPENDIX A: SPREADSHEET 8a
REQUIRED STORAGE VS. RELEASE RATE CA4

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA4

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0134	0.90	**0.78**	0.99	**0.86**	1.00	**0.88**
	Asphalt	0.0412	0.90		0.99		1.00	
0.0754	Sidewalk	0.0072	0.90		0.99		1.00	
	Grass	0.0136	0.25		0.28		0.31	

Impervious Ratio 0.82

REQUIRED STORAGE VERSUS RELEASE RATE FOR 2 YEAR STORM

Runoff Coeffcient, C = **0.78**
Drainage Area (ha) = **0.075**
Return Period (yrs) = **2**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	116.4	19.0	5.7	5.1	4.5	3.9	3.3	2.7	2.1	1.5	0.9	0.3
10	71.7	11.7	7.0	5.8	4.6	3.4	2.2	1.0	-0.2	-1.4	-2.6	-3.8
20	44.2	7.2	8.7	6.3	3.9	1.5	-0.9	-3.3	-5.7	-8.1	-10.5	-12.9
30	33.3	5.4	9.8	6.2	2.6	-1.0	-4.6	-8.2	-11.8	-15.4	-19.0	-22.6
40	27.2	4.4	10.7	5.9	1.1	-3.7	-8.5	-13.3	-18.1	-22.9	-27.7	-32.5
50	23.3	3.8	11.4	5.4	-0.6	-6.6	-12.6	-18.6	-24.6	-30.6	-36.6	-42.6
60	20.5	3.4	12.1	4.9	-2.3	-9.5	-16.7	-23.9	-31.1	-38.3	-45.5	-52.7
70	18.4	3.0	12.6	4.2	-4.2	-12.6	-21.0	-29.4	-37.8	-46.2	-54.6	-63.0
80	16.8	2.7	13.2	3.6	-6.0	-15.6	-25.2	-34.8	-44.4	-54.0	-63.6	-73.2
90	15.4	2.5	13.6	2.8	-8.0	-18.8	-29.6	-40.4	-51.2	-62.0	-72.8	-83.6
100	14.3	2.3	14.1	2.1	-9.9	-21.9	-33.9	-45.9	-57.9	-69.9	-81.9	-93.9
110	13.4	2.2	14.5	1.3	-11.9	-25.1	-38.3	-51.5	-64.7	-77.9	-91.1	-104.3
120	12.6	2.1	14.9	0.5	-13.9	-28.3	-42.7	-57.1	-71.5	-85.9	-100.3	-114.7
130	11.9	2.0	15.2	-0.4	-16.0	-31.6	-47.2	-62.8	-78.4	-94.0	-109.6	-125.2
140	11.3	1.9	15.6	-1.2	-18.0	-34.8	-51.6	-68.4	-85.2	-102.0	-118.8	-135.6
150	10.8	1.8	15.9	-2.1	-20.1	-38.1	-56.1	-74.1	-92.1	-110.1	-128.1	-146.1
160	10.3	1.7	16.2	-3.0	-22.2	-41.4	-60.6	-79.8	-99.0	-118.2	-137.4	-156.6
170	9.9	1.6	16.5	-3.9	-24.3	-44.7	-65.1	-85.5	-105.9	-126.3	-146.7	-167.1
180	9.5	1.6	16.8	-4.8	-26.4	-48.0	-69.6	-91.2	-112.8	-134.4	-156.0	-177.6
190	9.2	1.5	17.1	-5.7	-28.5	-51.3	-74.1	-96.9	-119.7	-142.5	-165.3	-188.1
Maximum Storage Rate =			17.1	6.3	4.6	3.9	3.3	2.7	2.1	1.5	0.9	0.3

REQUIRED STORAGE VERSUS RELEASE RATE FOR 100 YEAR STORM

Runoff Coeffcient, C = **0.88**
Drainage Area (ha) = **0.075**
Return Period (yrs) = **100**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

		Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
5	259.0	47.8	14.3	13.7	13.1	12.5	11.9	11.3	10.7	10.1	9.5	8.9
10	159.5	29.4	17.7	16.5	15.3	14.1	12.9	11.7	10.5	9.3	8.1	6.9
20	98.3	18.1	21.8	19.4	17.0	14.6	12.2	9.8	7.4	5.0	2.6	0.2
30	74.0	13.7	24.6	21.0	17.4	13.8	10.2	6.6	3.0	-0.6	-4.2	-7.8
40	60.5	11.2	26.8	22.0	17.2	12.4	7.6	2.8	-2.0	-6.8	-11.6	-16.4
50	51.8	9.6	28.7	22.7	16.7	10.7	4.7	-1.3	-7.3	-13.3	-19.3	-25.3
60	45.6	8.4	30.3	23.1	15.9	8.7	1.5	-5.7	-12.9	-20.1	-27.3	-34.5
70	40.9	7.6	31.7	23.3	14.9	6.5	-1.9	-10.3	-18.7	-27.1	-35.5	-43.9
80	37.3	6.9	33.0	23.4	13.8	4.2	-5.4	-15.0	-24.6	-34.2	-43.8	-53.4
90	34.3	6.3	34.2	23.4	12.6	1.8	-9.0	-19.8	-30.6	-41.4	-52.2	-63.0
100	31.9	5.9	35.3	23.3	11.3	-0.7	-12.7	-24.7	-36.7	-48.7	-60.7	-72.7
110	29.9	5.5	36.3	23.1	9.9	-3.3	-16.5	-29.7	-42.9	-56.1	-69.3	-82.5
120	28.1	5.2	37.3	22.9	8.5	-5.9	-20.3	-34.7	-49.1	-63.5	-77.9	-92.3
130	26.6	4.9	38.2	22.6	7.0	-8.6	-24.2	-39.8	-55.4	-71.0	-86.6	-102.2
140	25.2	4.7	39.1	22.3	5.5	-11.3	-28.1	-44.9	-61.7	-78.5	-95.3	-112.1
150	24.0	4.4	39.9	21.9	3.9	-14.1	-32.1	-50.1	-68.1	-86.1	-104.1	-122.1
160	23.0	4.2	40.7	21.5	2.3	-16.9	-36.1	-55.3	-74.5	-93.7	-112.9	-132.1
170	22.0	4.1	41.4	21.0	0.6	-19.8	-40.2	-60.6	-81.0	-101.4	-121.8	-142.2
180	21.2	3.9	42.1	20.5	-1.1	-22.7	-44.3	-65.9	-87.5	-109.1	-130.7	-152.3
190	20.4	3.8	42.8	20.0	-2.8	-25.6	-48.4	-71.2	-94.0	-116.8	-139.6	-162.4
200	19.7	3.6	43.5	19.5	-4.5	-28.5	-52.5	-76.5	-100.5	-124.5	-148.5	-172.5
Maximum Storage Rate =			43.5	23.4	17.4	14.6	12.9	11.7	10.7	10.1	9.5	8.9

APPENDIX A: SPREADSHEET 8b
REQUIRED STORAGE VS. RELEASE RATE CA4

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA4

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0134	0.90	**0.76**	0.99	**0.84**	1.00	**0.86**
	Asphalt& Sidewalk	0.0412	0.90		0.99		1.00	
0.0754	Gravel	0.0072	0.70		0.77		0.88	
	Grass	0.0136	0.25		0.28		0.31	

REQUIRED STORAGE VERSUS RELEASE RATE FOR 5 YEAR STORM

Runoff Coeffcient, C = **0.78**
Drainage Area (ha) = **0.075**
Return Period (yrs) = **5**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

			Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)		Storage Required (m^3)									
5	155.1	25.4		7.6	7.0	6.4	5.8	5.2	4.6	4.0	3.4	2.8	2.2
10	95.5	15.6		9.4	8.2	7.0	5.8	4.6	3.4	2.2	1.0	-0.2	-1.4
20	58.8	9.6		11.5	9.1	6.7	4.3	1.9	-0.5	-2.9	-5.3	-7.7	-10.1
30	44.3	7.2		13.0	9.4	5.8	2.2	-1.4	-5.0	-8.6	-12.2	-15.8	-19.4
40	36.2	5.9		14.2	9.4	4.6	-0.2	-5.0	-9.8	-14.6	-19.4	-24.2	-29.0
50	31.0	5.1		15.2	9.2	3.2	-2.8	-8.8	-14.8	-20.8	-26.8	-32.8	-38.8
60	27.3	4.5		16.1	8.9	1.7	-5.5	-12.7	-19.9	-27.1	-34.3	-41.5	-48.7
70	24.5	4.0		16.8	8.4	0.0	-8.4	-16.8	-25.2	-33.6	-42.0	-50.4	-58.8
80	22.3	3.7		17.5	7.9	-1.7	-11.3	-20.9	-30.5	-40.1	-49.7	-59.3	-68.9
90	20.6	3.4		18.2	7.4	-3.4	-14.2	-25.0	-35.8	-46.6	-57.4	-68.2	-79.0
100	19.1	3.1		18.7	6.7	-5.3	-17.3	-29.3	-41.3	-53.3	-65.3	-77.3	-89.3
110	17.9	2.9		19.3	6.1	-7.1	-20.3	-33.5	-46.7	-59.9	-73.1	-86.3	-99.5
120	16.8	2.7		19.8	5.4	-9.0	-23.4	-37.8	-52.2	-66.6	-81.0	-95.4	-109.8
130	15.9	2.6		20.3	4.7	-10.9	-26.5	-42.1	-57.7	-73.3	-88.9	-104.5	-120.1
140	15.1	2.5		20.7	3.9	-12.9	-29.7	-46.5	-63.3	-80.1	-96.9	-113.7	-130.5
150	14.4	2.4		21.2	3.2	-14.8	-32.8	-50.8	-68.8	-86.8	-104.8	-122.8	-140.8
160	13.8	2.2		21.6	2.4	-16.8	-36.0	-55.2	-74.4	-93.6	-112.8	-132.0	-151.2
170	13.2	2.2		22.0	1.6	-18.8	-39.2	-59.6	-80.0	-100.4	-120.8	-141.2	-161.6
180	12.7	2.1		22.4	0.8	-20.8	-42.4	-64.0	-85.6	-107.2	-128.8	-150.4	-172.0
190	12.2	2.0		22.7	-0.1	-22.9	-45.7	-68.5	-91.3	-114.1	-136.9	-159.7	-182.5
Maximum Storage Rate =				22.7	9.4	7.0	5.8	5.2	4.6	4.0	3.4	2.8	2.2

REQUIRED STORAGE VERSUS RELEASE RATE FOR 25 YEAR STORM

Runoff Coeffcient, C = **0.86**
Drainage Area (ha) = **0.075**
Return Period (yrs) = **25**
Duration Interval (min) = **10**
Release Rate Start (L/s) = **0**
Release Rate Interval (L/s) = **2**

			Release Rate -->	0	2	4	6	8	10	12	14	16	18
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)		Storage Required (m^3)									
5	211.9	38.2		11.5	10.9	10.3	9.7	9.1	8.5	7.9	7.3	6.7	6.1
10	130.5	23.5		14.1	12.9	11.7	10.5	9.3	8.1	6.9	5.7	4.5	3.3
20	80.4	14.5		17.4	15.0	12.6	10.2	7.8	5.4	3.0	0.6	-1.8	-4.2
30	60.6	10.9		19.6	16.0	12.4	8.8	5.2	1.6	-2.0	-5.6	-9.2	-12.8
40	49.5	8.9		21.4	16.6	11.8	7.0	2.2	-2.6	-7.4	-12.2	-17.0	-21.8
50	42.4	7.6		22.9	16.9	10.9	4.9	-1.1	-7.1	-13.1	-19.1	-25.1	-31.1
60	37.3	6.7		24.2	17.0	9.8	2.6	-4.6	-11.8	-19.0	-26.2	-33.4	-40.6
70	33.5	6.0		25.4	17.0	8.6	0.2	-8.2	-16.6	-25.0	-33.4	-41.8	-50.2
80	30.5	5.5		26.4	16.8	7.2	-2.4	-12.0	-21.6	-31.2	-40.8	-50.4	-60.0
90	28.1	5.1		27.3	16.5	5.7	-5.1	-15.9	-26.7	-37.5	-48.3	-59.1	-69.9
100	26.1	4.7		28.2	16.2	4.2	-7.8	-19.8	-31.8	-43.8	-55.8	-67.8	-79.8
110	24.4	4.4		29.1	15.9	2.7	-10.5	-23.7	-36.9	-50.1	-63.3	-76.5	-89.7
120	23.0	4.1		29.8	15.4	1.0	-13.4	-27.8	-42.2	-56.6	-71.0	-85.4	-99.8
130	21.7	3.9		30.5	14.9	-0.7	-16.3	-31.9	-47.5	-63.1	-78.7	-94.3	-109.9
140	20.6	3.7		31.2	14.4	-2.4	-19.2	-36.0	-52.8	-69.6	-86.4	-103.2	-120.0
150	19.7	3.5		31.9	13.9	-4.1	-22.1	-40.1	-58.1	-76.1	-94.1	-112.1	-130.1
160	18.8	3.4		32.5	13.3	-5.9	-25.1	-44.3	-63.5	-82.7	-101.9	-121.1	-140.3
170	18.0	3.2		33.1	12.7	-7.7	-28.1	-48.5	-68.9	-89.3	-109.7	-130.1	-150.5
180	17.3	3.1		33.7	12.1	-9.5	-31.1	-52.7	-74.3	-95.9	-117.5	-139.1	-160.7
190	16.7	3.0		34.2	11.4	-11.4	-34.2	-57.0	-79.8	-102.6	-125.4	-148.2	-171.0
200	16.1	2.9		34.8	10.8	-13.2	-37.2	-61.2	-85.2	-109.2	-133.2	-157.2	-181.2
Maximum Storage Rate =				34.8	17.0	12.6	10.5	9.3	8.5	7.9	7.3	6.7	6.1

APPENDIX A: SPREADSHEET 9a
REQUIRED STORAGE VS. RELEASE RATE CA5

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA5

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0000	0.90	**0.27**	0.99	**0.30**	1.00	**0.33**
	Asphalt	0.0000	0.90		0.99		1.00	
0.0761	Sidewalk	0.0024	0.90		0.99		1.00	
	Grass	0.0737	0.25		0.28		0.31	

Impervious Ratio 0.03

REQUIRED STORAGE VERSUS RELEASE RATE FOR 2 YEAR STORM

Runoff Coeffcient, C = **0.27** Duration Interval (min) = **10**
Drainage Area (ha) = **0.076** Release Rate Start (L/s) = **0**
Return Period (yrs) = **2** Release Rate Interval (L/s) = **3**

Max Flow From Upstream Catchments					CA1	5.3	CA2	6	CA3	6.5	CA4	5.1		
Release Rate -->					**0**	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**	**27**
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow CA5 (L/sec)	Flow CA1 to CA4 (L/sec)	Total Peak Flow (L/Sec)	**Storage Required (m^3)**									
5	116.4	6.7	22.9	29.6	8.9	8.0	7.1	6.2	5.3	4.4	3.5	2.6	1.7	0.8
10	71.7	4.1	22.6	26.7	16.0	14.2	12.4	10.6	8.8	7.0	5.2	3.4	1.6	-0.2
20	44.2	2.5	20.2	22.7	27.3	23.7	20.1	16.5	12.9	9.3	5.7	2.1	-1.5	-5.1
30	33.3	1.9	18.5	20.4	36.8	31.4	26.0	20.6	15.2	9.8	4.4	-1.0	-6.4	-11.8
40	27.2	1.6	16.5	18.1	43.4	36.2	29.0	21.8	14.6	7.4	0.2	-7.0	-14.2	-21.4
50	23.3	1.3	14.5	15.8	47.4	38.4	29.4	20.4	11.4	2.4	-6.6	-15.6	-24.6	-33.6
60	20.5	1.2	12.8	13.9	50.1	39.3	28.5	17.7	6.9	-3.9	-14.7	-25.5	-36.3	-47.1
70	18.4	1.1	11.4	12.5	52.5	39.9	27.3	14.7	2.1	-10.5	-23.1	-35.7	-48.3	-60.9
80	16.8	1.0	10.4	11.4	54.6	40.2	25.8	11.4	-3.0	-17.4	-31.8	-46.2	-60.6	-75.0
90	15.4	0.9	9.6	10.5	56.6	40.4	24.2	8.0	-8.2	-24.4	-40.6	-56.8	-73.0	-89.2
100	14.3	0.8	8.9	9.7	58.4	40.4	22.4	4.4	-13.6	-31.6	-49.6	-67.6	-85.6	-103.6
110	13.4	0.8	8.3	9.1	60.1	40.3	20.5	0.7	-19.1	-38.9	-58.7	-78.5	-98.3	-118.1
120	12.6	0.7	7.9	8.6	61.7	40.1	18.5	-3.1	-24.7	-46.3	-67.9	-89.5	-111.1	-132.7
130	11.9	0.7	7.4	8.1	63.2	39.8	16.4	-7.0	-30.4	-53.8	-77.2	-100.6	-124.0	-147.4
140	11.3	0.6	7.1	7.7	64.7	39.5	14.3	-10.9	-36.1	-61.3	-86.5	-111.7	-136.9	-162.1
150	10.8	0.6	6.7	7.3	66.0	39.0	12.0	-15.0	-42.0	-69.0	-96.0	-123.0	-150.0	-177.0
160	10.3	0.6	6.4	7.0	67.3	38.5	9.7	-19.1	-47.9	-76.7	-105.5	-134.3	-163.1	-191.9
170	9.9	0.6	6.2	6.7	68.6	38.0	7.4	-23.2	-53.8	-84.4	-115.0	-145.6	-176.2	-206.8
180	9.5	0.5	5.9	6.5	69.8	37.4	5.0	-27.4	-59.8	-92.2	-124.6	-157.0	-189.4	-221.8
190	9.2	0.5	5.7	6.2	70.9	36.7	2.5	-31.7	-65.9	-100.1	-134.3	-168.5	-202.7	-236.9
Maximum Storage Rate =					70.9	40.4	29.4	21.8	15.2	9.8	5.7	3.4	1.7	0.8

REQUIRED STORAGE VERSUS RELEASE RATE FOR 100 YEAR STORM

Runoff Coeffcient, C = **0.33** Duration Interval (min) = **10**
Drainage Area (ha) = **0.076** Release Rate Start (L/s) = **0**
Return Period (yrs) = **100** Release Rate Interval (L/s) = **3**

