S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing & Stormwater Management Report

650 MAIN STREET WEST

CITY OF PORT COLBORNE

M5V 650 MAIN LP

JUNE 2023

SLA File: 23036

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1.0 INTRODUCTION AND BACKGROUND

1.1 Overview

S. Llewellyn & Associates Limited has been retained by M5V 650 Main LP to provide Consulting Engineering services for the proposed development at 650 Main Street West in the City of Port Colborne (see Figure 1.0 for location plan).

The 0.53 ha site is bound by Main Street West to the north, existing residential lands to the east and existing commercial lands west and south. The proposed development consists of constructing a 6-storey mixed-use building with 95 residential units and 352m^2 of commercial space including associated asphalt driveways, a 2-storey parking structure, 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 the Preliminary Site Engineering Plans prepared by S. Llewellyn and Associates Limited and the Site Plan prepared by Saplys Architects 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: *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 Port Colborne and Niagara Region requirements:

Quantity Control
The stormwater discharge rate from the proposed site shall be controlled to the pre-development condition discharges rates for the 2-year to the 100-year storm events.

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 Port Colborne.

2.1 Pre-Development Conditions

In the pre-development condition, the 0.53ha site is comprised of a one-storey motel with an asphalt driveway/parking stalls and grassed areas. Runoff from the site sheet drains north to the roadside ditch along Main Street West.

One catchment area, Catchment 101, has been identified in the existing condition. Catchment 101 represents drainage from the site to the roadside ditch along Main Street West. See Table 2.1 and the Pre-Development 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 Main Street West	0.53	34%	0.47

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 Welland storm intensities at a time of concentration of 10 minutes (Tc=10min). An example of the 2-year calculation for Catchment 101 is shown below and a summary can be found in Table 2.2.

$Q_{2\text{-yr (Catchment 101)}}$ = 2.78CiA=2.78(0.47)(78.31 mm/hr)(0.53ha)
= **54.2 *l/s (0.0542 m^3/s)***

Table 2.2: Pre-Development Condition Site Discharge

Storm Event	Catchment 101 Runoff (m^3/s)
2-Yr Event	0.0542
5-Yr Event	0.0627
10-Yr Event	0.0701
25-Yr Event	0.0820
50-Yr Event	0.0901
100-Yr Event	0.0989

2.2 Post-Development Conditions

The proposed development consists of constructing a 6-storey mixed-use building with 95 residential units and 352m^2 of commercial space including associated asphalt driveways, a 2-storey parking structure, concrete curbing and landscaped areas. It is proposed to service the site with a private storm sewer system, designed and constructed in accordance with City of Port Colborne standards.

Three catchment areas, Catchment 201, 202 and 203, have been identified in the proposed condition. Catchment 201 represents the drainage area which is captured from the asphalt driveways and landscaped areas and will outlet via the proposed storm sewer and discharge to the roadside ditch along Main Street West. Catchment 202 represents

the drainage area which is captured from the roof of the proposed building and outlets to the proposed storm sewer. Catchment 203 represents the uncontrolled drainage area which will sheet drain to the roadside ditch along Main Street West. See Table 2.3 and the Post-Development 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 Main Street West	0.27	99	0.90
202	Proposed Rooftop Controlled	0.15	100	0.95
203	Uncontrolled to Main Street West	0.11	15	0.35

2.2.1 Water Quantity Control

It is required to restrict the post-development discharge rate from the subject site to the pre-development discharge rate up to and including the 100-year storm.

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 135mmø orifice plate within MH2 and Catchment 202 by Zurn Z-105 roof drains to restrict discharge from the site to the pre-development discharge rates. Refer to the Preliminary Site Servicing Plan for the orifice plate and roof drain locations.

With the installation of on-site quantity control measures for Catchment 201 and 202, 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 provide surface ponding on the asphalt parking lot as well as rooftop ponding on the proposed building. The stage-storage-discharge characteristics can be seen in Table 2.4 and 2.5 below and Appendix A for details.

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

Elevation (m)	Storage (m^3)	Discharge (m^3/s)
179.66 (Orifice Invert)	0	0.0000
180.85 (Top of Grate)	0	0.0403
180.90	1	0.0412
180.95	6	0.0421
181.00	21	0.0429
181.05	47	0.0437
181.10 (0.25m Ponding)	90	0.0446

Table 2.5: Proposed Condition Stage-Storage-Discharge for Catchment 202

Depth (m)	Storage (m^3)	Discharge (m^3/s)
0	0	0.0000
0.05	45	0.0038
0.075	68	0.0057
0.10	90	0.0076
0.15	135	0.0114

The maximum discharge rates for Catchment 203 were calculated using the Rational Method based on the proposed condition runoff coefficients for the 2-year to 100-year storm events. Additionally, the 2-year to 100-year storage volumes for Catchments 201 and 202 were calculated using the Modified Rational Method (MRM). The proposed discharge rates and storage volumes are summarized in Table 2.6 below and in Appendix A for details.

Table 2.6: Proposed Condition Stormwater Discharge (To Main Street West)

Storm Event	Catchment 201 + 202 Controlled Discharge (m^3/s)	Catchment 203 Uncontrolled Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge (m^3/s)	Required Storage (m^3)
2-Yr	0.0446	0.0084	0.0530	0.0542	19.8
5-Yr	0.0446	0.0097	0.0543	0.0627	27.8
10-Yr	0.0446	0.0108	0.0554	0.0701	34.9
25-Yr	0.0446	0.0127	0.0574	0.0820	45.9
50-Yr	0.0446	0.0139	0.0585	0.0901	55.6
100-Yr	0.0446	0.0153	0.0599	0.0989	65.0

This analysis determined the following:

- The post-development condition discharge rates to Main Street West will not exceed the pre-development condition discharge rate during the 2-year to 100-year storm events with the installation of a 135mmø orifice plate and Zurn Z-105 roof drains;

- Sufficient stormwater storage is provided on the surface of the asphalt parking lot. A storage volume of $90m^3$ is provided while only $65m^3$ of storage is required during the 100-year storm event.

- Sufficient stormwater storage is provided on the roof of the proposed building. A storage volume of $135m^3$ is provided while only $45m^3$ of storage is required during the 100-year storm event.

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 roadside ditch along Main Street West. 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 61% TSS removal and 99% 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. With the combination of a HydroStorm HS5 oil/grit separator and Flexstorm Inlet Filters, it is expected that a “Normal” (70% TSS removal) level of water quality will be achieved.

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 Grading and Erosion Control Plan.

3.0 SANITARY SEWER SERVICING

3.1 Existing Conditions

There is an existing 450mmø sanitary sewer which flows east along Main Street West.

3.2 Sanitary Demand

Niagara Region requires that the Peak Dry Weather Flow (DWF) and Peak Wet Weather Flow (WWF) be provided for the site in accordance with Section C.1 of the Niagara Region Water-Wastewater Project Design Manual. Table 3.1 summarizes the Peak DWF and WWF.

Table 3.1: Post-Development Sanitary Sewer Discharge

RDII[1] (l/s)	DWF[2] (l/s)	**Peak DWF[3] (l/s)**	WWF[4] (l/s)	**Peak WWF[5] (l/s)**
0.15	1.16	**4.64**	1.31	**4.79**

Population = (95 units x 2 persons/unit) + (352m^2 of commercial x 90 persons/ha) = 194 persons
Peaking Factor = (1+(14/(4+P$^{0.5}$))) with P expressed in thousands, Min. 2.0, Max. 4.0
Dry Weather Infiltration = Area x Infiltration Rate = 0.53 ha x 0.28 l/ha/s = 0.15 l/s
[1]RDII (Rain Derived Inflow and infiltration) = Area x 0.286 l/s/ha = 0.53 ha x 0.286 l/s = 0.15 l/s
[2]DWF (Dry Weather Flow) = Average Sanitary Flow + Dry Weather Infiltration = (average daily per capita flow x population) + Dry Weather Infiltration = (450 lcpd x 194 persons) + 0.15 l/s= 1.16 l/s
[3]Peak DWF = DWF x Peaking Factor = 1.16 x 4.0 = 4.64 l/s
[4]WWF (Wet Weather Flow) = DWF + Inflow and All Infiltration (Dry Weather and Rain Derived) = 1.16 l/s + 0.15 l/s = 1.31 l/s
[5] Peak WWF = Peak DWF + RDII = 4.64 l/s + 0.15 l/s = 4.79 l/s

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 Port Colborne standards. Drainage from the proposed sanitary sewer system will discharge to the existing 450mmø sanitary sewer along Main Street West.

The minimum grade of the proposed 200mmø sanitary sewer will be 1.0%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.033 m^3/s (33 l/s). Therefore, the proposed 200mmø sanitary sewer at a minimum of 1.0% 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 Main Street West. There is an existing fire hydrant fronting the site on Main Street West.

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)**
194 persons	0.81	4.9	7.4	**3.97**	**5.99**

[A] Population =(95 units x 2 persons/unit) + (352m^2 of commercial x 90 persons/ha) = 194 persons
[B] Average Daily Demand = (270 l/cap/day + 450 l/cap/day)/2 = 360 l/cap/day x population
[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.

