S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing & Stormwater Management Report

7525 GARNER ROAD

CITY OF NIAGARA FALLS

MADAN-ARIANNA DEVELOPMENTS INC.

JUNE 2025

SLA File: 24043

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1.0 INTRODUCTION AND BACKGROUND

1.1 Overview

S. Llewellyn & Associates Limited has been retained by Madan-Arianna Developments Inc. to provide Consulting Engineering services for the proposed development at 7525 Garner Road in the City of Niagara Falls (see Figure 1.0 for location plan).

The 0.81ha site is bound by Garner Road to the east, existing wood lot and wetlands to the west, and existing residential lands to the south and north. The proponent proposes to construct three (3) 3-storey stacked townhouse blocks with a total of 51 units. The proposed development also includes associated asphalt driveways, concrete curbing, and landscaped areas.

This Functional Servicing and Stormwater Management Report will provide detailed information of the proposed stormwater management and functional servicing scheme for this development. Please refer to Site Engineering Plans prepared by S. Llewellyn & Associates Limited and the Site Plan prepared by Jansen Consulting for additional information.

1.2 Background Information

The following documents were referenced in the preparation of this report:

Ref. 1: *The City of Niagara Falls Engineering Design Guidelines Manual* (April 2016)

Ref. 2: *City Standards for Site Planning* (April 1992).

Ref. 3: *MOE Stormwater Management Practices Planning and Design Manual*, Ministry of Environment (March 2003).

Ref. 4: *Erosion & Sediment Control Guidelines for Urban Construction* (December 2006).

Figure 1.0 – Location Plan

2.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, in accordance with the City of Niagara Falls requirements:

Quantity Control
The stormwater discharge rate from the proposed site shall be controlled to the pre-development condition discharge rate for the 5-year storm event.

Quality Control
The stormwater runoff from the proposed condition site must meet Level 2 (Normal) stormwater quality control (70% TSS removal, 80% average annual runoff treatment).

Erosion Control
Erosion and sediment control measures will be implemented in accordance with the standards of the City of Niagara Falls and NPCA.

2.1 Pre-Development Conditions

In the pre-development condition, the 0.81ha site consists of 4 existing garages, gravel driveway, wooded and grassed area. A portion of the site sheet drains east towards Garner Road where runoff is captured by the existing 900mmø storm sewer along Garner Road. The remainder of the site sheet drains west to the wetlands.

Two catchments area, catchment 101 and 102 have been identified in the existing condition. Catchment 101 represents the drainage area from the site, which is captured by the existing 900mmø storm sewer along Garner Road. Catchment 102 represents the drainage area which sheet drains towards the wetlands. See Table 2.1 and the Existing Condition Storm Drainage Area Plan in Appendix A for details.

Table 2.1: Pre-Development Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
101	To Garner Road	0.52	10%	0.31
102	To Wetlands	0.29	0%	0.25

The existing conditions discharge from the site was calculated for Catchment 101 using the Rational Method based on the above runoff coefficient (C) and the City of Niagara Falls storm intensities at a time of concentration of 10 minutes (Tc=10min). An example of the 5-year calculation for Catchment 101 is shown below and a summary can be found in Table 2.2.

$Q_{5\text{-yr (Catchment 101)}}$ = 2.78CiA=2.78(0.31)(84.02 mm/hr)(0.52ha)
= ***37.7 l/s (0.0377 m³/s)***

Table 2.2: Pre-Development Condition Site Discharge

Storm Event	Catchment 101 Runoff (m^3/s)	Catchment 102 Runoff (m^3/s)
5-Yr Event	0.0377	0.0169

2.2 Post-Development Conditions

The proposed development consists of constructing three (3) 3-storey stacked townhouse blocks with a total of 51 units including associated asphalt driveways, concrete curbing, and landscaped areas. It is proposed to service the site with a private storm sewer system, designed and constructed in according to the City of Niagara Falls standards.

Three (3) catchment areas, Catchment 201, 202, and 203 have been identified in the proposed condition. Catchments 201 represents the drainage area which is captured from the roof of the proposed building, asphalt surface, concrete walkways and landscaped areas and will outlet via the proposed storm sewer and discharge to the existing 900mmø storm sewer along Garner Road.

Catchment 202 represents the uncontrolled drainage area, which sheet drains to the municipal right of way and is captured by the existing 900mmø storm along Garner Road.

Catchment 203 represents the uncontrolled drainage area, which sheet drains to the adjacent wetlands. See Table 2.3 and the Proposed Condition Storm Drainage Area Plan in Appendix A for details.

Table 2.3: Post-Development Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Runoff Coefficient
201	Controlled to Garner Road	0.49	93%	0.86
202	Uncontrolled to Garner Road	0.07	0%	0.25
203	Uncontrolled to Wetlands	0.25	0%	0.25

2.2.1 Water Quantity Control

It is required to restrict the 5-year post-development discharge rate from the subject site to the 5-year pre-development discharges rate. Stormwater quantity control for Catchment 201 will function through an 100mmø orifice plate located within MH2. The orifice plate will restrict discharge from the site to the allowable discharge rate. Details of this design can be found on the Preliminary Site Servicing Plan, prepared by S. Llewellyn and Associates Limited. A summary of the stage-storage-discharge characteristics and proposed discharge rates for the proposed condition can be seen in Table 2.4 and Appendix A.

Table 2.4: Proposed Condition Stage-Storage-Discharge for Catchment 201

Elevation (m)	Storage (m^3)	Discharge (m^3/s)
178.62 (Orifice Invert)	0	0.0000
180.60 (Top of Grade)	0	0.0290
180.65	1	0.0294
180.70	7	0.0297
180.75	25	0.0301
180.80	64	0.0305
180.85	133	0.0308

The maximum discharge rates for Catchments 202 and 203 were calculated using the Rational Method based on the proposed condition runoff coefficients for the 5-year storm event. Additionally, the 5-year storage volume for Catchment 201 was calculated using the Modified Rational Method (MRM). The proposed discharge rate and required storage volume is summarized in Tables 2.5 and 2.6 below and in Appendix A for details.

Table 2.5: Proposed Condition Stormwater Discharge (To Garner Rd)

Storm Event	Catchment 201 Controlled Discharge (m^3/s)	Catchment 202 Uncontrolled Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge (m^3/s)	Required Storage (m^3)
5-Yr	0.0308	0.0029	0.0337	0.0377	60

Table 2.6: Proposed Condition Stormwater Discharge (To Wetlands)

Storm Event	Catchment 203 (Proposed Discharge) (m^3/s)	Catchment 102 (Existing Discharge) (m^3/s)	Change (%)
2-Yr	0.0124	0.0133	- 6.8
5-Yr	0.0158	0.0169	- 6.5
10-Yr	0.0200	0.0215	- 7.0
25-Yr	0.0208	0.0223	- 6.7
100-Yr	0.0251	0.0270	- 7.0

This analysis determined the following:

- The post-development condition discharge rates to Garner Road will not exceed the pre-development condition discharge rate during the 5-year storm event.

- Sufficient stormwater storage is provided on the surface of the asphalt parking lot. A total storage volume of $133m^3$ is provided while only $60m^3$ of storage is required during the 5-year storm event.

- The post-development condition discharge rates to the wetlands will not exceed the pre-development condition discharge rates.

2.2.2 Water Quality Control

The proposed development is required to achieve a “Normal” (70% TSS removal) level of water quality protection. To achieve this criteria, discharge from Catchment 201 will be subject to treatment from a HydroStorm oil/grit separator before ultimately discharging to the existing storm sewer system along Garner Road. The HydroStorm sizing software was used to determine the required size of oil/grit separator unit for the site. It was determined that a HydroStorm HS5 will provide 71% TSS removal and 98% average annual runoff treatment. See HydroStorm unit sizing procedures in Appendix B for details.

As part of a treatment train approach, Flexstorm Inlet Filters have been proposed within the proposed catchbasins in the asphalt driveways. The installation of the Flexstorm Inlet Filters will contribute to the removal of TSS and the capture of floatables within the catchbasins. Technical information regarding the Flexstorm Inlet Filters can be found in Appendix B.