Max Flow From Upstream Catchments					CA1	5.7	CA2	6.3	CA3	6.8	CA4	5.4		
Release Rate -->					**0**	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**	**27**
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Flow CA1 to CA4 (L/sec)	Total Peak Flow (L/Sec)	**Storage Required (m^3)**									
5	259.0	18.1	24.2	42.3	12.7	11.8	10.9	10.0	9.1	8.2	7.3	6.4	5.5	4.6
10	159.5	11.1	24.2	35.3	21.2	19.4	17.6	15.8	14.0	12.2	10.4	8.6	6.8	5.0
20	98.3	6.9	24.2	31.1	37.3	33.7	30.1	26.5	22.9	19.3	15.7	12.1	8.5	4.9
30	74.0	5.2	24.2	29.4	52.9	47.5	42.1	36.7	31.3	25.9	20.5	15.1	9.7	4.3
40	60.5	4.2	23.2	27.4	65.8	58.6	51.4	44.2	37.0	29.8	22.6	15.4	8.2	1.0
50	51.8	3.6	22.4	26.0	78.0	69.0	60.0	51.0	42.0	33.0	24.0	15.0	6.0	-3.0
60	45.6	3.2	21.8	25.0	89.8	79.0	68.2	57.4	46.6	35.8	25.0	14.2	3.4	-7.4
70	40.9	2.9	21.3	24.2	101.6	89.0	76.4	63.8	51.2	38.6	26.0	13.4	0.8	-11.8
80	37.3	2.6	21.0	23.6	113.2	98.8	84.4	70.0	55.6	41.2	26.8	12.4	-2.0	-16.4
90	34.3	2.4	20.4	22.8	123.0	106.8	90.6	74.4	58.2	42.0	25.8	9.6	-6.6	-22.8
100	31.9	2.2	19.8	22.0	132.0	114.0	96.0	78.0	60.0	42.0	24.0	6.0	-12.0	-30.0
110	29.9	2.1	19.3	21.3	140.8	121.0	101.2	81.4	61.6	41.8	22.0	2.2	-17.6	-37.4
120	28.1	2.0	18.6	20.5	147.9	126.3	104.7	83.1	61.5	39.9	18.3	-3.3	-24.9	-46.5
130	26.6	1.9	17.9	19.8	154.2	130.8	107.4	84.0	60.6	37.2	13.8	-9.6	-33.0	-56.4
140	25.2	1.8	17.3	19.1	160.4	135.2	110.0	84.8	59.6	34.4	9.2	-16.0	-41.2	-66.4
150	24.0	1.7	16.8	18.5	166.4	139.4	112.4	85.4	58.4	31.4	4.4	-22.6	-49.6	-76.6
160	23.0	1.6	16.1	17.7	169.9	141.1	112.3	83.5	54.7	25.9	-2.9	-31.7	-60.5	-89.3
170	22.0	1.5	15.4	17.0	173.0	142.4	111.8	81.2	50.6	20.0	-10.6	-41.2	-71.8	-102.4
180	21.2	1.5	14.8	16.3	176.0	143.6	111.2	78.8	46.4	14.0	-18.4	-50.8	-83.2	-115.6
190	20.4	1.4	14.3	15.7	178.9	144.7	110.5	76.3	42.1	7.9	-26.3	-60.5	-94.7	-128.9
200	19.7	1.4	13.8	15.1	181.7	145.7	109.7	73.7	37.7	1.7	-34.3	-70.3	-106.3	-142.3
Maximum Storage Rate =					181.7	145.7	112.4	85.4	61.6	42.0	26.8	15.4	9.7	5.0

APPENDIX A: SPREADSHEET9b
REQUIRED STORAGE VS. RELEASE RATE CA5

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

Post Dev run-off Coefficient "C" - CA5

			2, 5 Year Event		25 Year Event		100 Year Event	
Area (ha)	Surface	Area (ha)	"C"	C_{avg}	"C" x 1.10	$C_{25\ avg}$	"C" x 1.25	$C_{100\ avg}$
Total	Roof	0.0000	0.90	**0.26**	0.99	**0.29**	1.00	**0.33**
	Asphalt& Sidewalk	0.0000	0.90		0.99		1.00	
0.0761	Gravel	0.0024	0.70		0.77		0.88	
	Grass	0.0737	0.25		0.28		0.31	

REQUIRED STORAGE VERSUS RELEASE RATE FOR 5 YEAR STORM

Runoff Coeffcient, C =				**0.27**		Duration Interval (min) =		**10**				
Drainage Area (ha) =				**0.076**		Release Rate Start (L/s) =		**0**				
Return Period (yrs) =				**5**		Release Rate Interval (L/s) =		**3**				
Max Flow From Upstream Catchments				CA1	5.5	CA2	6.1	CA3	6.6	CA4	5.2	
Release Rate -->				**0**	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**	**27**
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Flow CA1 to CA4 (L/sec)	Total Peak Flow (L/Sec)	**Storage Required (m^3)**								
5	155.1	8.9	23.4	32.3	9.7	8.8	7.9	7.0	6.1	5.2	4.3	3.4	2.5	1.6
10	95.5	5.5	23.4	28.9	17.3	15.5	13.7	11.9	10.1	8.3	6.5	4.7	2.9	1.1
20	58.8	3.4	21.9	25.2	30.3	26.7	23.1	19.5	15.9	12.3	8.7	5.1	1.5	-2.1
30	44.3	2.5	20.6	23.1	41.7	36.3	30.9	25.5	20.1	14.7	9.3	3.9	-1.5	-6.9
40	36.2	2.1	19.4	21.5	51.5	44.3	37.1	29.9	22.7	15.5	8.3	1.1	-6.1	-13.3
50	31.0	1.8	18.1	19.9	59.6	50.6	41.6	32.6	23.6	14.6	5.6	-3.4	-12.4	-21.4
60	27.3	1.6	16.7	18.2	65.6	54.8	44.0	33.2	22.4	11.6	0.8	-10.0	-20.8	-31.6
70	24.5	1.4	15.2	16.6	69.9	57.3	44.7	32.1	19.5	6.9	-5.7	-18.3	-30.9	-43.5
80	22.3	1.3	13.9	15.2	72.8	58.4	44.0	29.6	15.2	0.8	-13.6	-28.0	-42.4	-56.8
90	20.6	1.2	12.8	14.0	75.4	59.2	43.0	26.8	10.6	-5.6	-21.8	-38.0	-54.2	-70.4
100	19.1	1.1	11.9	13.0	77.8	59.8	41.8	23.8	5.8	-12.2	-30.2	-48.2	-66.2	-84.2
110	17.9	1.0	11.1	12.1	80.1	60.3	40.5	20.7	0.9	-18.9	-38.7	-58.5	-78.3	-98.1
120	16.8	1.0	10.5	11.4	82.2	60.6	39.0	17.4	-4.2	-25.8	-47.4	-69.0	-90.6	-112.2
130	15.9	0.9	9.9	10.8	84.2	60.8	37.4	14.0	-9.4	-32.8	-56.2	-79.6	-103.0	-126.4
140	15.1	0.9	9.4	10.3	86.1	60.9	35.7	10.5	-14.7	-39.9	-65.1	-90.3	-115.5	-140.7
150	14.4	0.8	8.9	9.8	87.9	60.9	33.9	6.9	-20.1	-47.1	-74.1	-101.1	-128.1	-155.1
160	13.8	0.8	8.6	9.3	89.7	60.9	32.1	3.3	-25.5	-54.3	-83.1	-111.9	-140.7	-169.5
170	13.2	0.8	8.2	9.0	91.3	60.7	30.1	-0.5	-31.1	-61.7	-92.3	-122.9	-153.5	-184.1
180	12.7	0.7	7.9	8.6	92.9	60.5	28.1	-4.3	-36.7	-69.1	-101.5	-133.9	-166.3	-198.7
190	12.2	0.7	7.6	8.3	94.4	60.2	26.0	-8.2	-42.4	-76.6	-110.8	-145.0	-179.2	-213.4
Maximum Storage Rate =					94.4	60.9	44.7	33.2	23.6	15.5	9.3	5.1	2.9	1.6

REQUIRED STORAGE VERSUS RELEASE RATE FOR 25 YEAR STORM

Runoff Coeffcient, C =				**0.30**		Duration Interval (min) =		**10**				
Drainage Area (ha) =				**0.076**		Release Rate Start (L/s) =		**0**				
Return Period (yrs) =				**25**		Release Rate Interval (L/s) =		**3**				
Max Flow From Upstream Catchments				CA1	5.9	CA2	6.2	CA3	6.7	CA4	5.3	
Release Rate -->				**0**	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**	**27**
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Flow CA1 to CA4 (L/sec)	Total Peak Flow (L/Sec)	**Storage Required (m^3)**								
5	211.9	13.4	24.1	37.5	11.3	10.4	9.5	8.6	7.7	6.8	5.9	5.0	4.1	3.2
10	130.5	8.3	24.1	32.4	19.4	17.6	15.8	14.0	12.2	10.4	8.6	6.8	5.0	3.2
20	80.4	5.1	24.1	29.2	35.0	31.4	27.8	24.2	20.6	17.0	13.4	9.8	6.2	2.6
30	60.6	3.8	23.1	27.0	48.6	43.2	37.8	32.4	27.0	21.6	16.2	10.8	5.4	0.0
40	49.5	3.1	22.1	25.2	60.6	53.4	46.2	39.0	31.8	24.6	17.4	10.2	3.0	-4.2
50	42.4	2.7	21.4	24.1	72.3	63.3	54.3	45.3	36.3	27.3	18.3	9.3	0.3	-8.7
60	37.3	2.4	20.7	23.1	83.0	72.2	61.4	50.6	39.8	29.0	18.2	7.4	-3.4	-14.2
70	33.5	2.1	19.7	21.9	91.9	79.3	66.7	54.1	41.5	28.9	16.3	3.7	-8.9	-21.5
80	30.5	1.9	19.0	20.9	100.6	86.2	71.8	57.4	43.0	28.6	14.2	-0.2	-14.6	-29.0
90	28.1	1.8	18.2	20.0	107.8	91.6	75.4	59.2	43.0	26.8	10.6	-5.6	-21.8	-38.0
100	26.1	1.7	17.3	19.0	113.9	95.9	77.9	59.9	41.9	23.9	5.9	-12.1	-30.1	-48.1
110	24.4	1.5	16.6	18.2	119.9	100.1	80.3	60.5	40.7	20.9	1.1	-18.7	-38.5	-58.3
120	23.0	1.5	15.7	17.2	123.6	102.0	80.4	58.8	37.2	15.6	-6.0	-27.6	-49.2	-70.8
130	21.7	1.4	14.8	16.2	126.6	103.2	79.8	56.4	33.0	9.6	-13.8	-37.2	-60.6	-84.0
140	20.6	1.3	14.1	15.4	129.4	104.2	79.0	53.8	28.6	3.4	-21.8	-47.0	-72.2	-97.4
150	19.7	1.2	13.4	14.7	132.1	105.1	78.1	51.1	24.1	-2.9	-29.9	-56.9	-83.9	-110.9
160	18.8	1.2	12.8	14.0	134.7	105.9	77.1	48.3	19.5	-9.3	-38.1	-66.9	-95.7	-124.5
170	18.0	1.1	12.3	13.5	137.2	106.6	76.0	45.4	14.8	-15.8	-46.4	-77.0	-107.6	-138.2
180	17.3	1.1	11.8	12.9	139.6	107.2	74.8	42.4	10.0	-22.4	-54.8	-87.2	-119.6	-152.0
190	16.7	1.1	11.4	12.4	141.9	107.7	73.5	39.3	5.1	-29.1	-63.3	-97.5	-131.7	-165.9
200	16.1	1.0	11.0	12.0	144.1	108.1	72.1	36.1	0.1	-35.9	-71.9	-107.9	-143.9	-179.9
Maximum Storage Rate =					144.1	108.1	80.4	60.5	43.0	29.0	18.3	10.8	6.2	3.2

Kollaard Associates
Engineers
210 Prescott Street, Unit 1
P.O. Box 189
Kemptville, Ontario K0G 1J0

Civil ●
Geotechnical ●
Hydrogeological ●
Inspection Testing ●
Septic Systems Grading ●
Structural ● Environmental ●

APPENDIX A: SPREADSHEET 10

CATCHMENT AREA OUTLET CONTROL DESIGN SHEET

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West, Gananoque
Date: October 6, 2021

CA1

Infiltration Information: Permeability k = 0.000001; Depth of Layer = 0.4
ICD Information: Outlet Pipe Dia: 0.250; ICD Type: Hydrovex; Model: 75SVHV-1; ICD Inv (m): 91.57
Weir Information: Width 1.000; Coeff, Cd: 0.50; Weir Invert 93.00

Stage, WSE Elev (m)	Comments	Layer Thickness (m)	Top Layer Area (m^2)	Bottom Layer Area (m^2)	Layer Volume (m^3)	Infiltration Head* (m)	Infiltration Hydraulic Gradient	Infiltration Rate (m^3/sec)	ICD Flow Head* (m)	ICD Flow Orifice Flow (m^3/sec)	Weir Flow Head* (m)	Weir Flow Weir Flow (m^3/sec)	Combined Outflow (L/sec)	Quantity Storage m3)
93.00		0.050	293	223	12.9	0.40	2.00	0.0006	1.430	0.0062	0.000	0.0000	6.8	36.9
92.95		0.050	223	156	9.4	0.35	1.87	0.0004	1.380	0.0060	0.000	0.0000	6.4	24.0
92.90		0.050	156	80	5.8	0.30	1.75	0.0003	1.330	0.0058	0.000	0.0000	6.1	14.6
92.85		0.050	80	61	3.5	0.25	1.62	0.0001	1.280	0.0056	0.000	0.0000	5.7	8.8
92.80		0.050	61	42	2.6	0.20	1.50	0.0001	1.230	0.0054	0.000	0.0000	5.5	5.3
92.75		0.050	42	25	1.7	0.15	1.37	0.0001	1.180	0.0053	0.000	0.0000	5.4	2.7
92.70		0.050	25	10	0.8	0.10	1.25	0.0000	1.130	0.0052	0.000	0.0000	5.2	1.1
92.65		0.050	10	1	0.2	0.05	1.12	0.0000	1.080	0.0051	0.000	0.0000	5.1	0.2
92.60		0.000	1	0	0.0	0.00	1.00	0.0000	1.030	0.0050	0.000	0.0000	5.0	0.0

CA2

Infiltration Information: Permeability k = 0; Depth of Layer = 0.4
ICD Information: Outlet Pipe Dia: 0.250; ICD Type: Hydrovex; Model: 75SVHV-1; ICD Inv (m): 91.53
Weir Information: Width 1.000; Coeff, Cd: 0.50; Weir Invert 93.00

Stage, WSE Elev (m)	Comments	Layer Thickness (m)	Top Layer Area (m^2)	Bottom Layer Area (m^2)	Layer Volume (m^3)	Infiltration Head* (m)	Infiltration Hydraulic Gradient	Infiltration Rate (m^3/sec)	Orifice Flow Head* (m)	Orifice Flow Orifice Flow (m^3/sec)	Weir Flow Head* (m)	Weir Flow Weir Flow (m^3/sec)	Combined Outflow (L/sec)	Quantity Storage m3)
93.05		0.050	416	416	20.8	0.25	1.62	0.0000	1.520	0.0066	0.050	0.0165	6.6	52.6
93.00		0.050	416	267	16.9	0.20	1.50	0.0000	1.470	0.0064	0.000	0.0000	6.4	31.8
92.95		0.050	267	136	9.9	0.15	1.37	0.0000	1.420	0.0062	0.000	0.0000	6.2	14.9
92.90		0.050	136	42	4.2	0.10	1.25	0.0000	1.370	0.0060	0.000	0.0000	6.0	5.0
92.85		0.050	42	1	0.8	0.05	1.12	0.0000	1.320	0.0058	0.000	0.0000	5.8	0.8
92.80		0.000	1	0	0.0	0.00	1.00	0.0000	1.270	0.0056	0.000	0.0000	5.6	0.0

CA3

Infiltration Information: Permeability k = 0; Depth of Layer = 0.4
ICD Information: Outlet Pipe Dia: 0.250; ICD Type: Hydrovex; Model: 75SVHV-1; ICD Inv (m): 91.35
Weir Information: Width 1.000; Coeff, Cd: 0.50; Weir Invert 93.00

Stage, WSE Elev (m)	Comments	Layer Thickness (m)	Top Layer Area (m^2)	Bottom Layer Area (m^2)	Layer Volume (m^3)	Infiltration Head* (m)	Infiltration Hydraulic Gradient	Infiltration Rate (m^3/sec)	Orifice Flow Head* (m)	Orifice Flow Orifice Flow (m^3/sec)	Weir Flow Head* (m)	Weir Flow Weir Flow (m^3/sec)	Combined Outflow (L/sec)	Quantity Storage m3)
93.05		0.050	290	277	14.2	0.25	1.62	0.0000	1.700	0.0073	0.050	0.0165	7.3	39.6
93.00		0.050	277	234	12.8	0.20	1.50	0.0000	1.650	0.0071	0.000	0.0000	7.1	25.4
92.95		0.050	234	111	8.4	0.15	1.37	0.0000	1.600	0.0069	0.000	0.0000	6.9	12.6
92.90		0.050	111	36	3.5	0.10	1.25	0.0000	1.550	0.0067	0.000	0.0000	6.7	4.2
92.85		0.050	36	1	0.7	0.05	1.12	0.0000	1.500	0.0065	0.000	0.0000	6.5	0.7
92.80		0.000	1	0	0.0	0.00	1.00	0.0000	1.450	0.0063	0.000	0.0000	6.3	0.0

CA4

Infiltration Information: Permeability k = 0; Depth of Layer = 0.4
ICD Information: Outlet Pipe Dia: 0.250; ICD Type: Hydrovex; Model: 75SVHV-1; ICD Inv (m): 91.55
Weir Information: Width 6.000; Coeff, Cd: 0.50; Weir Invert 92.75

Stage, WSE Elev (m)	Comments	Layer Thickness (m)	Top Layer Area (m^2)	Bottom Layer Area (m^2)	Layer Volume (m^3)	Infiltration Head* (m)	Infiltration Hydraulic Gradient	Infiltration Rate (m^3/sec)	Orifice Flow Head* (m)	Orifice Flow Orifice Flow (m^3/sec)	Weir Flow Head* (m)	Weir Flow Weir Flow (m^3/sec)	Combined Outflow (L/sec)	Quantity Storage m3)
92.80		0.050	268	227	12.4	0.25	1.62	0.0000	1.250	0.0055	0.050	0.0990	5.5	34.1
92.75		0.050	227	181	10.2	0.20	1.50	0.0000	1.200	0.0054	0.000	0.0000	5.4	21.8
92.70		0.050	181	91	6.7	0.15	1.37	0.0000	1.150	0.0053	0.000	0.0000	5.3	11.6
92.65		0.050	91	62	3.8	0.10	1.25	0.0000	1.100	0.0052	0.000	0.0000	5.2	4.9
92.60		0.050	62	1	1.1	0.05	1.12	0.0000	1.050	0.0051	0.000	0.0000	5.1	1.1
92.55		0.000	1	0	0.0	0.00	1.00	0.0000	1.000	0.0050	0.000	0.0000	5.0	0.0

CA5

Infiltration Information: Permeability k = 0.000001; Depth of Layer = 0.4
ICD Information: Outlet Pipe Dia: 0.250; ICD Type: Hydrovex; Model: 100SVHV-2; ICD Inv (m): 91.20
Weir Information: Width 6.000; Coeff, Cd: 0.50; Weir Invert 92.75

