S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing Report

117 FOREST AVENUE &
175 CATHARINE STREET SOUTH

PROPOSED 14-STOREY RESIDENTIAL BUILDING

CITY OF HAMILTON

OCTOBER 2016
REVISED AUGUST 2022
SLA File: 16092A

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Representative Holdings Inc. to provide Consulting Engineering services for the proposed development at 117 Forest Avenue & 175 Catharine Street South in the City of Hamilton (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed development.

The proposed development consists of constructing a 14-storey Residential building containing a total of 216 residential units and three levels of underground parking structure. The proposed site will also include concrete curbing/sidewalk, an asphalt parking lot and landscaped areas.

This Functional Servicing Report will provide detailed information of the proposed servicing scheme for this development. Please refer to the preliminary engineering plans prepared by S. Llewellyn and Associates Limited and the site plan prepared by KNYMH Inc. for additional information.

1.2 BACKGROUND INFORMATION

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

Ref. 1: MOE Stormwater Management Practices Planning and Design Manual (Ministry of Environment, March 2003)

Ref. 2: Engineering Guidelines for Servicing Land under Development Applications (City of Hamilton, December 2012)

Ref. 3: City of Hamilton Criteria and Guidelines for Stormwater Management Infrastructure (September 2007)

Ref. 4: City of Hamilton Storm Drainage Policy (2004)

Ref. 5: 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 Hamilton requirements:

Quantity Control

The stormwater discharge rate from the proposed site shall be controlled to the existing 5-year discharge rate with a run-off co-efficient of 0.63 for all storm events up to and including 100-year event.

Quality Control

The stormwater runoff from the proposed site must meet Level 1 (Enhanced) stormwater quality control (80% TSS removal, 90% average annual runoff treatment).

Erosion Control

Erosion and sediment control measures will be implemented in accordance with the standards of the City of Hamilton.

2.1 EXISTING CONDITIONS

In the existing conditions, the approximate 0.45ha land consists of an existing 11-storey residential building with an underground parking structure, asphalt parking lot and a vacant land of 0.21ha which consists of landscaped and gravel areas. The site is bounded by Forest Avenue to the south, Catharine Street South to the west and existing residential lands to the north and east.

Under the existing condition, 0.21ha of the site generally slopes towards Forest Avenue with a portion of the site ponding near the north part of the site. The entire site sheet drains south to the existing 375mmø storm sewer on Forest Avenue.

One catchment area, Catchment 101 has been identified in the existing condition. Catchment 101 represents the drainage area from City records which was allocated to the existing 375mmø storm sewer along Forest Avenue. City records indicate that an area of 0.24ha with a runoff coefficient of 0.63 has been allocated to the existing storm sewer. See Table 2.1 below and Appendix A for the Allowable Catchment areas to Forest Avenue.

Table 2.1 – Allowable Catchment Areas to Forest Avenue				
Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
101	To Forest Avenue	0.24	60%	0.63

The allowable discharge from the development was calculated using the Rational Method based on the above runoff coefficient (C) and the City of Hamilton storm intensities at a time of concentration of 10 minutes (Tc=10min). See below for the allowable discharge calculation for Catchment 101 and Table 2.2 for the summary.

$Q_{(Allowable)}$ = 2.78 C i A
= 2.78 (0.63) (103.04 mm/hr) (0.24 ha)
= ***43.3 l/s (0.0043 m^3/s)***

Table 2.2 – Existing Conditions Stormwater Discharge	
Storm Event	Catchment 101 (m^3/s)
2-Yr Event	0.0311
5-Yr Event	**0.0433**
10-Yr Event	0.0514
25-Yr Event	0.0614
50-Yr Event	0.0691
100-Yr Event	0.0764

2.2 PROPOSED CONDITIONS

It is proposed to develop the site by constructing a 14-storey residential building containing a total of 216 dwelling units and three levels of an underground parking structure. The proposed site will also include concrete curbing/sidewalk, an asphalt parking lot and landscaped areas. It is proposed to service the site with a private storm sewer system designed and constructed in accordance with the standards and specifications of the City of Hamilton.

Two catchment areas, Catchment 201 and 202 have been identified in the proposed condition. Catchment 201 represents the drainage area for the portion of the site which will be captured and controlled by the private storm sewer system, and will ultimately discharge to the existing 375mmø storm sewer along Forest Avenue. Catchment 202 represents the portion of the site which will sheet drain uncontrolled to Forest Avenue. Refer to Table 2.3 below and the Proposed Condition Drainage Area Plan in Appendix A for details.

Table 2.3 – Proposed Condition Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
201	Controlled to Forest Avenue	0.29	97%	0.90
202	Uncontrolled to Forest Avenue	0.03	21%	0.39

Water Quantity Control

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 105mmø orifice located at the outlet on the proposed cast-in-place concrete storage tank to restrict discharge from the site to the allowable discharge rate of 43.3 l/s.

With the installation of on-site quantity control measures for Catchment 201, it will be required to provide stormwater storage during storm events up to and including the 100-year event. To provide the required storage, it is proposed to install a cast-in-place concrete storage tank within the underground parking Level 1. Details of the proposed tank can be found on the Preliminary Site Servicing Plan. The stage-storage-discharge characteristics can be seen in Table 2.4 below and Appendix A for details.

Table 2.4 – Proposed Condition Stage-Storage-Discharge

Elevation (m)	Storage (m^3)	Discharge (m^3/s)
98.50 (Orifice Invert)	0	0.0000
98.50 (Bottom of Tank)	0	0.0000
99.00 (0.5m Deep)	21	0.0154
99.50 (1.00m Deep)	42	0.0224
100.00 (1.50m Deep)	63	0.0277
100.50 (2.00m Deep)	84	0.0321
101.00 (Top of Tank)	105	0.0360

The maximum discharge rates for Catchment 201 and 202 were calculated using the Rational Method based on the post-development condition runoff coefficients for the 2-year to 100-year storm events. Additionally, the 2-year to 100-year storage volumes for Catchment 201 were calculated using the Modified Rational Method (MRM). The proposed discharge rates and storage volumes are summarized in Table 2.5 below and in Appendix A for details.

Table 2.5 – Proposed Condition Stormwater Discharge					
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)
2-Yr	0.0071	0.0024	0.0095	0.0433	12.6
5-Yr	0.0186	0.0033	0.0219	0.0433	32.0
10-Yr	0.0232	0.0040	0.0272	0.0433	46.9
25-Yr	0.0282	0.0047	0.0329	0.0433	67.2
50-Yr	0.0313	0.0053	0.0366	0.0433	82.3
100-Yr	0.0346	0.0059	0.0405	0.0433	99.6

This analysis determined the following:

- The proposed condition discharge rates will not exceed the allowable discharge of 0.0433 m^3/s to the existing 375mmø storm sewer.

- Catchment 201 will require 99.6m^3 of stormwater storage during the 100-year event, which can be accommodated within the proposed cast-in-place storage tank, having a minimum volume of 105m^3.

Water Quality Control

The proposed development is required to achieve an "Enhanced" (80% 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 along Forest Avenue. The Hydrostorm sizing software was used to determine the required size of oil/grit separator unit for the site. It was determined that a Hydrostrorm HS6 will provide 81% TSS removal and 99% average annual runoff treatment. The Hydrostorm unit (HS6) has been certified under the ETV for a 53% removal credit. As such, the HydroStorm units have been designed to achieve an 'Enhanced' (80% TSS Removal) level of stormwater quality control, but only credited for 53% TSS removal within the treatment train. See HydroStorm unit sizing procedures in Appendix B for details.

As part of a treatment train approach, area drains within the proposed asphalt parking lot will be fitted with FlexStrom inlet filters. The installation of the inlet filters will contribute to the removal of TSS and the capture of floatable within the area drains. The units also provide scour protection and reduce the resuspension of solids during heavy rain events which would otherwise enter the storm system.

Table 2.6 – Proposed Condition Stormwater Treatment Train				
Surface Type	Drainage Area (ha)	Treatment Train Mechanism #1 (% TSS Removal)	Treatment Train Mechanism #2 (% TSS Removal)	Total TSS Removal (%) [3]
Asphalt Parking Lot	0.08	HydroStorm O/G Units (53%) [1]	FlexStorm Inlet Filters (52%) [2]	77%
[1] The HydroStorm units have been designed to achieve a minimum of 80% but credited with only 53% TSS Removal. [2] The FlexStorm Inlet Filters have been assigned a TSS removal rate of 52% based on similar products. [3] Total TSS removal calculated using the following formula: R=A+B-[(AxB)/100] where R=total TSS removal rate, A=TSS removal rate for first mechanism, B=TSS removal rate for second mechanism.				

As such, the weighted TSS removal from the proposed asphalt parking lot reveals that the best management treatment train approach will provide 77% TSS removal rates.

HydroStorm units and FlexStorm inlet filters require regular inspection and maintenance as per the manufacture's specifications to ensure the units operate properly. See HydroStorm and FlexStorm maintenance manuals in Appendix B for details.

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 his contractor shall be responsible for any costs incurred during the remediation of problem areas.

For details on the proposed erosion and sediment control for the proposed site, see the Preliminary Grading & Erosion Control Plan included in the engineering drawings.

3.0 SANITARY SEWER SERVICING

3.1 EXISTING CONDITIONS

The site is located on the north east corner of Forest Avenue and Catharine Street. There is an existing 300mmø Combined sewer which flows east along Forest Avenue and 1350mmø Combined sewer which flows north along Catharine Street.

3.2 SANITARY DEMAND

The proposed development consists of constructing a 14-storey residential building containing a total of 216 dwelling units.

Table 3.1 summarizes the sanitary sewer discharge rates for the residential portion of the proposed development in accordance with the City of Hamilton comprehensive development guidelines. Table 3.1 summarizes sanitary sewer discharge rate for the commercial portion of the development in accordance with Table 8.2.1.3.B – Other Occupancies of the 2012 Ontario Plumbing Code.

Table 3.1 – Proposed Sanitary Sewer Discharge

Population [A]	Avg. Dry weather flows (l/s) [B]	Peaking Factor [c]	Infiltration [D] (l/s)	**Peak Flow [F] (l/s)**
470 persons	1.96	5.0	0.14	**9.94**

[A] Population = 1 bedroom = 2 persons/bed x 197 units = 394 persons
= 2 bedroom = 2 persons/bed x 19 units = 76 persons
[B] Average Dry Weather Flows = 360 L/Day/cap x 496 persons = 169,200 L/day
[C] Peak Factor (2<Peak Factor<5) = $(5/(\text{Population in thousands})^{0.2})=(5/(0.496)^{0.2})=5.8$
[E] Infiltration flow based on city of Hamilton Standard 0.4 l/sec/ha = 0.4 l/sec x 0.29 ha=0.12
[F] Peak Flow = (Average Flow x Peaking Factor) + Infiltration

Based on the above, the estimate of sanitary demand for the retirement building is:

9.94 L/s

3.3 PROPOSED SANITARY SERVICING

The proposed residential building will be serviced by a 200mmø sanitary sewer, designed and constructed in accordance with the City of Hamilton standards. Drainage from this sewer will discharge to the existing 300mmø combined sewer along Forest Avenue.

The minimum grade of the proposed 200mmø sanitary sewer will be 2.0%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.046 m^3/s (46 l/s). Therefore, the proposed 200mmø sanitary sewer at 2.0% grade is adequately sized to service the proposed development.

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of a 300mmø watermain located along Forest Avenue and 600mmø watermain along Catharine Street. Existing fire hydrant is located fronting the proposed development on Forest Avenue.

4.2 DOMESTIC WATER DEMAND

The following is an estimate of the water usage for the proposed building. Water usage for the site was calculated based on the "Fixture Unit Method" as per Table 7.6.3.2.A. forming part of sentences 7.6.3.1(1) to (3) and 7.6.3.4.(2), (3) and (5) of the 2012 Ontario Building Code. See Table 4.1 for fixture unit (FU) calculations. Fixture unit calculations will be confirmed upon completion of the Water Usage Assessment, which will be prepared as part of the Site Plan Approval process.

Table 4.1 – Proposed Domestic Water Demand

Component	No. of Fixtures	FU/ Fixture	Total FU
Lavatory (8.3L/min or less per head) (Private)	356	0.7	249.2
Shower Head (9.5L/min or less per head) (Private)	235	1.4	329
Water Closet (6 LPF or less with flush tank) (Private)	356	2.2	783.2
Sink (kitchen, domestic, 8.3 L/min or less) (Private)	217	1.4	303.8
Dishwasher, domestic (Private)	217	1.4	303.8
Clothes Washer (3.5 kg) (Private)	216	1.4	302.4
		Total FU:	**2271.4**

Total peak water usage for the site was derived below from the fixture unit count as per Table 7.4.10.5 of the Ontario Building Code.

Total Fixture Unit Count = 2271.4 FU

Water Usage: 289 IGPM (21.91 L/s)

4.3 FIRE FLOW DEMAND

Fire flow demands for development are governed by a number of guidelines and criteria, such as the Ontario Building Code (OBC), various codes and standards published by the National Fire Protection Association (NFPA) and most recently, the Target Available Fire Flows provided by the City of Hamilton.

The proposed development consists of constructing a 14-storey residential building containing a total of 216 residential units. Existing hydrant is located fronting the proposed site on Forest Avenue, within the required 90m separation to the building face of the proposed building (as per Sentence 3.2.5.7 of the Ontario Building Code).

The fire flow for this building was determined to be the greater of the OBC fire flow calculation (OBC section A-3.2.5.7) or the City of Hamilton Target Available Fire Flow. The result of the OBC fire flow calculation was a minimum flow rate of 9000 l/min (150 l/sec). This is equal to the City of Hamilton target available fire flow for a Residential Multi (greater than 3 units), which is 150 l/sec. Therefore, the minimum required fire flow for this site is **150 l/sec**. Refer to Appendix C for fire flow calculations.