There is an existing fire hydrant fronting the site on Main Street West within the required 90m separation to the building face of the proposed building (as per Sentence 3.2.5.7 of the 2020 Ontario Building Code). No additional private hydrants are proposed for this development.

The proposed building is non-combustible construction type (C=0.8), with limited combustible occupancy (-15% correction) and a fully supervised sprinkler system (-50% correction). Exposure corrections are based on the following:

North Face: 0% correction (>30m)
South Face: 0% correction (>30m)
East Face: 10% correction (20.1m to 30m)
West Face: 10% correction (20.1m to 30m)
Total: 20%

Based on the FUS calculations, it was determined that the required fire flow demand for the proposed development is 133 l/s. See the Fire Flow Demand Requirements Sheet in Appendix C for details.

There is currently no hydrant flow test data available. A hydrant flow test will be completed at a later date to confirm that the municipal distribution system has adequate pressure and capacity to service the proposed development.

4.4 Proposed Water Servicing and Analysis

The proposed development will be serviced with a 200mmø watermain feeding off the existing 250mmø watermain along Main Street West. The proposed 200mm watermain will split inside the property to provide a 200mmø fire service and a 150mmø domestic service.

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 & Erosion Control Plan and Preliminary Site Servicing Plan prepared by S. Llewellyn & Associates Limited;

- A 135mmø orifice plate and Zurn Z-105 roof drains be installed as per the Preliminary Site Servicing Plan and this report to achieve effective stormwater quantity control for the subject site;

- A HydroStorm HS5 oil/grit separator and Flexstorm Inlet Filters, or approved equivalent, 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 Port Colborne;

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

S. Nelson, P. Eng.

APPENDIX A
STORMWATER QUANTITY INFORMATION

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MAIN STREET WEST

EX. HYDRANT (NOT SURVEYED)

EX. 250mmø WTM (APPROX. LOCATION)

EX. 450mmø SAN @ 0.22% (APPROX. LOCATION)

EX. SANMH (APPROX. LOCATION) (NOT SURVEYED) INV.=177.33±

EX. 450mmø SAN @ 0.22% (APPROX. LOCATION)

EX. CENTRE LINE OF ROAD

EX. EDGE OF ASPHALT ROAD

EX. METAL CULVERT

EX. CB T/G=180.08

EX. CB T/G=180.20

EX. CENTRE LINE OF DITCH

EX. CENTRE LINE OF DITCH

EX. PILLAR

EX. PILLAR

EX. PILLAR

EX. MH

EX. METAL SIGN

EX. MH

EX. ASPHALT DRIVEWAY

EX. ASPHALT DRIVEWAY

EX. 1.0m HIGH CHAIN LINK FENCE

EX. METAL POLE

EX. SWIMMING POOL WITH CONCRETE DECK

EX. GW

EX. GARDEN

EX. GARDEN

EX. GARDEN

EX. SHED

EX. ASPHALT PARKING LOT

EX. CONCRETE SIDEWALK

EX. MUNICIPAL No. 650
ONE STOREY MOTEL

EX. MH

EX. METAL

EX. 2.4m HIGH BOARD FENCE

EX. CENTRE LINE OF DITCH

EX. 1.8m HIGH CHAIN LINK FENCE

EXISTING COMMERCIAL LANDS

EXISTING COMMERCIAL LANDS

EXISTING RESIDENTIAL LANDS

LOT 32

LOT 37

LOT 38

LOT 39

LOT 40

LOT 41

PART 3, 59R-9938

PART 2, 59R-13422

PART 1, 59R-13260

PART 1, 59R-8638

101
0.53
34%
0.47

LEGEND

101 / 1.67 / 15% / 0.35	DRAINAGE AREA I.D. / DRAINAGE AREA (ha) / PERCENT IMPERVIOUS / RUNOFF COEFFICIENT
	DRAINAGE AREA BOUNDARY

FIGURE 1.0
PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:500

PROJECT: 650 MAIN STREET WEST, PORT COLBORNE, ON
PROJECT No.: 23036

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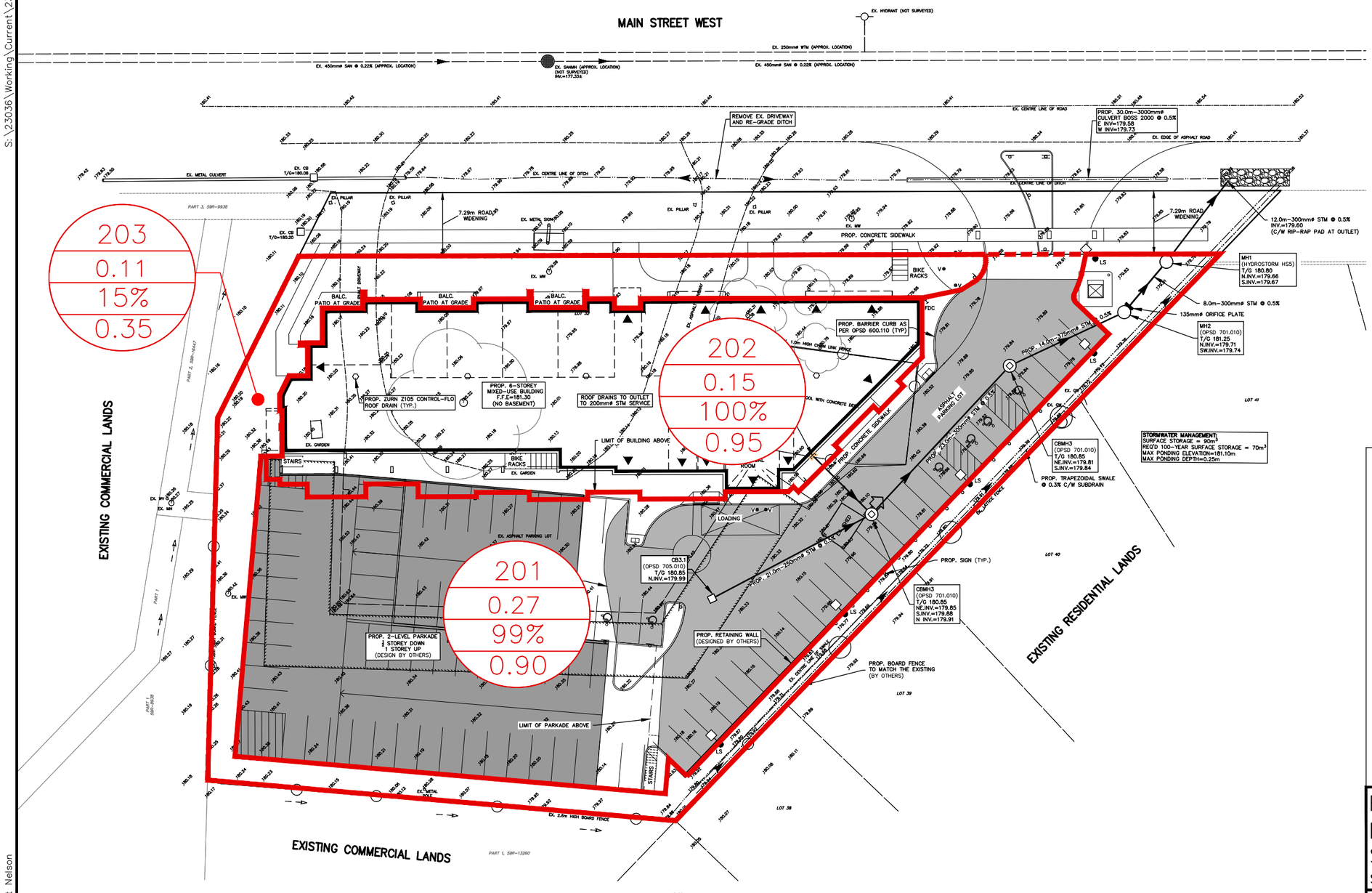

LEGEND

101	DRAINAGE AREA I.D.
1.67	DRAINAGE AREA (ha)
15%	PERCENT IMPERVIOUS
0.35	RUNOFF COEFFICIENT
	DRAINAGE AREA BOUNDARY

FIGURE 2.0
POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE: 1:500

PROJECT: 650 MAIN STREET WEST, PORT COLBORNE, ON
PROJECT No.: 23036

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CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type:	Orifice Plate
Diameter (mm)	**135**
Area (m^2)	0.01431
Invert Elev. (m)	179.66
C/L Elev. (m)	179.73
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	Additional Incremental Underground	Additional Incremental Surface m^3	Cumulative Volume m^3	Active Storage Volume m^3	H m	Discharge m^3/s
Top of Grade	180.85	0	0.0	0	0	0	1.123	0.0403
0.05m Ponding	180.90	43	0.0	1	1	1	1.173	0.0412
0.10m Ponding	180.95	174	0.0	5	6	6	1.223	0.0421
0.15m Ponding	181.00	387	0.0	14	21	21	1.273	0.0429
0.20m Ponding	181.05	677	0.0	27	47	47	1.323	0.0437
0.25m Ponding	181.10	1025	0.0	43	90	90	1.373	0.0446