Stage, WSE Elev (m)	Comments	Layer Thickness (m)	Top Layer Area (m^2)	Bottom Layer Area (m^2)	Layer Volume (m^3)	Infiltration Head* (m)	Infiltration Hydraulic Gradient	Infiltration Rate (m^3/sec)	Orifice Flow Head* (m)	Orifice Flow Orifice Flow (m^3/sec)	Weir Flow Head* (m)	Weir Flow Weir Flow (m^3/sec)	Combined Outflow (L/sec)	Quantity Storage m3)
92.80		0.050	513	500	25.3	0.30	1.75	0.0009	1.600	0.0118	0.050	0.0990	111.7	106.5
92.75		0.050	500	437	23.4	0.25	1.62	0.0008	1.550	0.0116	0.000	0.0000	12.4	81.2
92.70		0.050	437	371	20.2	0.20	1.50	0.0007	1.500	0.0114	0.000	0.0000	12.1	57.8
92.65		0.050	371	298	16.7	0.15	1.37	0.0005	1.450	0.0112	0.000	0.0000	11.7	37.6
92.60		0.050	298	216	12.8	0.10	1.25	0.0004	1.400	0.0110	0.000	0.0000	11.4	20.9
92.55		0.050	216	114	8.1	0.05	1.12	0.0002	1.350	0.0108	0.000	0.0000	11.0	8.1
92.50		0.000	114	0	0.0	0.00	1.00	0.0001	1.300	0.0106	0.000	0.0000	10.7	0.0

Orifice FLOW

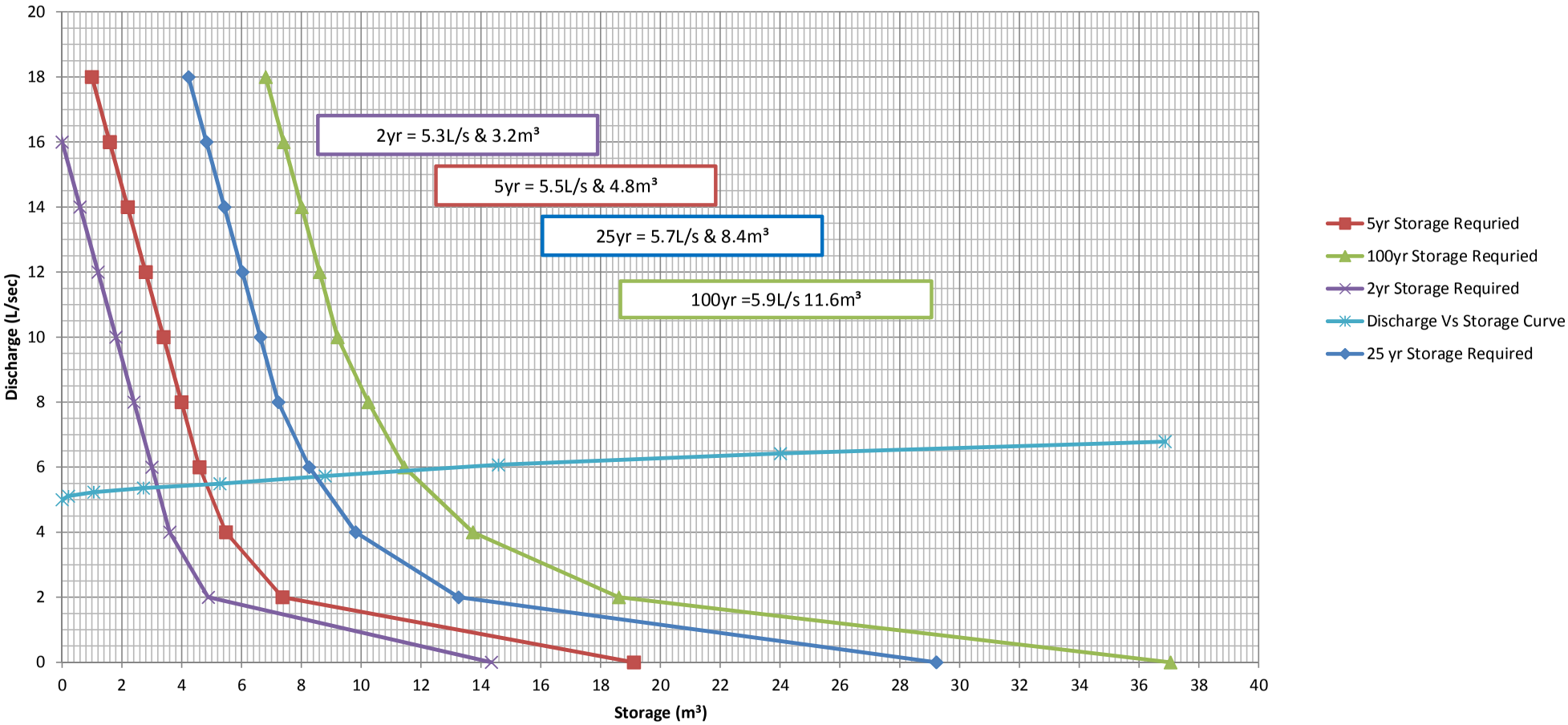
$Q_{ORIFICE} = C\ A\ (2\ g\ H)^{0.5}$

where:

C = Discharge Coefficient
$Q_{ORIFICE}$ = Orifice Flow (m^3/s)
A = Orifice Area (m^2)
g = Accel due to Gravity (9.81 m/s^2)
H = Head above centre of orifice (m)

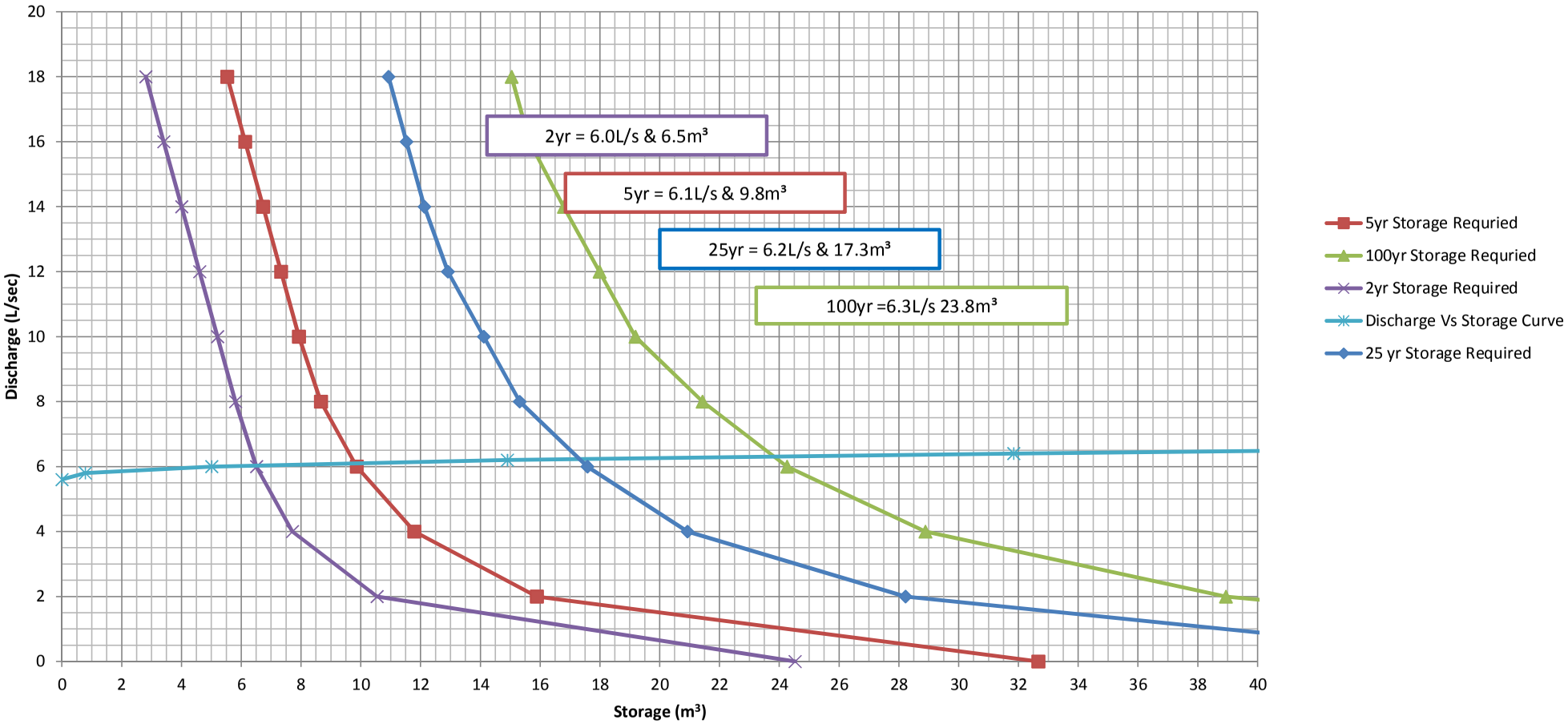
APPENDIX A: FIGURE 1
CA1 - Discharge-Storage Curve

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West Gananoque, ON
Date: October 6, 2021



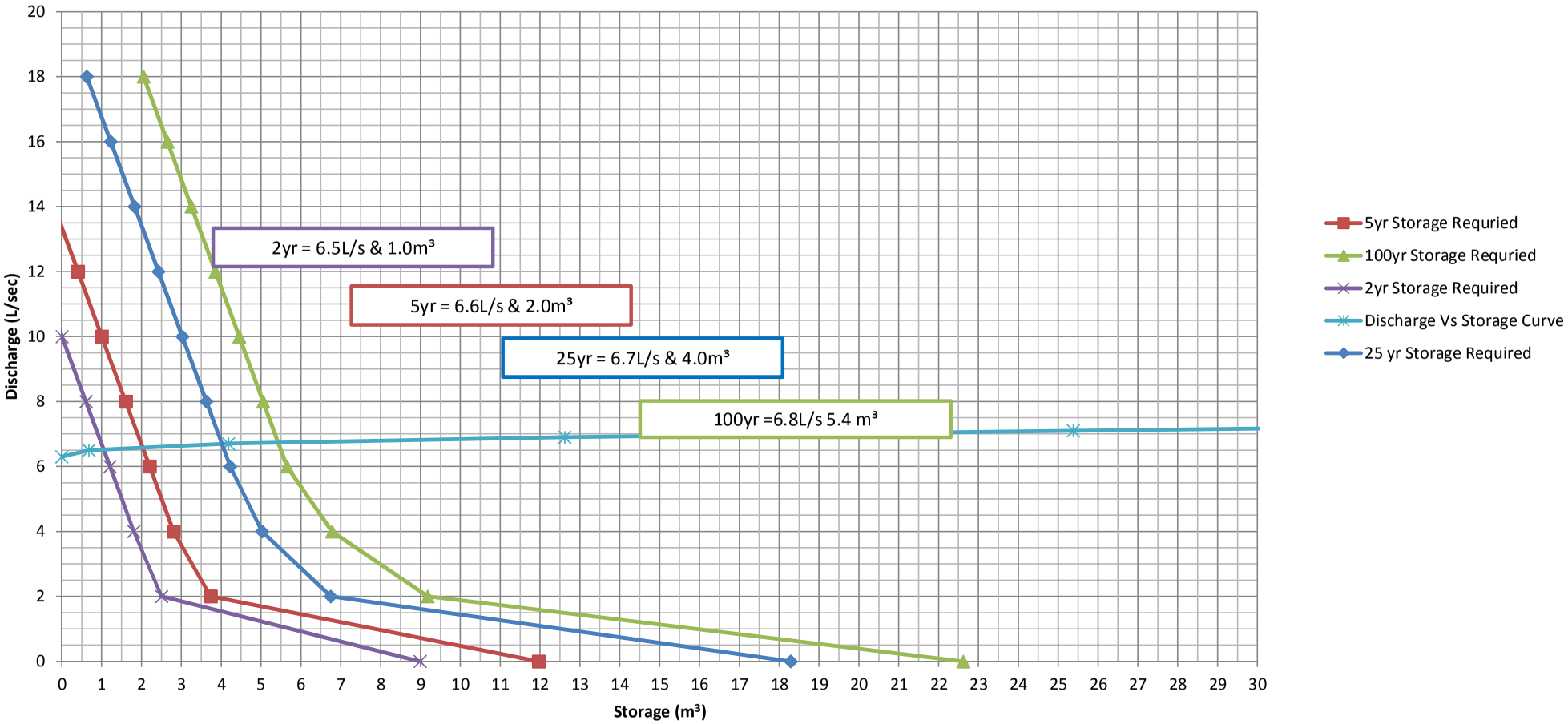
APPENDIX A: FIGURE 2
CA2 - Discharge-Storage Curve

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West Gananoque, ON
Date: October 6, 2021



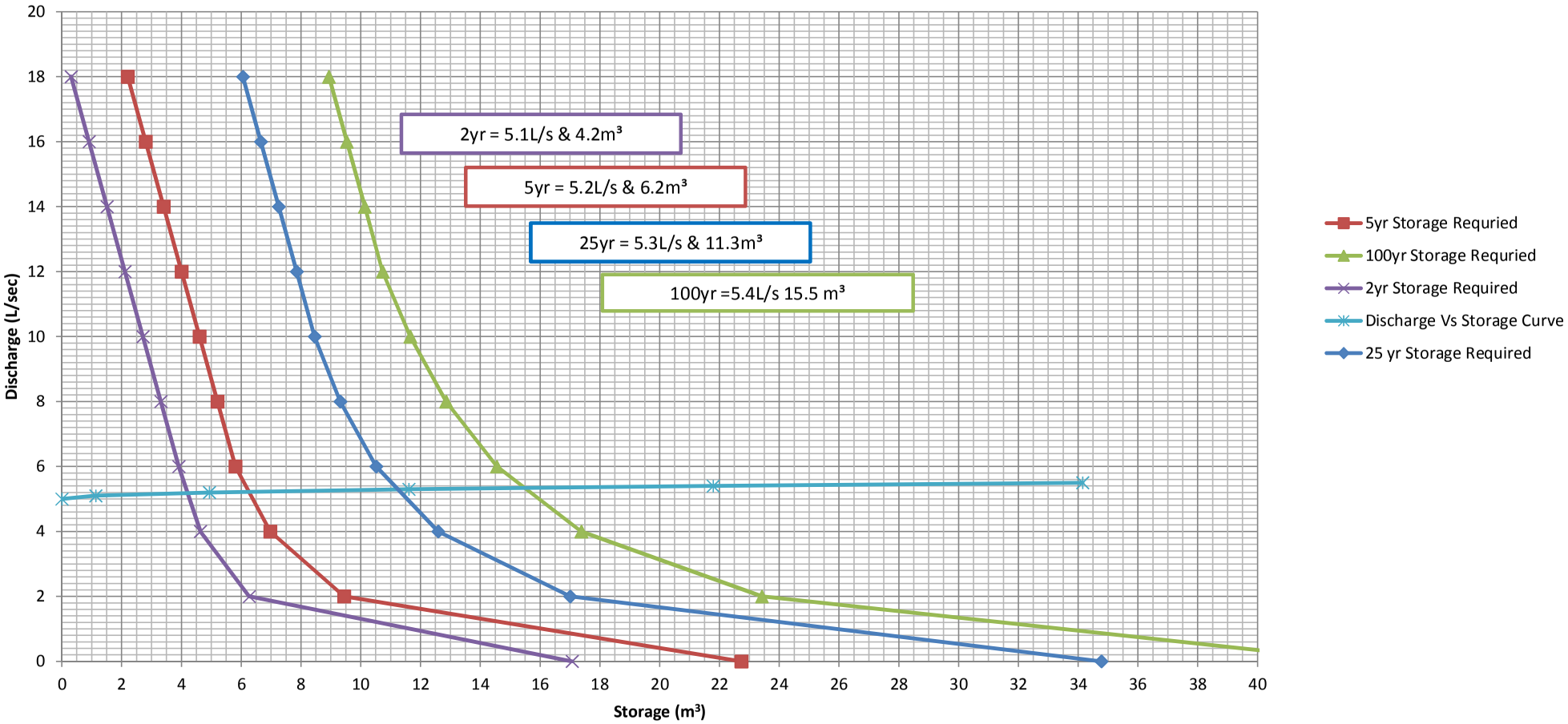
APPENDIX A: FIGURE 3
CA3 - Discharge-Storage Curve

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West Gananoque, ON
Date: October 6, 2021



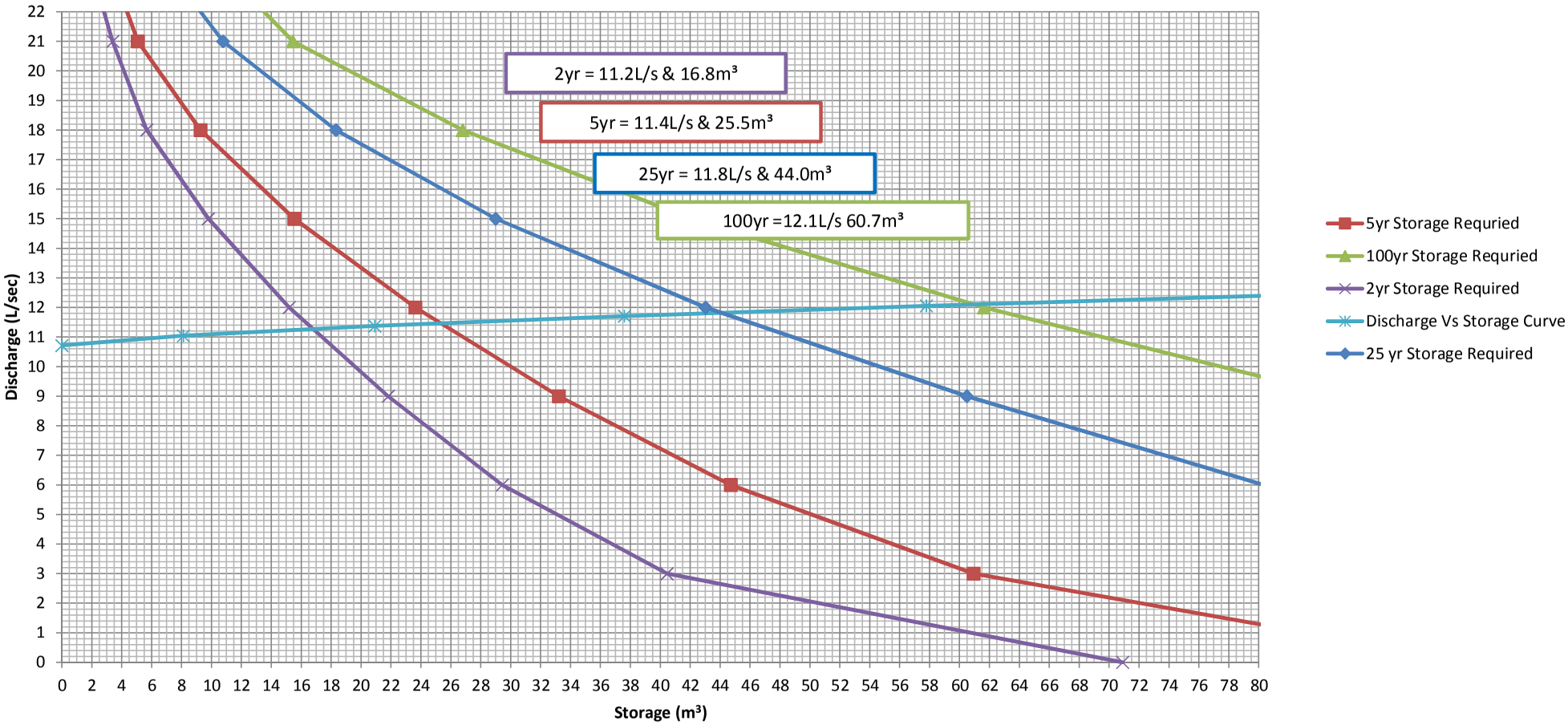
APPENDIX A: FIGURE 4
CA4 - Discharge-Storage Curve

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West Gananoque, ON
Date: October 6, 2021



APPENDIX A: FIGURE 5
CA5 - Discharge-Storage Curve

Client: 9695443 Canada Inc.
Job No.: 201052
Location: King Street West Gananoque, ON
Date: October 6, 2021



Appendix B: Product Information

- Hydrovex Selection Chart
- CDS Treatment Unit

*There are no changes to this Appendix from the March 17, 2021 Submission.