The following hydrant flow test data for the public fire hydrants in closest proximity to the proposed development has been analyzed to determine if the municipal system adjacent to the subject site is adequate to provide the required fire flow, with a minimum pressure of 20 psi. Table 4.2 below summarizes the hydrant flow data completed by SCG Flowmetrix. Refer to the attached flow data prepared by SCG Flowmetrix for more information.

Table 4.2 – Hydrant Flow Test Data	
Hydrant ID	HA15H026
Location	146 Forest Avenue
Static Pressure	63.1 psi
Residual Pressure During Test Flow	60.0 psi
Test Flow Rate	972 IGPM (61 l/s)
Theoretical Flow @ 20 psi	**4,025 IGPM (254 l/s)**

Based on the above hydrant flow test data, the theoretical maximum available flow rate from the hydrant is **254 l/s**, while the maximum required fire flow for the proposed development is only **150 l/s**. Therefore, the water distribution system has adequate pressure and capacity to service the subject site.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

Proposed water servicing for the site consists of connecting a 150mmø water service off of the existing 300mmø watermain adjacent to the site on Forest Avenue. The proposed 150mmø water service will provide domestic and fire water service for the proposed condominium building. Water services for the site are to be designed and constructed in accordance with City of Hamilton standards.

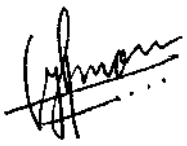
5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development of 117 Forest Avenue & 175 Catharine Street South can be constructed to meet the requirements of the City of Hamilton. Therefore, it is recommended that:

- The development be graded and serviced in accordance with the Preliminary Grading & Erosion Control Plan and the Preliminary Site Servicing Plan prepared by S. Llewellyn & Associates Limited;
- A 105mmø orifice plate be installed at the outlet on the cast-in-place storage tank as per the Preliminary Site Servicing Plan and this report to provide adequate quantity control;
- A cast-in-place concrete storage tank be installed as per the Preliminary Site Servicing Plan and this report to provide effective stormwater storage;
- Erosion and sediment controls be installed as described in this report to meet City of Hamilton requirements;
- HydroStorm HS6 oil/grit separator be installed as per the Preliminary Site Servicing Plan and this report to provide efficient stormwater quality control;
- Area drains within the parking lot are to be fitted with FlexStorm inlet filters as illustrated on the Preliminary Site Servicing Plan and this report;
- 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;

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



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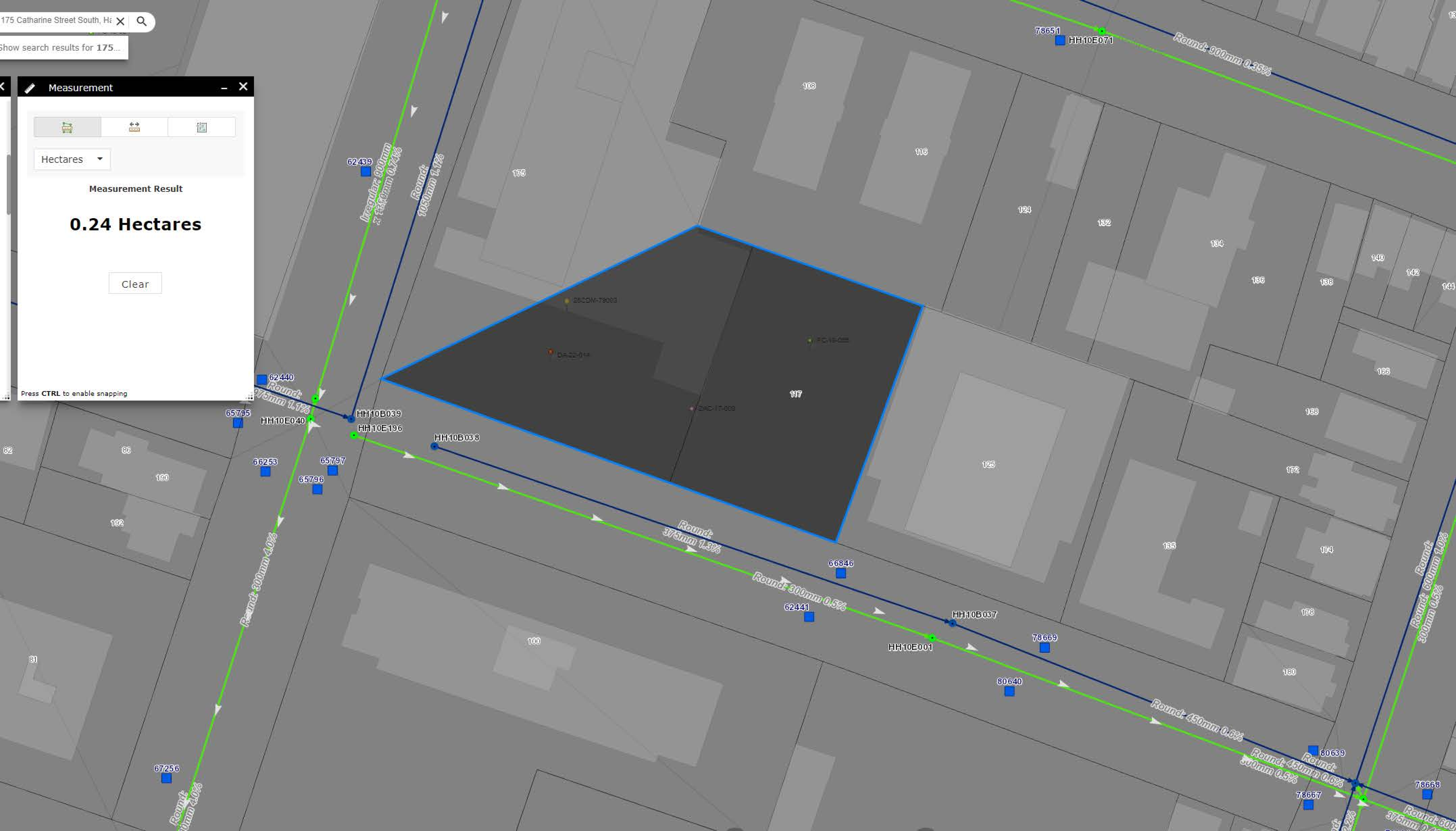
APPENDIX A

STORMWATER MANAGEMENT INFORMATION


175 Catharine Street South, Ha
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Measurement Result
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Round: 900mm 0.35%
108
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136
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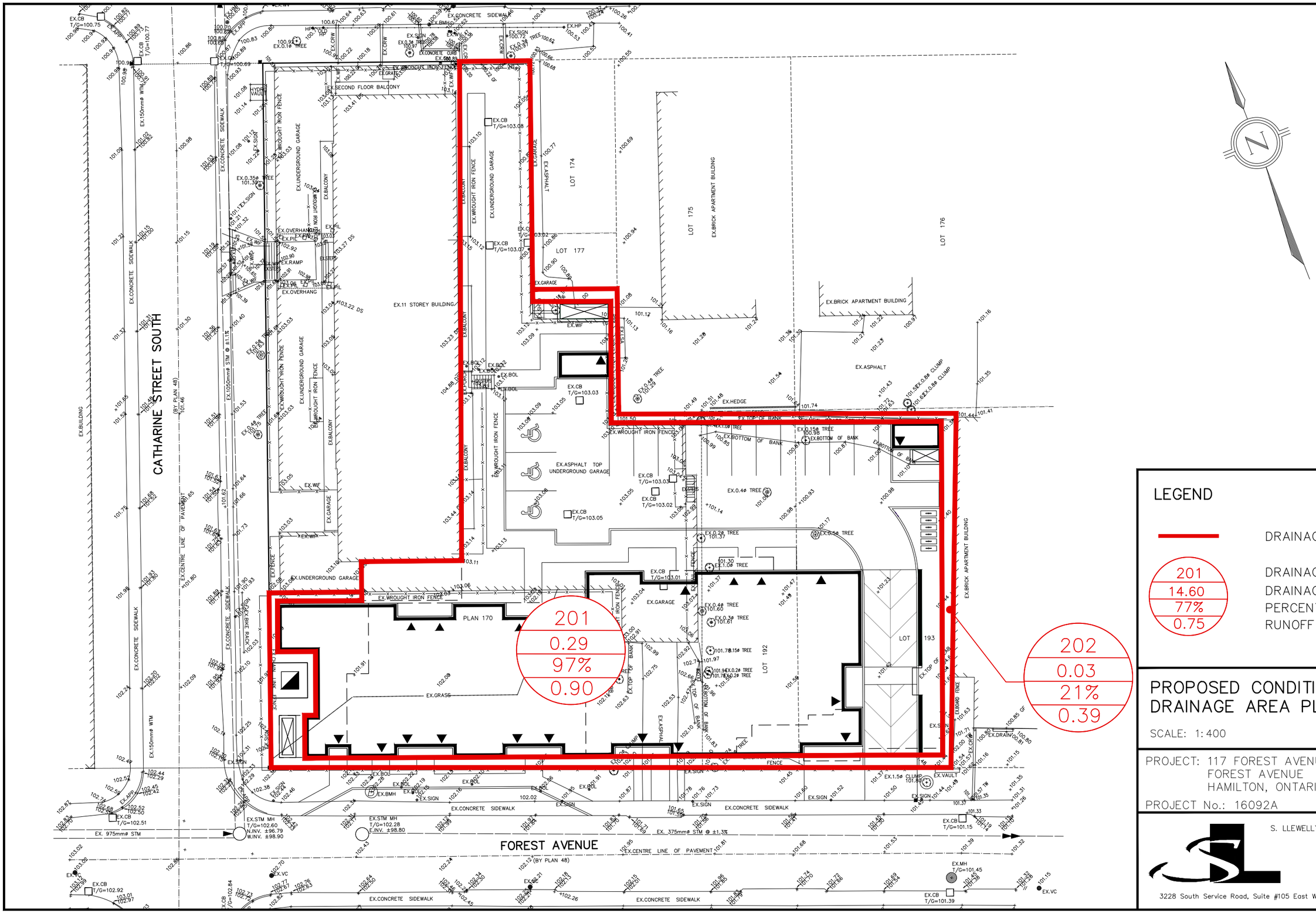
HH10B037
HH10E001
78669
80640
Round: 450mm 0.6%
80639
78667
78668
Round: 300mm 4.0%
67256

(2 of 2)

Storm Combined Sewer Catchment Areas

Catchment Name: HH10E035.2
Type:
Sub Name:
Year Sketched: 2002
Direction From: HH10E040
Actual C Runoff: 0.63
Ultimate C Runoff: 0.63
Comments:

Zoom to



LEGEND

DRAINAGE BOUNDARY

201 — DRAINAGE AREA I.D.
14.60 — DRAINAGE AREA (ha)
77% — PERCENT IMPERVIOUS
0.75 — RUNOFF COEFFICIENT

PROPOSED CONDITION STORM DRAINAGE AREA PLAN

SCALE: 1:400

PROJECT: 117 FOREST AVENUE & 117 FOREST AVENUE
HAMILTON, ONTARIO

PROJECT No.: 16092A

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CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type:	Tank Outlet
Diameter (mm)	**105**
Area (m^2)	0.00866
Invert Elev. (m)	98.50
C/L Elev. (m)	98.55
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 m	Area m^2	Tank Incremental Volume	Active Storage Volume m^3	H m	Discharge m^3/s
Orifice Invert	98.50	42.0	0.0	0	0.000	0.0000
Bottom of Tank	98.50	42.0	0.0	0	0.000	0.0000
0.5m Deep	99.00	42.0	21.0	21	0.448	0.0154
1.0m Deep	99.50	42.0	21.0	42	0.948	0.0224
1.5m Deep	100.00	42.0	21.0	63	1.448	0.0277
2.0m Deep	100.50	42.0	21.0	84	1.948	0.0321
Top of Tank	101.00	42.0	21.0	105	2.448	0.0360

2-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:	**Hamilton**
Return Period:	**2** Years
A =	**646.000**
B =	**6.000**
C=	**0.781**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.29**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.036**	(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	99.290	0.0000276	0.073	0.0	0.0730	21.89	16.20	5.69
10	600	74.099	0.0000206	0.054	0.0	0.0545	32.68	21.60	11.08
15	900	59.921	0.0000166	0.044	0.0	0.0440	39.64	27.00	12.64
20	1200	50.715	0.0000141	0.037	0.0	0.0373	44.73	32.40	12.33
25	1500	44.206	0.0000123	0.032	0.0	0.0325	48.74	37.80	10.94
30	1800	39.333	0.0000109	0.029	0.0	0.0289	52.04	43.20	8.84
35	2100	35.534	0.0000099	0.026	0.0	0.0261	54.85	48.60	6.25

Max. required storage volume = 12.64 m^3

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

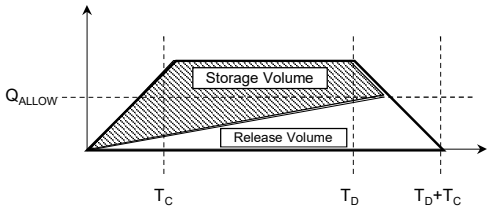
Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)$ Q_{ALLOW}