HydroStorm units and Flexstorm Inlet Filters require regular inspection and maintenance as per the manufacturer's specifications to ensure the units operate properly. See the Maintenance Manuals in Appendix B for details.

2.2.3 Sediment and Erosion Control

In order to minimize erosion during the grading and site servicing period of construction, the following measures will be implemented:

- Install silt fencing along the outer boundary of the site to ensure that sediment does not migrate to the adjacent properties;
- Install sediment control (silt sacks) in the proposed catchbasins as well as the nearby existing catchbasins to ensure that no untreated runoff enters the existing conveyance system;
- Stabilize all disturbed or landscaped areas with hydro seeding/sodding to minimize the opportunity for erosion.

To ensure and document the effectiveness of the erosion and sediment control structures, an appropriate inspection and maintenance program is necessary. The program will include the following activities:

- Inspection of the erosion and sediment controls (e.g. silt fences, sediment traps, outlets, vegetation, etc.) with follow up reports to the governing municipality; and
- The developer and/or their contractor shall be responsible for any costs incurred during the remediation of problem areas.

Details of the proposed erosion & sediment control measures are provided on the Preliminary Site Erosion and Sediment Control Plan.

3.0 SANITARY SEWER SERVICING

3.1 Existing Conditions

There is an existing 375mmø sanitary sewer, which flows south along Garner Road and outlets to Brown Road.

3.2 Sanitary Demand

Sanitary discharge from the proposed site was estimated in accordance with the Niagara Region Master Servicing Plan. Table 3.1 below summarizes the sanitary sewer discharge rate from the subject lands.

Table 3.1- Post-Development Sanitary Sewer Discharge

Site Area (ha)	Population [A]	Avg. Demand [B] (l/s)	Peaking Factor [C]	Infiltration [D] (l/s)	**Peak Flow [E] (l/s)**
0.81	153 persons	0.45	4.0	0.23	**2.03**

[A] Population = 51 units x 3 persons/unit = 153 persons
[B] Average demand (q) = 255 l/cap/day
[C] Peaking Factor (M) = (1+(14/(4+$P^{0.5}$))) with P expressed in thousands Min. 2.0, Max. 4.0
[D] Infiltration flow based on 0.286 l/ha/sec infiltration rate x Site Area
[E] Peak Flow = (Average Demand x Peaking Factor) + Infiltration

3.3 Proposed Sanitary Servicing

The proposed site will be serviced by a 200mmø sanitary sewer system, and will be designed and constructed in accordance with the City of Niagara Falls standards. Drainage from the proposed sanitary sewer system will discharge to the existing 375mmø sanitary sewer along Garner Road.

The minimum grade of the proposed 200mmø sanitary sewer will be 0.5%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.023 m^3/s (23 l/s). Therefore, the proposed 200mmø sanitary sewer at a minimum of 0.5% grade is adequately sized to service the proposed site.

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 Existing Conditions

The existing municipal water distribution system consists of a 250mmø watermain along Garner Road. There is an existing fire hydrant fronting the site on Garner Road.

4.2 Domestic Water Demand

Water demand for the site was estimated in accordance with the Ministry of the Environment Design Guidelines for Drinking-Water Systems. Table 4.1 summarizes the domestic water demand requirements for the Average Daily, Maximum Daily and Peaking Hourly demand scenarios.

Table 4.1: Post-Development Domestic Water Demand

Population [A]	Average Daily Demand [B] (l/s)	Max. Daily Peaking Factor [C]	Max. Hourly Peaking Factor [D]	**Max. Daily Demand [E] (l/s)**	**Max. Hourly Demand [F] (l/s)**
153 persons	0.48	4.9	7.4	**2.35**	**3.55**

[A] Population = 51 units x 3 persons/unit = 153 persons
[B] Average Daily Demand = 270 l/cap/day
[C] Max. Daily Peaking Factor = 4.9 (refer to Table 3-3 from MOE Manual)
[D] Max. Hourly Peaking Factor = 7.4 (refer to Table 3-3 from MOE Manual)
[E] Max. Daily Demand = Average Daily Demand x Max. Daily Peaking Factor
[F] Max. Hourly Demand = Average Daily Demand x Max. Hourly Peaking Factor

4.3 Fire Flow Demand

Fire flow demands for development are governed by a number of guidelines and criteria, such as the Water Supply for Public Fire Protection (Fire Underwriters Survey, 2020), Ontario Building Code (OBC), and various codes and standards published by the National Fire Protection Association (NFPA). The Fire Underwriters Survey - 2020 was used to determine the required flow rate for the proposed development which was based on the worst-case scenario which is Block 2.

There is an existing fire hydrant fronting the site on Garner Road which does not meet the required 90m separation to the building face of the proposed buildings (as per Sentence 3.2.5.5 of the 2020 Ontario Building Code). Therefore, an additional private hydrant is proposed for the development.

The stacked townhouse blocks are non-combustible construction buildings (C=1.5), with limited-combustible occupancy (15% correction) and no sprinkler system (0% correction).

Exposure components for Block 2 are based on the following:

North Face: 0% correction (30m+)
South Face: 10% correction (20.1 to 30m)
East Face: 15% correction (10.1 to 20m)
West Face: 15% correction (10.1 to 20m)
Total: 40%

An estimate of the required flow rate for the proposed building can be found in Appendix C. The flow rate was determined in accordance with the Fire Underwriters Survey – 2020 Water Supply for Public Fire Protection. It has been determined that the required fire flow for the site is **17000 l/min (283 l/s)**.

There is currently no hydrant flow test data available. A flow test will be completed at a later date and the results will be provided in an updated report.

4.4 Proposed Water Servicing and Analysis

The proposed development will be serviced with a 200mmø watermain feeding off the existing 250mmø watermain along Garner Road. The municipal watermain and fire hydrants will supply firefighting water for the development.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that:

- The development be graded and serviced in accordance with the Preliminary Grading and Erosion Control Plan and Preliminary Site Servicing Plan prepared by S. Llewellyn & Associates Limited;
- A 100mmø orifice plate be installed as per the Preliminary Site Servicing Plan and this report to provide adequate control to the Garner Road storm sewer;
- The development be graded in accordance with the Preliminary Grading Plan and this report to provide adequate stormwater storage;
- A Hydrostorm HS5 oil/grit separator, or approved equivalent, and Flexstorm Inlet filters be installed as per the Preliminary Site Servicing Plan and this report to provide effective stormwater quality control;
- The proposed sanitary and water servicing system be installed as per the Preliminary Site Servicing Plan and this report to adequately service the proposed development;
- Erosion and sediment controls be installed as described in this report, and as per the standards and specifications of the City of Niagara Falls;

We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Prepared by:

S. LLEWELLYN & ASSOCIATES LIMITED

M.Tran, B. Eng.