HYDROVEX®

SVHV Vertical Vortex Flow Regulator

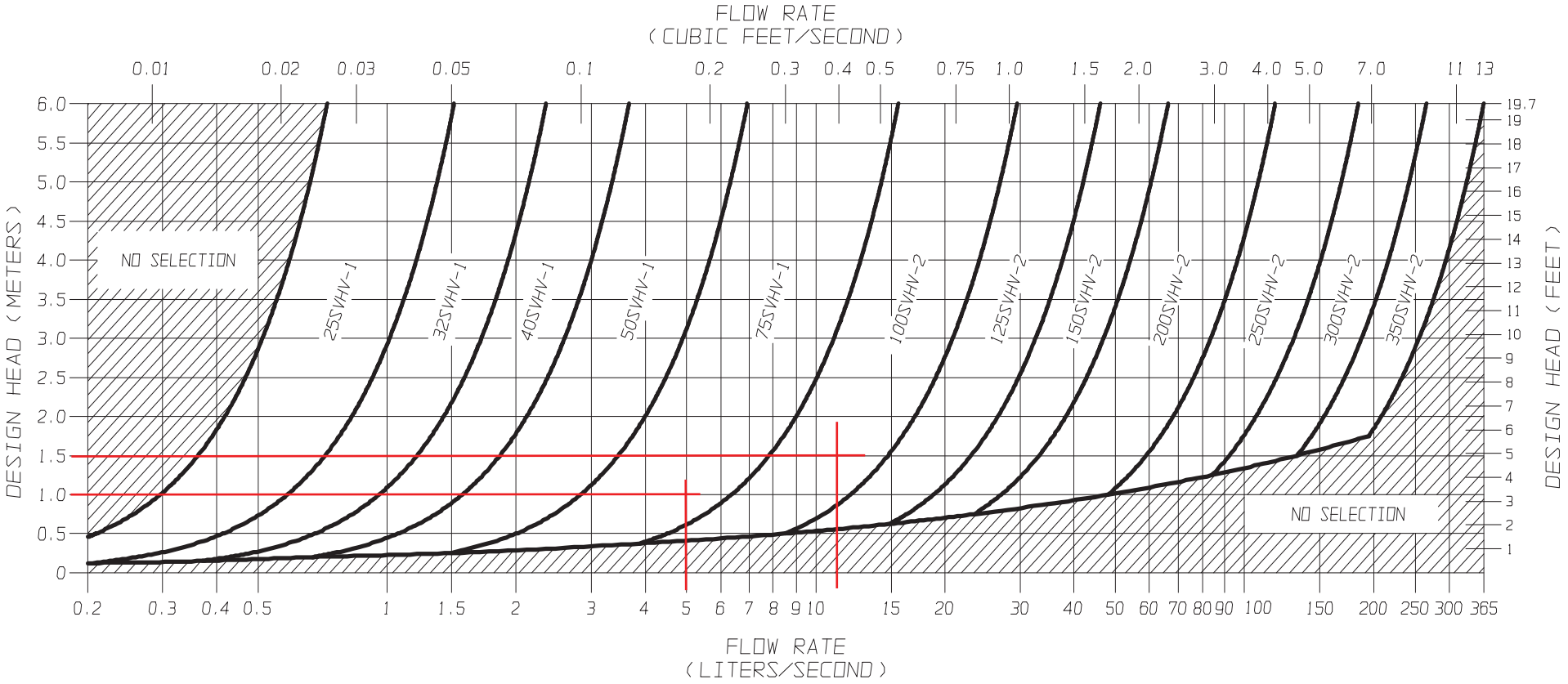


FIGURE 3 - SVHV

JOHN MEUNIER

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

Project Name: King Street West
Location: Norwich, ON
OGS #: OGS

Engineer: **Kollaard Associates Inc**
Contact: Steven deWit, P.Eng.
Report Date: 4-Mar-21

Area	0.3987	ha	**Rainfall Station #**	214	
Weighted C	0.59		**Particle Size Distribution**	FINE	
CDS Model	2015-4		**CDS Treatment Capacity**	20	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	9.9%	9.9%	0.3	0.3	1.6	98.4	9.7
1.0	10.8%	20.7%	0.7	0.7	3.3	97.9	10.6
1.5	10.1%	30.8%	1.0	1.0	4.9	97.4	9.9
2.0	9.1%	39.9%	1.3	1.3	6.6	97.0	8.8
2.5	7.0%	46.9%	1.6	1.6	8.2	96.5	6.8
3.0	6.9%	53.9%	2.0	2.0	9.9	96.0	6.7
3.5	4.5%	58.4%	2.3	2.3	11.5	95.6	4.3
4.0	4.5%	62.9%	2.6	2.6	13.2	95.1	4.3
4.5	4.1%	67.0%	2.9	2.9	14.8	94.6	3.9
5.0	3.8%	70.8%	3.3	3.3	16.4	94.1	3.6
6.0	5.7%	76.5%	3.9	3.9	19.7	93.2	5.3
7.0	4.5%	81.0%	4.6	4.6	23.0	92.3	4.2
8.0	3.6%	84.5%	5.2	5.2	26.3	91.3	3.3
9.0	2.3%	86.8%	5.9	5.9	29.6	90.4	2.0
10.0	1.9%	88.7%	6.5	6.5	32.9	89.4	1.7
15.0	6.1%	94.8%	9.8	9.8	49.3	84.7	5.2
20.0	2.6%	97.5%	13.0	13.0	65.8	80.0	2.1
25.0	2.0%	99.4%	16.3	16.3	82.2	75.3	1.5
30.0	0.4%	99.9%	19.6	19.6	98.6	70.6	0.3
35.0	0.1%	100.0%	22.8	19.8	100.0	61.0	0.1
40.0	0.0%	100.0%	26.1	19.8	100.0	53.4	0.0
45.0	0.0%	100.0%	29.3	19.8	100.0	47.4	0.0
50.0	0.0%	100.0%	32.6	19.8	100.0	42.7	0.0
							94.1

Removal Efficiency Adjustment[2] = 6.5%

Predicted Net Annual Load Removal Efficiency = 87.6%

Predicted Annual Rainfall Treated = 100.0%

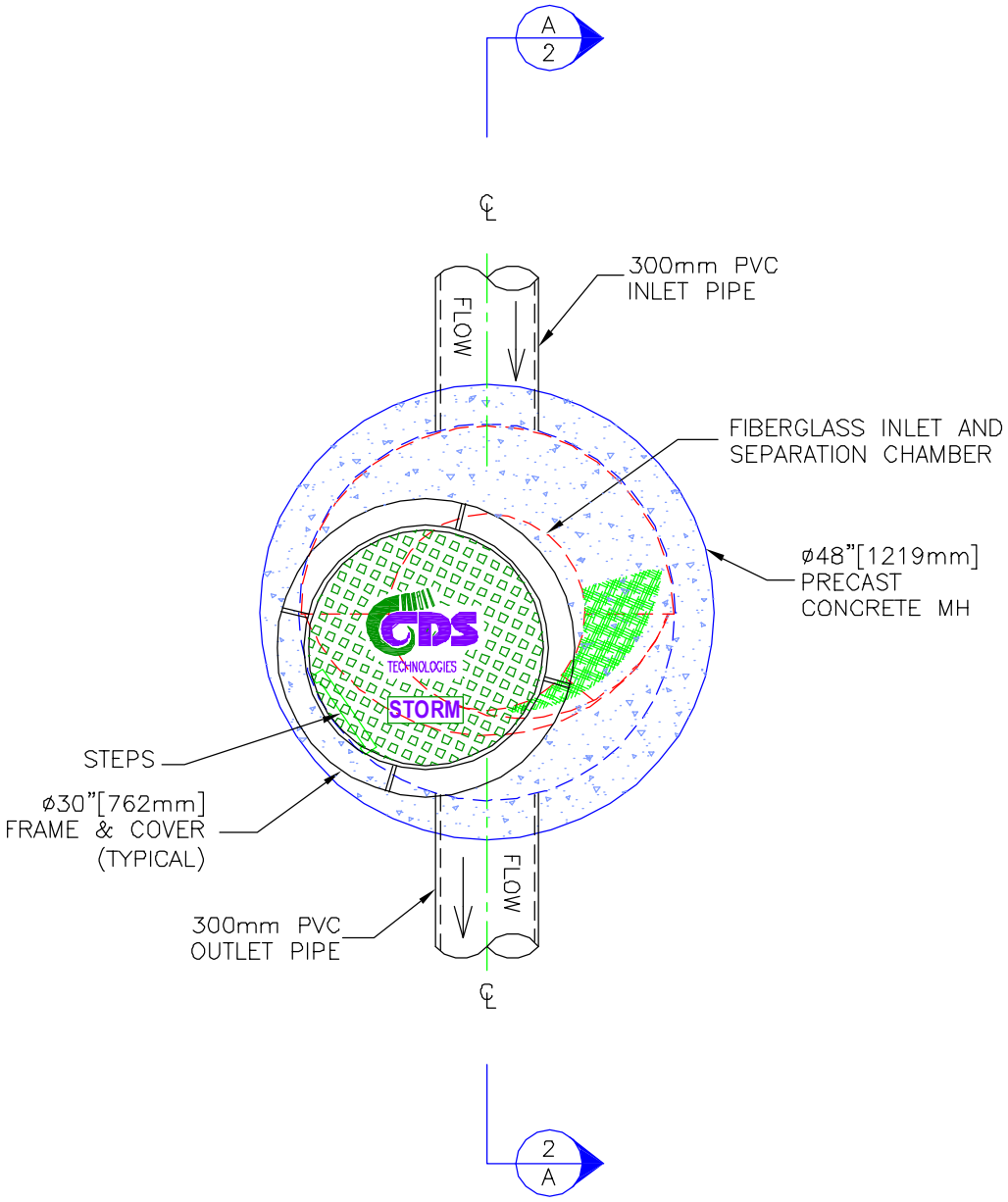
1 - Based on 44 years of hourly rainfall data from Canadian Station 6104175, Kingston ON

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

3 - CDS Efficiency based on testing conducted at the University of Central Florida

4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

PLAN VIEW

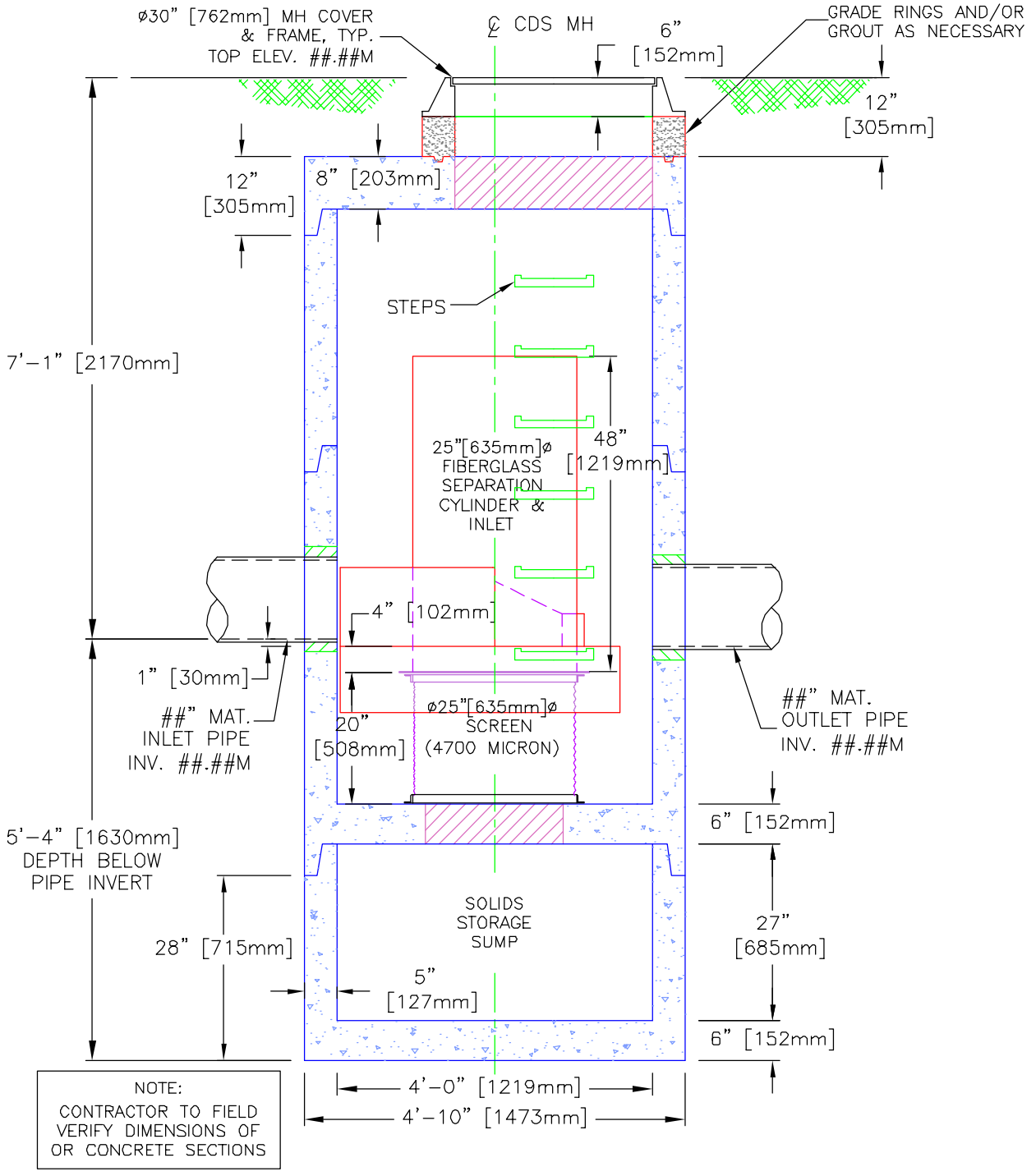


CDS MODEL PMSU20_15_4m
STORMWATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB# XX-##-###	SCALE 1" = 2'
		DATE ##/##/##	SHEET 1
		DRAWN INITIALS	
		APPROV.	

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

SECTION A–A
ELEVATION VIEW



NOTE:
CONTRACTOR TO FIELD VERIFY DIMENSIONS OF OR CONCRETE SECTIONS

CDS MODEL PMSU20_15_4m
STORMWATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB# XX–##–###	SCALE 1" = 2'
		DATE ##/##/##	SHEET 2
		DRAWN INITIALS	
		APPROV.	

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

Appendix C: Sanitary Sewer Calculation Sheet

*There are no changes to this Appendix from the March 17, 2021 Submission.

APPENDIX A: STORMWATER MANAGEMENT MODEL

Sanitary Sewer Design Sheet

Client: 9695443 Canada Inc.
Job No.: 201152
Location: King Street West, Gananoque, Ontario
Date: March 17, 2021

Location			Residential Flow								Commercial/Institutional		
							Cumulative						
STREET	From	To	No. of Single Dwellings	No. of Row/Semi Dwellings	Pop.	Area, A	Pop.	Area	Peaking Factor	Res. Flow, $Q_{(p)}$	Area	Tributary Area, A	Com. Flow, $Q_{(p)}$
	MH	MH			[no.]	[ha]	[no.]	[ha]		[L/s]	[ha]	[Sq.m]	[L/s]
South Side	SAN.107	SAN.103	NA	12	17	0.12	17	0.12	4.00	0.22	0.00	0.00	0.000
	SAN.103	SAN.101	NA	NA		0.02	17	0.14	4.00	0.22	0.00	0.00	0.000
North Side	SAN.105	SAN.101	NA	10	14	0.12	31	0.12	4.00	0.40	0.00	0.00	0.000
	SAN.101	EX.SAN	NA	NA		0.04	31	0.30	4.00	0.40	0.00	0.00	0.000

	Infiltration		Flow	Sanitary Sewer Design						
STREET	Total Tributary Area	Infiltration Flow	Peak Design	Length, L	Diameter, d_{nom}*	Slope, s	Pipe Capacit	Full Flow	Flow Check > 0.6 m/s	Percent of
	[ha]	[L/s]	[L/s]	[m]	[mm]	[%]	[L/s]	[m/s]		[%]
South Side	0.12	0.04	0.26	61	200	0.50%	23.19	0.74	Ok	1.1%
	0.14	0.05	0.26	20	200	0.50%	23.19	0.74	Ok	1.1%
North Side	0.12	0.04	0.44	67	200	0.50%	23.19	0.74	Ok	1.9%
	0.30	0.10	0.50	26	200	1.30%	37.40	1.19	Ok	1.3%

Notes:

Q = Average daily flow per capita	280 L/day per capita	
$Q_{ext.}$ = Unit peak extraneous flow	0.33 L/s per gross ha.	Min Velocity of flow > 0.6m/s
Micro Row House	1.4 Persons/unit	Max Velocity of flow > 3m/s

Appendix D: Fire Flow Calculations

- Fire Flow Requirements – FUS

*There are no changes to this Appendix from the March 17, 2021 Submission.

Kollaard Associates
Engineers
210 Prescott Street, Unit 1
P.O. Box 189
Kemptville, Ontario K0G 1J0

Civil • Geotechnical •
Structural • Environmental •
Hydrogeology

(613) 860-0923
FAX: (613) 258-0475

APPENDIX C: CALCULATION OF FIRE FLOW REQURIEMENTS - King Street West

Calculation Based on Fire Underwriters Survey

Proposed Building:

2 storey wood frame - Brick or non combustible Exterior Cladding -6 unit Rowhouse buildings.