Storage Volume = Runoff Volume - Release Volume



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:	**Hamilton**
Return Period:	**5** Years
A =	**1049.500**
B =	**8.000**
C=	**0.803**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.29**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.036**	(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	133.809	0.0000372	0.098	0.0	0.0983	29.50	16.20	13.30
10	600	103.038	0.0000286	0.076	0.0	0.0757	45.44	21.60	23.84
15	900	84.628	0.0000235	0.062	0.0	0.0622	55.98	27.00	28.98
20	1200	72.263	0.0000201	0.053	0.0	0.0531	63.74	32.40	31.34
25	1500	63.331	0.0000176	0.047	0.0	0.0465	69.82	37.80	32.02
30	1800	56.548	0.0000157	0.042	0.0	0.0416	74.81	43.20	31.61
35	2100	51.204	0.0000142	0.038	0.0	0.0376	79.03	48.60	30.43
40	2400	46.875	0.0000130	0.034	0.0	0.0345	82.69	54.00	28.69
45	2700	43.290	0.0000120	0.032	0.0	0.0318	85.91	59.40	26.51
50	3000	40.267	0.0000112	0.030	0.0	0.0296	88.79	64.80	23.99
55	3300	37.680	0.0000105	0.028	0.0	0.0277	91.39	70.20	21.19
60	3600	35.439	0.0000098	0.026	0.0	0.0260	93.77	75.60	18.17
65	3900	33.476	0.0000093	0.025	0.0	0.0246	95.96	81.00	14.96
70	4200	31.742	0.0000088	0.023	0.0	0.0233	97.99	86.40	11.59
75	4500	30.197	0.0000084	0.022	0.0	0.0222	99.88	91.80	8.08
80	4800	28.811	0.0000080	0.021	0.0	0.0212	101.65	97.20	4.45

Max. required storage volume = 32.02 m^3

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

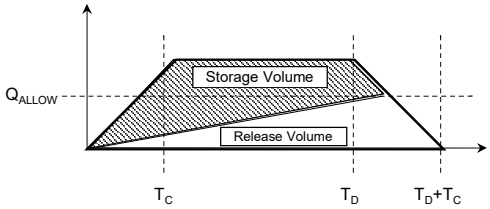
Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)$ Q_{ALLOW}

Storage Volume = Runoff Volume - Release Volume



10-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:	**Hamilton**
Return Period:	**10** Years
A =	**1343.700**
B =	**9.000**
C=	**0.814**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.29**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.036**	(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	156.803	0.0000436	0.115	0.0	0.1153	34.58	16.20	18.38
10	600	122.292	0.0000340	0.090	0.0	0.0899	53.93	21.60	32.33
15	900	101.114	0.0000281	0.074	0.0	0.0743	66.89	27.00	39.89
20	1200	86.678	0.0000241	0.064	0.0	0.0637	76.45	32.40	44.05
25	1500	76.152	0.0000212	0.056	0.0	0.0560	83.96	37.80	46.16
30	1800	68.104	0.0000189	0.050	0.0	0.0501	90.10	43.20	46.90
35	2100	61.735	0.0000171	0.045	0.0	0.0454	95.29	48.60	46.69
40	2400	56.557	0.0000157	0.042	0.0	0.0416	99.77	54.00	45.77
45	2700	52.256	0.0000145	0.038	0.0	0.0384	103.70	59.40	44.30
50	3000	48.622	0.0000135	0.036	0.0	0.0357	107.21	64.80	42.41
55	3300	45.506	0.0000126	0.033	0.0	0.0334	110.38	70.20	40.18
60	3600	42.803	0.0000119	0.031	0.0	0.0315	113.26	75.60	37.66
65	3900	40.434	0.0000112	0.030	0.0	0.0297	115.90	81.00	34.90
70	4200	38.338	0.0000106	0.028	0.0	0.0282	118.35	86.40	31.95
75	4500	36.470	0.0000101	0.027	0.0	0.0268	120.63	91.80	28.83
80	4800	34.794	0.0000097	0.026	0.0	0.0256	122.75	97.20	25.55
85	5100	33.279	0.0000092	0.024	0.0	0.0245	124.75	102.60	22.15
90	5400	31.905	0.0000089	0.023	0.0	0.0234	126.63	108.00	18.63
95	5700	30.650	0.0000085	0.023	0.0	0.0225	128.41	113.40	15.01
100	6000	29.501	0.0000082	0.022	0.0	0.0217	130.10	118.80	11.30
105	6300	28.443	0.0000079	0.021	0.0	0.0209	131.71	124.20	7.51

Max. required storage volume = 46.90 m^3

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

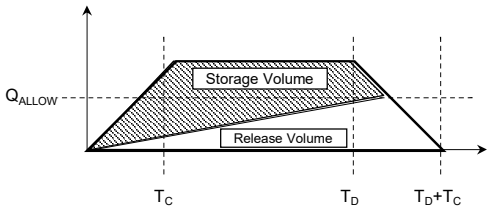
Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C) Q_{ALLOW}$

Storage Volume = Runoff Volume - Release Volume



25-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:	**Hamilton**
Return Period:	**25** Years
A =	**1719.500**
B =	**10.000**
C=	**0.823**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.29**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.036**	(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	185.131	0.0000514	0.136	0.0	0.1361	40.82	16.20	24.62
10	600	146.101	0.0000406	0.107	0.0	0.1074	64.43	21.60	42.83
15	900	121.590	0.0000338	0.089	0.0	0.0894	80.43	27.00	53.43
20	1200	104.648	0.0000291	0.077	0.0	0.0769	92.30	32.40	59.90
25	1500	92.179	0.0000256	0.068	0.0	0.0678	101.63	37.80	63.83
30	1800	82.586	0.0000229	0.061	0.0	0.0607	109.26	43.20	66.06
35	2100	74.956	0.0000208	0.055	0.0	0.0551	115.70	48.60	67.10
40	2400	68.731	0.0000191	0.051	0.0	0.0505	121.24	54.00	67.24
45	2700	63.545	0.0000177	0.047	0.0	0.0467	126.11	59.40	66.71
50	3000	59.154	0.0000164	0.043	0.0	0.0435	130.43	64.80	65.63
55	3300	55.383	0.0000154	0.041	0.0	0.0407	134.33	70.20	64.13
60	3600	52.106	0.0000145	0.038	0.0	0.0383	137.87	75.60	62.27
65	3900	49.230	0.0000137	0.036	0.0	0.0362	141.12	81.00	60.12
70	4200	46.683	0.0000130	0.034	0.0	0.0343	144.11	86.40	57.71
75	4500	44.411	0.0000123	0.033	0.0	0.0326	146.89	91.80	55.09
80	4800	42.370	0.0000118	0.031	0.0	0.0311	149.48	97.20	52.28
85	5100	40.526	0.0000113	0.030	0.0	0.0298	151.91	102.60	49.31
90	5400	38.851	0.0000108	0.029	0.0	0.0286	154.20	108.00	46.20
95	5700	37.322	0.0000104	0.027	0.0	0.0274	156.36	113.40	42.96
100	6000	35.920	0.0000100	0.026	0.0	0.0264	158.41	118.80	39.61
105	6300	34.630	0.0000096	0.025	0.0	0.0255	160.35	124.20	36.15
110	6600	33.438	0.0000093	0.025	0.0	0.0246	162.21	129.60	32.61
115	6900	32.333	0.0000090	0.024	0.0	0.0238	163.98	135.00	28.98
120	7200	31.306	0.0000087	0.023	0.0	0.0230	165.67	140.40	25.27

Max. required storage volume = 67.24 m^3

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

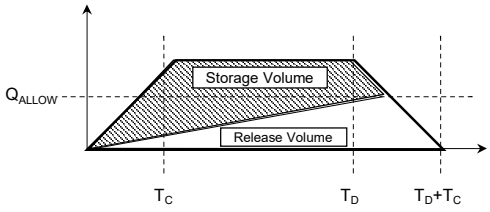
Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)$ Q_{ALLOW}

Storage Volume = Runoff Volume - Release Volume



50-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:	**Hamilton**
Return Period:	**50** Years
A =	**1954.800**
B =	**10.000**
C=	**0.826**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.29**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post-development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.036**	(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	208.762	0.0000580	0.153	0.0	0.1534	46.03	16.20	29.83
10	600	164.608	0.0000457	0.121	0.0	0.1210	72.59	21.60	50.99
15	900	136.900	0.0000380	0.101	0.0	0.1006	90.56	27.00	63.56
20	1200	117.761	0.0000327	0.087	0.0	0.0866	103.86	32.40	71.46
25	1500	103.682	0.0000288	0.076	0.0	0.0762	114.31	37.80	76.51
30	1800	92.854	0.0000258	0.068	0.0	0.0682	122.85	43.20	79.65
35	2100	84.246	0.0000234	0.062	0.0	0.0619	130.03	48.60	81.43
40	2400	77.224	0.0000215	0.057	0.0	0.0568	136.22	54.00	82.22
45	2700	71.378	0.0000198	0.052	0.0	0.0525	141.65	59.40	82.25
50	3000	66.428	0.0000185	0.049	0.0	0.0488	146.47	64.80	81.67
55	3300	62.178	0.0000173	0.046	0.0	0.0457	150.81	70.20	80.61
60	3600	58.486	0.0000162	0.043	0.0	0.0430	154.75	75.60	79.15
65	3900	55.246	0.0000153	0.041	0.0	0.0406	158.36	81.00	77.36
70	4200	52.378	0.0000145	0.038	0.0	0.0385	161.69	86.40	75.29
75	4500	49.820	0.0000138	0.037	0.0	0.0366	164.78	91.80	72.98
80	4800	47.522	0.0000132	0.035	0.0	0.0349	167.66	97.20	70.46
85	5100	45.447	0.0000126	0.033	0.0	0.0334	170.36	102.60	67.76
90	5400	43.561	0.0000121	0.032	0.0	0.0320	172.90	108.00	64.90
95	5700	41.841	0.0000116	0.031	0.0	0.0308	175.29	113.40	61.89
100	6000	40.264	0.0000112	0.030	0.0	0.0296	177.56	118.80	58.76
105	6300	38.812	0.0000108	0.029	0.0	0.0285	179.72	124.20	55.52
110	6600	37.471	0.0000104	0.028	0.0	0.0275	181.77	129.60	52.17
115	6900	36.229	0.0000101	0.027	0.0	0.0266	183.73	135.00	48.73
120	7200	35.074	0.0000097	0.026	0.0	0.0258	185.61	140.40	45.21

Max. required storage volume = 82.25 m^3

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

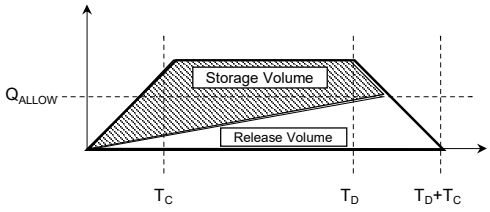
Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)\ Q_{ALLOW}$

Storage Volume = Runoff Volume - Release Volume



100-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:	**Hamilton**
Return Period:	**100** Years
A =	**2317.400**
B =	**11.000**
C=	**0.836**
Tc =	**10** minutes
	600 seconds

Area of site being investigated (ha) =	**0.29**	(Lot Area)
Composite Runoff Coeff. (C) =	**0.9**	(Post development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.036**	(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	228.222	0.0000634	0.168	0.0	0.1677	50.32	16.20	34.12
10	600	181.813	0.0000505	0.134	0.0	0.1336	80.18	21.60	58.58
15	900	152.084	0.0000422	0.112	0.0	0.1118	100.60	27.00	73.60
20	1200	131.287	0.0000365	0.096	0.0	0.0965	115.80	32.40	83.40
25	1500	115.860	0.0000322	0.085	0.0	0.0852	127.74	37.80	89.94
30	1800	103.923	0.0000289	0.076	0.0	0.0764	137.49	43.20	94.29
35	2100	94.392	0.0000262	0.069	0.0	0.0694	145.69	48.60	97.09
40	2400	86.591	0.0000241	0.064	0.0	0.0636	152.75	54.00	98.75
45	2700	80.078	0.0000222	0.059	0.0	0.0589	158.92	59.40	99.52
50	3000	74.553	0.0000207	0.055	0.0	0.0548	164.39	64.80	99.59
55	3300	69.801	0.0000194	0.051	0.0	0.0513	169.30	70.20	99.10
60	3600	65.667	0.0000182	0.048	0.0	0.0483	173.76	75.60	98.16
65	3900	62.036	0.0000172	0.046	0.0	0.0456	177.82	81.00	96.82
70	4200	58.818	0.0000163	0.043	0.0	0.0432	181.57	86.40	95.17
75	4500	55.945	0.0000155	0.041	0.0	0.0411	185.04	91.80	93.24
80	4800	53.363	0.0000148	0.039	0.0	0.0392	188.27	97.20	91.07
85	5100	51.030	0.0000142	0.038	0.0	0.0375	191.28	102.60	88.68
90	5400	48.909	0.0000136	0.036	0.0	0.0359	194.12	108.00	86.12
95	5700	46.973	0.0000130	0.035	0.0	0.0345	196.79	113.40	83.39
100	6000	45.197	0.0000126	0.033	0.0	0.0332	199.32	118.80	80.52
105	6300	43.563	0.0000121	0.032	0.0	0.0320	201.72	124.20	77.52
110	6600	42.053	0.0000117	0.031	0.0	0.0309	204.00	129.60	74.40
115	6900	40.653	0.0000113	0.030	0.0	0.0299	206.17	135.00	71.17
120	7200	39.352	0.0000109	0.029	0.0	0.0289	208.25	140.40	67.85

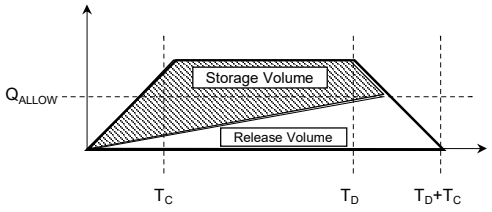
Max. required storage volume = 99.59 m^3

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
= ½ $(T_D + T_C)$ Q_{ALLOW}

Storage Volume = Runoff Volume - Release Volume



APPENDIX B

QUALITY CONTROL INFORMATION

Hydroworks Sizing Summary

117 Forest Avenue & 175 Catherine Street South Hamilton, Ontario

08-18-2022

Recommended Size: HS 6

A HydroStorm HS 6 is recommended to provide 80 % annual TSS removal based on a drainage area of 0.294 (ha) with an imperviousness of 97 % and Hamilton Airport, Ontario rainfall for the ETV Canada particle size distribution.