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:	**Welland**	
Return Period:	**2**	Years
A =	**766.000**	
B =	**0.789**	
C=	**8.000**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) = **0.27** (Catchment 201)

Composite Runoff Coeff. (C) = **0.9** (Post development "C")

Release Rate - Q_{ALLOW} (m^3/s) = **0.0446** (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	101.234	0.0000281	0.068	0.0114	0.0797	23.92	20.07	3.85
10	600	78.310	0.0000218	0.053	0.0114	0.0643	38.56	26.76	11.80
15	900	64.539	0.0000179	0.044	0.0114	0.0550	49.47	33.45	16.02
20	1200	55.261	0.0000154	0.037	0.0114	0.0487	58.44	40.14	18.30
25	1500	48.542	0.0000135	0.033	0.0114	0.0442	66.25	46.83	19.42
30	1800	43.429	0.0000121	0.029	0.0114	0.0407	73.29	53.52	19.77
35	2100	39.393	0.0000109	0.027	0.0114	0.0380	79.78	60.21	19.57
40	2400	36.118	0.0000100	0.024	0.0114	0.0358	85.87	66.90	18.97
45	2700	33.402	0.0000093	0.023	0.0114	0.0339	91.66	73.59	18.07
50	3000	31.109	0.0000086	0.021	0.0114	0.0324	97.20	80.28	16.92
55	3300	29.144	0.0000081	0.020	0.0114	0.0311	102.54	86.97	15.57
60	3600	27.440	0.0000076	0.019	0.0114	0.0299	107.72	93.66	14.06
65	3900	25.946	0.0000072	0.018	0.0114	0.0289	112.76	100.35	12.41
70	4200	24.624	0.0000068	0.017	0.0114	0.0280	117.69	107.04	10.65
75	4500	23.446	0.0000065	0.016	0.0114	0.0272	122.52	113.73	8.79
80	4800	22.389	0.0000062	0.015	0.0114	0.0265	127.26	120.42	6.84
85	5100	21.434	0.0000060	0.014	0.0114	0.0259	131.93	127.11	4.82
90	5400	20.566	0.0000057	0.014	0.0114	0.0253	136.52	133.80	2.72
95	5700	19.774	0.0000055	0.013	0.0114	0.0247	141.06	140.49	0.57
100	6000	19.048	0.0000053	0.013	0.0114	0.0243	145.55	147.18	-1.63
105	6300	18.380	0.0000051	0.012	0.0114	0.0238	149.98	153.87	-3.89
110	6600	17.763	0.0000049	0.012	0.0114	0.0234	154.37	160.56	-6.19
115	6900	17.191	0.0000048	0.012	0.0114	0.0230	158.73	167.25	-8.52
120	7200	16.659	0.0000046	0.011	0.0114	0.0226	163.04	173.94	-10.90

Max. required storage volume = **19.77 m^3**

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

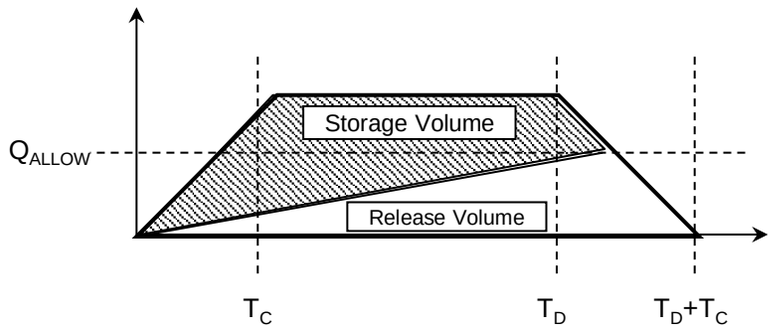
Runoff Volume = Area under trapezoidal hydrograph

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

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:	**Welland**	
Return Period:	**5**	Years
A =	**830.000**	
B =	**0.777**	
C=	**7.300**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) = **0.27** (Catchment 201)

Composite Runoff Coeff. (C) = **0.9** (Post development "C")

Release Rate - Q_{ALLOW} (m^3/s) = **0.0446** (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	118.092	0.0000328	0.080	0.0114	0.0911	27.33	20.07	7.26
10	600	90.598	0.0000252	0.061	0.0114	0.0726	43.53	26.76	16.77
15	900	74.378	0.0000207	0.050	0.0114	0.0616	55.44	33.45	21.99
20	1200	63.559	0.0000177	0.043	0.0114	0.0543	65.16	40.14	25.02
25	1500	55.773	0.0000155	0.038	0.0114	0.0490	73.57	46.83	26.74
30	1800	49.872	0.0000139	0.034	0.0114	0.0451	81.11	53.52	27.59
35	2100	45.228	0.0000126	0.031	0.0114	0.0419	88.05	60.21	27.84
40	2400	41.468	0.0000115	0.028	0.0114	0.0394	94.54	66.90	27.64
45	2700	38.353	0.0000107	0.026	0.0114	0.0373	100.68	73.59	27.09
50	3000	35.727	0.0000099	0.024	0.0114	0.0355	106.55	80.28	26.27
55	3300	33.478	0.0000093	0.023	0.0114	0.0340	112.19	86.97	25.22
60	3600	31.529	0.0000088	0.021	0.0114	0.0327	117.66	93.66	24.00
65	3900	29.821	0.0000083	0.020	0.0114	0.0315	122.96	100.35	22.61
70	4200	28.311	0.0000079	0.019	0.0114	0.0305	128.14	107.04	21.10
75	4500	26.966	0.0000075	0.018	0.0114	0.0296	133.21	113.73	19.48
80	4800	25.758	0.0000072	0.017	0.0114	0.0288	138.18	120.42	17.76
85	5100	24.667	0.0000069	0.017	0.0114	0.0281	143.06	127.11	15.95
90	5400	23.676	0.0000066	0.016	0.0114	0.0274	147.86	133.80	14.06
95	5700	22.772	0.0000063	0.015	0.0114	0.0268	152.60	140.49	12.11
100	6000	21.943	0.0000061	0.015	0.0114	0.0262	157.27	147.18	10.09
105	6300	21.180	0.0000059	0.014	0.0114	0.0257	161.89	153.87	8.02
110	6600	20.475	0.0000057	0.014	0.0114	0.0252	166.46	160.56	5.90
115	6900	19.822	0.0000055	0.013	0.0114	0.0248	170.98	167.25	3.73
120	7200	19.214	0.0000053	0.013	0.0114	0.0244	175.46	173.94	1.52

Max. required storage volume = **27.84 m^3**

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

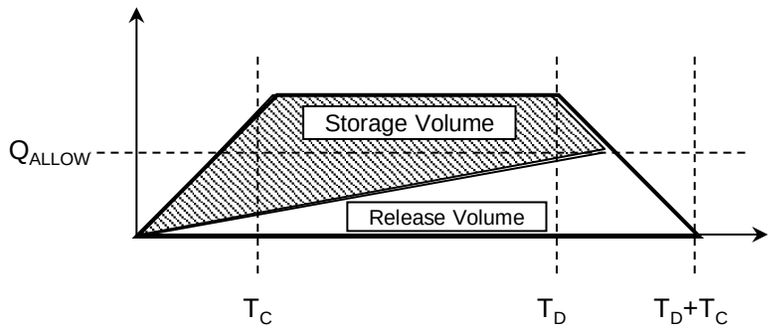
Runoff Volume = Area under trapezoidal hydrograph

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

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:	**Welland**	
Return Period:	**10**	Years
A =	**860.000**	
B =	**0.763**	
C=	**6.500**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) = **0.27** (Catchment 201)

Composite Runoff Coeff. (C) = **0.9** (Post development "C")

Release Rate - Q_{ALLOW} (m^3/s) = **0.0446** (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	133.409	0.0000371	0.090	0.0114	0.1015	30.44	20.07	10.37
10	600	101.288	0.0000281	0.068	0.0114	0.0798	47.86	26.76	21.10
15	900	82.765	0.0000230	0.056	0.0114	0.0673	60.54	33.45	27.09
20	1200	70.561	0.0000196	0.048	0.0114	0.0590	70.83	40.14	30.69
25	1500	61.843	0.0000172	0.042	0.0114	0.0531	79.72	46.83	32.89
30	1800	55.267	0.0000154	0.037	0.0114	0.0487	87.67	53.52	34.15
35	2100	50.110	0.0000139	0.034	0.0114	0.0452	94.97	60.21	34.76
40	2400	45.944	0.0000128	0.031	0.0114	0.0424	101.79	66.90	34.89
45	2700	42.500	0.0000118	0.029	0.0114	0.0401	108.24	73.59	34.65
50	3000	39.599	0.0000110	0.027	0.0114	0.0381	114.39	80.28	34.11
55	3300	37.118	0.0000103	0.025	0.0114	0.0365	120.30	86.97	33.33
60	3600	34.969	0.0000097	0.024	0.0114	0.0350	126.02	93.66	32.36
65	3900	33.087	0.0000092	0.022	0.0114	0.0337	131.56	100.35	31.21
70	4200	31.424	0.0000087	0.021	0.0114	0.0326	136.97	107.04	29.93
75	4500	29.942	0.0000083	0.020	0.0114	0.0316	142.25	113.73	28.52
80	4800	28.612	0.0000079	0.019	0.0114	0.0307	147.42	120.42	27.00
85	5100	27.412	0.0000076	0.019	0.0114	0.0299	152.50	127.11	25.39
90	5400	26.321	0.0000073	0.018	0.0114	0.0292	157.50	133.80	23.70
95	5700	25.326	0.0000070	0.017	0.0114	0.0285	162.42	140.49	21.93
100	6000	24.414	0.0000068	0.016	0.0114	0.0279	167.27	147.18	20.09
105	6300	23.574	0.0000065	0.016	0.0114	0.0273	172.07	153.87	18.20
110	6600	22.798	0.0000063	0.015	0.0114	0.0268	176.80	160.56	16.24
115	6900	22.078	0.0000061	0.015	0.0114	0.0263	181.49	167.25	14.24
120	7200	21.409	0.0000059	0.014	0.0114	0.0259	186.13	173.94	12.19