S. Nelson, P. Eng.

APPENDIX A
STORMWATER QUANTITY INFORMATION

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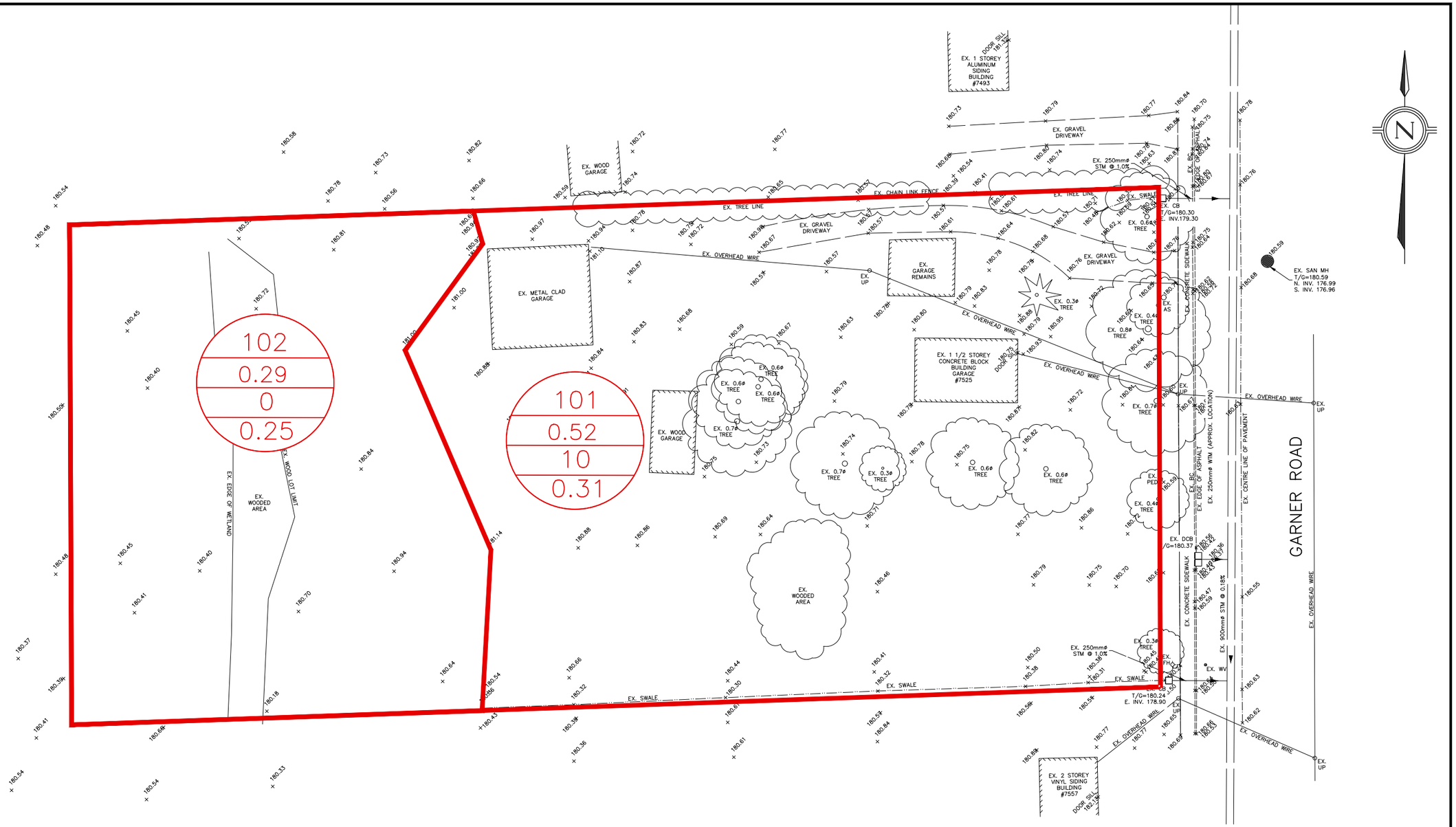

LEGEND

201
0.72
95
0.88

DRAINAGE AREA I.D.
DRAINAGE AREA (ha)
PERCENT IMPERVIOUS
RUNOFF COEFFICENT

PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:500

PROJECT: 7525 GARNER ROAD, NIAGARA FALLS
PROJECT No.: 24043

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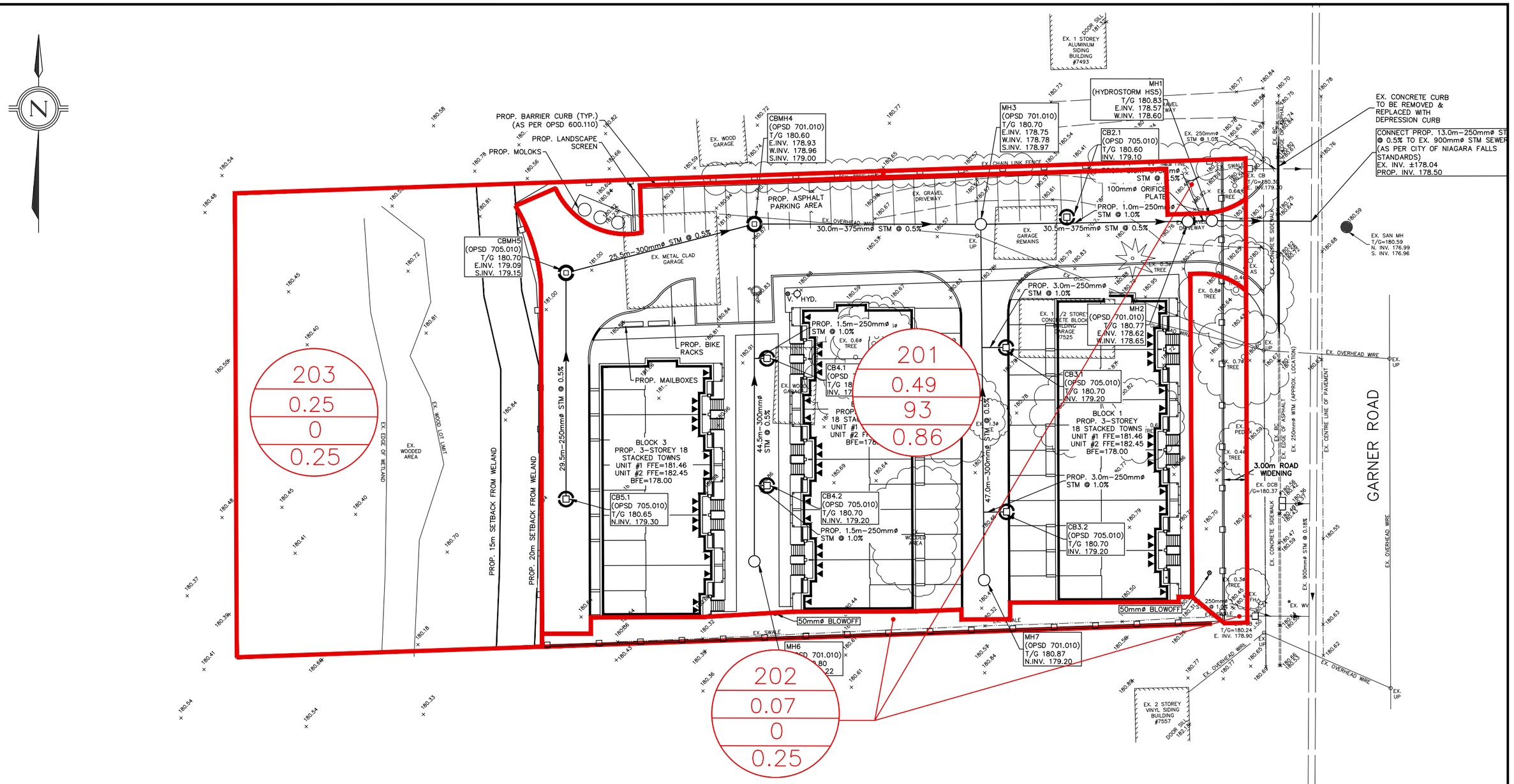

POST–DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:500

PROJECT: 7525 GARNER ROAD, NIAGARA FALLS
PROJECT No.: 24043

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7525 Garner Road
Niagara Falls, ON

RUNOFF COEFFICIENT CALCULATIONS

PRE

Catchment 101 Drainage		C-Value
Drainage Area #:	101	
Roof/Building Area (m²):	362	0.90
Asphalt/Conc. Area (m²):	0	0.90
Gravel Area (m²):	177	0.80
Grass Area - Pervious (m²):	4644	0.25
Total Area (m²):	5183	0.31
Impervious	504	**0.10**
Pervious	4679	**0.90**
Site	5183	

Catchment 102 Drainage		C-Value
Drainage Area #:	102	
Roof/Building Area (m²):	0	0.90
Asphalt/Conc. Area (m²):	0	0.90
Gravel Area (m²):	0	0.80
Grass Area - Pervious (m²):	2906	0.25
Total Area (m²):	2906	0.25
Impervious	0	**0.00**
Pervious	2906	**1.00**
Site	2906	