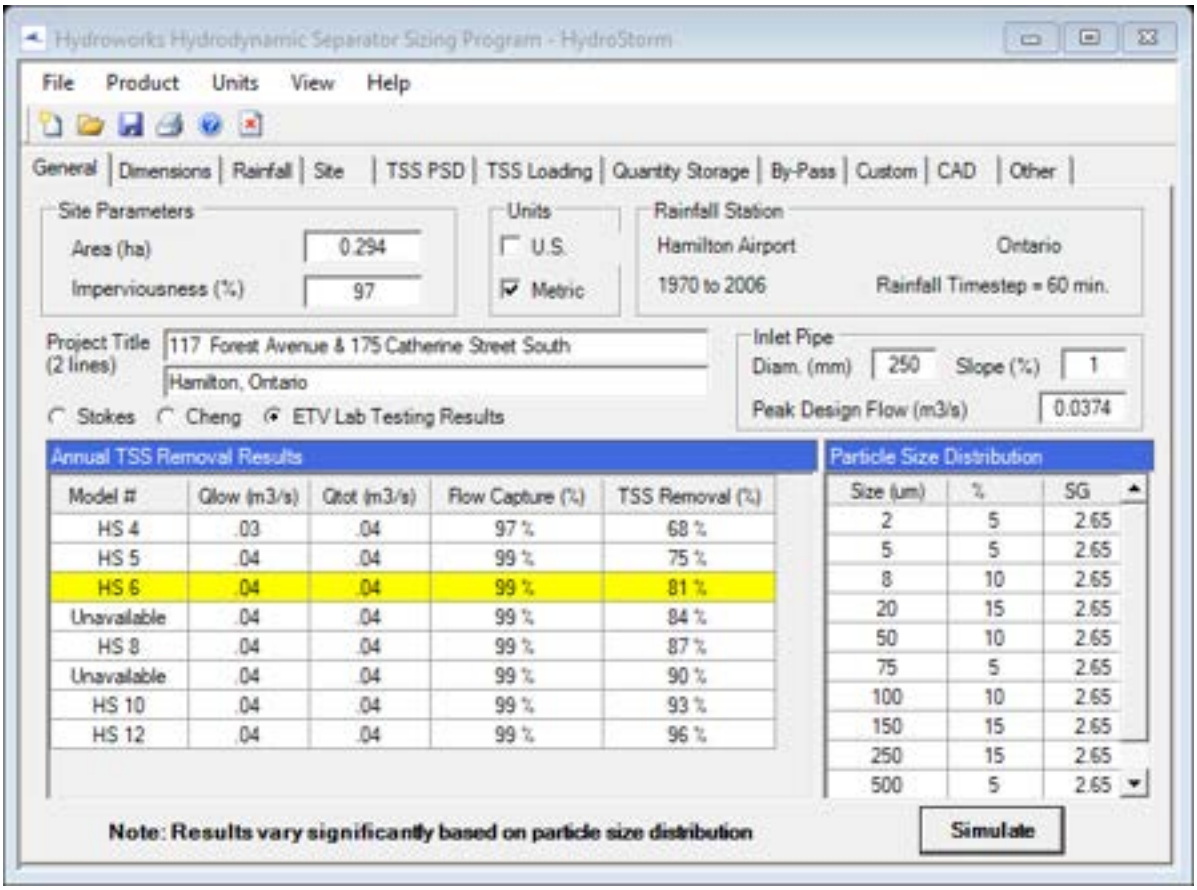
The recommended HydroStorm HS 6 treats 99 % of the annual runoff and provides 81 % annual TSS removal for the Hamilton Airport rainfall records and ETV Canada particle size distribution.

The HydroStorm has a headloss coefficient (K) of 1.04. The given peak flow of .037 (m3/s) is less than the full pipe flow of .06 (m3/s) indicating free flow in the pipe during the peak flow assuming no tailwater condition. Partial pipe flow was assumed For the headloss calculations. The critical depth is greater than the normal depth For the peak flow and 250 (mm) pipe diameter and 1 % slope given. Critical depth was assumed For the headloss calculations. The headloss was calculated to be 71 (mm) based on a flow depth of 156 (mm) .

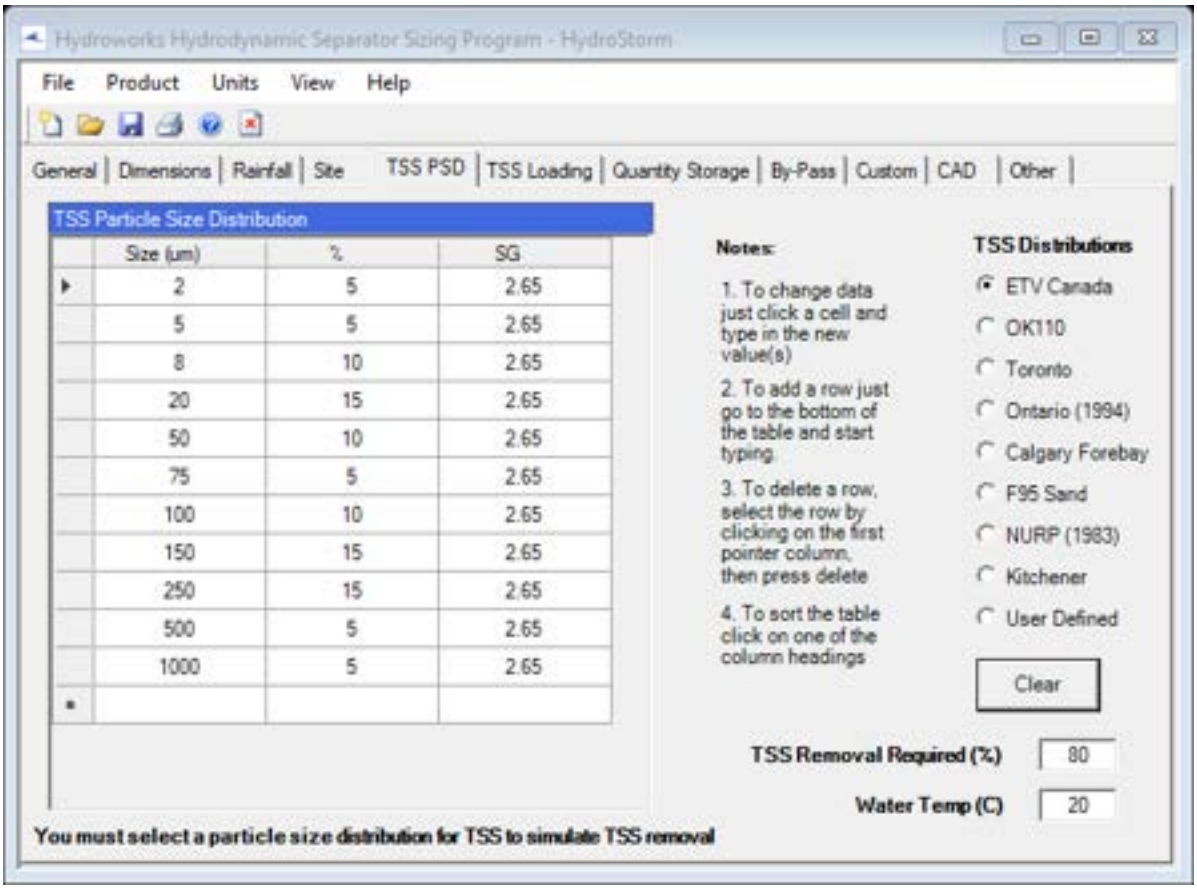
This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

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.

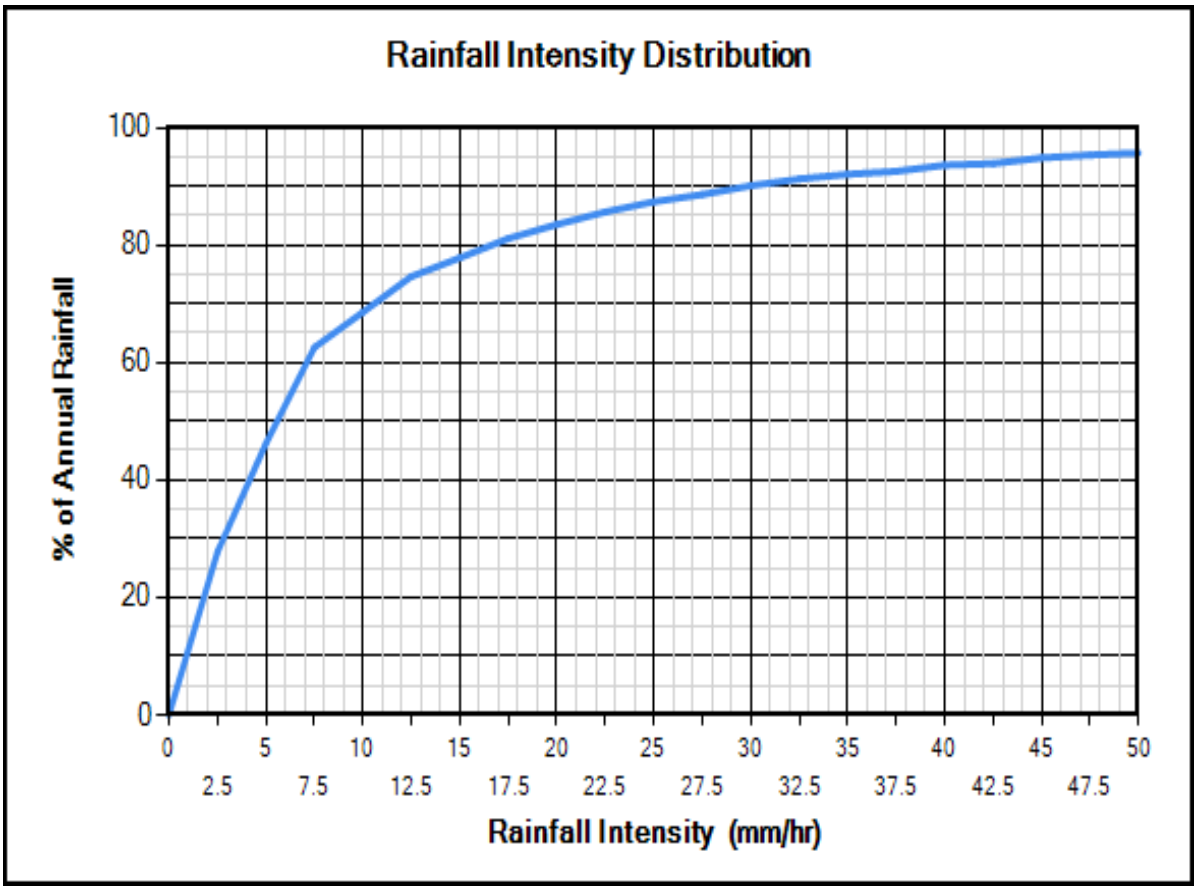
TSS Removal Sizing Summary



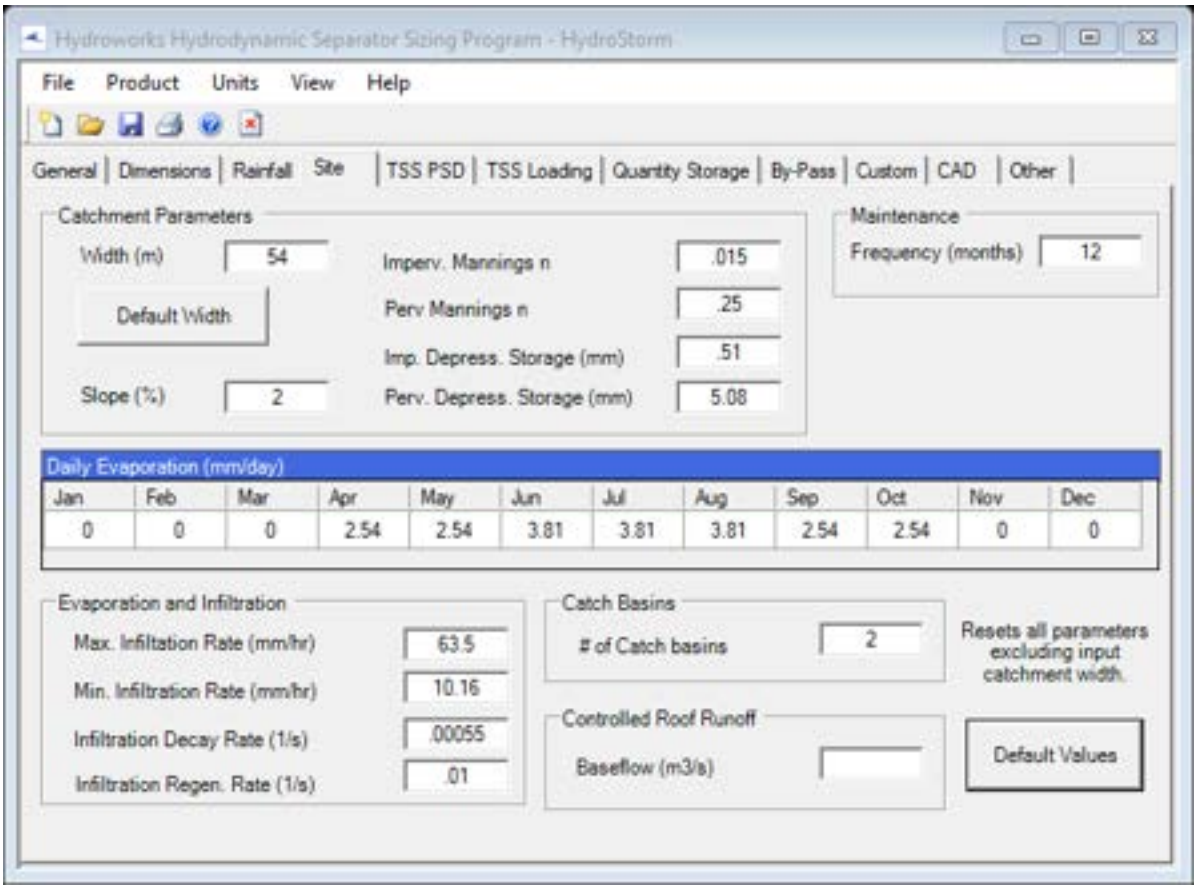
TSS Particle Size Distribution



Rainfall Station - Hamilton Airport, Ontario(1970 to 2006)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - HydroStorm