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

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

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:

1.5	for wood construction (structure essentially combustible)
1.0	for ordinary construction (brick or other masonry walls, combustible floor and interior)
0.8	for noncombustible construction (unprotected metal structural components, masonary or metal walls)
0.6	for fire-resistive construction (fully protected frame, floors, roof)

No. of Floors = 2 (FUS excludes basements that are at least 50% below grade)

Area (per floor) = 200.0 m^2

A = 400 m^2

C = 1.0

F = 4,400 L/min ----------> Rounded to nearest 1000 = **4,000** L/min

2) The value obtained in 1) may be reduced by as much as 25% for occupancies having a low

Non-combustible =	-25%
Limited Combustible =	-15%
Combustible =	0%
Free Burning =	15%
Rapid Burning =	25%

Reduction due to low occupancy hazard = -25% x 4,000 = = **3,000** L/min

3) The value above my be reduced by up to 50% for automatic sprinlker system

Reduction due to automatic sprinker system = 0% x 3,000 = **0** L/min

4) The value obtained in 2. may be increased for structures exposed within 45 metres by the fire

Separation (metres)	Condtion	Max Charge*
0m to 3.0m	1	25%
3.1m to 10.0m	2	20%
10.1m to 20.0m	3	15%
20.1m to 30.0m	4	10%
30.1m to 45.0m	5	5%
45.1m to	6	0%

Exposures	Distance(m)	Condition		Charge
Back (south)	9.1	2	-------->	20%
Front (north)	27.0	4	-------->	10%
Side 1 (east)	3.1	2	-------->	20%
Side 2 (west)	16.5	3	-------->	15%
				65%

Increase due to separation = 65% x 3,000 = **1,950** L/min

The fire flow requirement is = **3,000**

Reduction due to Sprinkler = **0**

Increase due to Separation = 1,950

4,950

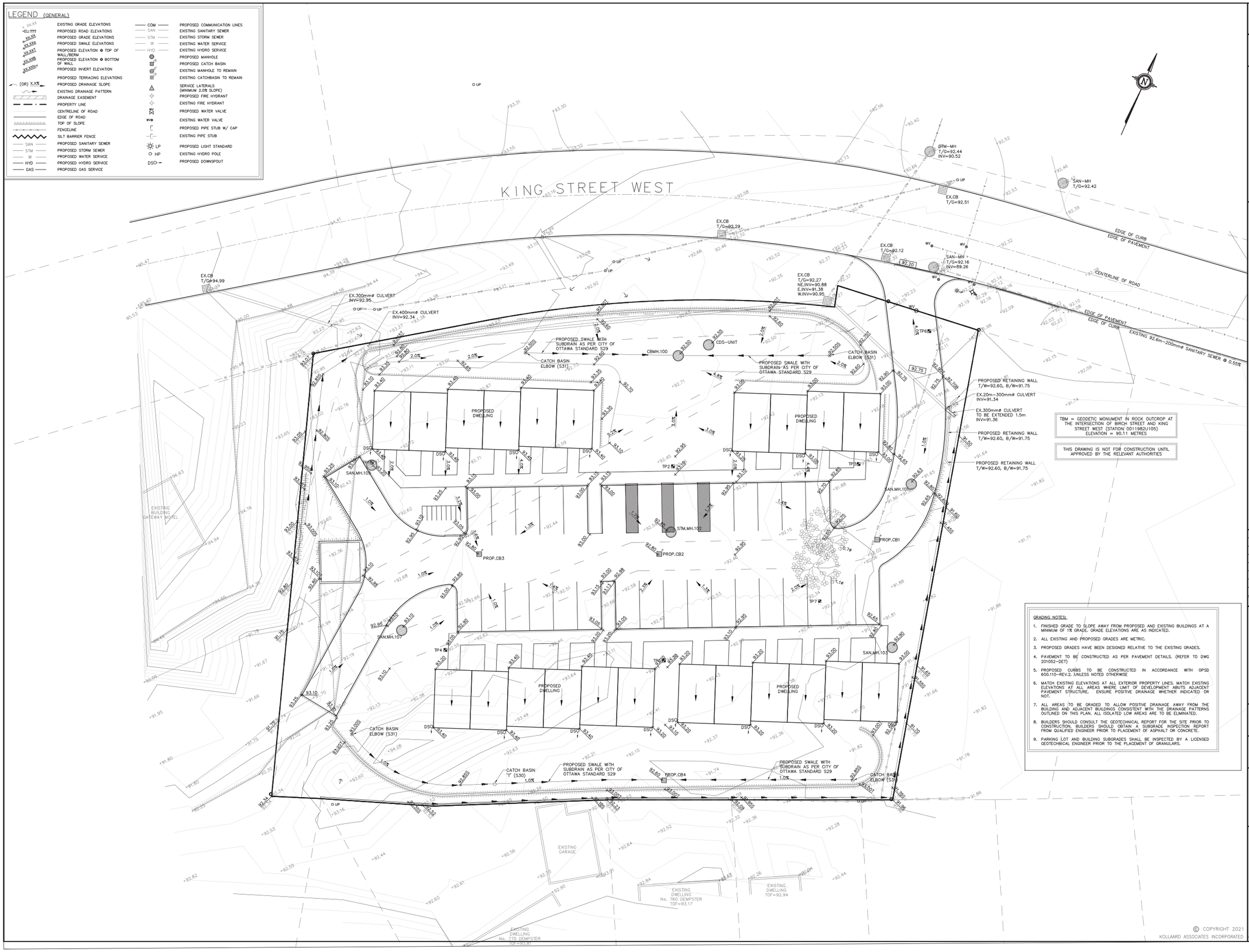
The Total fire flow requirement is = 4,950 L/min

or **82.5** **L/sec**

1,308 US gpm

Appendix E: Drawings

201052 – GRD – Site Grading Plan
201052 – SER – Site Servicing Plan
201052 – ER – Sediment and Erosion Control
201052 – PRE – CA – Pre-Development Catchment Area Plan
201052 – POST – CA – Post-Development Catchment Area Plan
201052 – ND – Notes & Details

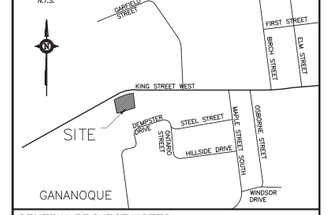


DRAWING No.

201052-GR

DRAWING

SITE GRADING PLAN



GENERAL PROJECT NOTES:

1. All dimensions are in metres; all elevations are in metres and are local.
2. TBM=Geodetic monument in rock outcrop at the intersection of Birch Street and King Street West (Station 0011982u105). elevation = 90.11 metres.
3. This drawing is not a legal survey, a utility plan or a site plan and is for grading purposes only.
4. Client is responsible for acquiring all necessary permits. This drawing is not for construction until a building permit has been granted.
5. Contractor is responsible for location and protection of utilities.
6. All dimensions to be verified on site by contractor prior to construction.
7. Any changes made to this plan must be verified and approved by Kollaard Associates Inc.
8. The proposed grades have been set and verified for site grading control only. The grade raise at the building location should be verified with regard to subsurface conditions by qualified geotechnical personnel after completion of the excavation.
9. The underside of footing elevation has been set based on the information available and may not have accounted for actual ground water conditions at the exact building location and should be verified by qualified geotechnical personnel upon completion of the excavation.
10. A geotechnical engineer should be retained to provide recommendations with respect to the sub-grade conditions prior to footing installation.
11. The owner agrees to prepare and implement an erosion and sediment control plan to the satisfaction of the regulatory agency or township, appropriate to the site conditions, prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and during all phases of site preparation and construction in accordance with the current Best Management Practices for Erosion and Sediment Control such as, and not limited to installing filter cloths across manhole/catchbasin lids to prevent sediments from entering structures and install and maintain a light duty silt fence barrier as required.
12. Shop drawings for items such as (but not limited to) storm catch basins and underground storm water storage chambers to be reviewed and approved by Kollaard Associates Inc. prior to fabrication.
13. This drawing is part of Kollaard Associates File No. 201052.

No.	REVISION	DATE	BY
1	AS PER ENGINEERING COMMENTS #1	04.OCT.2021	NR

Kollaard Associates Engineers

P.O. BOX 189, 210 PRESCOTT ST. (613) 860-0923
KEMPTVILLE, ONTARIO info@kollaard.ca
K0G 1J0 FAX (613) 258-0475
http://www.kollaard.ca

CLIENT NAME

STEFANO FERRANTE

PROJECT NAME

22-UNIT RESIDENTIAL DEVELOPMENT

PROJECT LOCATION

KING STREET WEST
GANANOQUE, ONTARIO

LICENSED PROFESSIONAL ENGINEER
October 04, 2021
S.E. deWit
100079612
PROVINCE OF ONTARIO

DESIGNED BY	CHECKED BY
NR	SD
DRAWN BY	APPROVED BY
NR	SD

DATE 17.MAR.2021

SCALE 1:200

PROJECT No. 201052

SHEET SET 1 OF 6

LEGEND (GENERAL)

XX.XX	EXISTING GRADE ELEVATIONS
•EL:???	PROPOSED ROAD ELEVATIONS
XX.XX	PROPOSED GRADE ELEVATIONS
XX.XXs	PROPOSED SWALE ELEVATIONS
XX.XXT	PROPOSED ELEVATION @ TOP OF WALL/BERM
XX.XXB	PROPOSED ELEVATION @ BOTTOM OF WALL
XX.XXIE	PROPOSED INVERT ELEVATION
XX.XXTR	PROPOSED TERRACING ELEVATIONS
(OR) X.X%	PROPOSED DRAINAGE SLOPE
	EXISTING DRAINAGE PATTERN
	DRAINAGE EASEMENT
	PROPERTY LINE
	CENTRELINE OF ROAD
	EDGE OF ROAD
	TOP OF SLOPE
	FENCELINE
	SILT BARRIER FENCE
SAN	PROPOSED SANITARY SEWER
STM	PROPOSED STORM SEWER
W	PROPOSED WATER SERVICE
HYD	PROPOSED HYDRO SERVICE
GAS	PROPOSED GAS SERVICE
COM	PROPOSED COMMUNICATION LINES
SAN	EXISTING SANITARY SEWER
STM	EXISTING STORM SEWER
W	EXISTING WATER SERVICE
HYD	EXISTING HYDRO SERVICE
	PROPOSED MANHOLE
	PROPOSED CATCH BASIN
EX.MH	EXISTING MANHOLE TO REMAIN
EX.CB	EXISTING CATCHBASIN TO REMAIN
	SERVICE LATERALS (MINIMUM 2.0% SLOPE)
	PROPOSED FIRE HYDRANT
	EXISTING FIRE HYDRANT
	PROPOSED WATER VALVE
WV	EXISTING WATER VALVE
	PROPOSED PIPE STUB W/ CAP
	EXISTING PIPE STUB
LP	PROPOSED LIGHT STANDARD
HP	EXISTING HYDRO POLE
DSO	PROPOSED DOWNSPOUT

SEWER NOTES:

1. SUPPLY AND CONSTRUCT ALL SEWERS AND APPURTENANCES IN ACCORDANCE WITH THE TOWN OF GANANOQUE AND THE ONTARIO PROVINCIAL STANDARDS AND SPECIFICATIONS.

2. SPECIFICATIONS:

ITEM	SPEC. No.
CATCH BASIN (600mm x 600mm)	OPSD 705.010
STORM/SANITARY MANHOLE (1200ø)	OPSD 701.010
STORM/SANITARY MANHOLE (1500ø)	OPSD 701.011
STORM/SANITARY MANHOLE (1800ø)	OPSD 701.012
SANITARY BENCHING	OPSD 701.021
CATCH BASIN & MANHOLE ADJUSTMENTS	OPSD 704.010
STORM MANHOLE FRAME & COVER	OPSD 401.010
CATCH BASIN FRAME & COVER	OPSD 400.020
SANITARY MANHOLE FRAME & COVER	OPSD 401.030
SEWER TRENCH:	
BEDDING (GRANULAR "A")	
COVER (GRANULAR "A")	
STORM SEWER 375mmø OR LARGER:	HDPE – DOUBLE WALL, SMOOTH INTERIOR (CHALLENGER 2000)
SANITARY SEWER:	250mmø – PVC DR 35
CATCHBASIN LEAD:	HDPE – DOUBLE WALL, SMOOTH INTERIOR (CHALLENGER 2000)

SERVICE LATERALS:

SANITARY – 1–125mmø PVC DR 28 @ 2.0% (MIN)
STORM – 1–100mmø PVC DR 28 @ 2.0% (MIN)
WATER – 1–19mmø TYPE 'K' SOFT COPPER

** CURB STOPS AND RESIDENTIAL SERVICES ARE NOT TO BE INSTALLED UNDER DRIVEWAYS.

3. INSULATE ALL STORM PIPES THAT HAVE LESS THAN 1.5m COVER AND ALL SANITARY PIPES THAT HAVE LESS THAN 2.0m COVER WITH THERMAL INSULATION. PROVIDE 150mm CLEARANCE BETWEEN PIPE AND INSULATION. REFER TO DETAIL SHEET.

4. PIPE BEDDING, COVER AND BACKFILL ARE TO BE COMPACTED TO AT LEAST 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY.

5. FLEXIBLE CONNECTIONS ARE REQUIRED FOR CONNECTION PIPES TO MANHOLES (FOR EXAMPLE KOR-N-SEAL, PSX: POSITIVE SEAL AND DURASEAL). SANITARY RUBBER GASKET TYPE JOINTS SHALL CONFORM TO CSA (B-182.2,3,4).

6. THE OWNER SHALL REQUIRE THAT THE SITE SERVICING CONTRACTOR PERFORM FIELD TESTS FOR QUALITY CONTROL OF ALL SANITARY SEWERS. LEAKAGE TESTING SHALL BE COMPLETED IN ACCORDANCE WITH OPSS 410.07.16, 410.07.16.04 AND 407.07.24. DYE TESTING IS TO BE COMPLETED ON ALL SANITARY SERVICES TO CONFIRM PROPER CONNECTION TO THE SANITARY SEWER MAIN. THE FIELD TESTS SHALL BE PERFORMED IN THE PRESENCE OF A CERTIFIED PROFESSIONAL ENGINEER WHO SHALL SUBMIT A CERTIFIED COPY OF THE TEST RESULTS.

7. STORM MANHOLES AND CBMHS ARE TO HAVE 300mm SUMPS UNLESS OTHERWISE INDICATED.

8. BUILDING CONTRACTOR TO PROVIDE TEMPORARY ADDITIONAL GRANULAR BACKFILL ABOVE SHALLOW CULVERTS AND STORM SEWERS TO SUPPORT HEAVY CONSTRUCTION EQUIPMENT.

9. CONTRACTOR TO TELEVISE (CCTV) ALL PROPOSED SEWERS, 200mmØ OR GREATER PRIOR TO BASE COURSE ASPHALT. UPON COMPLETION OF CONTRACT, THE CONTRACTOR IS RESPONSIBLE TO FLUSH AND CLEAN ALL SEWERS & APPURTENANCES TO MUNICIPAL SATISFACTION.

10. WHERE THE SANITARY SEWER CROSSES ABOVE THE WATERMAIN, THE CONTRACTOR IS TO PROVIDE A MINIMUM OF 0.5m VERTICAL SEPARATION, ADEQUATE STRUCTURAL SUPPORT OF THE SEWER TO PREVENT SETTLING AND EXCESSIVE JOINT DEFLECTION AND ENSURE THAT THE LENGTH OF THE WATER PIPE BE CENTERED AT THE POINT OF CROSSING SO THAT THE JOINTS ARE EQUIDISTANT AND AS FAR AS POSSIBLE FROM THE SEWER.

WATERMAIN NOTES:

1. SUPPLY AND CONSTRUCT ALL WATERMAINS AND APPURTENANCES IN ACCORDANCE WITH THE TOWN OF GANANOQUE, OPS & AWWA STANDARDS AND SPECIFICATIONS. MATERIALS, EXCAVATION INSTALLATION, BACKFILL AND RESTORATION OF ALL WATERMAINS BY THE CONTRACTOR. CONNECTIONS, PRESSURE TESTING, SWABBING, CHLORINATION AND FLUSHING OF THE WATER SYSTEM SHALL BE PERFORMED BY THE CONTRACTOR AND ALL ACTIVITIES MUST BE INSPECTED BY A MUNICIPAL CERTIFIED WATER OPERATOR.

2. SPECIFICATIONS:

ITEM	SPEC. No.	REFERENCE
WATERMAIN BEDDING	802.010	OPSD
CATHODIC PROTECTION	1109.010	OPSD
HYDRANT INSTALLATION	1105.010	OPSD
PRESSURE TESTING	C–605–5	AWWA
CHLORINATION	C–651–05	AWWA
WATERMAIN MATERIAL	PVC DR18 (CLASS 150)	

3. WATERMAIN SHALL BE MINIMUM 2.4m DEPTH BELOW GRADE UNLESS OTHERWISE INDICATED. ALL WATER SERVICES SHALL BE CONSTRUCTED AT A MINIMUM DEPTH OF 1.8m.

4. PROVIDE MINIMUM .25m CLEARANCE BETWEEN OUTSIDE OF PIPES AT ALL CROSSINGS.

5. A MINIMUM OF 0.5m VERTICAL CLEARANCE IS REQUIRED BETWEEN THE WATERMAINS AND ALL UTILITIES AND SEWERS. IN LOCATIONS WHERE THIS IS NOT ACHIEVABLE, MUST FOLLOW PROCEDURE F–6–1 SEC. 5.2 OF THE ONTARIO DRINKING WATER RESOURCES ACT.

6. METALLIC WARNING TAPE SHALL BE USED OVER ALL WATERMAINS.

7. INSTALL AND TEST TRACER WIRE FOR ALL PROPOSED WATERMAIN IN ACCORDANCE WITH THE TOWN OF GANANOQUE STANDARDS.

8. EXISTING WATERMAIN INFORMATION SHOWN ON KING STREET WEST IS BASED ON BEST CURRENT INFORMATION. CONTRACTOR TO VERIFY EXACT LOCATION OF WATERMAIN AND REPORT ANY DISCREPANCIES TO KOLLAARD ASSOCIATES INC.

9. ALL CURB STOPS TO BE WITHIN THE ROAD ALLOWANCE AND LOCATED 0.15 METRES TROM THE PROPERTY LINE UNLESS OTHERWISE NOTED.

10. FIRE HYDRANTS TO BE DARLING 'CENTURY' 3 WAY C/W 2–2½" HOSE CONNECTIONS AND PUMPER CONNECTION AND 6"MECHANICAL JOINT INLET ELBOW, ALL HOSE CONNECTIONS TO BE THREADED. HYDRANT TO BE PAINTED YELLOW WITH A YELLOW SNOW MARKER INSTALLED. HYDRANT INSTALLATION TO BE IN ACCORDANCE WITH OPSD 1105.010/OPSS 441 .

11. VALVES, VALVE BOXES, SADDLES, MAIN STOPS, CURB STOPS, COUPLERS, SERVICE BOXES AND METERS TO BE IN ACCORDANCE WITH THE ONTARIO PROVINCIAL DESIGN STANDARDS AS SPECIFIED IN SECTION 8.12.6.

12. CONNECTIONS AT ELBOWS AND TEEs IN WATER MAINS SHOULD BE MADE WITH THE USE OF JOINT RESTRAINERS DESIGNED FOR WATERMAIN APPLICATION. JOINT AND PIPE RESTRAINERS SHOULD MEET THE REQUIREMENTS OF AWWA C900, C905 AND C907 AND ASTM F1674–11. JOINT RETRAINERS SHOULD BE INSTALLED AS PER MANUFACTURERS RECOMMENDATIONS.

13. ALL CONNECTORS, RODS AND VALVE BOLTS SHALL BE STAINLESS STEEL.

14. VALVES ARE TO BE OPERATED BY THE TOWN OF GANANOQUE STAFF ONLY.

15. ALL VALVES TO WHICH THE NEW SYSTEM WILL BE CONNECTED TO MUST BE EXPOSED AND INSPECTED BY THE TOWN OF GANANOQUE.

16. NO CONNECTION TO EXISTING WATER NETWORK SHALL BE COMPLETED UNTIL WRITTEN APPROVAL IS OBTAINED FROM THE TOWN OF GANANOQUE.

GENERAL NOTES:

1. COORDINATE AND SCHEDULE ALL WORK WITH OTHER TRADES AN CONTRACTORS.

2. DETERMINE THE EXACT LOCATION, SIZE, MATERIAL AND ELEVATION OFF ALL EXISTING UTILITIES PRIOR TO COMMENCING CONSTRUCTION. PROTECT AND ASSUME RESPONSIBILITY FOR ALL EXISTING UTILITIES WHETHER OR NOT SHOWN ON THIS DRAWING.

3. OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE TOWN AND CONSERVATION AUTHORITY BEFORE COMMENCING CONSTRUCTION.

4. BEFORE COMMENCING CONSTRUCTION OBTAIN AND PROVIDE PROOF OF COMPREHENSIVE, ALL RISK AND OPERATIONAL LIABILITY INSURANCE FOR $2,000,000.00. INSURANCE POLICY TO NAME OWNERS, ENGINEERS AND ARCHITECTS AS CO–INSURED.

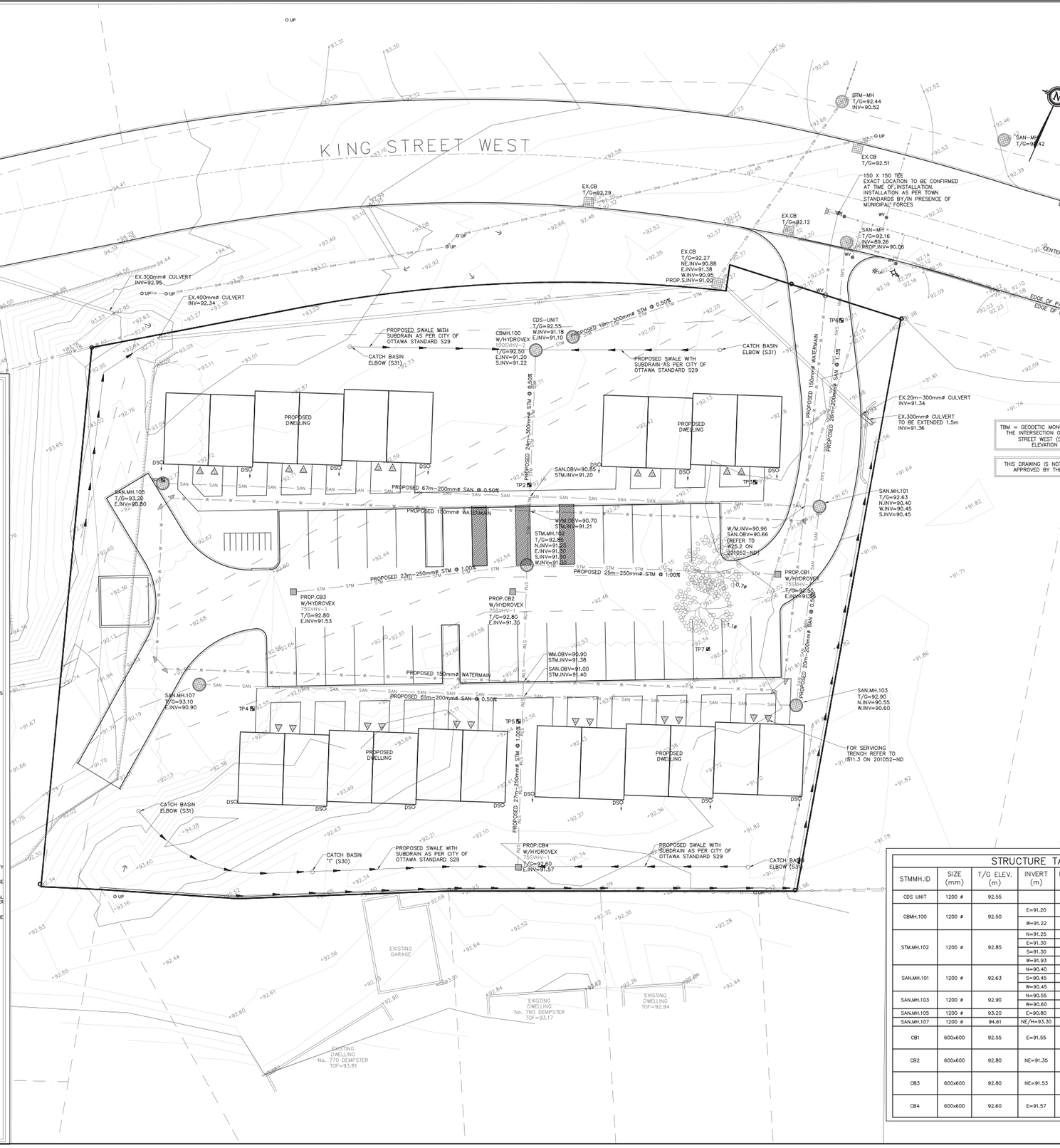
5. RESTORE ALL DISTURBED AREAS ON–SITE AND OFF–SITE, INCLUDING TRENCHES AND SURFACES ON PUBLIC ROAD ALLOWANCES TO EXISTING CONDITIONS OR BETTER TO THE SATISFACTION OF THE TOWN AND ENGINEER.

6. REMOVE FROM SITE ALL EXCESS EXCAVATED MATERIAL, ORGANIC MATTER AND DEBRIS UNLESS OTHERWISE INSTRUCTED BY ENGINEER. EXCAVATE AND REMOVE FROM SITE ANY CONTAMINATED MATERIAL. ALL CONTAMINATED MATERIAL SHALL BE DISPOSED OF AT A LICENCED LANDFILL FACILITY.

7. ALL ELEVATIONS ARE GEODETIC.

8. REFER TO STORMWATER MANAGEMENT REPORT (201052) PREPARED BY KOLLAARD ASSOCIATES ENGINEERS.

9. CONTRACTOR TO PROVIDE THE CONSULTANT WITH A GENERAL PLAN OF SERVICES INDICATING ALL SERVICING AS–BUILT INFORMATION SHOWN ON THIS PLAN. AS–BUILT INFORMATION MUST INCLUDE; PIPE MATERIAL, SIZES, LENGTHS, SLOPES, INVERT & T/G ELEVATIONS, STRUCTURE LOCATIONS, VALVE AND HYDRANT LOCATIONS, T/MM ELEVATIONSAND ANY ALIGNMENT CHANGES, ETC.



TBM = GEODETIC MONUMENT IN ROCK OUTCROP AT THE INTERSECTION OF BIRCH STREET AND KING STREET WEST (STATION 0011982U105) ELEVATION = 90.11 METRES

THIS DRAWING IS NOT FOR CONSTRUCTION UNTIL APPROVED BY THE RELEVANT AUTHORITIES

STRUCTURE TABLE

STMMH.ID	SIZE (mm)	T/G ELEV. (m)	INVERT (m)	PIPE ø (mm)	ICD M=MEAD Q=RELEASE RATE	OPSD (STRUCTURE)	OPSD (FRAME & GRATE)
CDS UNIT	1200 ø	92.55			N/A		
CBMH.100	1200 ø	92.50	E=91.20	300	HYDROVEX 100SVHV–1 H=1.0m Q=11.4 L/S	0701.0100	401.010–B
			W=91.22	300			
STM.MH.102	1200 ø	92.85	N=91.25	300	N/A	0701.0100	401.010–A
			E=91.30	250			
			S=91.30	250			
			W=91.93	250			
SAN.MH.101	1200 ø	92.63	N=90.40	200	N/A	0701.0100	401.010–A
			S=90.45	200			
			W=90.45	200			
SAN.MH.103	1200 ø	92.90	N=90.55	200	N/A	0701.0100	401.010–A
			W=90.60	200			
SAN.MH.105	1200 ø	93.20	E=90.80	200	N/A	0701.0100	401.010–A
SAN.MH.107	1200 ø	94.61	NE./H=93.30	200	N/A	0701.0100	401.010–A
CB1	600x600	92.55	E=91.55	250	HYDROVEX 75SVHV–1 H=1.0m Q=5.0 L/S	0705.010	040.0500
CB2	600x600	92.80	NE=91.35	250	HYDROVEX 75SVHV–1 H=1.0m Q=5.0 L/S	0705.010	040.0500
CB3	600x600	92.80	NE=91.53	250	HYDROVEX 75SVHV–1 H=1.0m Q=5.0 L/S	0705.010	040.0500
CB4	600x600	92.60	E=91.57	250	HYDROVEX 75SVHV–1 H=1.0m Q=5.0 L/S	0705.010	040.0500

DRAWING No.

201052–SER

DRAWING

SITE SERVICING PLAN

KEY PLAN: N.T.S.

GENERAL PROJECT NOTES:

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5. Contractor is responsible for location and protection of utilities.
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7. Any changes made to this plan must be verified and approved by Kollaard Associates Inc.
8. The proposed grades have been set and verified for site grading control only. The grade raise at the building location should be verified with regard to subsurface conditions by qualified geotechnical personnel after completion of the excavation.
9. The underside of footing elevation has been set based on the information available and may not have accounted for actual ground water conditions at the exact building location and should be verified by qualified geotechnical personnel upon completion of the excavation.
10. A geotechnical engineer should be retained to provide recommendations with respect to the sub–grade conditions prior to footing installation.
11. The owner agrees to prepare and implement an erosion and sediment control plan to the satisfaction of the regulatory agency or township, appropriate to the site conditions, prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and during all phases of site preparation and construction in accordance with the current Best Management Practices for Erosion and Sediment Control such as, and not limited to installing filter cloths across manhole/catchbasin lids to prevent sediments from entering structures and install and maintain a light duty silt fence barrier as required.
12. Shop drawings for items such as (but not limited to) storm catch basins and underground storm water storage chambers to be reviewed and approved by Kollaard Associates Inc. prior to fabrication.
13. This drawing is part of Kollaard Associates File No. 201052.

No.	REVISION	DATE	BY
1	AS PER ENGINEERING COMMENTS #1	04.OCT.2021	NR

Kollaard Associates Engineers
P.O. BOX 189, 210 PRESCOTT ST. (613) 860–0923
KEMPTVILLE, ONTARIO info@kollaard.ca
K0G 1J0 FAX (613) 258–0475
http://www.kollaard.ca

CLIENT NAME

STEFANO FERRANTE

PROJECT NAME

22–UNIT RESIDENTIAL DEVELOPMENT

PROJECT LOCATION

KING STREET WEST
GANANOQUE, ONTARIO

LICENCED PROFESSIONAL ENGINEER
October 04, 2021
S.E. deWit
100079612
PROVINCE OF ONTARIO

DESIGNED BY	CHECKED BY
NR	SD
DRAWN BY	APPROVED BY
NR	SD

DATE: 17.MAR.2021
SCALE: 1:200
PROJECT No.: 201052
SHEET SET: 2 of 6

KING STREET WEST

EDGE OF CURB
EDGE OF PAVEMENT
CENTERLINE OF ROAD
EDGE OF PAVEMENT
EDGE OF CURB
EXISTING 92.6m-200mm⌀ SANITARY SEWER @ 0.55%

EX.CB T/G=94.99
EX.300mm⌀ CULVERT INV=92.95
EX.400mm⌀ CULVERT INV=92.34
STRAW BALE FLOW CHECK AS PER OPSD 219.180
PROVIDE FILTER SOCK (SEDIMENT INSERT)
EX.CB T/G=92.27 NE.INV=90.88 E.INV=91.38 W.INV=90.95
EX.CB T/G=92.12
STM-MH T/G=92.44 INV=90.52
EX.CB T/G=92.51
SAN-MH T/G=92.42
SAN-MH T/G=92.16 INV=89.26
EX.20m-300mm⌀ CULVERT INV=91.34
EX.300mm⌀ CULVERT TO BE EXTENDED 1.5m INV=91.36
STRAW BALE FLOW CHECK AS PER OPSD 219.180

PROPOSED SWALE WITH SUBDRAIN AS PER CITY OF OTTAWA STANDARD S29
CATCH BASIN ELBOW (S31)
CATCH BASIN "T" (S30)
PROPOSED DWELLING
DSC
TP1
TP2
TP3
TP4
TP5
TP6
TP7

EXISTING BUILDING GATEWAY MOTEL
EXISTING GARAGE
EXISTING DWELLING No. 760 DEMPSTER TOF=93.17
EXISTING DWELLING TOF=92.94
EXISTING DWELLING No. 770 DEMPSTER TOF=93.81

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LEGEND
- SILT BARRIER FENCE (AS PER OPSD 219.110)
- GRANULAR 'A' ACCESS PAD
- PROPERTY LIMITS

EROSION AND SEDIMENT CONTROL NOTES:

1. 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.
2. THE OWNER (AND/OR CONTRACTOR) AGREES TO PREPARE AND IMPLEMENT AN EROSION AND SEDIMENT CONTROL PLAN AT LEAST EQUAL TO THE STATED MINIMUM REQUIREMENTS AND TO THE SATISFACTION OF THE MUNICIPALITY OF NORTH GRENVILLE, APPROPRIATE TO THE SITE CONDITIONS, PRIOR TO UNDERTAKING ANY SITE ALTERATIONS (FILLING, GRADING, REMOVAL OF VEGETATION, ETC.) AND DURING ALL PHASES OF SITE PREPARATION AND CONSTRUCTION IN ACCORDANCE WITH THE CURRENT BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL.
3. THE CONTRACTOR IS TO ENSURE THAT THE SITE ACCESS POINTS AND ADJACENT STREETS TO THE ACCESS POINTS ARE MAINTAINED AND KEPT CLEAN OF CONSTRUCTION MATERIALS SUCH AS, BUT NOT LIMITED TO MUD, DIRT, CLAY AND GRANULARS ON A DAILY BASIS OR AS NECESSARY, TO THE SATISFACTION OF THE TOWN OF GANANOQUE.
4. EVERY EFFORT WILL BE MADE TO ENSURE THAT ALL DISTURBED AREAS ARE TOPSOILED AND SEEDED AS SOON AS REASONABLY POSSIBLE.
5. THE SEDIMENT AND EROSION CONTROL PLAN IS A LIVING DOCUMENT WHICH MAY BE AMENDED BY ONSITE REQUIREMENTS AT THE APPROVAL OF THE TOWN AND THE CONSERVATION AUTHORITY.
6. INSTALL FILTER SOCKS (SEDIMENT INSERTS) ACROSS ALL EXISTING AND PROPOSED CATCH BASINS/CATCH BASIN MANHOLES PRIOR TO CONSTRUCTION.

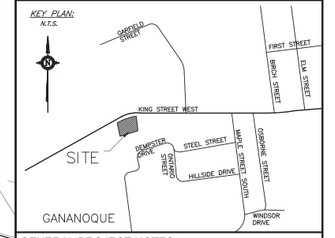
DRAWING No.

201052-ER

DRAWING

SEDIMENT AND EROSION CONTROL PLAN

KEY PLAN:
N.T.S.



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12. Shop drawings for items such as (but not limited to) storm catch basins and underground storm water storage chambers to be reviewed and approved by Kollaard Associates Inc. prior to fabrication.
13. This drawing is part of Kollaard Associates File No. 201052.

No.	REVISION	DATE	BY
1	AS PER ENGINEERING COMMENTS #1	04.OCT.2021	NR

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K0G 1J0 FAX (613) 258-0475
http://www.kollaard.ca

CLIENT NAME

STEFANO FERRANTE

PROJECT NAME

22-UNIT RESIDENTIAL DEVELOPMENT

PROJECT LOCATION

KING STREET WEST
GANANOQUE, ONTARIO

LICENSED PROFESSIONAL ENGINEER
October 04, 2021
S.E. deWit
100079612
PROVINCE OF ONTARIO

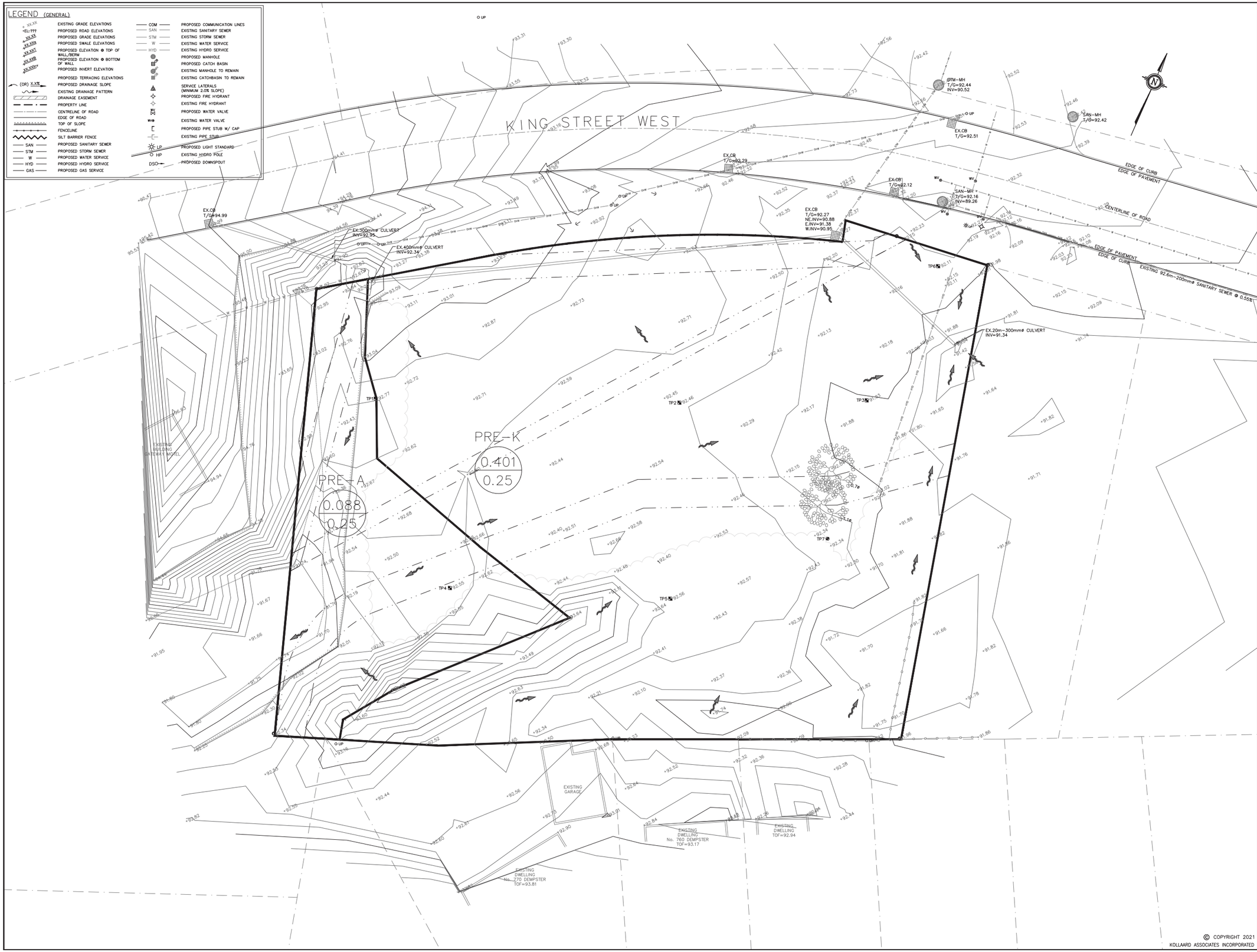
DESIGNED BY	CHECKED BY
NR	SD
DRAWN BY	APPROVED BY
NR	SD

DATE 17.MAR.2021

SCALE 1:200

PROJECT No. 201052

SHEET SET 3 OF 6



DRAWING No.