POST

Catchment 201 Drainage		C-Value
Drainage Area #:	201	
Roof/Building Area (m²):	1621	0.90
Asphalt/Conc. Area (m²):	2930	0.90
Gravel Area (m²):	0	0.80
Grass Area - Pervious (m²):	323	0.25
Total Area (m²):	4874	0.86
Impervious	4551	**0.93**
Pervious	323	**0.07**
Site	4874	

Catchment 203 Drainage		C-Value
Drainage Area #:	203	
Roof/Building Area (m²):	0	0.90
Asphalt/Conc. Area (m²):	0	0.90
Gravel Area (m²):	0	0.80
Grass Area - Pervious (m²):	2522	0.25
Total Area (m²):	2522	0.25
Impervious	0	**0.00**
Pervious	2522	**1.00**
Site	2522	

Catchment 202 Drainage		C-Value
Drainage Area #:	202	
Roof/Building Area (m²):	0	0.90
Asphalt/Conc. Area (m²):	0	0.90
Gravel Area (m²):	0	0.80
Grass Area - Pervious (m²):	693	0.25
Total Area (m²):	693	0.25
Impervious	0	**0.00**
Pervious	693	**1.00**
Site	693	

7525 Garner Road
Niagara Falls, ON

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type:	Orifice Plate
Diameter (mm)	**100**
Area (m^2)	0.00785
Invert Elev. (m)	178.62
C/L Elev. (m)	178.67
Disch. Coeff. (C_d)	0.6
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

		SWM Pond Volumes					Outlet No. 1	
	Elevation	Area	Additional Incremental Underground	Additional Incremental Surface	Cumulative Volume	Active Storage Volume	H	Discharge
	m	m^2		m^3	m^3	m^3	m	m^3/s
Top of Grade	180.60	0	0.0	0	0	0	1.930	0.0290
0.05m Ponding	180.65	43	0.0	1	1	1	1.980	0.0294
0.10m Ponding	180.70	190	0.0	6	7	7	2.030	0.0297
0.15m Ponding	180.75	521	0.0	18	25	25	2.080	0.0301
0.20m Ponding	180.80	1060	0.0	40	64	64	2.130	0.0305
0.25m Ponding	180.85	1674	0.0	68	133	133	2.180	0.0308

5-Year Storm - Modified Rational Method

Stormwater Storage Volume

Determination of required storage volume under proposed conditions to control the 100-year proposed conditions runoff to the allowable release rate. Storage volume calculated using the Modified Rational Method.

Storm Rainfall Information		
City/Town/Region:	**Niagara Falls**	
Return Period:	**5**	Years
A =	**719.500**	
B =	**6.340**	
C=	**0.7687**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) =	**0.49**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.86**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0308**	(Allowable discharge)

Flows from Lot area calculated from area indicated above

Roof flows (Q_{ROOF}) added in as a constant flow rate into the orifice controlled system (if applicable)

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	111.263	0.0000309	0.130	0.0	0.1302	39.07	13.86	25.21
10	600	84.024	0.0000233	0.098	0.0	0.0984	59.01	18.48	40.53
15	900	68.435	0.0000190	0.080	0.0	0.0801	72.10	23.10	49.00
20	1200	58.211	0.0000162	0.068	0.0	0.0681	81.77	27.72	54.05
25	1500	50.931	0.0000141	0.060	0.0	0.0596	89.43	32.34	57.09
30	1800	45.453	0.0000126	0.053	0.0	0.0532	95.77	36.96	58.81
35	2100	41.165	0.0000114	0.048	0.0	0.0482	101.19	41.58	59.61
40	2400	37.706	0.0000105	0.044	0.0	0.0441	105.93	46.20	59.73
45	2700	34.850	0.0000097	0.041	0.0	0.0408	110.14	50.82	59.32
50	3000	32.447	0.0000090	0.038	0.0	0.0380	113.94	55.44	58.50
55	3300	30.394	0.0000084	0.036	0.0	0.0356	117.41	60.06	57.35
60	3600	28.618	0.0000079	0.033	0.0	0.0335	120.59	64.68	55.91
65	3900	27.063	0.0000075	0.032	0.0	0.0317	123.55	69.30	54.25
70	4200	25.690	0.0000071	0.030	0.0	0.0301	126.30	73.92	52.38
75	4500	24.467	0.0000068	0.029	0.0	0.0286	128.88	78.54	50.34
80	4800	23.370	0.0000065	0.027	0.0	0.0274	131.31	83.16	48.15
85	5100	22.381	0.0000062	0.026	0.0	0.0262	133.61	87.78	45.83
90	5400	21.482	0.0000060	0.025	0.0	0.0251	135.79	92.40	43.39
95	5700	20.663	0.0000057	0.024	0.0	0.0242	137.86	97.02	40.84
100	6000	19.912	0.0000055	0.023	0.0	0.0233	139.85	101.64	38.21
105	6300	19.221	0.0000053	0.022	0.0	0.0225	141.74	106.26	35.48
110	6600	18.583	0.0000052	0.022	0.0	0.0218	143.56	110.88	32.68
115	6900	17.991	0.0000050	0.021	0.0	0.0211	145.31	115.50	29.81
120	7200	17.441	0.0000048	0.020	0.0	0.0204	146.99	120.12	26.87

Max. required storage volume = 59.73 m^3

Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

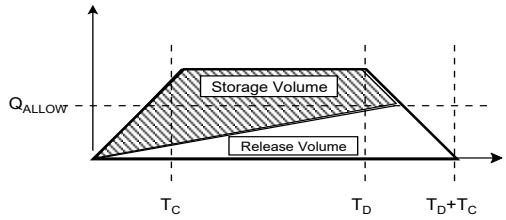
Runoff Volume = Area under trapezoidal hydrograph

= $(T_D - T_C)Q_{POST} + (T_C Q_{POST})$

Release Volume = Area under triangular outflow hydrograph

= $\frac{1}{2}(T_D + T_C) Q_{ALLOW}$

Storage Volume = Runoff Volume - Release Volume



APPENDIX B
STORMWATER QUALITY INFORMATION

Hydroworks Sizing Summary

7525 Garner Road

09-11-2024

Recommended Size: HydroStorm HS 5

A HydroStorm HS 5 is recommended to provide 70 % annual TSS removal based on a drainage area of .49 (ha) with an imperviousness of 76 % and St. Catherines A, Ontario rainfall for the ETV/NJDEP particle size distribution.

The recommended HydroStorm HS 5 treats 98 % of the annual runoff and provides 71 % annual TSS removal for the St. Catherines A rainfall records and ETV/NJDEP particle size distribution.