File Product Units View Help

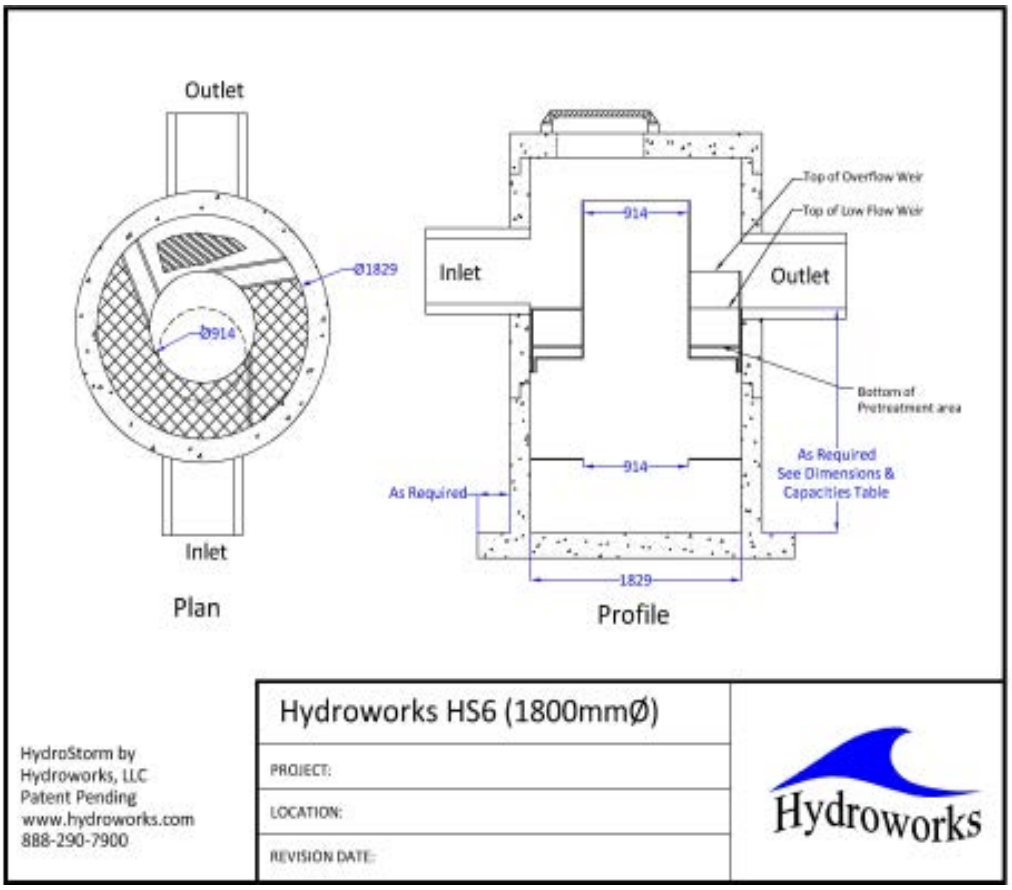
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Other

Dimensions and Capacities

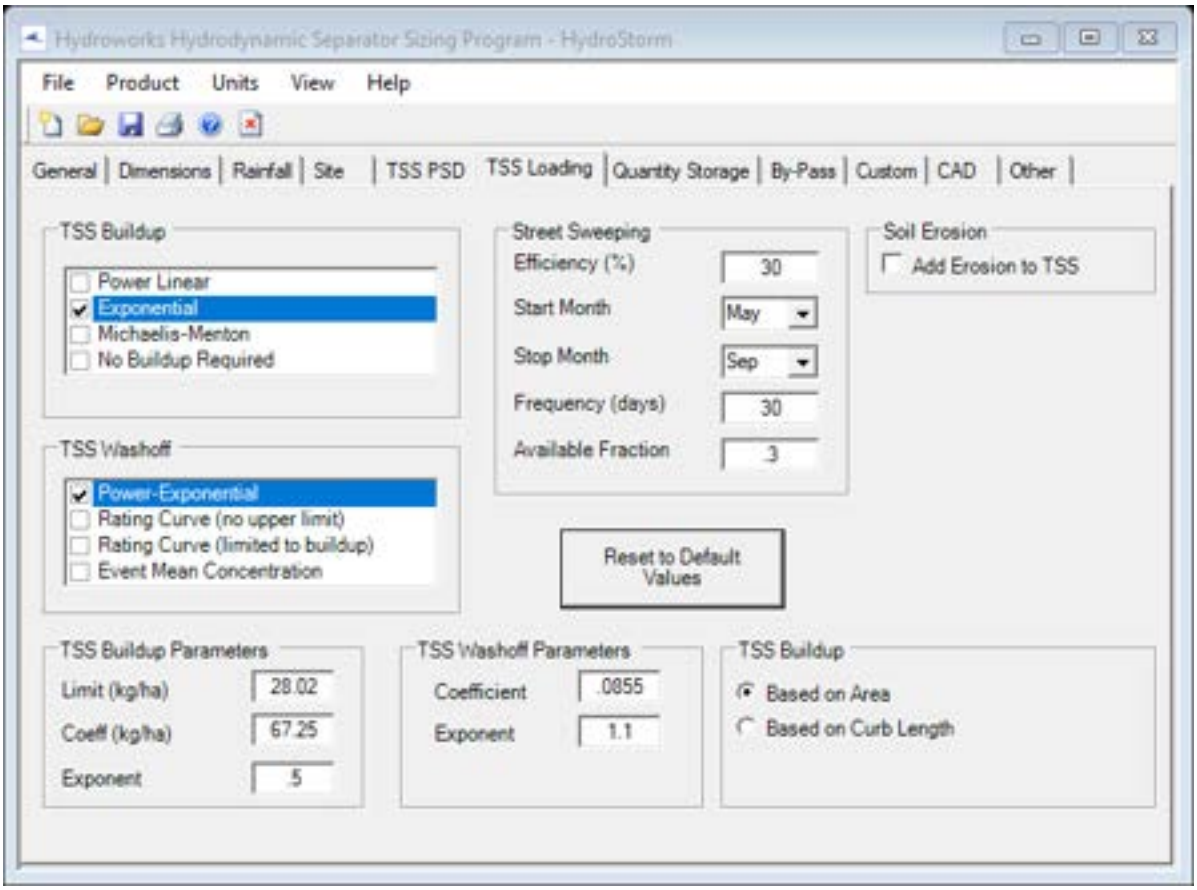
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 9	2.74	2.44	3242	9.3	14.4
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

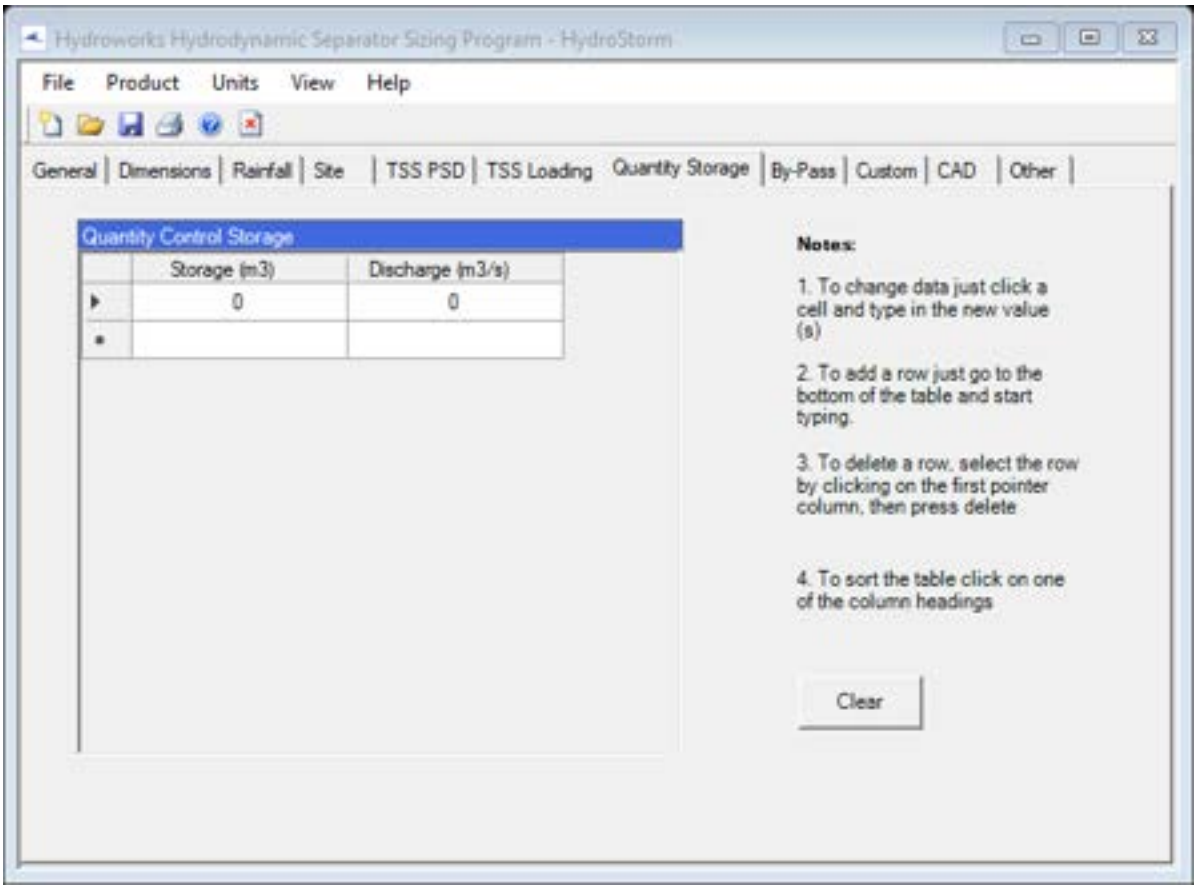
Generic HS 6 CAD Drawing



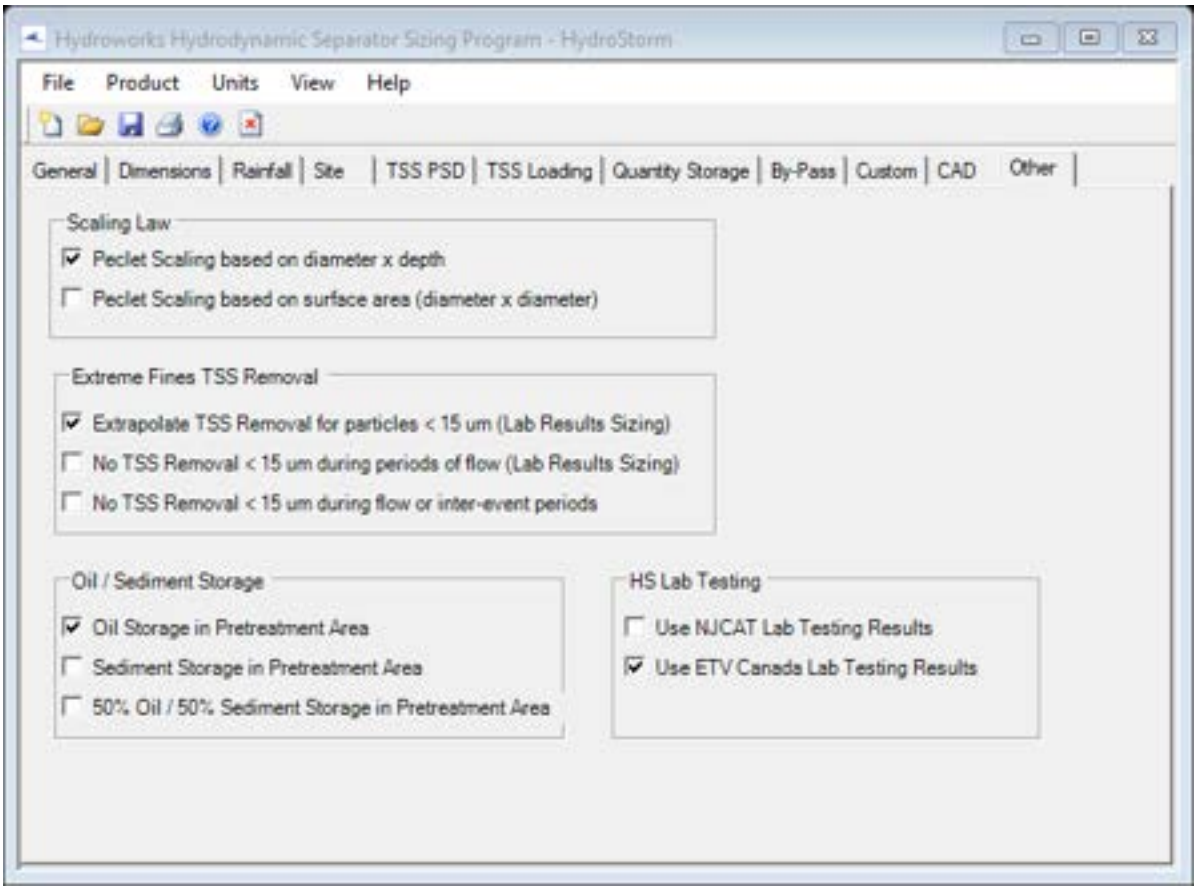
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Hydroworks® HydroStorm

Operations & Maintenance Manual

Version 1.0

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please fax a copy of the completed checklist to Hydroworks at 888-783-7271 for our records.