Max. required storage volume = **34.89 m^3**

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

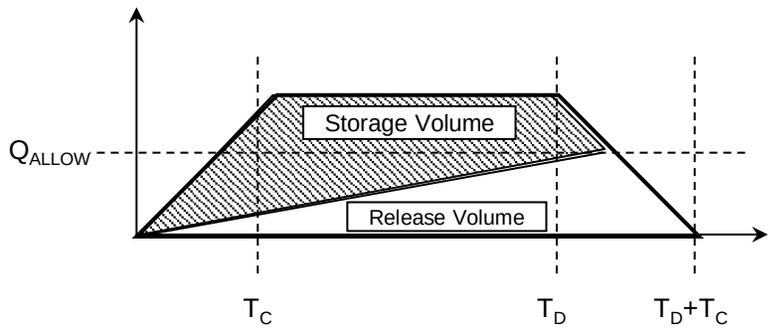
Runoff Volume = Area under trapezoidal hydrograph

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

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:	**Welland**	
Return Period:	**25**	Years
A =	**900.000**	
B =	**0.745**	
C=	**5.200**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) = **0.27** (Catchment 201)

Composite Runoff Coeff. (C) = **0.9** (Post development "C")

Release Rate - Q_{ALLOW} (m^3/s) = **0.0446** (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	159.527	0.0000443	0.108	0.0114	0.1191	35.72	20.07	15.65
10	600	118.514	0.0000329	0.080	0.0114	0.0914	54.84	26.76	28.08
15	900	95.886	0.0000266	0.065	0.0114	0.0761	68.51	33.45	35.06
20	1200	81.320	0.0000226	0.055	0.0114	0.0663	79.55	40.14	39.41
25	1500	71.062	0.0000197	0.048	0.0114	0.0594	89.05	46.83	42.22
30	1800	63.397	0.0000176	0.043	0.0114	0.0542	97.55	53.52	44.03
35	2100	57.424	0.0000160	0.039	0.0114	0.0502	105.34	60.21	45.13
40	2400	52.622	0.0000146	0.036	0.0114	0.0469	112.61	66.90	45.71
45	2700	48.665	0.0000135	0.033	0.0114	0.0442	119.47	73.59	45.88
50	3000	45.342	0.0000126	0.031	0.0114	0.0420	126.02	80.28	45.74
55	3300	42.505	0.0000118	0.029	0.0114	0.0401	132.30	86.97	45.33
60	3600	40.052	0.0000111	0.027	0.0114	0.0384	138.37	93.66	44.71
65	3900	37.907	0.0000105	0.026	0.0114	0.0370	144.25	100.35	43.90
70	4200	36.013	0.0000100	0.024	0.0114	0.0357	149.98	107.04	42.94
75	4500	34.327	0.0000095	0.023	0.0114	0.0346	155.57	113.73	41.84
80	4800	32.814	0.0000091	0.022	0.0114	0.0335	161.04	120.42	40.62
85	5100	31.449	0.0000087	0.021	0.0114	0.0326	166.40	127.11	39.29
90	5400	30.211	0.0000084	0.020	0.0114	0.0318	171.68	133.80	37.88
95	5700	29.080	0.0000081	0.020	0.0114	0.0310	176.87	140.49	36.38
100	6000	28.044	0.0000078	0.019	0.0114	0.0303	181.98	147.18	34.80
105	6300	27.091	0.0000075	0.018	0.0114	0.0297	187.02	153.87	33.15
110	6600	26.210	0.0000073	0.018	0.0114	0.0291	192.00	160.56	31.44
115	6900	25.393	0.0000071	0.017	0.0114	0.0285	196.93	167.25	29.68
120	7200	24.634	0.0000068	0.017	0.0114	0.0280	201.80	173.94	27.86

Max. required storage volume = **45.88 m^3**

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

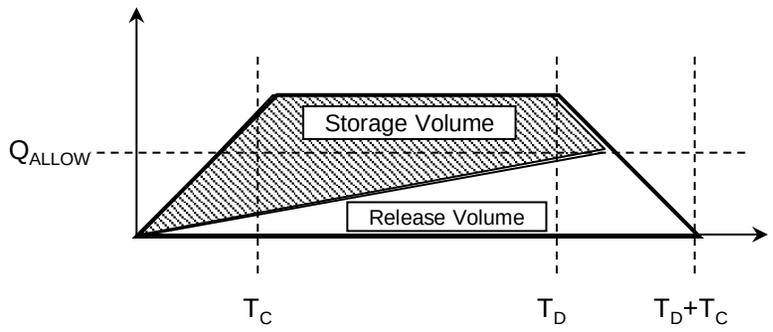
Runoff Volume = Area under trapezoidal hydrograph

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

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:	**Welland**	
Return Period:	**50**	Years
A =	**960.000**	
B =	**0.736**	
C=	**5.100**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) = **0.27** (Catchment 201)

Composite Runoff Coeff. (C) = **0.9** (Post development "C")

Release Rate - Q_{ALLOW} (m^3/s) = **0.0446** (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	175.021	0.0000486	0.118	0.0114	0.1295	38.86	20.07	18.79
10	600	130.180	0.0000362	0.088	0.0114	0.0993	59.56	26.76	32.80
15	900	105.468	0.0000293	0.071	0.0114	0.0826	74.33	33.45	40.88
20	1200	89.559	0.0000249	0.060	0.0114	0.0719	86.22	40.14	46.08
25	1500	78.351	0.0000218	0.053	0.0114	0.0643	96.43	46.83	49.60
30	1800	69.972	0.0000194	0.047	0.0114	0.0586	105.54	53.52	52.02
35	2100	63.439	0.0000176	0.043	0.0114	0.0542	113.86	60.21	53.65
40	2400	58.183	0.0000162	0.039	0.0114	0.0507	121.62	66.90	54.72
45	2700	53.851	0.0000150	0.036	0.0114	0.0477	128.92	73.59	55.33
50	3000	50.209	0.0000139	0.034	0.0114	0.0453	135.87	80.28	55.59
55	3300	47.100	0.0000131	0.032	0.0114	0.0432	142.53	86.97	55.56
60	3600	44.409	0.0000123	0.030	0.0114	0.0414	148.96	93.66	55.30
65	3900	42.055	0.0000117	0.028	0.0114	0.0398	155.17	100.35	54.82
70	4200	39.976	0.0000111	0.027	0.0114	0.0384	161.21	107.04	54.17
75	4500	38.124	0.0000106	0.026	0.0114	0.0371	167.10	113.73	53.37
80	4800	36.462	0.0000101	0.025	0.0114	0.0360	172.86	120.42	52.44
85	5100	34.962	0.0000097	0.024	0.0114	0.0350	178.50	127.11	51.39
90	5400	33.599	0.0000093	0.023	0.0114	0.0341	184.03	133.80	50.23
95	5700	32.356	0.0000090	0.022	0.0114	0.0332	189.47	140.49	48.98
100	6000	31.216	0.0000087	0.021	0.0114	0.0325	194.82	147.18	47.64
105	6300	30.166	0.0000084	0.020	0.0114	0.0318	200.10	153.87	46.23
110	6600	29.196	0.0000081	0.020	0.0114	0.0311	205.31	160.56	44.75
115	6900	28.296	0.0000079	0.019	0.0114	0.0305	210.45	167.25	43.20
120	7200	27.459	0.0000076	0.019	0.0114	0.0299	215.53	173.94	41.59

Max. required storage volume = **55.59 m^3**

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

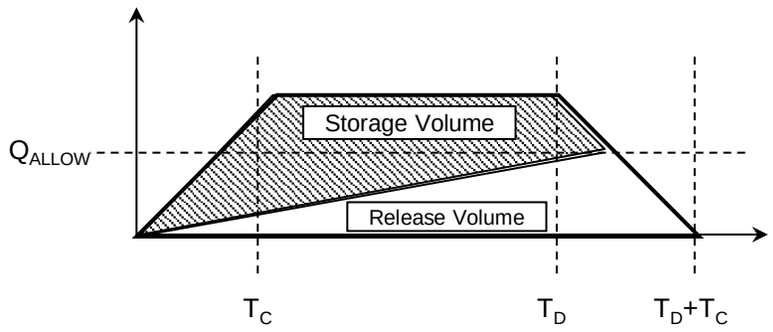
Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)\, Q_{ALLOW}$