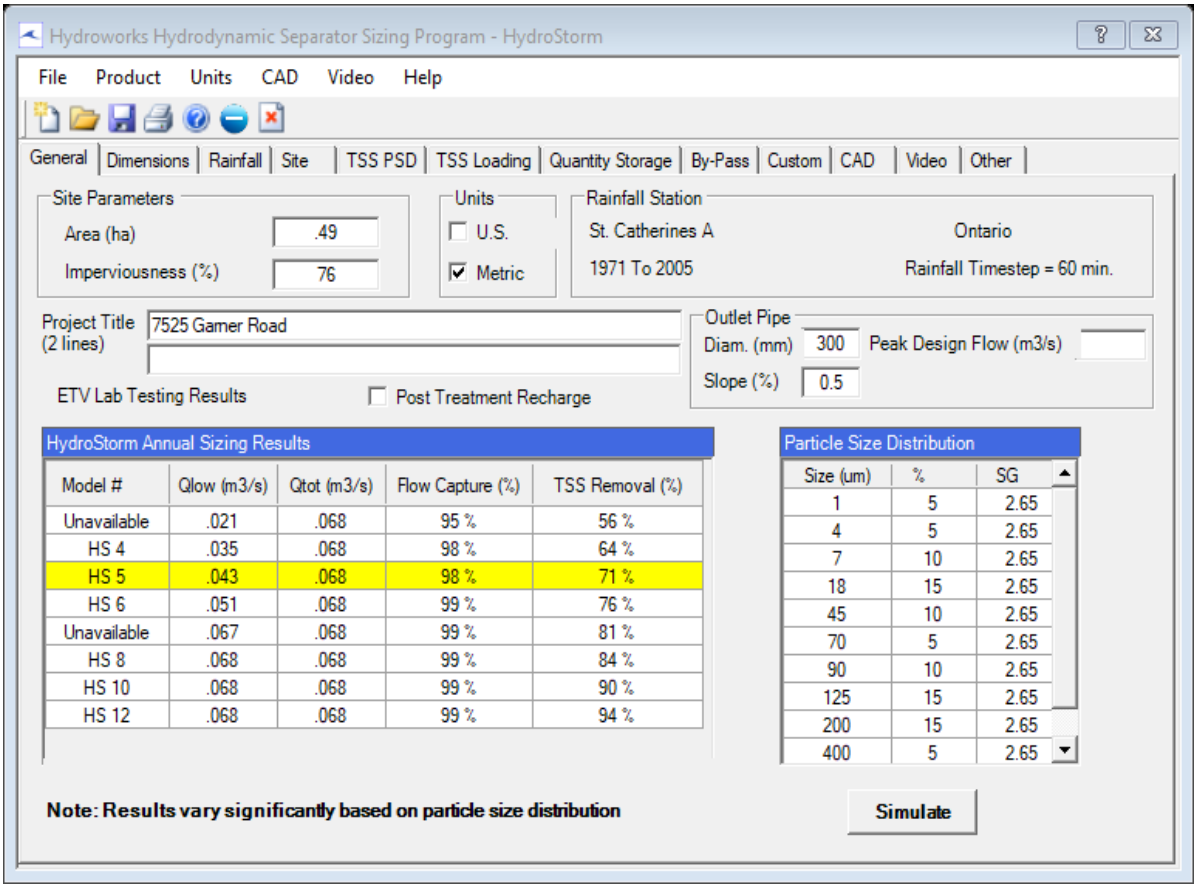
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .07 (m3/s) for the given 300 (mm) pipe diameter at .5% slope. The headloss was calculated to be 50 (mm) based on a flow depth of 300 (mm) (full pipe flow).

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

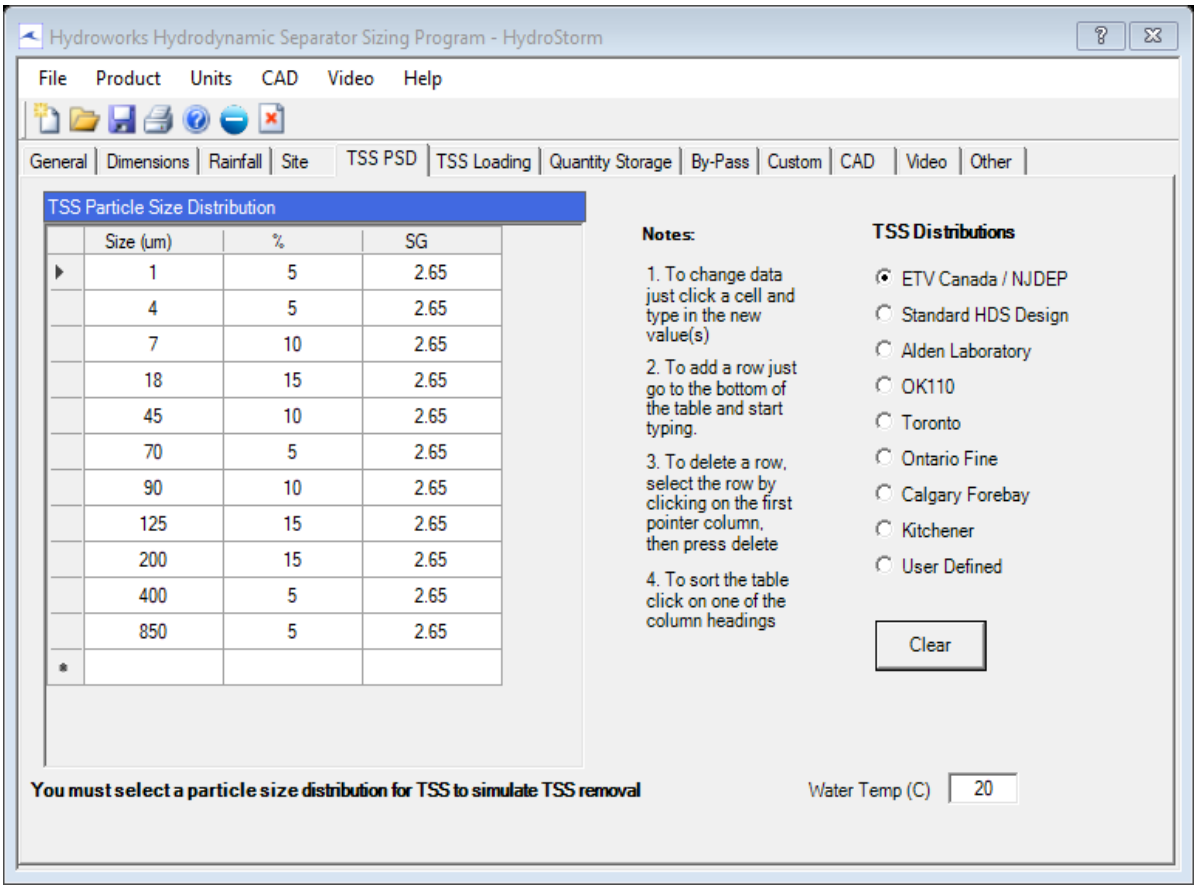
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroStorm .

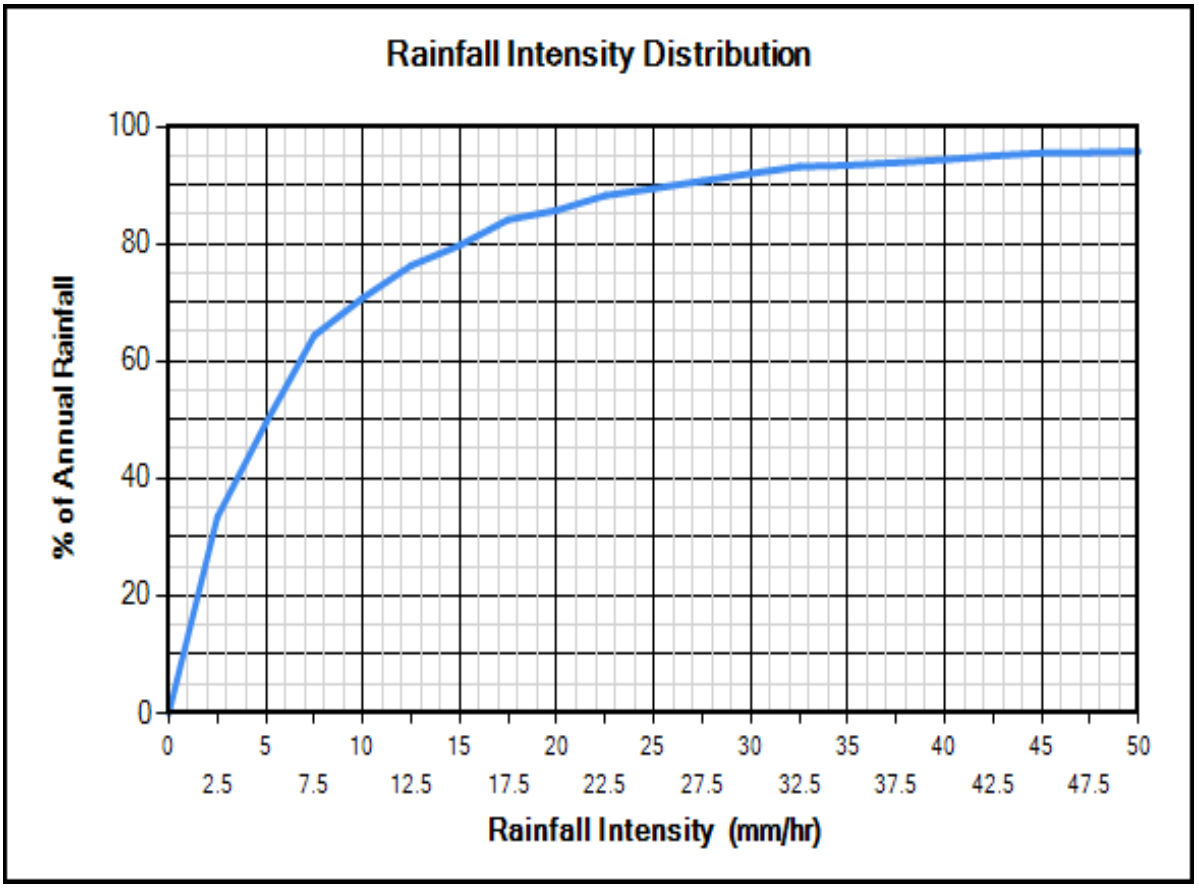
TSS Removal Sizing Summary



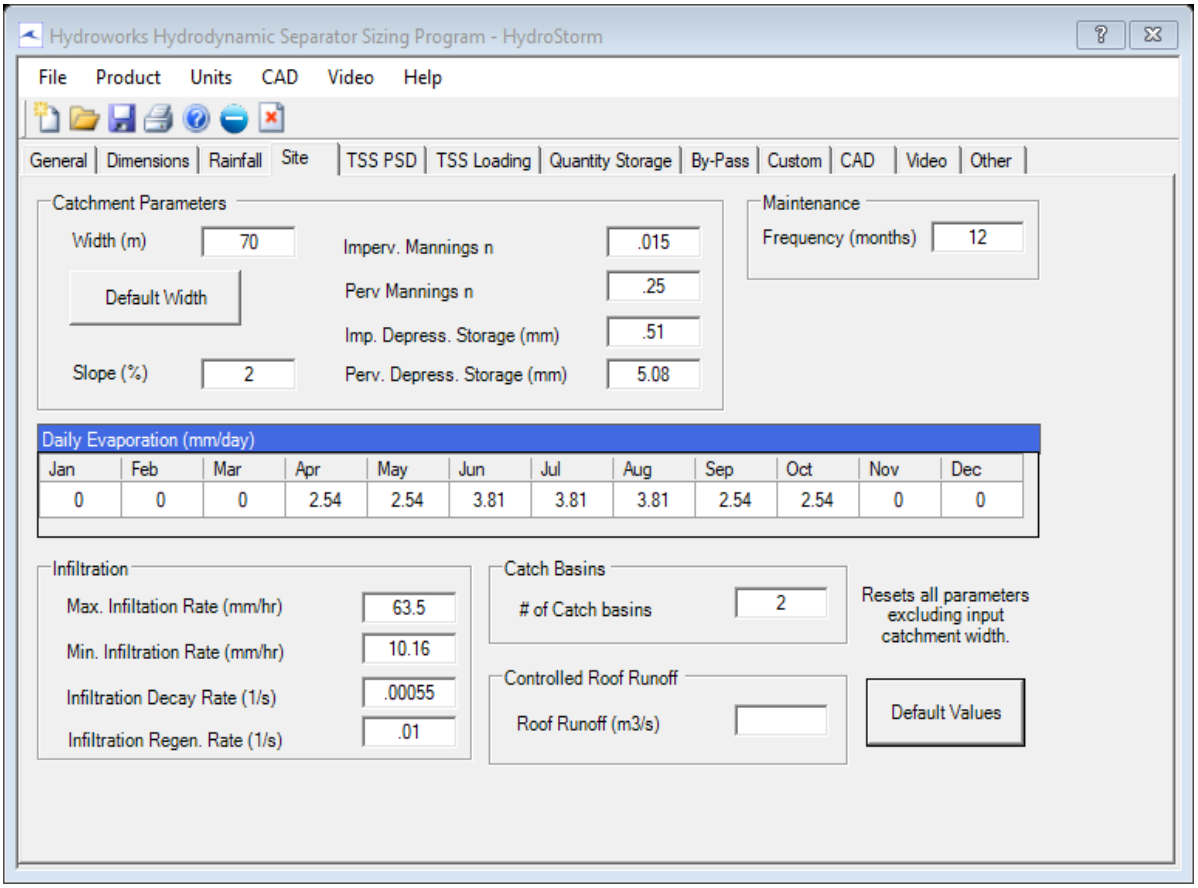
TSS Particle Size Distribution



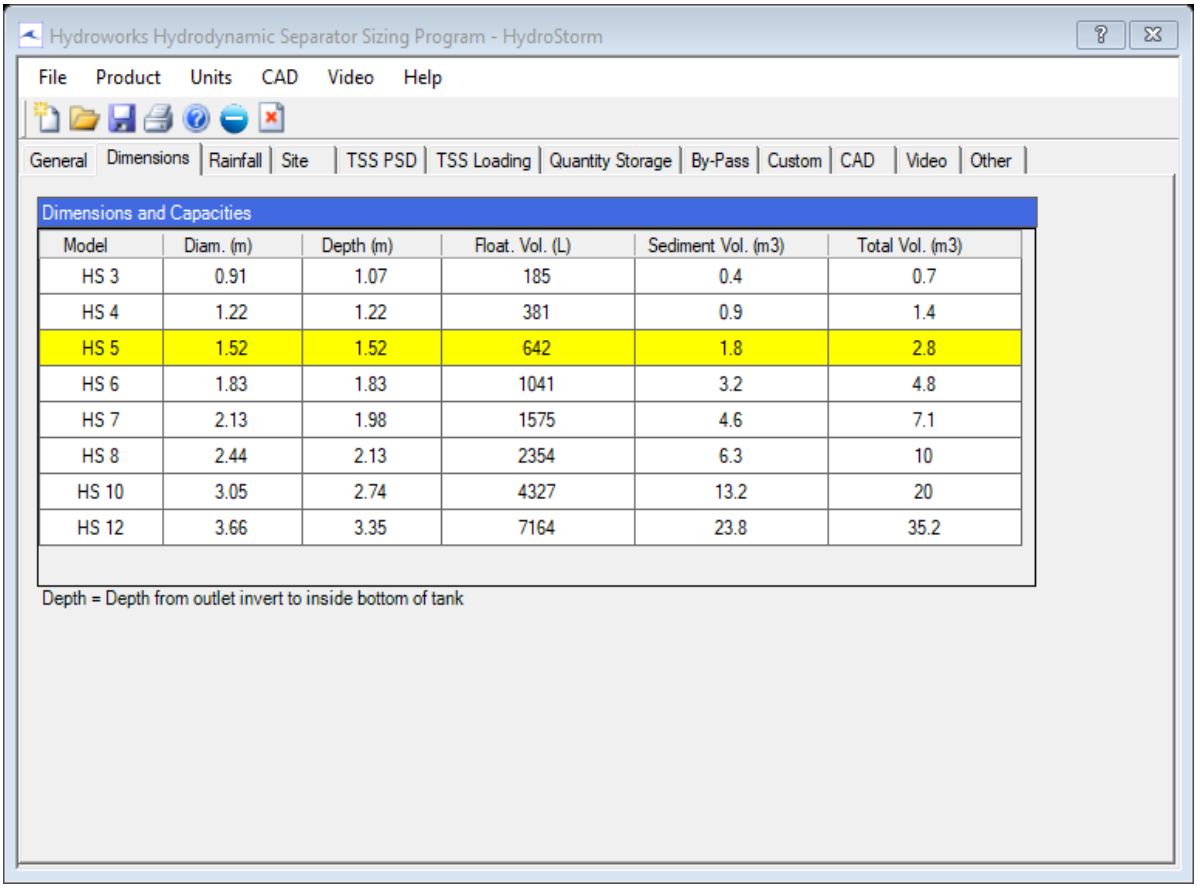
Rainfall Station - St. Catherines A, Ontario(1971 To 2005)