Introduction

The HydroStorm is a state of the art hydrodynamic separator. Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroStorm is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroStorm.

Hydroworks® HydroStorm Operation

The Hydroworks HydroStorm (HS) separator is a unique hydrodynamic by-pass separator. It incorporates a protected submerged pretreatment zone to collect larger solids, a treatment tank to remove finer solids, and a dual set of weirs to create a high flow bypass. High flows are conveyed directly to the outlet and do not enter the treatment area, however, the submerged pretreatment area still allows removal of coarse solids during high flows.

Under normal or low flows, water enters an inlet area with a horizontal grate. The area underneath the grate is submerged with openings to the main treatment area of the separator. Coarse solids fall through the grate and are either trapped in the pretreatment area or conveyed into the main treatment area depending on the flow rate. Fines are transported into the main treatment area. Openings and weirs in the pretreatment area allow entry of water and solids into the main treatment area and cause water to rotate in the main treatment area creating a vortex motion. Water in the main treatment area is forced to rise along the walls of the separator to discharge from the treatment area to the downstream pipe.

The vortex motion forces solids and floatables to the middle of the inner chamber. Floatables are trapped since the inlet to the treatment area is submerged. The design maximizes the retention of settled solids since solids are forced to the center of the inner chamber by the vortex motion of water while water must flow up the walls of the separator to discharge into the downstream pipe.

A set of high flow weirs near the outlet pipe create a high flow bypass over both the pretreatment area and main treatment chamber. The rate of flow into the treatment area is regulated by the number and size of openings into the treatment chamber and the height of by-pass weirs. High flows flow over the weirs directly to the outlet pipe preventing the scour and resuspension of any fines collected in the treatment chamber.

A central access tube is located in the structure to provide access for cleaning. The arrangement of the inlet area and bypass weirs near the outlet pipe facilitate the use of multiple inlet pipes.

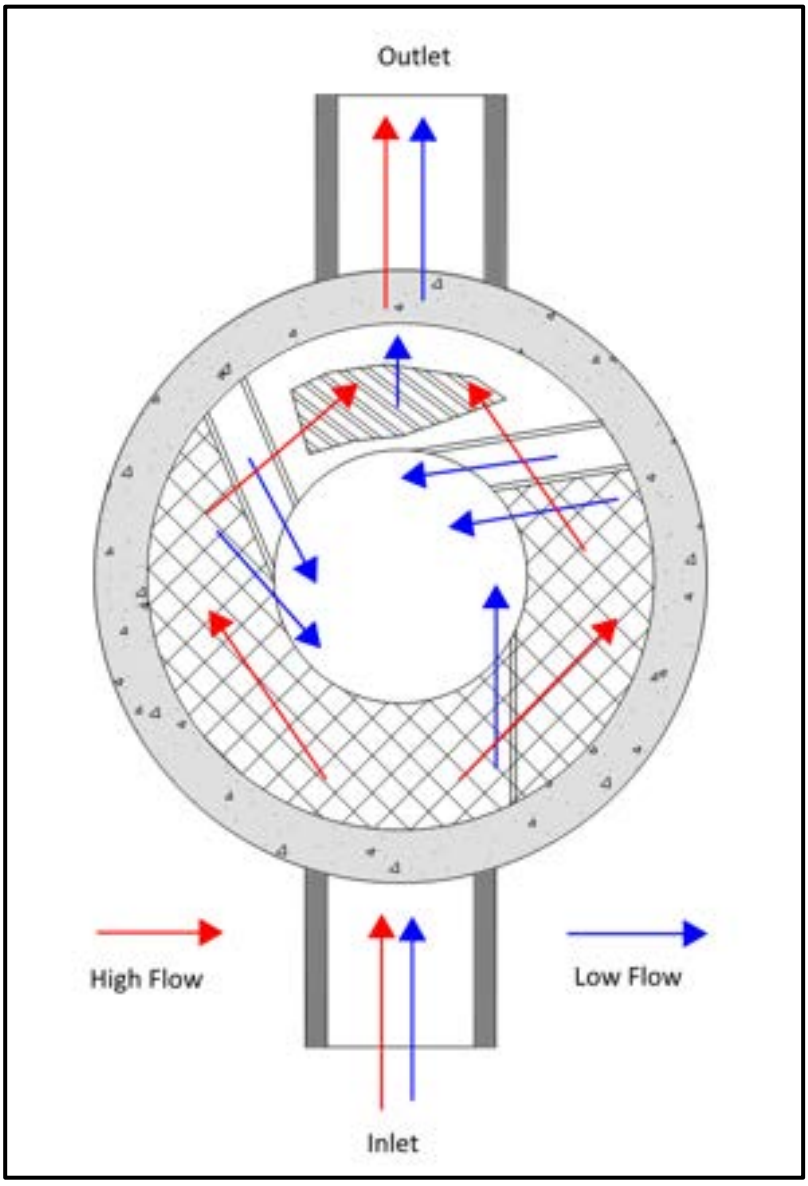


Figure 1. Hydroworks HydroStorm Operation – Plan View

Figure 2 is a profile view of the HydroStorm separator showing the flow patterns for low and high flows.

Hydroworks

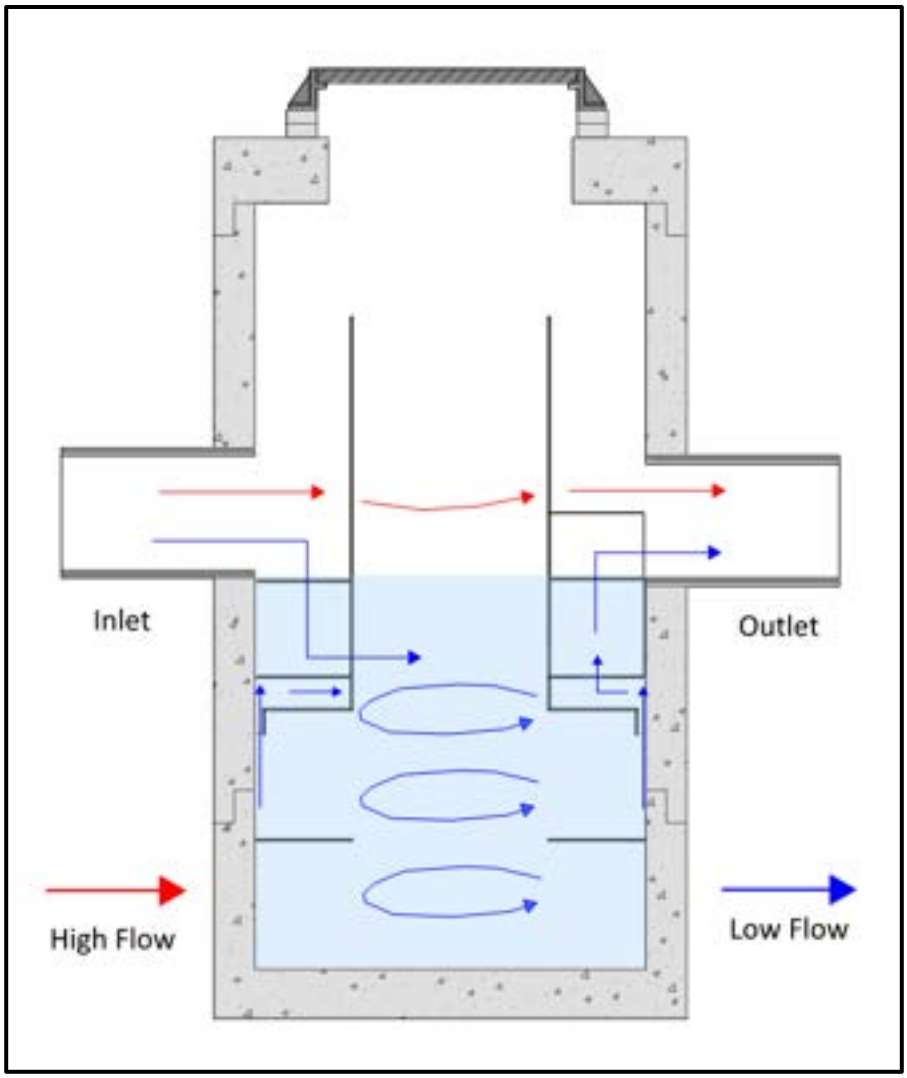


Figure 2. Hydroworks HydroStorm Operation – Profile View

The HS 4i is an inlet version of the HS 4 separator. There is a catch-basin grate on top of the HS 4i. A funnel sits sits underneath the grate on the frame and directs the water to the inlet side of the separator to ensure all lows flows are properly treated. The whole funnel is removed for inspection and cleaning.

Hydroworks

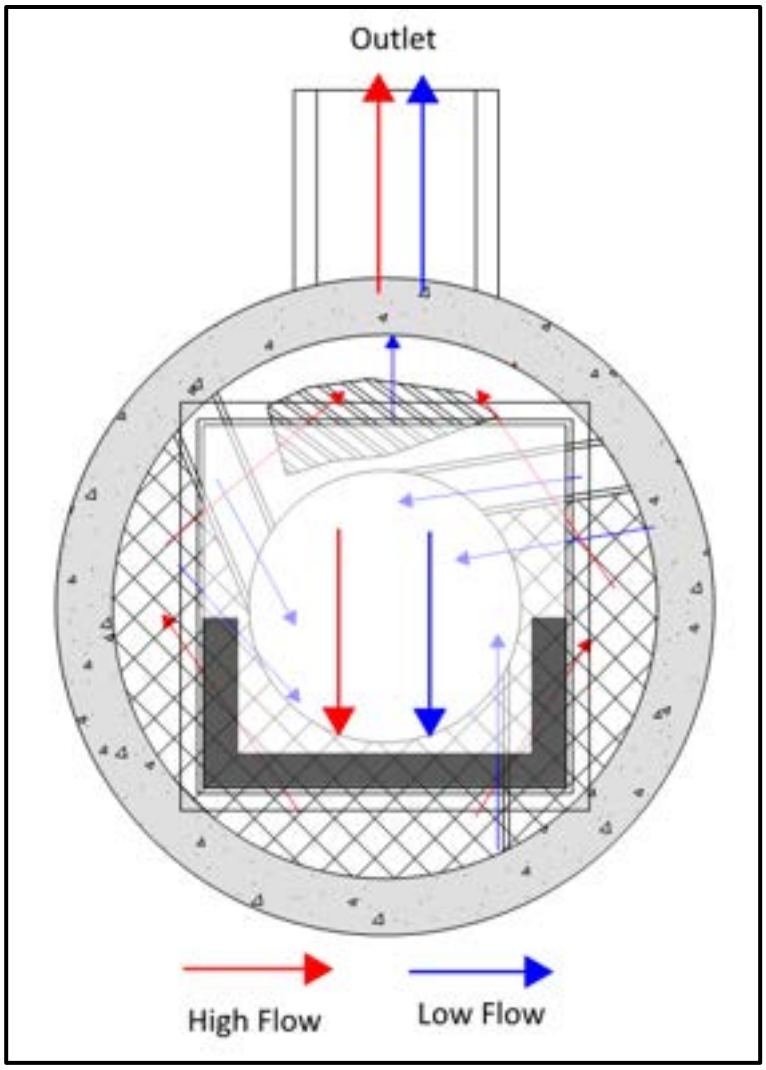


Figure 3. Hydroworks HS 4i Funnel

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the covers and looking down into the center access tube of the separator. Separators with an inlet grate (HS 4i or custom separator) will have a plastic funnel located under the grate that must be removed from the frame prior to inspection or maintenance. If you are missing a funnel please contact Hydroworks at the numbers provided at the end of this document.

Hydroworks

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. The unit should be inspected for TSS through each of the access covers. Several readings (2 or 3) should be made at each access cover to ensure that an accurate TSS depth measurement is recorded.

Frequency

Construction Period

The HydroStorm separator should be inspected every four weeks and after every large storm (over 0.5" (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroStorm separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized (storage piles, exposed soils) areas the HydroStorm separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required future frequency of inspection and maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, blockages)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HydroStorm unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroStorm separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

A central access opening (24” or greater) is provided to the gain access to the lower treatment tank of the unit. This is the primary location to maintain by vacuum truck. The pretreatment area can also be vacuumed and/or flushed into the lower treatment tank of the separator for cleaning via the central access once the water level is lowered below the pretreatment floor.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature. Disposal of the water will depend on local requirements. Disposal options for the decanted water may include:

1. Discharge into a nearby sanitary sewer manhole
2. Discharge into a nearby LID practice (grassed swale, bioretention)
3. Discharge through a filter bag into a downstream storm drain connection

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Disposal of the contents of the separator depend on local requirements. Maintenance of a Hydroworks HydroStorm unit will typically take 1 to 2 hours based on a vacuum truck and longer for other cleaning methods (i.e. clamshell bucket).