Storage Volume = Runoff Volume - Release Volume



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:	**Welland**	
Return Period:	**100**	Years
A =	**1020.000**	
B =	**0.731**	
C=	**4.700**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) =	**0.27**	(Catchment 201)
Composite Runoff Coeff. (C) =	**0.9**	(Post development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0446**	(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	193.763	0.0000538	0.131	0.0114	0.1422	42.66	20.07	22.59
10	600	142.985	0.0000397	0.097	0.0114	0.1079	64.75	26.76	37.99
15	900	115.437	0.0000321	0.078	0.0114	0.0893	80.39	33.45	46.94
20	1200	97.845	0.0000272	0.066	0.0114	0.0774	92.93	40.14	52.79
25	1500	85.510	0.0000238	0.058	0.0114	0.0691	103.68	46.83	56.85
30	1800	76.317	0.0000212	0.052	0.0114	0.0629	113.24	53.52	59.72
35	2100	69.165	0.0000192	0.047	0.0114	0.0581	121.98	60.21	61.77
40	2400	63.420	0.0000176	0.043	0.0114	0.0542	130.10	66.90	63.20
45	2700	58.690	0.0000163	0.040	0.0114	0.0510	137.74	73.59	64.15
50	3000	54.718	0.0000152	0.037	0.0114	0.0483	145.00	80.28	64.72
55	3300	51.329	0.0000143	0.035	0.0114	0.0460	151.96	86.97	64.99
60	3600	48.398	0.0000134	0.033	0.0114	0.0441	158.65	93.66	64.99
65	3900	45.835	0.0000127	0.031	0.0114	0.0423	165.12	100.35	64.77
70	4200	43.572	0.0000121	0.029	0.0114	0.0408	171.41	107.04	64.37
75	4500	41.556	0.0000115	0.028	0.0114	0.0395	177.53	113.73	63.80
80	4800	39.748	0.0000110	0.027	0.0114	0.0382	183.50	120.42	63.08
85	5100	38.116	0.0000106	0.026	0.0114	0.0371	189.35	127.11	62.24
90	5400	36.634	0.0000102	0.025	0.0114	0.0361	195.09	133.80	61.29
95	5700	35.282	0.0000098	0.024	0.0114	0.0352	200.73	140.49	60.24
100	6000	34.042	0.0000095	0.023	0.0114	0.0344	206.27	147.18	59.09
105	6300	32.901	0.0000091	0.022	0.0114	0.0336	211.73	153.87	57.86
110	6600	31.846	0.0000088	0.021	0.0114	0.0329	217.12	160.56	56.56
115	6900	30.868	0.0000086	0.021	0.0114	0.0322	222.43	167.25	55.18
120	7200	29.959	0.0000083	0.020	0.0114	0.0316	227.68	173.94	53.74

Max. required storage volume = 64.99 m^3

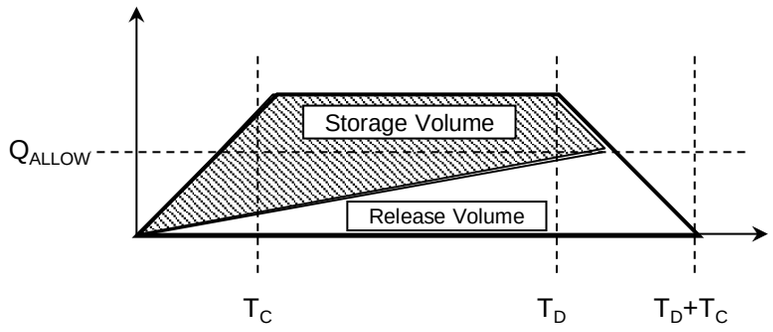
Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)\, Q_{ALLOW}$



S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS-ROOFTOP STORAGE

Type of Drain=Zurn105 (Canadian Market) Control-Flo Roof Drain

Discharge per Drain=5 Imperial gpm per 1" head (0.38l/s per 0.025m head)

Available Storage= (60% x Roof Area) x Depth Above Drain

Roof Area=1500m^2

Of Roof Drains=5

Table 1.0- Stage Storage Discharge (Catchment 201)		
5 Zurn Z105 Control-Flow Roof Drains		
Head Above Drain (m)	Available Storage (m^3)	Discharge (l/s)
0m	$0m^3$	0
0.05m	$45m^3$	3.8
0.075m	$68m^3$	5.7
0.10m	$90m^3$	7.6
0.15m	$135m^3$	11.4

100-Year Storm - Modified Rational Method

Stormwater Storage Volume (Rooftop)

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:	**Welland**	
Return Period:	**100**	Years
A =	**1020.000**	
B =	**0.731**	
C=	**4.700**	
Tc =	**10**	minutes
	600	seconds

Area of site being investigated (ha) =	**0.15**	(Roof Area)
Composite Runoff Coeff. (C) =	**0.95**	(Post development "C")
Release Rate - Q_{ALLOW} (m^3/s) =	**0.0114**	(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	193.763	0.0000538	0.077	0.0000	0.0767	23.01	5.13	17.88
10	600	142.985	0.0000397	0.057	0.0000	0.0566	33.96	6.84	27.12
15	900	115.437	0.0000321	0.046	0.0000	0.0457	41.12	8.55	32.57
20	1200	97.845	0.0000272	0.039	0.0000	0.0387	46.48	10.26	36.22
25	1500	85.510	0.0000238	0.034	0.0000	0.0338	50.77	11.97	38.80
30	1800	76.317	0.0000212	0.030	0.0000	0.0302	54.38	13.68	40.70
35	2100	69.165	0.0000192	0.027	0.0000	0.0274	57.49	15.39	42.10
40	2400	63.420	0.0000176	0.025	0.0000	0.0251	60.25	17.10	43.15
45	2700	58.690	0.0000163	0.023	0.0000	0.0232	62.72	18.81	43.91
50	3000	54.718	0.0000152	0.022	0.0000	0.0217	64.98	20.52	44.46
55	3300	51.329	0.0000143	0.020	0.0000	0.0203	67.05	22.23	44.82
60	3600	48.398	0.0000134	0.019	0.0000	0.0192	68.97	23.94	45.03
65	3900	45.835	0.0000127	0.018	0.0000	0.0181	70.76	25.65	45.11
70	4200	43.572	0.0000121	0.017	0.0000	0.0172	72.44	27.36	45.08
75	4500	41.556	0.0000115	0.016	0.0000	0.0164	74.02	29.07	44.95
80	4800	39.748	0.0000110	0.016	0.0000	0.0157	75.52	30.78	44.74
85	5100	38.116	0.0000106	0.015	0.0000	0.0151	76.95	32.49	44.46
90	5400	36.634	0.0000102	0.015	0.0000	0.0145	78.31	34.20	44.11
95	5700	35.282	0.0000098	0.014	0.0000	0.0140	79.61	35.91	43.70
100	6000	34.042	0.0000095	0.013	0.0000	0.0135	80.85	37.62	43.23
105	6300	32.901	0.0000091	0.013	0.0000	0.0130	82.05	39.33	42.72
110	6600	31.846	0.0000088	0.013	0.0000	0.0126	83.20	41.04	42.16
115	6900	30.868	0.0000086	0.012	0.0000	0.0122	84.31	42.75	41.56
120	7200	29.959	0.0000083	0.012	0.0000	0.0119	85.38	44.46	40.92

Max. required storage volume = 45.11 m^3

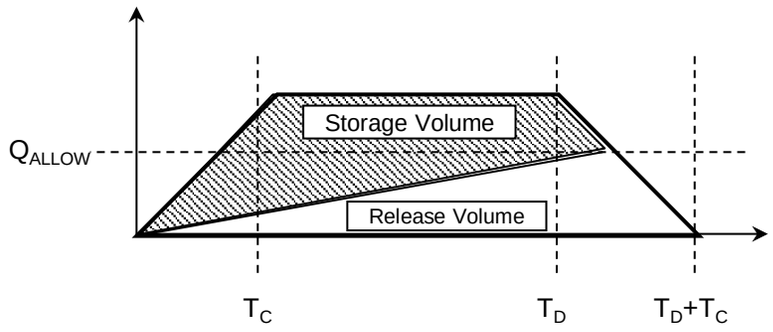
Q_{POST} = (C i A) x 10000 m^2/ha (Rational Method)

Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)\, Q_{ALLOW}$



APPENDIX B
STORMWATER QUALITY INFORMATION

Hydroworks Sizing Summary

650 Main Street West, Port Colborne

06-27-2023

Recommended Size: HydroStorm HS 5

A HydroStorm HS 5 is recommended to provide 60.0 % annual TSS removal based on a drainage area of 0.42 (ha) with an imperviousness of 99 % and St. Catherines A, Ontario rainfall for the ETV Canada particle size distribution.

The recommended HydroStorm HS 5 treats 99 % of the annual runoff and provides 61 % annual TSS removal for the St. Catherines A rainfall records and ETV Canada particle size distribution.