Site Physical Characteristics



Dimensions And Capacities

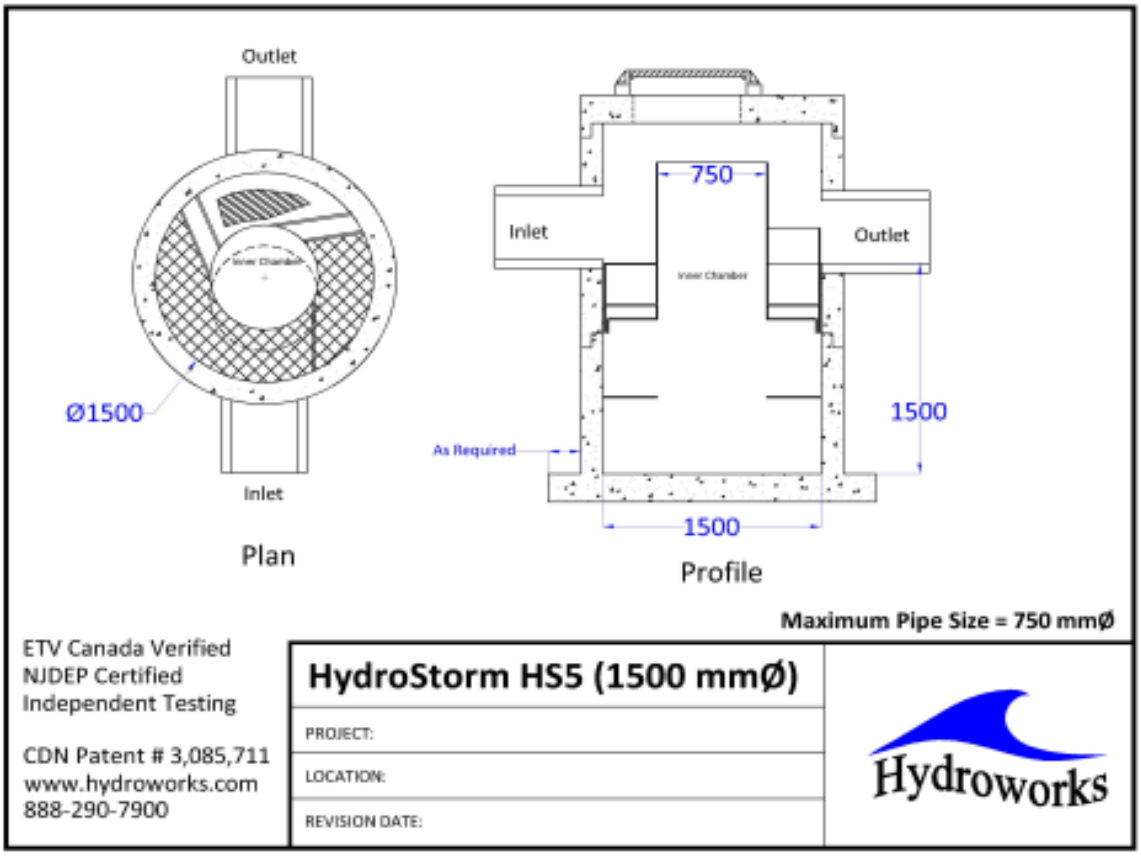


Dimensions and Capacities

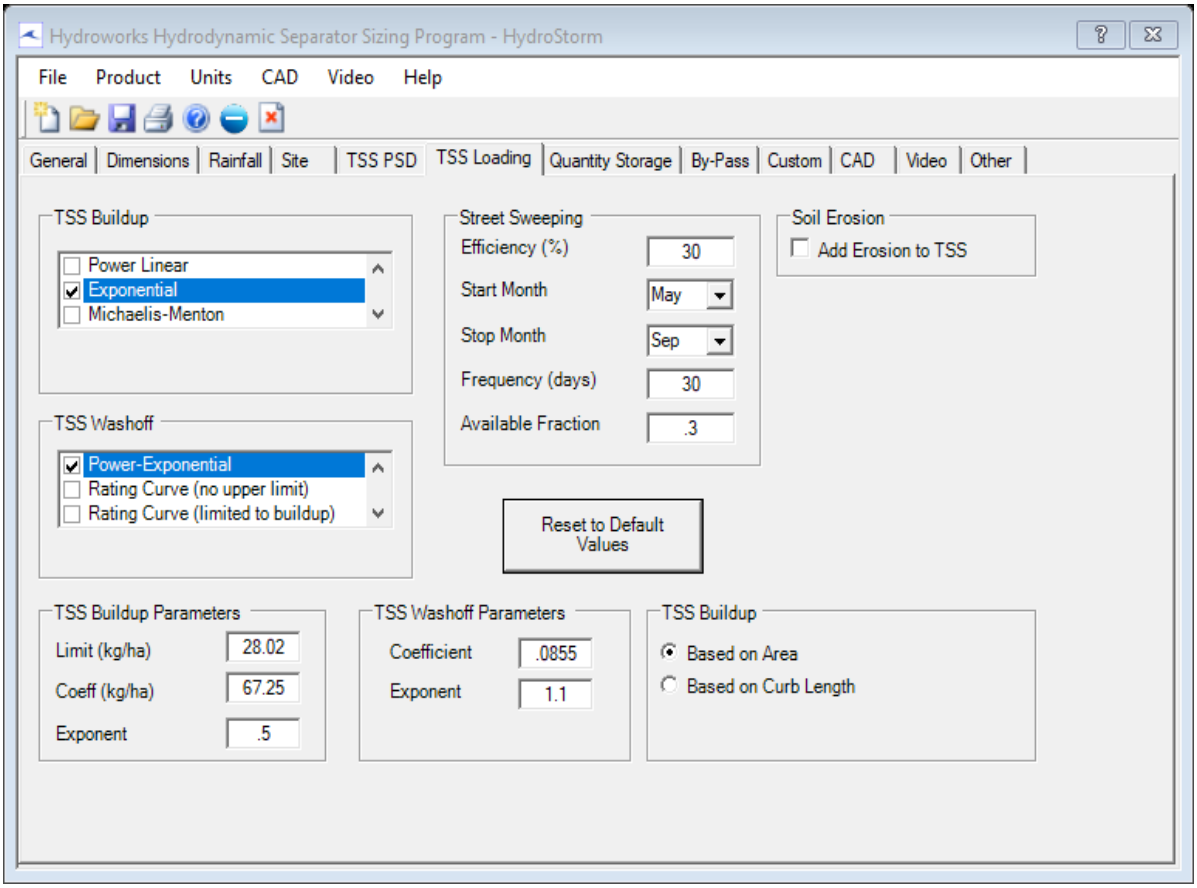
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