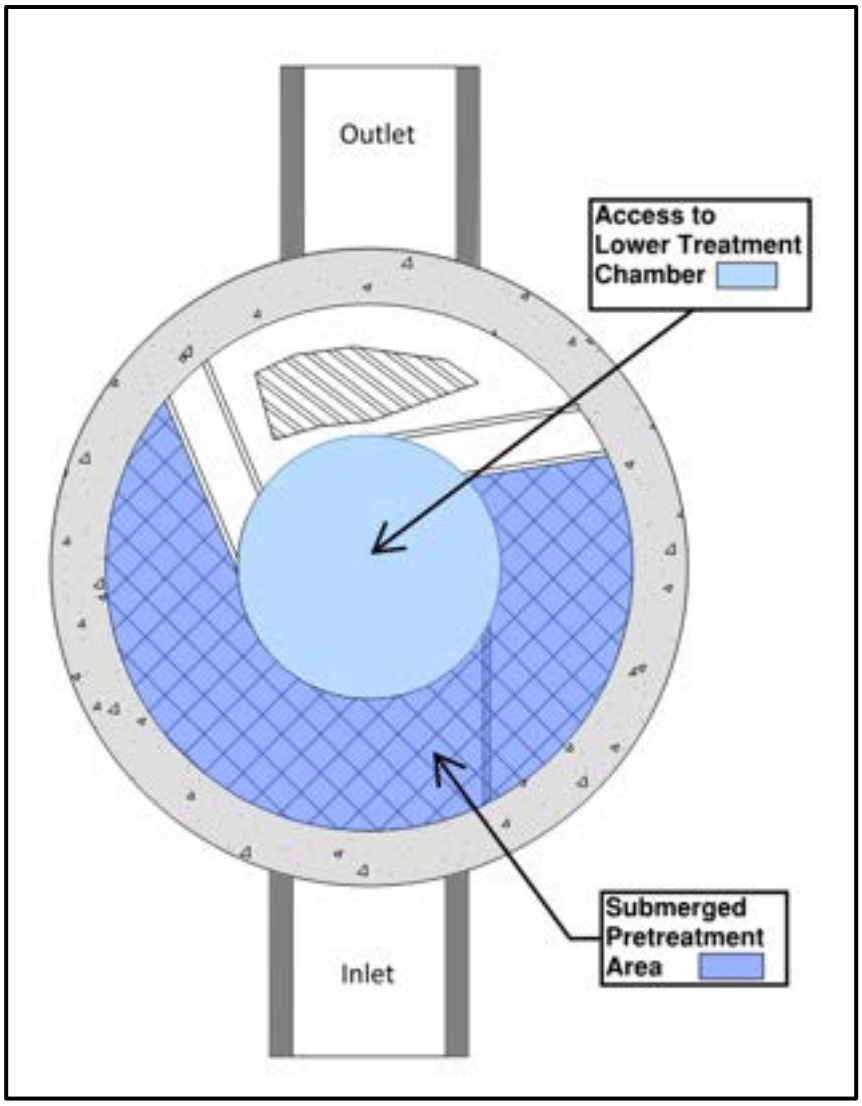


Figure 3. Maintenance Access

Frequency

Construction Period

A HydroStorm separator can fill with construction sediment quickly during the construction period. The HydroStorm must be maintained during the construction period when the depth of TSS/sediment reaches 24” (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroStorm separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

Post-Construction Period

The HydroStorm was independently tested by Alden Research Laboratory in 2017. A HydroStorm HS 4 was tested for scour with a 50% sediment depth of 0.5 ft. Therefore, maintenance for sediment accumulation is required if the depth of sediment is 1 ft or greater in separators with standard water (sump) depths (Table 1).

There will be designs with increased sediment storage based on specifications or site-specific criteria. A measurement of the total water depth in the separator through the central access tube should be taken and compared to water depth given in Table 1. The standard water depth from Table 1 should be subtracted from the measured water depth and the resulting extra depth should be added to the 1 ft to determine the site-specific sediment maintenance depth for that separator.

For example, if the measured water depth in the HS-7 is 7 feet, then the sediment maintenance depth for that HS-7 is 2 ft (= 1 + 7 – 6) and the separator does not need to be cleaned for sediment accumulation until the measure sediment depth is 2 ft.

The HydroStorm separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroStorm Models

Model	Diameter (ft)	Total Water Depth (ft)	Sediment Maintenance Depth for Table 1 Total Water Depth(ft)
HS-3	3	3	1
HS-4	4	4	1
HS-5	5	4	1
HS-6	6	4	1
HS-7	7	6	1
HS-8	8	7	1
HS-9	9	7.5	1
HS-10	10	8	1
HS-11	11	9	1
HS-12	12	9.5	1

HYDROSTORM INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroStorm	**Yes**	**No**
Obstructions in the inlet or outlet	☐ *	☐
Missing internal components	☐ **	☐
Improperly installed inlet or outlet pipes	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐

Water level depth below outlet pipe invert _____"

Routine Measurements

Floating debris depth	**< 0.5" (13mm)**	☐	**>0.5" 13mm)**	☐ *
Floating debris coverage	**< 50% of surface area**	☐	**> 50% surface area**	☐ *
Sludge depth	**< 12" (300mm)**	☐	**> 12" (300mm)**	☐ *****

* Maintenance required
** Repairs required
*** Further investigation is required

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroStorm

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroStorm to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroStorm are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroStorm, or the cost of other goods or services related to the purchase and installation of the HydroStorm. For this Limited Warranty to apply, the HydroStorm must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroStorm arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroStorm, whether the claim is based upon contract, tort, or other legal basis.

FLEXSTORM™ Inlet Filter Specifications and Work Instructions

Product: **FLEXSTORM Inlet Filters**

Manufacturer: **Inlet & Pipe Protection, Inc** www.inletfilters.com

A subsidiary of **Advanced Drainage Systems (ADS)** www.ads-pipe.com

1.0 Description of Work:

1.1 The work covered shall consist of supplying, installing, and maintaining/cleaning of the FLEXSTORM Inlet Filter assembly. The purpose of the FLEXSTORM Inlet Filter system is to collect silt and sediment from surface storm water runoff at drainage locations shown on the plans or as directed by the Engineer. FLEXSTORM PURE, permanent filters, are capable of removing small particles, hydrocarbons, and other contaminants from drainage "hot spots".

2.0 Material:

2.1 The FLEXSTORM Inlet Filter system is comprised of a corrosion resistant steel frame and a replaceable geotextile sediment bag attached to the frame with a stainless steel locking band. The sediment bag hangs suspended from the rigid frame at a distance below the grate that shall allow full water flow into the drainage structure if the bag is completely filled with sediment.




2.2 The FLEXSTORM Inlet Filter frame includes lifting handles in addition to the standard overflow feature. A FLEXSTORM Removal Tool engages the lifting bars or handles to allow manual removal of the assembly without machine assistance. The frame suspension system on most rectangular designs is adjustable in ½" increments up to 5" per side should the casting or drainage structure have imperfections.



2.3 **FLEXSTORM CATCH-IT** Inlet Filters for temporary inlet protection: The FLEXSTORM CATCH-IT framing is galvanized or zinc plated for corrosion resistance. The **"FX"** Woven Polypropylene filter bag is the design standard, although the **"IL"** Nonwoven geotextile is also available if preferred by the engineer. These products are typically used for temporary inlet protection lasting 3 months (short term road work) to 5 years (residential developments).

2.4 **FLEXSTORM PURE** Inlet Filters for permanent inlet protection: The FLEXSTORM PURE framing is comprised of 304 stainless steel with a 25 year life rating. Multiple filter bags are available: **FX, FX+, PC, PC+, LL** and others. The Post Construction **"PC+"** is the design standard consisting of the **"FX"** Woven Polypropylene sediment bag lined with Adsorb-it filter fabric, which is made from recycled polyester fibers. The **"PC+"** includes a replaceable hydrocarbon skimmer pouch strapped to the bottom of the bag for advanced TPH removal.

3.0 Filter Bag Specifications and Capabilities:

3.1 Material Properties (taken from manufacturers average roll value):

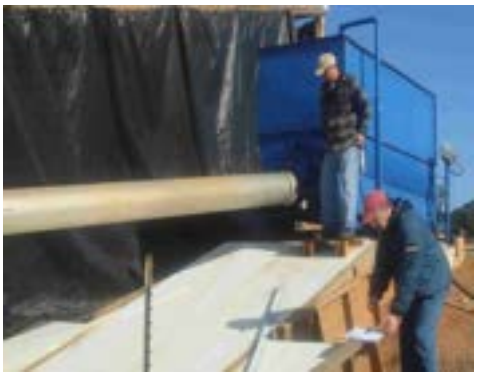
FLEXSTORM FILTER BAGS	(22" depth) STD Bag P/N	(12" depth) Short Bag P/N	Clean Water Flow Rate (GPM/SqFt)	Min A.O.S. (US Sieve)
FX: Standard Woven Bag	FX	FX-S	200	40
FX+: Woven w/ Oil Skimmer	FXP	FXP-S	200	40
FXO: Woven w/ Oil Boom	FXO	FXO-S	200	40
PC: Post Construction Bag	PC	PC-S	137	140
PC+: PC w/ Oil Skimmer	PCP	PCP-S	137	140
LL: Litter and Leaf Bag	LL	LL-S	High	3.5
IL: IDOT Non-Woven Bag	IL	IL-S	145	70

3.2 Standard Bag Sizes and Capabilities: Bag Sizes are determined by clear opening dimensions of the drainage structure. Once frame design size is confirmed, Small - XL bag ratings can be confirmed to meet design criteria. Ratings below are for standard 22" deep bags.

Standard Bag Size[4]	Solids Storage Capacity (CuFt)	Filtered Flow Rate at 50% Max (CFS)			Oil Retention (Oz)	
		FX	PC	IL	PC*	PCP**
Small	1.6	1.2	0.8	0.9	66	155
Medium	2.1	1.8	1.2	1.3	96	185
Large	3.8	2.2	1.5	1.6	120	209
XL	4.2	3.6	2.4	2.6	192	370

4.0 Tested Filtration Efficiency and Removal Rates: Filtration Efficiency, TSS, and TPH testing performed under large scale, real world conditions at accredited third party erosion and sediment control testing laboratory. (See Full Test Reports at www.inletfilters.com)

Inside View of Hopper Agitator



Hopper With Outlet Pipe Leading To Area Inlet

Area Inlet Simulated Showing Influent Discharge From Pipe

4.1 **FLEXSTORM "FX" Filtration Efficiency Test Results:** All testing performed in general accordance with the ASTM D 7351, *Standard Test Method For Determination of Sediment Retention Device Effectiveness in Sheet Flow Application,* with flow diverted into an area inlet. Test Soil used as sediment had the following characteristics with a nominal 7% sediment to water concentration mix. This is representative of a heavy sediment load running off of a construction site.

Soil Characteristics	Test Method	Value		Filtration Efficiency of "FX" FLEXSTORM Bag
% Gravel	ASTM D 422	2		**82%**
% Sand		60		
% Silt		24		
% Clay		14		
Liquid Limit, %	ASTM D 4318	34		
Plasticity Index, %		9		
Soil Classification	USDA	Sandy Loam		
Soil Classification	USCS	Silty Sand (SM)		

4.2 **FLEXSTORM "PC" and "PC+" Test Results:** TSS measured on effluent samples in accordance with SM 2540D and TPH in accordance with EPA 1664A.

Product Tested	110 micron Sediment Load	Ave Flow Rate GPM	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	1750 mg/L using OK-110 Silica Sand and Clean Water	23	**99.28%**	98.96%
		48	**99.32%**	99.25%
		70	**98.89%**	98.80%

Product Tested	Street Sweep Sediment Load	Particle Size of Sediment Load	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	2.5% = 100 lbs Sed / 4000 lbs water	.001 mm – 10.0 mm (median 200 micron)	**99.68%**	95.61%

Product Tested	Hydrocarbon Load	Ave Flow Rate GPM	% TPH Removal	Oil Retention Efficiency
FLEXSTORM PC+	243 mg/L using 750 mL (1.45 lb) used motor oil + lube oil and clean water	19	**99.04%**	97.22%
FLEXSTORM PC		20	**97.67%**	91.61%
FLEXSTORM PC+		92	**96.88%**	99.11%

5.0 Identification of Drainage Structures to Determine FLEXSTORM Item Codes:

5.1 The Installer (Contactor) shall inspect the plans and/or worksite to determine the quantity of each drainage structure casting type. The foundry casting number or the exact grate size and clear opening size will provide the information necessary to identify the required FLEXSTORM Inlet Filter part number. Inlet Filters are supplied to the field pre-configured to fit the specified drainage structure. Item Codes can be built using the FLEXSTORM Product Configurator at www.inletfilters.com. Detailed Submittal / Specification drawings are linked to each Item Code and available for download by engineers and contractors to include on plans and/or verify field inlet requirements. An example of a typical drawing is shown below.

7.4 Sediment Bag Replacement: When replacing a Sediment Bag, remove the bag by loosening or cutting off the clamping band. Take the new sediment bag, which is equipped with a stainless steel worm drive clamping band, and use a drill or screw driver to tighten the bag around the frame channel. Ensure the bag is secure and that there is no slack around the perimeter of the band. For Oil absorbent boom bags, simply replace the oil boom or pouch when saturated by sliding it through the mesh support sleeve.

7.5 Operation & Maintenance Plan. (Download at www.inletfilters.com or www.ads-pipe.com)

FLEXSTORM OPERATION AND MAINTENANCE PLAN

OPERATION & MAINTENANCE PLAN

Installation Instructions:

1. Remove grate from the drainage structure
2. Clean stone and dirt from ledge (lip) of drainage structure
3. Drop the FLEXSTORM inlet filter through the clear opening such that the hangers rest firmly on the lip of the structure.
4. Replace the grate and confirm it is not elevated more than 1/8", the thickness of the steel hangers.