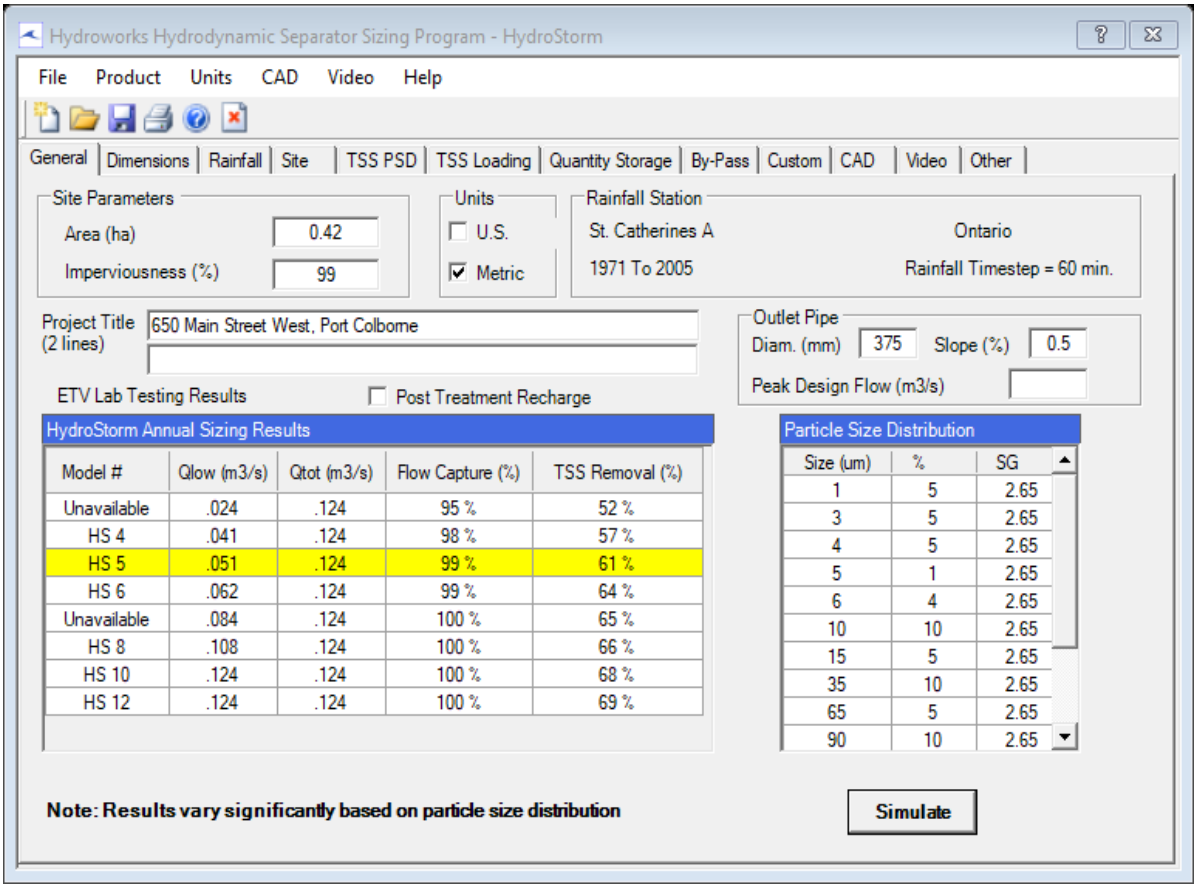
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .12 (m3/s) for the given 375 (mm) pipe diameter at .5% slope. The headloss was calculated to be 67 (mm) based on a flow depth of 375 (mm) (full pipe flow).

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.

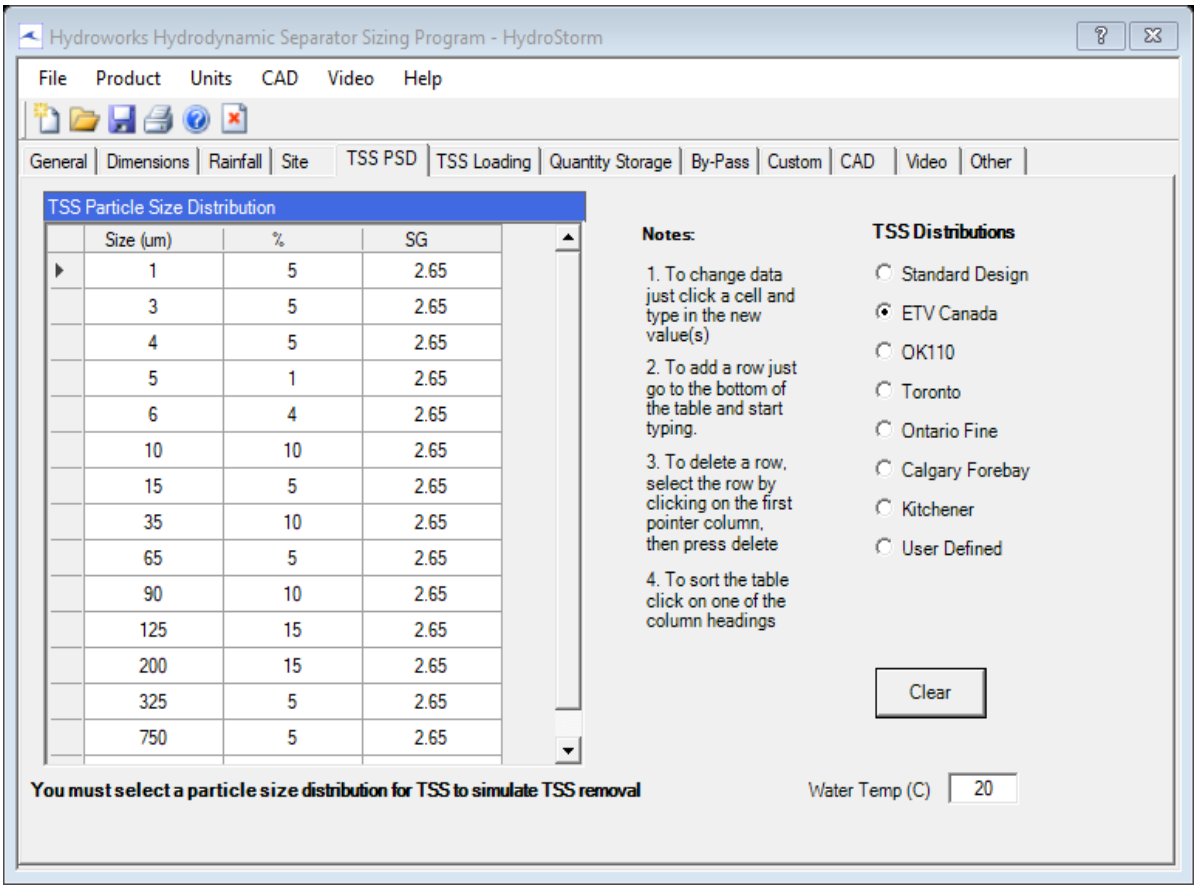
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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 .