201052–PRE–CA

DRAWING

PRE–DEVELOPMENT CATCHMENT AREA PLAN

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No.	REVISION	DATE	BY
0	REVISION NOTE	DD.MMM.YYYY	XX

Kollaard Associates Engineers
P.O. BOX 189, 210 PRESCOTT ST. KEMPTVILLE, ONTARIO KOG 1J0
(613) 860–0923 FAX (613) 258–0475
info@kollaard.ca
http://www.kollaard.ca

CLIENT NAME

STEFANO FERRANTE

PROJECT NAME

22–UNIT RESIDENTIAL DEVELOPMENT

PROJECT LOCATION

KING STREET WEST
GANANOQUE, ONTARIO

LICENCED PROFESSIONAL ENGINEER
October 04, 2021
S.E. deWit
100079612
PROVINCE OF ONTARIO

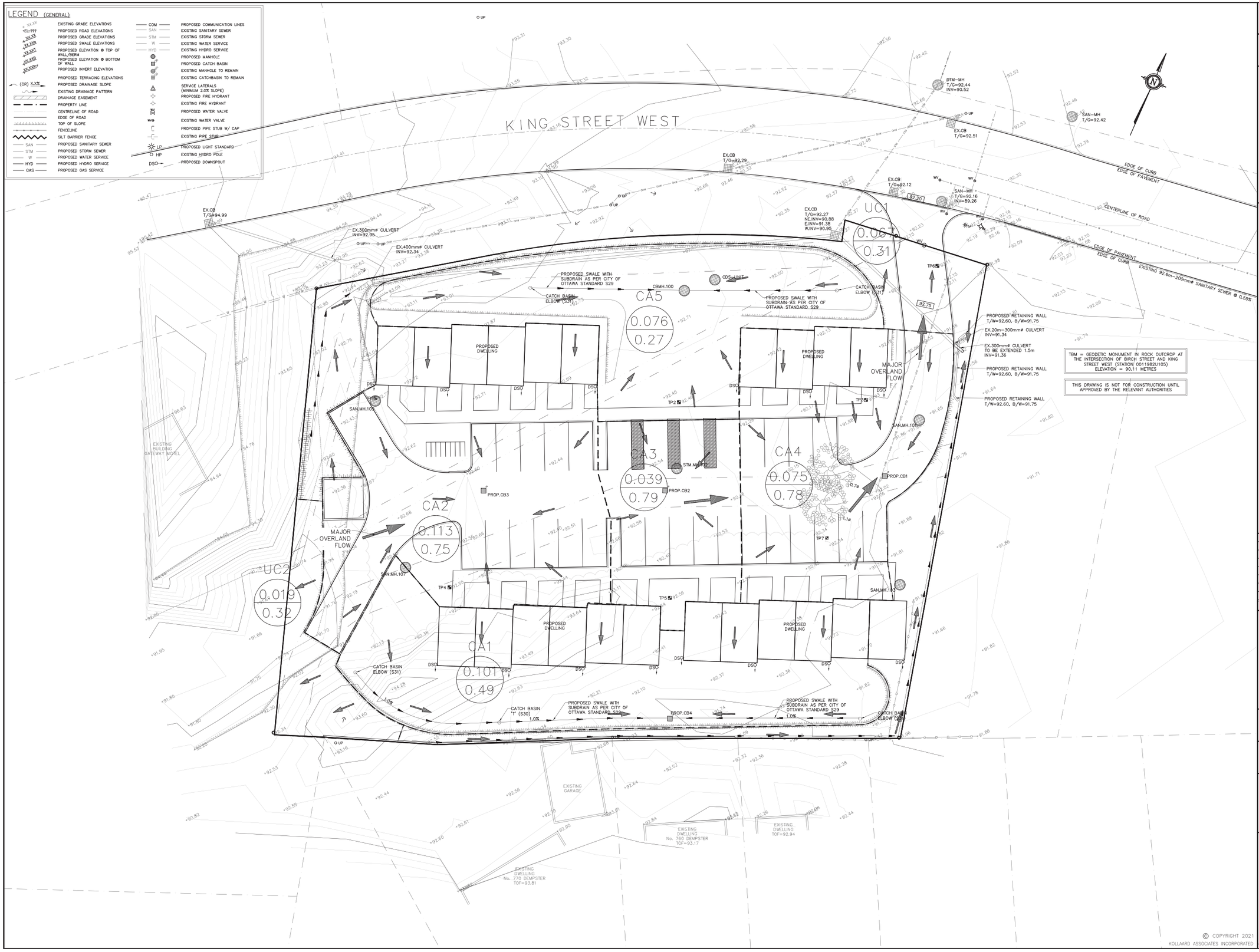
DESIGNED BY	CHECKED BY
NR	SD
DRAWN BY	APPROVED BY
NR	SD

DATE 17.MAR.2021

SCALE 1:200

PROJECT No. 201052

SHEET SET 4 OF 6

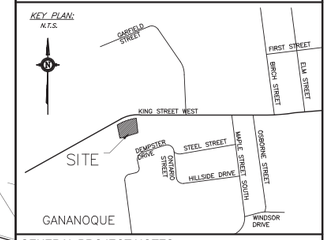


DRAWING No.

201052–POST–CA

DRAWING

POST–DEVELOPMENT CATCHMENT AREA PLAN



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7. Any changes made to this plan must be verified and approved by Kollaard Associates Inc.
8. The proposed grades have been set and verified for site grading control only. The grade raise at the building location should be verified with regard to subsurface conditions by qualified geotechnical personnel after completion of the excavation.
9. The underside of footing elevation has been set based on the information available and may not have accounted for actual ground water conditions at the exact building location and should be verified by qualified geotechnical personnel upon completion of the excavation.
10. A geotechnical engineer should be retained to provide recommendations with respect to the sub–grade conditions prior to footing installation.
11. The owner agrees to prepare and implement an erosion and sediment control plan to the satisfaction of the regulatory agency or township, appropriate to the site conditions, prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and during all phases of site preparation and construction in accordance with the current Best Management Practices for Erosion and Sediment Control such as, and not limited to installing filter cloths across manhole/catchbasin lids to prevent sediments from entering structures and install and maintain a light duty silt fence barrier as required.
12. Shop drawings for items such as (but not limited to) storm catch basins and underground storm water storage chambers to be reviewed and approved by Kollaard Associates Inc. prior to fabrication.
13. This drawing is part of Kollaard Associates File No. 201052.

No.	REVISION	DATE	BY
0	REVISION NOTE	DD.MMM.YYYY	XX

Kollaard Associates Engineers
P.O. BOX 189, 210 PRESCOTT ST. KEMPTVILLE, ONTARIO K0G 1J0
(613) 860–0923 FAX (613) 258–0475
info@kollaard.ca
http://www.kollaard.ca

CLIENT NAME

STEFANO FERRANTE

PROJECT NAME

22–UNIT RESIDENTIAL DEVELOPMENT

PROJECT LOCATION

KING STREET WEST
GANANOQUE, ONTARIO

LICENSED PROFESSIONAL ENGINEER
October 04, 2021
S. E. deWit
100079612
PROVINCE OF ONTARIO

DESIGNED BY	CHECKED BY
NR	SD
DRAWN BY	APPROVED BY
NR	SD

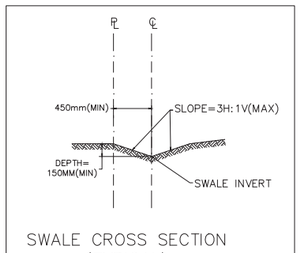
DATE: 17.MAR.2021
SCALE: 1:200
PROJECT No.: 201052
SHEET SET: 5 OF 6

GRADING NOTES:

1. FINISHED GRADE TO SLOPE AWAY FROM PROPOSED AND EXISTING BUILDINGS AT A MINIMUM OF 1% GRADE. GRADE ELEVATIONS ARE AS INDICATED.
2. ALL EXISTING AND PROPOSED GRADES ARE METRIC.
3. PROPOSED GRADES HAVE BEEN DESIGNED RELATIVE TO THE EXISTING GRADES.
4. PAVEMENT TO BE CONSTRUCTED AS PER PAVEMENT DETAILS. (REFER TO DWG 201052-DET)
5. PROPOSED CURBS TO BE CONSTRUCTED IN ACCORDANCE WITH OPSD 600.110-REV.2. UNLESS NOTED OTHERWISE
6. MATCH EXISTING ELEVATIONS AT ALL EXTERIOR PROPERTY LINES. MATCH EXISTING ELEVATIONS AT ALL AREAS WHERE LIMIT OF DEVELOPMENT ABUTS ADJACENT PAVEMENT STRUCTURE. ENSURE POSITIVE DRAINAGE WHETHER INDICATED OR NOT.
7. ALL AREAS TO BE GRADED TO ALLOW POSITIVE DRAINAGE AWAY FROM THE BUILDING AND ADJACENT BUILDINGS CONSISTENT WITH THE DRAINAGE PATTERNS OUTLINED ON THIS PLAN. ALL ISOLATED LOW AREAS ARE TO BE ELIMINATED.
8. BUILDERS SHOULD CONSULT THE GEOTECHNICAL REPORT FOR THE SITE PRIOR TO CONSTRUCTION. BUILDERS SHOULD OBTAIN A SUBGRADE INSPECTION REPORT FROM QUALIFIED ENGINEER PRIOR TO PLACEMENT OF ASPHALT OR CONCRETE.
9. PARKING LOT AND BUILDING SUBGRADES SHALL BE INSPECTED BY A LICENSED GEOTECHNICAL ENGINEER PRIOR TO THE PLACEMENT OF GRANULARS.

EROSION AND SEDIMENT CONTROL NOTES:

1. 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.
2. THE OWNER (AND/OR CONTRACTOR) AGREES TO PREPARE AND IMPLEMENT AN EROSION AND SEDIMENT CONTROL PLAN AT LEAST EQUAL TO THE STATED MINIMUM REQUIREMENTS AND TO THE SATISFACTION OF THE MUNICIPALITY OF NORTH GRENVILLE, APPROPRIATE TO THE SITE CONDITIONS, PRIOR TO UNDERTAKING ANY SITE ALTERATIONS (FILLING, GRADING, REMOVAL OF VEGETATION, ETC.) AND DURING ALL PHASES OF SITE PREPARATION AND CONSTRUCTION IN ACCORDANCE WITH THE CURRENT BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL.
3. THE CONTRACTOR IS TO ENSURE THAT THE SITE ACCESS POINTS AND ADJACENT STREETS TO THE ACCESS POINTS ARE MAINTAINED AND KEPT CLEAN OF CONSTRUCTION MATERIALS SUCH AS, BUT NOT LIMITED TO MUD, DIRT, CLAY AND GRANULARS ON A DAILY BASIS OR AS NECESSARY, TO THE SATISFACTION OF THE TOWN OF GANANOQUE.
4. EVERY EFFORT WILL BE MADE TO ENSURE THAT ALL DISTURBED AREAS ARE TOPSOILED AND SEEDED AS SOON AS REASONABLY POSSIBLE.
5. THE SEDIMENT AND EROSION CONTROL PLAN IS A LIVING DOCUMENT WHICH MAY BE AMENDED BY ONSITE REQUIREMENTS AT THE APPROVAL OF THE TOWN AND THE CONSERVATION AUTHORITY.
6. INSTALL FILTER SOCKS (SEDIMENT INSERTS) ACROSS ALL EXISTING AND PROPOSED CATCH BASINS/CATCH BASIN MANHOLES PRIOR TO CONSTRUCTION.



SWALE CROSS SECTION
(TYPICAL)
(NOT TO SCALE)

SEWER NOTES:

1. SUPPLY AND CONSTRUCT ALL SEWERS AND APPURTENANCES IN ACCORDANCE WITH THE TOWN OF GANANOQUE AND THE ONTARIO PROVINCIAL STANDARDS AND SPECIFICATIONS.
2. SPECIFICATIONS:

ITEM	SPEC. No.
CATCH BASIN (600mm x 600mm)	OPSD 705.010
STORM/SANITARY MANHOLE (1200ø)	OPSD 701.010
STORM/SANITARY MANHOLE (1500ø)	OPSD 701.011
STORM/SANITARY MANHOLE (1800ø)	OPSD 701.012
SANITARY BENCHING	OPSD 701.021
CATCH BASIN & MANHOLE ADJUSTMENTS	OPSD 704.010
STORM MANHOLE FRAME & COVER	OPSD 401.010
CATCH BASIN FRAME & COVER	OPSD 400.020
SANITARY MANHOLE FRAME & COVER	OPSD 401.030
SEWER TRENCH:	
BEDDING (GRANULAR 'A')	
COVER (GRANULAR 'A')	
STORM SEWER 375mmø OR LARGER:	HDPE – DOUBLE WALL, SMOOTH INTERIOR (CHALLENGER 2000)
SANITARY SEWER:	250mmø – PVC DR 35
CATCHBASIN LEAD:	HDPE – DOUBLE WALL, SMOOTH INTERIOR (CHALLENGER 2000)

SERVICE LATERALS:

SANITARY – 1–125mmø PVC DR 28 @ 2.0% (MIN)
STORM – 1–100mmø PVC DR 28 @ 2.0% (MIN)
WATER – 1–19mmø TYPE 'K' SOFT COPPER

** CURB STOPS AND RESIDENTIAL SERVICES ARE NOT TO BE INSTALLED UNDER DRIVEWAYS.

3. INSULATE ALL STORM PIPES THAT HAVE LESS THAN 1.5m COVER AND ALL SANITARY PIPES THAT HAVE LESS THAN 2.0m COVER WITH THERMAL INSULATION. PROVIDE 150mm CLEARANCE BETWEEN PIPE AND INSULATION. REFER TO DETAIL SHEET.
4. PIPE BEDDING, COVER AND BACKFILL ARE TO BE COMPACTED TO AT LEAST 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY.
5. FLEXIBLE CONNECTIONS ARE REQUIRED FOR CONNECTION PIPES TO MANHOLES (FOR EXAMPLE KOR-N-SEAL, PSX: POSITIVE SEAL AND DURASEAL). SANITARY RUBBER GASKET TYPE JOINTS SHALL CONFORM TO CSA (B-182.2,3,4).
6. THE OWNER SHALL REQUIRE THAT THE SITE SERVICING CONTRACTOR PERFORM FIELD TESTS FOR QUALITY CONTROL OF ALL SANITARY SEWERS. LEAKAGE TESTING SHALL BE COMPLETED IN ACCORDANCE WITH OPSS 410.07.16, 410.07.16.04 AND 407.07.24. DYE TESTING IS TO BE COMPLETED ON ALL SANITARY SERVICES TO CONFIRM PROPER CONNECTION TO THE SANITARY SEWER MAIN. THE FIELD TESTS SHALL BE PERFORMED IN THE PRESENCE OF A CERTIFIED PROFESSIONAL ENGINEER WHO SHALL SUBMIT A CERTIFIED COPY OF THE TEST RESULTS.
7. STORM MANHOLES AND CBMHS ARE TO HAVE 300mm SUMPS UNLESS OTHERWISE INDICATED.
8. BUILDING CONTRACTOR TO PROVIDE TEMPORARY ADDITIONAL GRANULAR BACKFILL ABOVE SHALLOW CULVERTS AND STORM SEWERS TO SUPPORT HEAVY CONSTRUCTION EQUIPMENT.
9. CONTRACTOR TO TELEVISE (CCTV) ALL PROPOSED SEWERS, 200mmø OR GREATER PRIOR TO BASE COURSE ASPHALT. UPON COMPLETION OF CONTRACT, THE CONTRACTOR IS RESPONSIBLE TO FLUSH AND CLEAN ALL SEWERS & APPURTENANCES TO MUNICIPAL SATISFACTION.
10. WHERE THE SANITARY SEWER CROSSES ABOVE THE WATERMAIN, THE CONTRACTOR IS TO PROVIDE A MINIMUM OF 0.5m VERTICAL SEPARATION. ADEQUATE STRUCTURAL SUPPORT OF THE SEWER TO PREVENT SETTLING AND EXCESSIVE JOINT DEFLECTION AND ENSURE THAT THE LENGTH OF THE WATER PIPE BE CENTERED AT THE POINT OF CROSSING SO THAT THE JOINTS ARE EQUIDISTANT AND AS FAR AS POSSIBLE FROM THE SEWER.

WATERMAIN NOTES:

1. SUPPLY AND CONSTRUCT ALL WATERMAINS AND APPURTENANCES IN ACCORDANCE WITH THE TOWN OF GANANOQUE, OPS & AWWA STANDARDS AND SPECIFICATIONS. MATERIALS, EXCAVATION INSTALLATION, BACKFILL AND RESTORATION OF ALL WATERMAINS BY THE CONTRACTOR. CONNECTIONS, PRESSURE TESTING, SWABBING, CHLORINATION AND FLUSHING OF THE WATER SYSTEM SHALL BE PERFORMED BY THE CONTRACTOR AND ALL ACTIVITIES MUST BE INSPECTED BY A MUNICIPAL CERTIFIED WATER OPERATOR.
2. SPECIFICATIONS:

ITEM	SPEC. No.	REFERENCE
WATERMAIN BEDDING	802.010	OPSD
CATHODIC PROTECTION	1109.010	OPSD
HYDRANT INSTALLATION	1105.010	OPSD
PRESSURE TESTING	C-655-5	AWWA
CHLORINATION	C-651-05	AWWA
WATERMAIN MATERIAL	PVC DR18 (CLASS 150)	

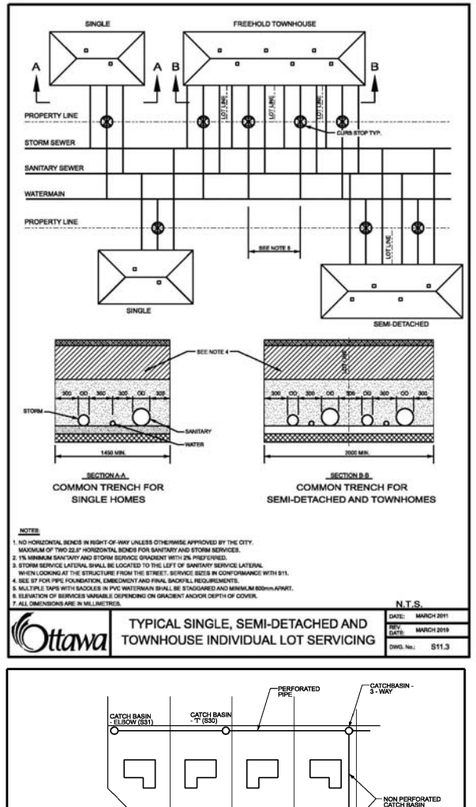
3. WATERMAIN SHALL BE MINIMUM 2.4m DEPTH BELOW GRADE UNLESS OTHERWISE INDICATED. ALL WATER SERVICES SHALL BE CONSTRUCTED AT A MINIMUM DEPTH OF 1.8m.
4. PROVIDE MINIMUM .25m CLEARANCE BETWEEN OUTSIDE OF PIPES AT ALL CROSSINGS.
5. A MINIMUM OF 0.5m VERTICAL CLEARANCE IS REQUIRED BETWEEN THE WATERMAINS AND ALL UTILITIES AND SEWERS. IN LOCATIONS WHERE THIS IS NOT ACHIEVABLE, MUST FOLLOW PROCEDURE F-6-1 SEC. 5.2 OF THE ONTARIO DRINKING WATER RESOURCES ACT.
6. METALLIC WARNING TAPE SHALL BE USED OVER ALL WATERMAINS.
7. INSTALL AND TEST TRACER WIRE FOR ALL PROPOSED WATERMAIN IN ACCORDANCE WITH THE TOWN OF GANANOQUE STANDARDS.
8. EXISTING WATERMAIN INFORMATION SHOWN ON KING STREET WEST IS BASED ON BEST CURRENT INFORMATION. CONTRACTOR TO VERIFY EXACT LOCATION OF WATERMAIN AND REPORT ANY DISCREPANCIES TO KOLLAARD ASSOCIATES INC.
9. ALL CURB STOPS TO BE WITHIN THE ROAD ALLOWANCE AND LOCATED 0.15 METRES FROM THE PROPERTY LINE UNLESS OTHERWISE NOTED.
10. FIRE HYDRANTS TO BE DARLING 'CENTURY' 3 WAY C/W 2–2½" HOSE CONNECTIONS AND PUMPER CONNECTION AND 6"MECHANICAL JOINT INLET ELBOW. ALL HOSE CONNECTIONS TO BE THREADED. HYDRANT TO BE PAINTED YELLOW WITH A YELLOW SNOW MARKER INSTALLED. HYDRANT INSTALLATION TO BE IN ACCORDANCE WITH OPSD 1105.010/OPSS 441 .
11. VALVES, VALVE BOXES, SADDLES, MAIN STOPS, CURB STOPS, COUPLERS, SERVICE BOXES AND METERS TO BE IN ACCORDANCE WITH THE ONTARIO PROVINCIAL DESIGN STANDARDS AS SPECIFIED IN SECTION 8.12.6.
12. CONNECTIONS AT ELBOWS AND TEEs IN WATER MAINS SHOULD BE MADE WITH THE USE OF JOINT RESTRAINERS DESIGNED FOR WATERMAIN APPLICATION. JOINT AND PIPE RESTRAINERS SHOULD MEET THE REQUIREMENTS OF AWWA C900, C905 AND C907 AND ASTM F1674-11. JOINT RETRAINERS SHOULD BE INSTALLED AS PER MANUFACTURERS RECOMMENDATIONS.
13. ALL CONNECTORS, RODS AND VALVE BOLTS SHALL BE STAINLESS STEEL.
14. VALVES ARE TO BE OPERATED BY THE TOWN OF GANANOQUE STAFF ONLY.
15. ALL VALVES TO WHICH THE NEW SYSTEM WILL BE CONNECTED TO MUST BE EXPOSED AND INSPECTED BY THE TOWN OF GANANOQUE.
16. NO CONNECTION TO EXISTING WATER NETWORK SHALL BE COMPLETED UNTIL WRITTEN APPROVAL IS OBTAINED FROM THE TOWN OF GANANOQUE.