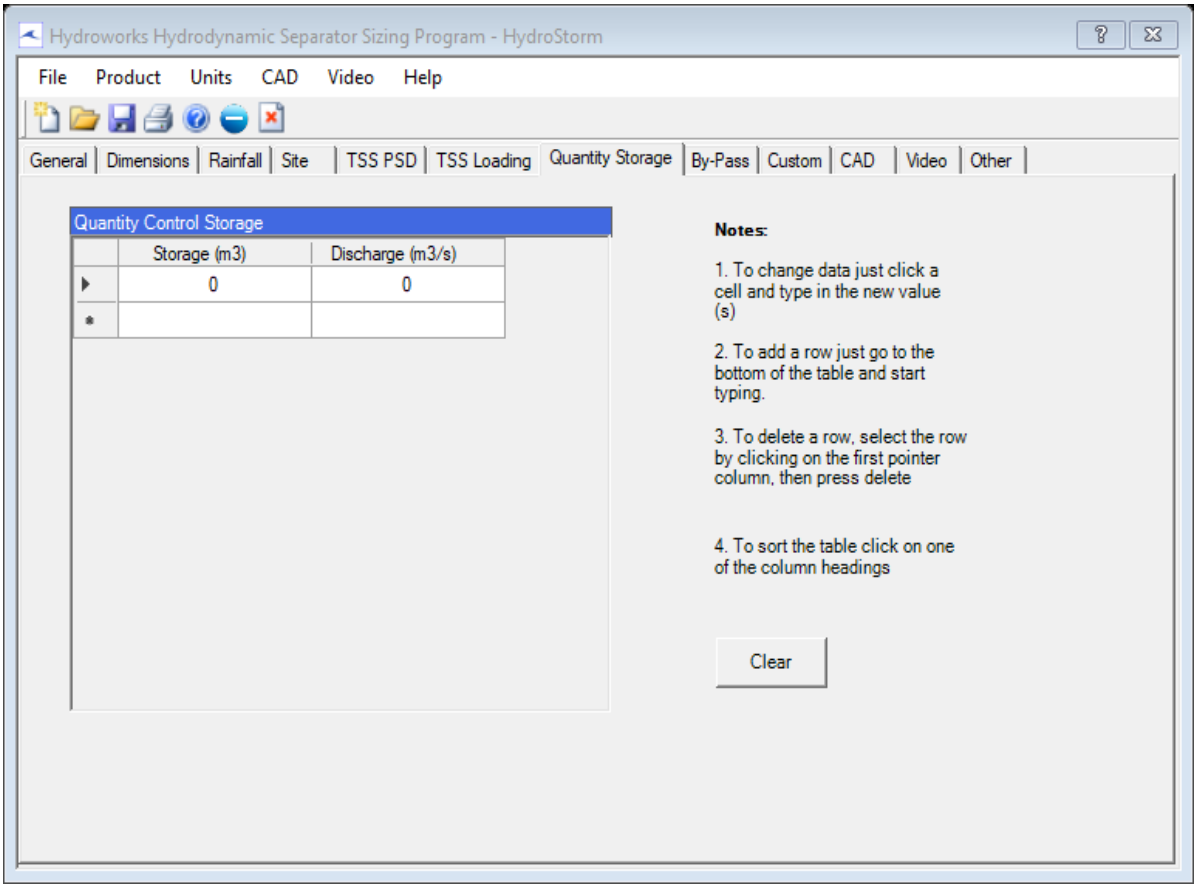
Generic HS 5 CAD Drawing



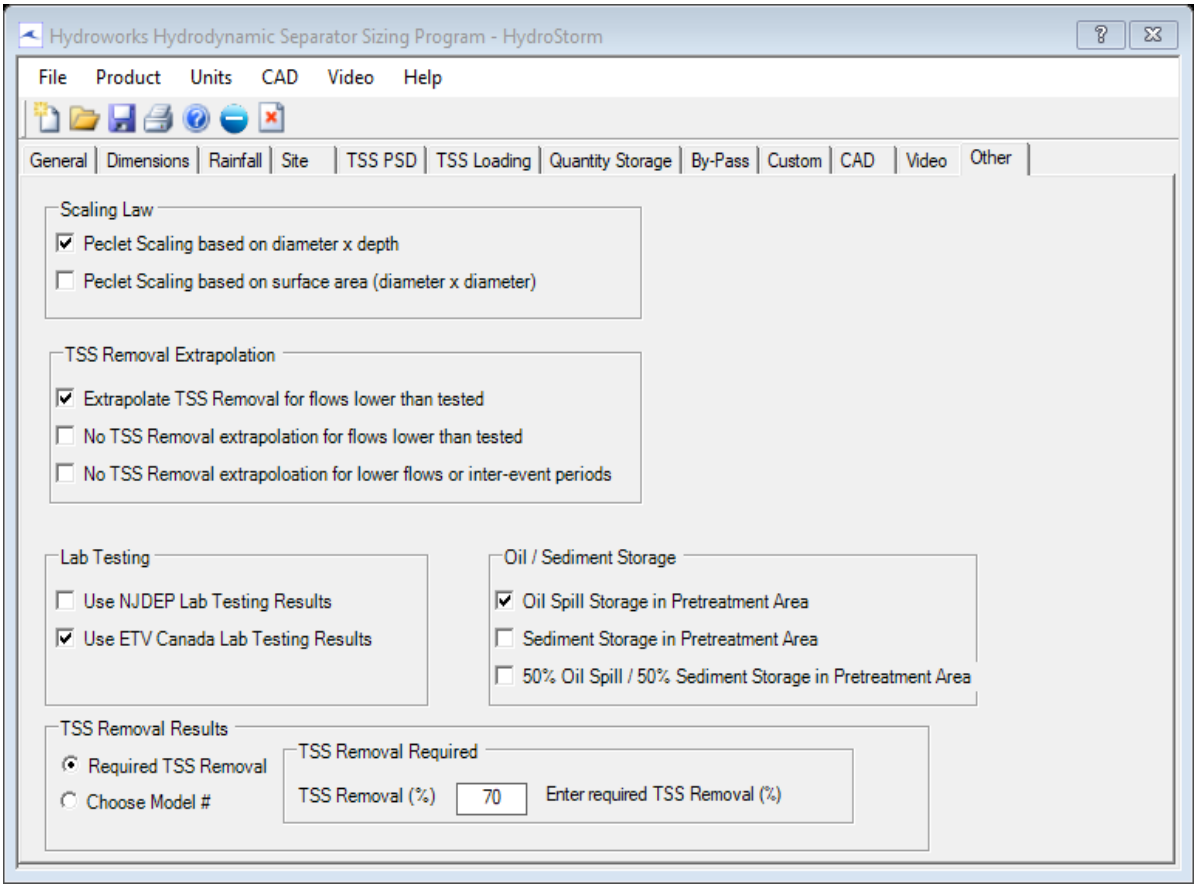
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.7

1-800-290-7900
www.hydroworks.com

APPENDIX C
FIRE FLOW CALCULATIONS

FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)

Project Number: **24043**
Project Name: **7525 Garner Road**
Date: **Jun-25**

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 2020).

An estimate of the fire flow required is given by the following formula:

$$F = 220\,C\sqrt{A} \qquad \textbf{(1)}$$

where:

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for Type V wood frame construction (structure essentially all combustible)
= 0.8 for Type IV-A mass timber construction (encapsulated mass timber)
= 0.9 for Type IV-B mass timber construction (rated mass timber)
= 1.0 for Type IV-C mass timber construction (ordinary mass timber)
= 1.5 for Type IV-D mass timber construction (un-rated mass timber)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = Total floor area in square metres

Building / Location	Building Area: Footprint Area (m^2)	Building Area: # of Storeys	Building Area: **Total GFA (m^2)**	Type of Construction	(1) ***Fire Flow "F"*** (l/min)	(1) ***Fire Flow "F"*** (l/s)	(2) ***Occupancy*** %	(2) ***Occupancy*** Adjustment (l/min)	(2) ***Occupancy*** **Adjusted Fire Flow (l/min)**	(3) ***Sprinkler*** %	(3) ***Sprinkler*** Adjustment (l/min)	(4) ***Exposure*** %	(4) ***Exposure*** Adjustment (l/min)	**Final Adjusted Fire Flow** (l/min)	**Final Adjusted Fire Flow** (l/s)
3-Storey Stacked Townhouse Blocks	**571.0**	**3**	**1857**	**1.5**	14000	233.3	**-15**	-2100.0	**11900.0**	**0**	0.0	40	4760.0	**17000**	**283**

(2) Occupancy

Non-Combustible	-25%
Limited Combustible	-15%
Combustible	No charge
Free Burning	15%
Rapid Burning	25%

(3) Sprinkler

Minimum credit for systems designed to NFPA 13 is 30%.

If the domestic and fire services are supplied by the same municipal water system, then take an additional 10%.

If the sprinkler system is fully supervised (ie. annunciator panel that alerts the Fire Dept., such as a school), then an additional 10% can be taken. Maximum credit = 50%.

(4) Exposure

0 to 3m	25%	
3.1 to 10m	20%	Calculate for all
10.1 to 20m	15%	sides. Maximum
20.1 to 30m	10%	charge shall not
> 30m	0%	exceed 75%

Side	Exposure (m)	Charge (%)
North =	**>30m**	**0**
South =	**20.1 to 30m**	**10**
East =	**10.1 to 20m**	**15**
West =	**10.1 to 20m**	**15**
Total Exposure =		***40***