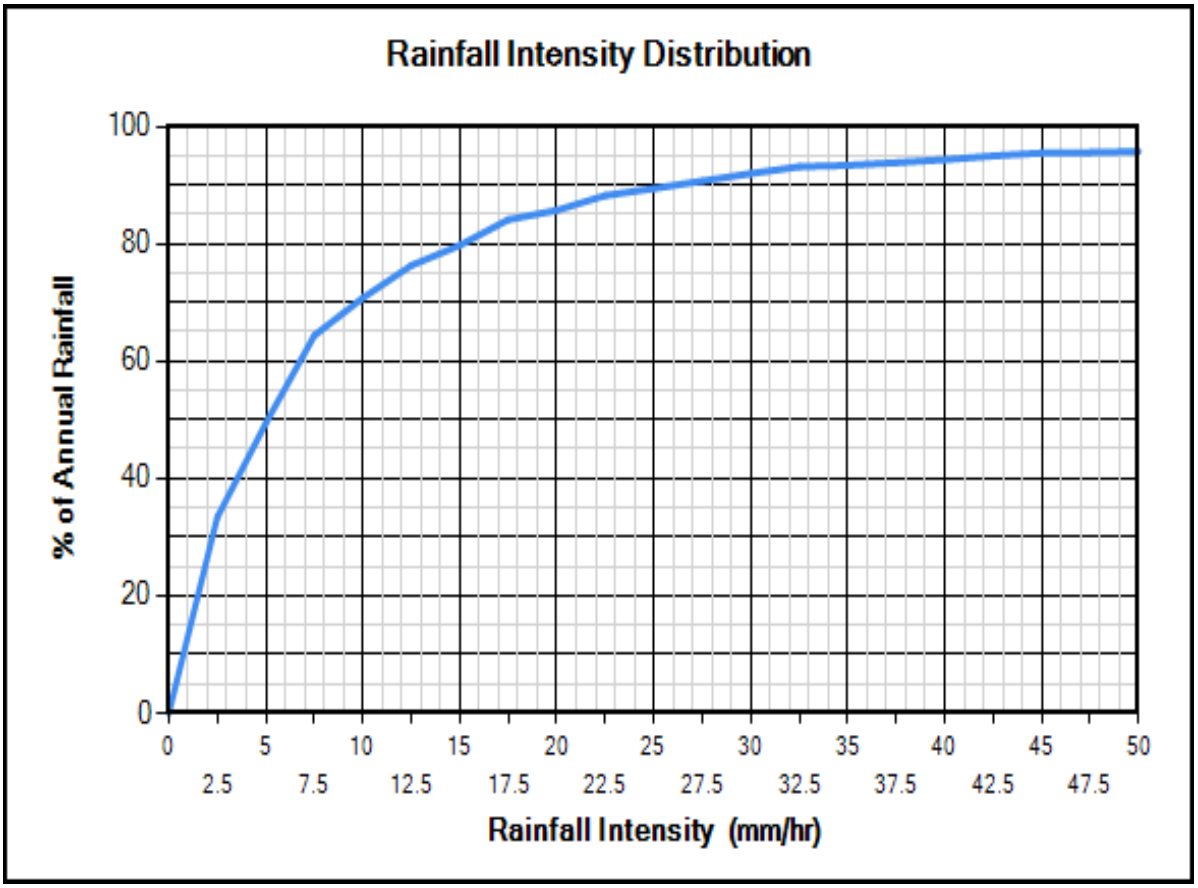
TSS Removal Sizing Summary



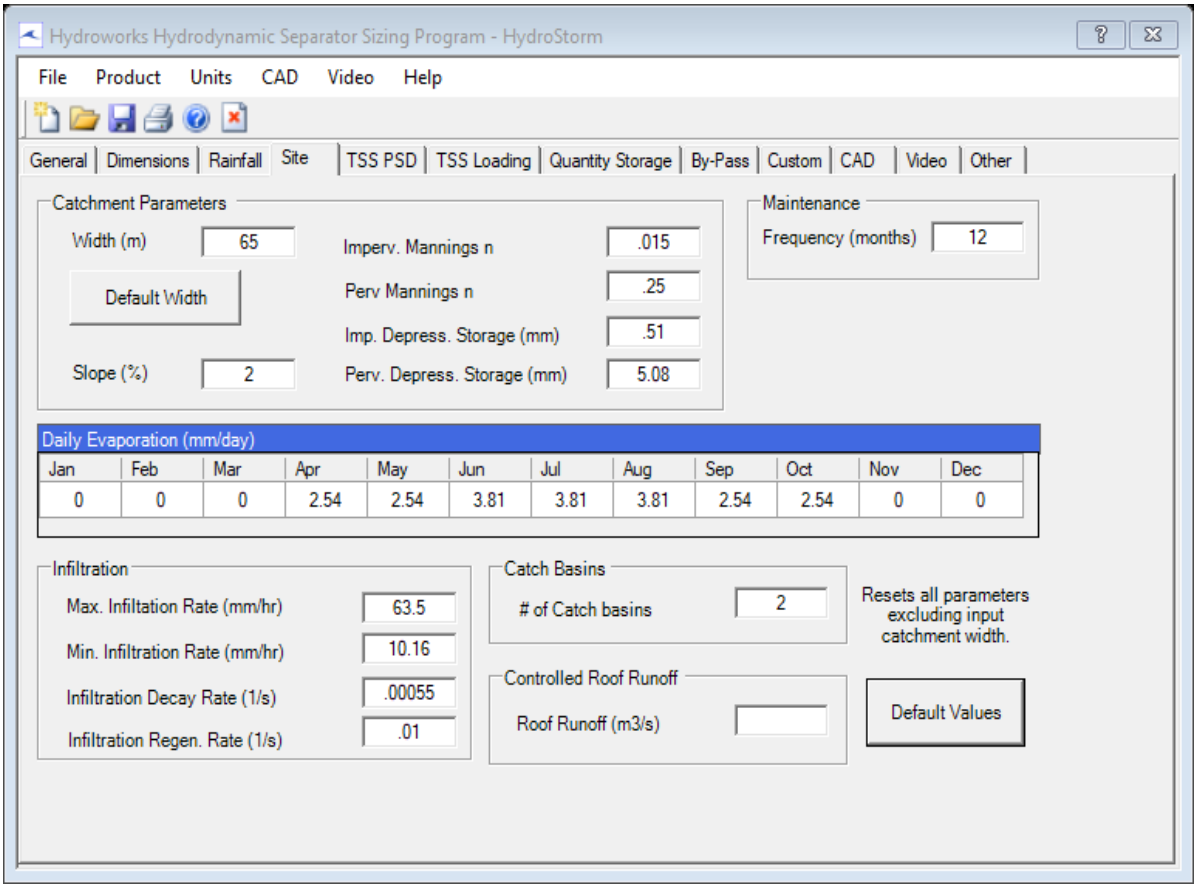
TSS Particle Size Distribution



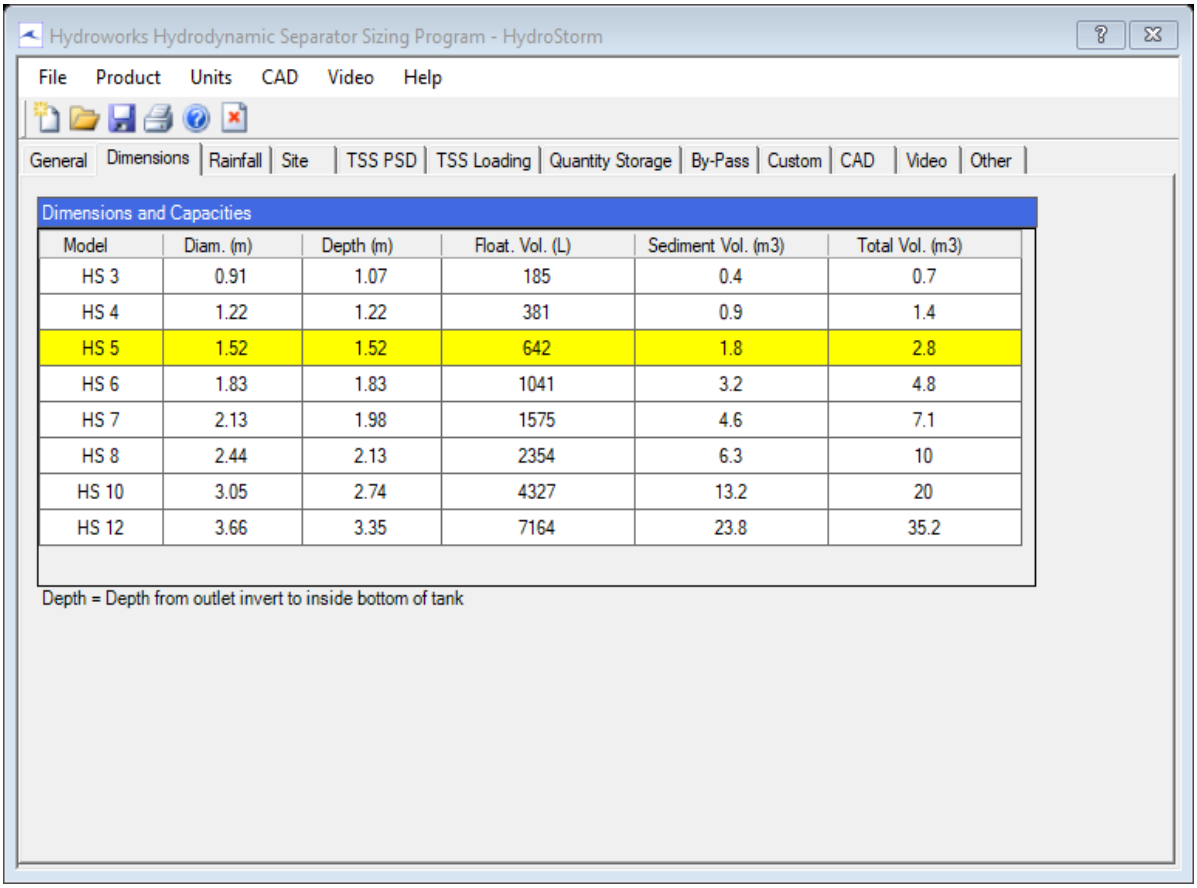
Rainfall Station - St. Catherines A, Ontario(1971 To 2005)