GENERAL NOTES:

1. COORDINATE AND SCHEDULE ALL WORK WITH OTHER TRADES AN CONTRACTORS.
2. DETERMINE THE EXACT LOCATION, SIZE, MATERIAL AND ELEVATION OFF ALL EXISTING UTILITIES PRIOR TO COMMENCING CONSTRUCTION. PROTECT AND ASSUME RESPONSIBILITY FOR ALL EXISTING UTILITIES WHETHER OR NOT SHOWN ON THIS DRAWING.
3. OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE TOWN AND CONSERVATION AUTHORITY BEFORE COMMENCING CONSTRUCTION.
4. BEFORE COMMENCING CONSTRUCTION OBTAIN AND PROVIDE PROOF OF COMPREHENSIVE, ALL RISK AND OPERATIONAL LIABILITY INSURANCE FOR $2,000,000.00. INSURANCE POLICY TO NAME OWNERS, ENGINEERS AND ARCHITECTS AS CO-INSURED.
5. RESTORE ALL DISTURBED AREAS ON-SITE AND OFF-SITE, INCLUDING TRENCHES AND SURFACES ON PUBLIC ROAD ALLOWANCES TO EXISTING CONDITIONS OR BETTER TO THE SATISFACTION OF THE TOWN AND ENGINEER.
6. REMOVE FROM SITE ALL EXCESS EXCAVATED MATERIAL, ORGANIC MATTER AND DEBRIS UNLESS OTHERWISE INSTRUCTED BY ENGINEER. EXCAVATE AND REMOVE FROM SITE ANY CONTAMINATED MATERIAL. ALL CONTAMINATED MATERIAL SHALL BE DISPOSED OF AT A LICENCED LANDFILL FACILITY.
7. ALL ELEVATIONS ARE GEODETIC.
8. REFER TO STORMWATER MANAGEMENT REPORT (201052) PREPARED BY KOLLAARD ASSOCIATES ENGINEERS.
9. CONTRACTOR TO PROVIDE THE CONSULTANT WITH A GENERAL PLAN OF SERVICES INDICATING ALL SERVICING AS-BUILT INFORMATION SHOWN ON THIS PLAN. AS-BUILT INFORMATION MUST INCLUDE: PIPE MATERIAL, SIZES, LENGTHS, SLOPES, INVERT & T/G ELEVATIONS, STRUCTURE LOCATIONS, VALVE AND HYDRANT LOCATIONS, T/WM ELEVATIONSAND ANY ALIGNMENT CHANGES, ETC.

STRUCTURE TABLE

STMMH.ID	SIZE (mm)	T/G ELEV. (m)	INVERT (m)	PIPE ø (mm)	ICD I=HEAD Q=RELEASE RATE	OPSD (STRUCTURE)	OPSD (FRAME & GRATE)
CDS UNIT	1200 ø	92.55			N/A		
CBMH.100	1200 ø	92.50	E=91.20	300	HYDROVEX 100SWV-1 H=1.0m Q=11.4 L/S	0701.0100	401.010-B
			W=91.22	300			
STM.MH.102	1200 ø	92.85	N=91.25	300	N/A	0701.0100	401.010-A
			E=91.30	250			
			S=91.30	250			
			W=91.93	250			
SAN.MH.101	1200 ø	92.63	N=90.40	200	N/A	0701.0100	401.010-A
			S=90.45	200			
			W=90.45	200			
SAN.MH.103	1200 ø	92.90	N=90.55	200	N/A	0701.0100	401.010-A
			W=90.60	200			
SAN.MH.105	1200 ø	93.20	E=90.80	200	N/A	0701.0100	401.010-A
SAN.MH.107	1200 ø	94.61	NE/I=93.30	200	N/A	0701.0100	401.010-A
CB1	600x600	92.55	E=91.55	250	HYDROVEX 750VHV-1 H=1.0m Q=5.0 L/S	0705.010	040.0500
CB2	600x600	92.80	NE=91.35	250	HYDROVEX 750VHV-1 H=1.0m Q=5.0 L/S	0705.010	040.0500
CB3	600x600	92.80	NE=91.53	250	HYDROVEX 750VHV-1 H=1.0m Q=5.0 L/S	0705.010	040.0500
CB4	600x600	92.60	E=91.57	250	HYDROVEX 750VHV-1 H=1.0m Q=5.0 L/S	0705.010	040.0500



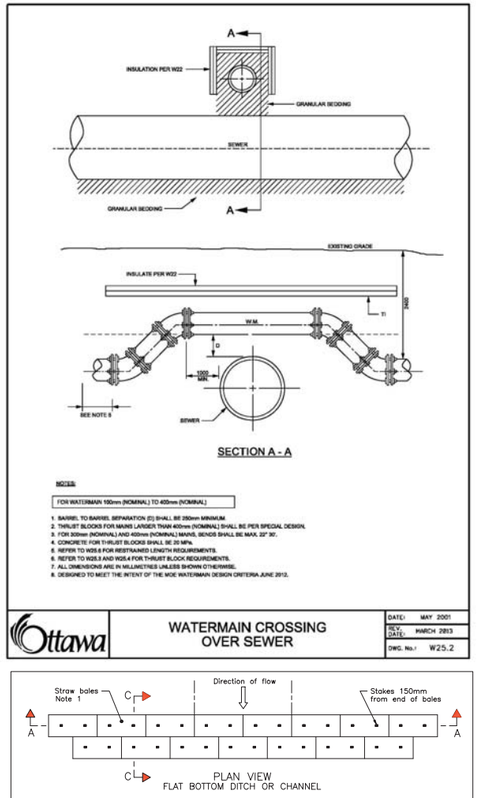
COMMON TRENCH FOR SINGLE HOMES

COMMON TRENCH FOR SEMI-DETACHED AND TOWNHOUSES

NOTES:
1. NO HORIZONTAL BENDS IN RIGHT-OF-WAY UNLESS OTHERWISE APPROVED BY THE CITY. MAXIMUM OF TWO 22.5° HORIZONTAL BENDS FOR SANITARY AND STORM SERVICES.
2. 1% MINIMUM SANITARY AND STORM SERVICE GRADIENT WITH 2% PREFERRED.
3. STORM SERVICE LATERAL SHALL BE LOCATED TO THE LEFT OF SANITARY SERVICE LATERAL WHEN LOOKING AT THE STRUCTURE FROM THE STREET. SERVICE SIZES IN CONFORMANCE WITH S11.
4. SEE ST FOR PIPE FOUNDATION, EMBEDMENT AND FINAL BACKFILL REQUIREMENTS.
5. MULTIPLE TAPS WITH SADDLES IN PVC WATERMAIN SHALL BE STAGGERED AND MINIMUM 600mm APART.
6. ELEVATION OF SERVICES VARIABLE DEPENDING ON GRADIENT AND/OR DEPTH OF COVER.
7. ALL DIMENSIONS ARE IN MILLIMETRES.

N.T.S.

Ottawa	TYPICAL SINGLE, SEMI-DETACHED AND TOWNHOUSE INDIVIDUAL LOT SERVICING	DATE: MARCH 2011; REV. DATE: MARCH 2019; DWG. No.: S11.3

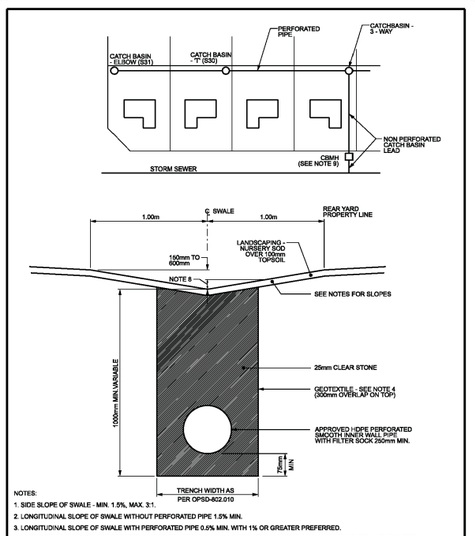


SECTION A - A

NOTES:
FOR WATERMAIN 150mm (NOMINAL) TO 400mm (NOMINAL)

1. BARREL TO BARREL SEPARATION (S) SHALL BE 250mm MINIMUM.
2. THRUST BLOCKS FOR MAINS LARGER THAN 400mm (NOMINAL) SHALL BE PER SPECIAL DESIGN.
3. FOR 300mm (NOMINAL) AND 400mm (NOMINAL) MAINS, BENDS SHALL BE MAX. 22° 30'.
4. CONCRETE FOR THRUST BLOCKS SHALL BE 20 MPa.
5. REFER TO W26.6 FOR RESTRAINED LENGTH REQUIREMENTS.
6. REFER TO W26.3 AND W26.4 FOR THRUST BLOCK REQUIREMENTS.
7. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SHOWN OTHERWISE.
8. DESIGNED TO MEET THE INTENT OF THE MOE WATERMAIN DESIGN CRITERIA JUNE 2012.

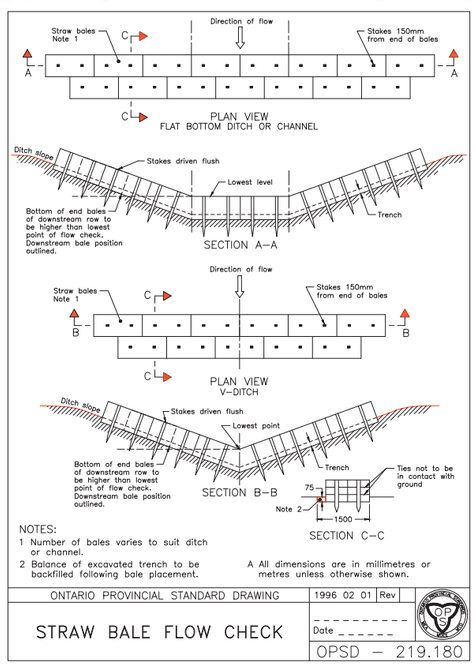
Ottawa	WATERMAIN CROSSING OVER SEWER	DATE: MAY 2001; LAST DATE: MARCH 2013; DWG. No.: W25.2



NOTES:
1. SIDE SLOPE OF SWALE - MIN. 1.5%, MAX. 3:1.
2. LONGITUDINAL SLOPE OF SWALE WITHOUT PERFORATED PIPE 1.5% MIN.
3. LONGITUDINAL SLOPE OF SWALE WITH PERFORATED PIPE 0.5% MIN. WITH 1% OR GREATER PREFERRED.
4. UNDER DRIVEWAYS NON PERFORATED PIPE TO BE USED WITH 75mm BEDDING AND BACKFILLED WITH APPROVED NATIVE MATERIAL.
5. CB "T" TO BE SPACED ABOUT EVERY 20 TO 25m AND LOCATED 1m OFF REAR YARD AND SIDE YARD PROPERTY LINES.
6. CB ELBOW TO BE AT UPPER ENDS OF PERFORATED PIPE AND LOCATED 1m OFF REAR YARD AND SIDE YARD PROPERTY LINES.
7. GEOTEXTILE SHALL BE APPROVED NON-WOVEN CLASS 1 OR AS SPECIFIED.
8. MAXIMUM REAR YARD WATER DEPTH IS 300mm.
9. A STANDARD CATCHBASIN NO DEEPER THAN 2.4m OR A CATCHBASIN MAINTENANCE HOLE. STANDARD FRAMES C/W PERFORATED OR SOLID COVER AS SPECIFIED. STANDARD ICD'S AS SPECIFIED

N.T.S.

Ottawa	PERFORATED PIPE INSTALLATION FOR REAR YARD AND LANDSCAPING APPLICATIONS	DATE: MARCH 2007; REV. DATE: MARCH 2019; DWG. No.: S29



NOTES:
1 Number of bales varies to suit ditch or channel.
2 Balance of excavated trench to be backfilled following bale placement.

A All dimensions are in millimetres or metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING		1996 02 01 Rev
STRAW BALE FLOW CHECK		Date _____
		OPSD – 219.180

DRAWING No.
201052–ND

DRAWING
NOTES & DETAILS

KEY PLAN:
N.T.S.

GENERAL PROJECT NOTES:

1. All dimensions are in metres; all elevations are in metres and are local.
2. TBM=Geodetic monument in rock outcrop at the intersection of Birch Street and King Street West (Station 0011982u105). elevation = 90.11 metres.
3. This drawing is not a legal survey, a utility plan or a site plan and is for grading purposes only.
4. Client is responsible for acquiring all necessary permits. This drawing is not for construction until a building permit has been granted.
5. Contractor is responsible for location and protection of utilities.
6. All dimensions to be verified on site by contractor prior to construction.
7. Any changes made to this plan must be verified and approved by Kollaard Associates Inc.
8. The proposed grades have been set and verified for site grading control only. The grade raise at the building location should be verified with regard to subsurface conditions by qualified geotechnical personnel after completion of the excavation.
9. The underside of footing elevation has been set based on the information available and may not have accounted for actual ground water conditions at the exact building location and should be verified by qualified geotechnical personnel upon completion of the excavation.
10. A geotechnical engineer should be retained to provide recommendations with respect to the sub-grade conditions prior to footing installation.
11. The owner agrees to prepare and implement an erosion and sediment control plan to the satisfaction of the regulatory agency or township, appropriate to the site conditions, prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and during all phases of site preparation and construction in accordance with the current Best Management Practices for Erosion and Sediment Control such as, and not limited to installing filter cloths across manhole/catchbasin lids to prevent sediments from entering structures and install and maintain a light duty silt fence barrier as required.
12. Shop drawings for items such as (but not limited to) storm catch basins and underground storm water storage chambers to be reviewed and approved by Kollaard Associates Inc. prior to fabrication.
13. This drawing is part of Kollaard Associates File No. 201052.

No.	REVISION	DATE	BY
1	AS PER ENGINEERING COMMENTS #1	04.OCT.2021	NR

Kollaard Associates Engineers
P.O. BOX 189, 210 PRESCOTT ST. (613) 860-0923
KEMPTVILLE, ONTARIO info@kollaard.ca
K0G 1J0 FAX (613) 258-0475
http://www.kollaard.ca

CLIENT NAME
STEFANO FERRANTE

PROJECT NAME
22–UNIT RESIDENTIAL DEVELOPMENT

PROJECT LOCATION
KING STREET WEST
GANANOQUE, ONTARIO

LICENCED PROFESSIONAL ENGINEER
October 04, 2021
S.E. deWit
100079612
PROVINCE OF ONTARIO

DESIGNED BY NR	CHECKED BY SD
DRAWN BY NR	APPROVED BY SD
DATE 17.MAR.2021	
SCALE N.T.S.	
PROJECT No. 201052	
SHEET SET 6 OF 6	

Appendix F: Communications

*There are no changes to this Appendix from the March 17, 2021 Submission.

Subject: RE: Stormwater Management Criteria, Proposed Residential Development, King Street West, Gananoque
From: Mike Dakin <MDakin@crca.ca>
Date: 10/02/2021, 3:37 p.m.
To: Steve deWit <steve@kollaard.ca>

Hi Steve,

Yes, you've got it bang on. Both quality and quantity recommended at the levels you note. If needed, attached are our SWM Guidelines.

Thanks and let me know if you need anything else.
Mike

Michael Dakin MCIP, RPP
Resource Planner

Cataraqui conservation

Phone: (613) 546-4228 ext. 228
Toll-Free: 1-877-956-2722
Web: www.CataraquiConservation.ca

From: Steve deWit <steve@kollaard.ca>
Sent: February 9, 2021 10:35 AM
To: Mike Dakin <MDakin@crca.ca>
Subject: Stormwater Management Criteria, Proposed Residential Development, King Street West, Gananoque

Good Morning Mike

Kollaard Associates is now completing the engineering work on a file started a while ago now.

The site is on the south side of King Street West in Gananoque directly across the Street from 780 King St W (Colonial Resort and Spa) Attached is a relatively close to final site plan for reference.

We had an initial consult with the Town on Feb 6, 2020 in Gananoque.

At that time we were informed that the Quantity Control and Quality Control Criteria would be provided by CRCA.

I have written in my file that the criteria consists of:

Quantity - Post to Pre from 2 up to and including the 100 yr storm with onsite storage to attenuate flows exceeding pre-development conditions.

Quality - normal or 70% TSS

I wish to confirm that this is correct

Thank you.

--

Steven deWit, P.Eng.
Kollaard Associates Inc
210 Prescott Street, Unit 1
P.O. Box 189
Kemptville, Ontario
K0G 1J0 CANADA
t: 613.860.0923 f: 613.258.0475
c: 613.223.4049
www.kollaard.ca

Attachments:

CRCA EPP App I Stormwater Management Guidelines.pdf 209 KB