Frequency of Inspections:

1. Inspection should occur following any rain event >½".
2. Post construction inspections should occur 4 times per year. In snowfall affected regions additional inspections should take place before and after snowfall season.
3. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than 3 times/year.

Maintenance Guidelines:

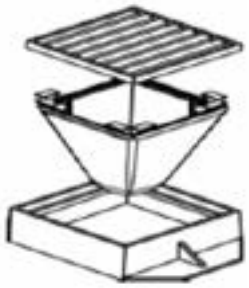
1. Empty the sediment bag if more than half filled with sediment and debris, or as directed.
2. Remove the grate, engage the lifting bars with the FLEXSTORM Removal Tool, and lift from drainage structure.
3. Dispose of sediment or debris as directed by the Engineer or Maintenance contract.
4. An industrial vacuum can be used to collect sediment.
5. Remove caked on silt from sediment bag and flush with Medium spray with optimal filtration.
6. Replace bag if torn or punctured to >½" diameter on lower half of bag.

Post Construction PC Bag Maintenance:

1. At 50% saturation the average 2'x2' Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil and should be serviced. To recover the oils the filter can be centrifuged or passed through a wringer.
2. Oil skimmer pouches start to turn black when saturated, indicating time for replacement. Each ClearTec Rubberizer pouch will absorb ~62oz (4 lbs) of oil before needing replacement.
3. Dispose of all oil contaminated products in accordance with EPA guidelines. ClearTec Rubberizer, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

Sediment Bag Replacement:

1. Remove the bag by loosening or cutting off clamping bag.
2. Take new sediment bag and secure worm drive clamping band to the frame channel.
3. Ensure Bag is secure and there is no slack around perimeter.



STRUCTURE ID#/LOCATION:

DATE	TASK PERFORMED	INSPECTOR

APPENDIX C

WATER ANALYSIS INFORMATION

OBC FIRE FLOW WATER SUPPLY

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Project: **117 Forest Avenue & 175 Catharine Street South**
Project Number: 16092A
Date: Aug-22

Type of Development: **Multi-Residential**

Required Fire Water Supply (Q) per OBC: **$Q = K\ V\ S_{tot}$** *(OBC Tables and Figures attached)*

Where:
Q = Minimim supply of water in litres
K = Water suppy coefficient from Table 1
V = total building volume in cubic meters
S_{tot} = total of spatial coefficient values from property line exposures on all sides
$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + ...]$ from Figure 1. Max. 2.0

Water Supply Coefficient (K)

Building Group/Division Classification: **C (Residential Occupancies)**

From Table 1, **K =** **16**

Building Volume (V)

14-Storey Building

Building Footprint Area: **1186** m^2

Building Height: **43.3** m

Building Volume (V): ***51353.8*** **m^3**

Spatial Coefficient (S)

See Figure 1 for Spatial Coefficients

Side	Dist (m)	S_{coeff}
Front	**2.4**	**0.5**
Back	**11.3**	**0**
Left	**11.2**	**0**
Right	**6.5**	**0.3**
	Total	0.8

Therefore, S_{tot} = **1.8**

Required Water Supply

$Q = K\ V\ S_{tot}$ = 1478989 m^3

From Table 2, the minimum required water supply flow rate = ***9000*** ***l/min*** ***or*** 150 l/s

City of Hamilton Target flow for Multi Residential (3 or more units) = **150** **l/s <-- governs**

OBC Tables and Figures

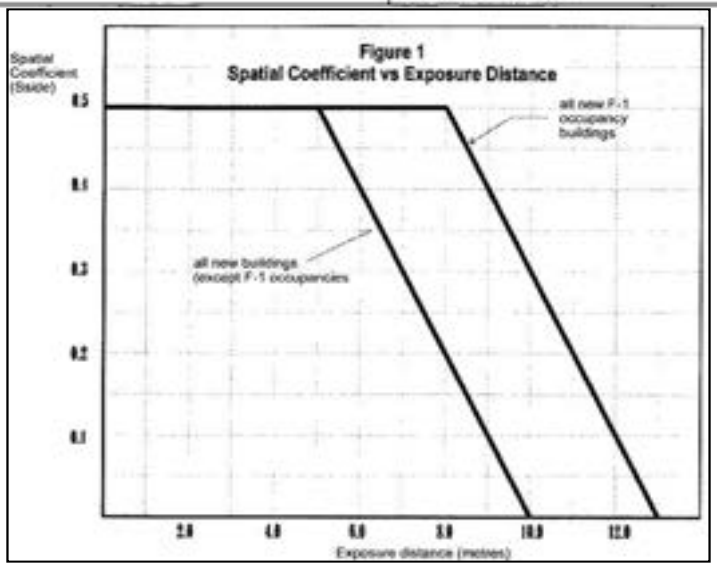
Table 1

Water Supply Coefficient - K

Type of Construction	Classification by Group or Division in Accordance with Table 3.1.2.1. of the Building Code				
	A-2 B-1 B-2 B-3 C D	A-4 F-3	A-1 A-3	E F-2	F-1
Building is of noncombustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2., including loadbearing walls, columns and arches.	10	12	14	17	23
Building is of noncombustible construction or of heavy timber construction conforming to Article 3.1.4.6. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	16	19	22	27	37
Building is of combustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2., including loadbearing walls, columns and arches. Noncombustible construction may be used in lieu of fire-resistance rating where permitted in Subsection 3.2.2.	18	22	25	31	41
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance rating.	23	28	32	39	53
Column 1	2	3	4	5	6

Table 2

Part 3 Buildings under the Building Code	Required Minimum Water Supply Flow Rate, L/min
One-storey building with building area not exceeding 600 m²	1 800
All other buildings	2 700 (if Q ≤ 108 000 L)[1] 3 600 (if Q > 108 000 L and ≤ 135 000 L)[1] 4 500 (if Q > 135 000 L and ≤ 162 000 L)[1] 5 400 (if Q > 162 000 L and ≤ 190 000 L)[1] 6 300 (if Q > 190 000 L and ≤ 270 000 L)[1] 9 000 (if Q > 270 000 L)[1]



City of Hamilton Target Flows (Policy PW19096)

Table 1: Target Available Fire Flow

Land Use	Target AFF (L/s)
Commercial	150
Small ICI (<1,800 m²)[1]	100
Industrial	250
Institutional	150
Residential Multi (greater than 3 units)	150
Residential Medium (3 or less units)	125
Residential Single	75
Residential Single (Dead End)	50

Adequate Water Services - Required Fire Flow-RFF and Available Fire Flow-AFF – (PILOT VERSION-01)

Application Number :	
Municipal Address :	117 Forest Avenue & 175 Catharine Street South

Through staff report PW19096 - City of Hamilton Watermain Fire Flow Requirement Design Guidelines Policy on November 27th, 2019 Council adopted the new fire flow policy. This form is intended to guide applicants through the documentation requirements of this change. FUS calculations are no longer required for new submissions. This form is supplemental to related and supporting documentation/calculations.

1 - REQUIRED FIRE FLOW – RFF

1 a) Required Fire Flow-RFF a)

$Q = KVS_{Tot}$

Please provide required fire flow-RFF using the water supply flow rate method (OBC section A-3.2.5.7 ; OFM-TG-03-1999 FIRE PROTECTION WATER SUPPLY GUIDELINE FOR PART 3 IN THE ONTARIO BUILDING CODE - 6.3 Buildings Requiring On-Site Fire Protection Water Supply ; **$Q = KVS_{Tot}$**). This methodology shall be applied to all buildings falling under Part 3 and Part 9 of the Building Code (OBC sections 1.1.2.2 and 1.1.2.4). Detailed calculations shall be submitted as an appended memo.

Enter calculated value here (highest if multiple buildings)

150 Litres / second

Comments :

1 b) Required Fire Flow-RFF b)

Target Table

Please select from **Table 1 : Target Available Fire Flow**

Table 1: Target Available Fire Flow

Land Use	Target AFF (L/s)
Commercial	150
Small ICI (<1,800 m^3)[1]	100
Industrial	250
Institutional	150
Residential Multi (greater than 3 units)	150
Residential Medium (3 or less units)	125
Residential Single	75
Residential Single (Dead End)	50

[1] 1800m^3 represents a maximum building volume that qualifies as "Small ICI"

Enter applicable value for Target Available Fire Flow (highest value if multiple Land Uses) here:

150 Litres / second

Comments :

Residential Multi (greater than 3 units)

1 c) Required Fire Flow-RFF c)

Enter higher of a) or b) from above

Enter value here :

150 Litres / second

Comments :

Adequate Water Services - Required Fire Flow-RFF and Available Fire Flow-AFF – (PILOT VERSION-01)

Application Number :	
Municipal Address :	117 Forest Avenue & 175 Catharine Street South

2 - AVAILABLE FIRE FLOW - AFF

2 a) Available Fire Flow-AFF a)

Field Hydrant Test calculated at 20 psi
Please provide available fire flow-AFF as determined through developer hydrant fire flow test or City Hydrant test database.
Enter value here : 407 Litres / second Please check : ☐ Developer hydrant fire flow test, or *(as directed in FC or thereafter)* ☑ City Hydrant test database
Comments :

OR (as directed in FC or thereafter)

2 b) Available Fire Flow-AFF b)

Computer Modelling
Please provide available fire flow-AFF as determined through computer modelling. ☐ Modelling criteria and boundary conditions were approved by Hamilton Water
Enter value here : Litres / second
Comments :

DECLARATION OF ADEQUATE SERVICES

☑ RFF c) is less than or equal to AFF, or

☐ RFF c) is greater than AFF.

Prepared by : Yagnik Moradiya

Date : August 23, 2022

FLOWMETRIX
INDU-TECH
PROCESS

Fire Flow Testing Report

Residual Hydrant # **HA15H026**

NFPA Colour Code **BLUE**

DATE	July 21, 2022
TIME	12:00 PM
ADDRESS	146 Forest Avenue
	Hamilton, ON
	L8N 1X5
SIZE-inches/mm	8 / 300
MATERIAL	DI
CONTACT INFO	Scott Beedie
	Urban Solutions
	(905) 546-1087
	sbeedie@urbansolutions.info

RESIDUAL HYDRANT INFO.

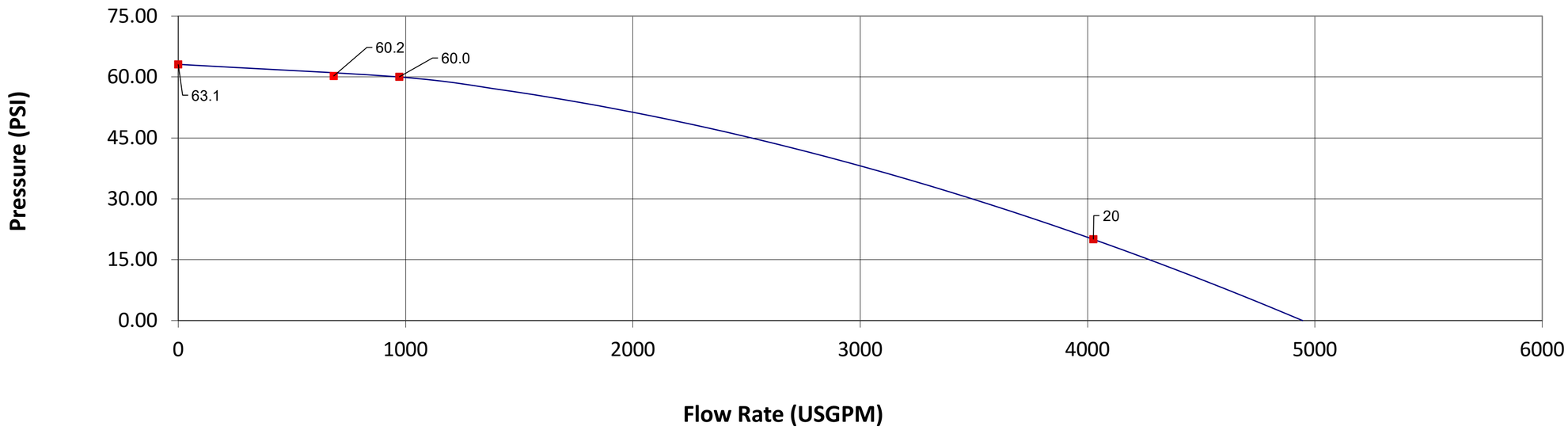
HYDRANT #	HA15H026	
N.F.P.A. COLOUR CODE	BLUE	
STATIC PRESSURE	63.1	psi
RESIDUAL PRESSURE - ONE PORT OPEN	60.2	psi
RESIDUAL PRESSURE - TWO PORTS OPEN	60.0	psi
PRESSURE DROP	3.1	psi
% PRESSURE DROP	4.9	% psi
Flow at Test Hydrant @ 20 psi	4025	USGPM

FLOW HYDRANT(S) INFO.

HYDRANT ASSET ID	HYD. # PORTS	OUTLET DIAMETER (INCHES)	NOZZLE COEFFICIENT	DIFFUSER TYPE	DIFFUSER COEFFICIENT	PITOT READING (psi)	PITOT FLOW (USGPM)	FLOW METER (USGPM)
HA15H025	1	2.5	Round	LPD250	0.90	**20.5**	683	0
								0
HA15H025	2	2.5	Round	LPD250	0.90	**10.4**	972	0
		2.5	Round	LPD250	0.90	**10.4**		0

FIRE FLOW CHART

Pressure - Flow Graph
at Test Hydrant



COMMENTS

OPERATOR	FMX	Jordan Whitlock
OPERATOR		Brendan Howatt
OPERATOR		City of Hamilton