Site Physical Characteristics



Dimensions And Capacities

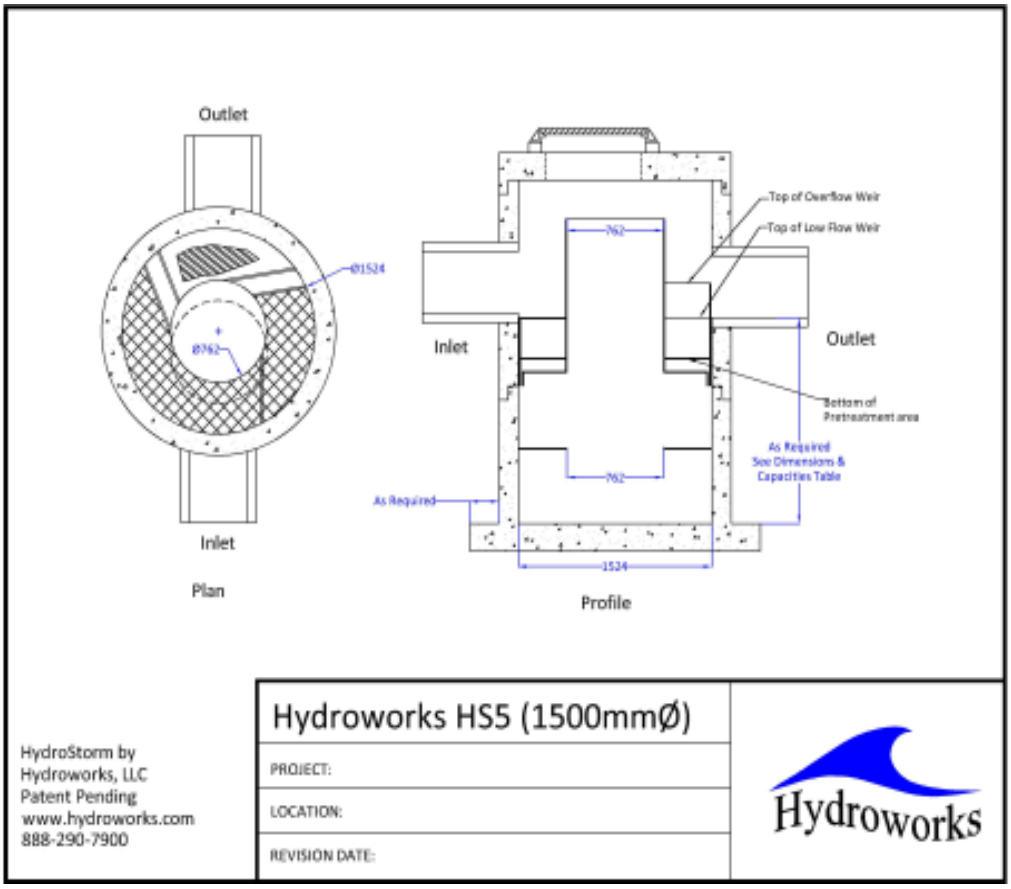


Dimensions and Capacities

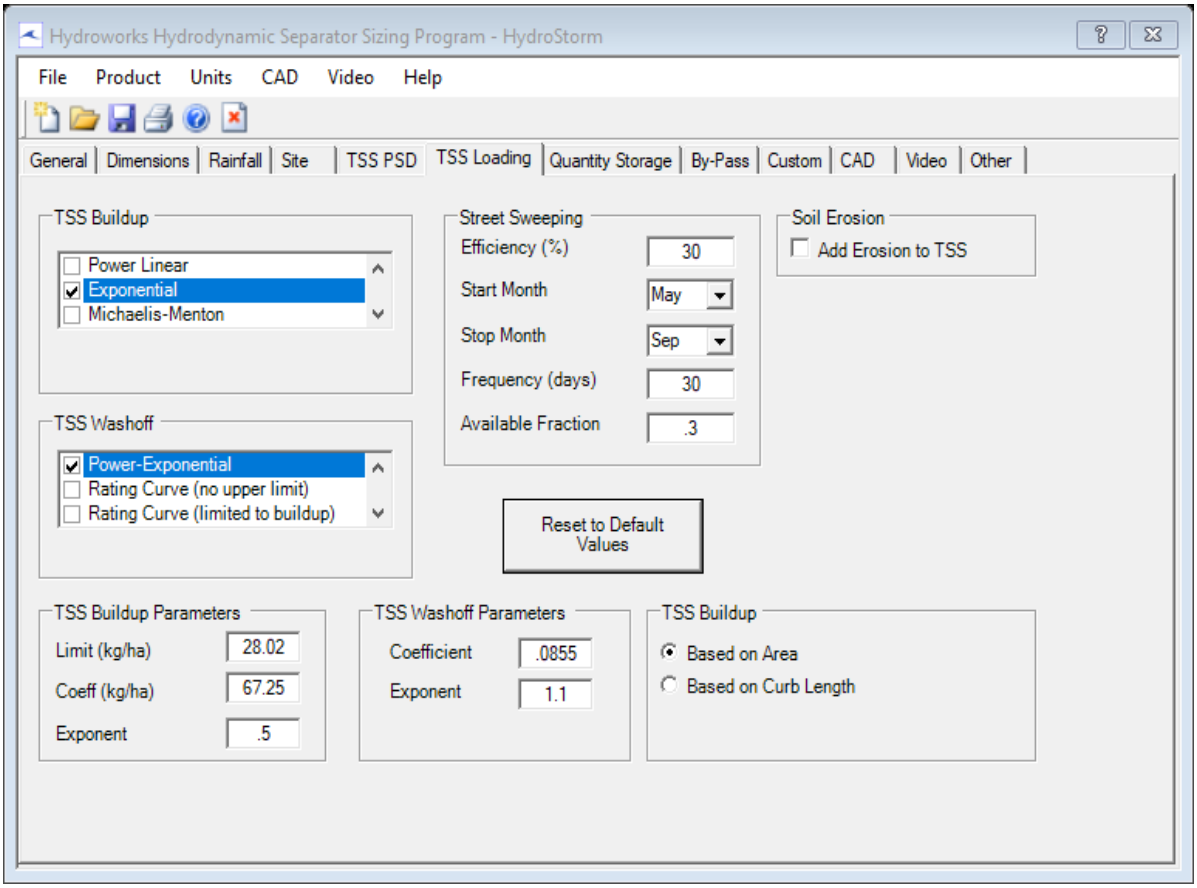
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

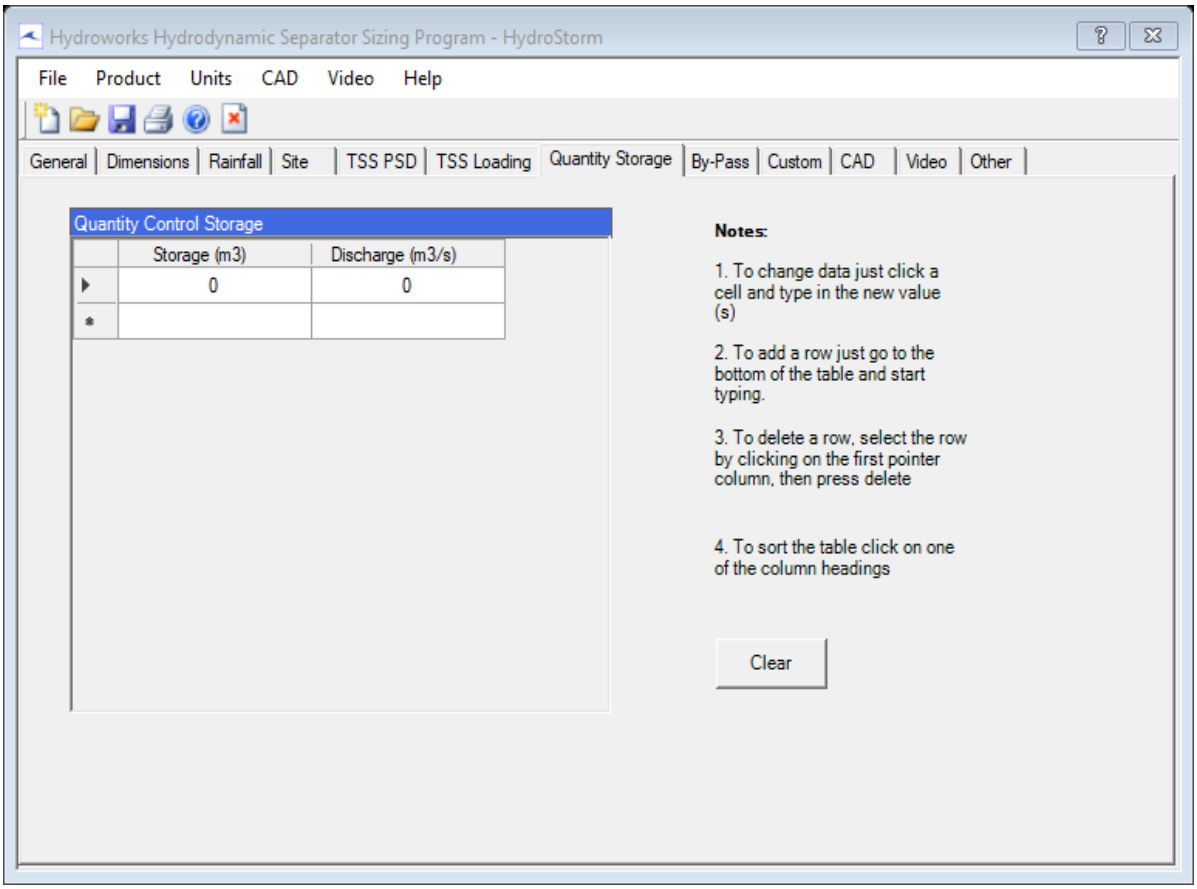
Generic HS 5 CAD Drawing



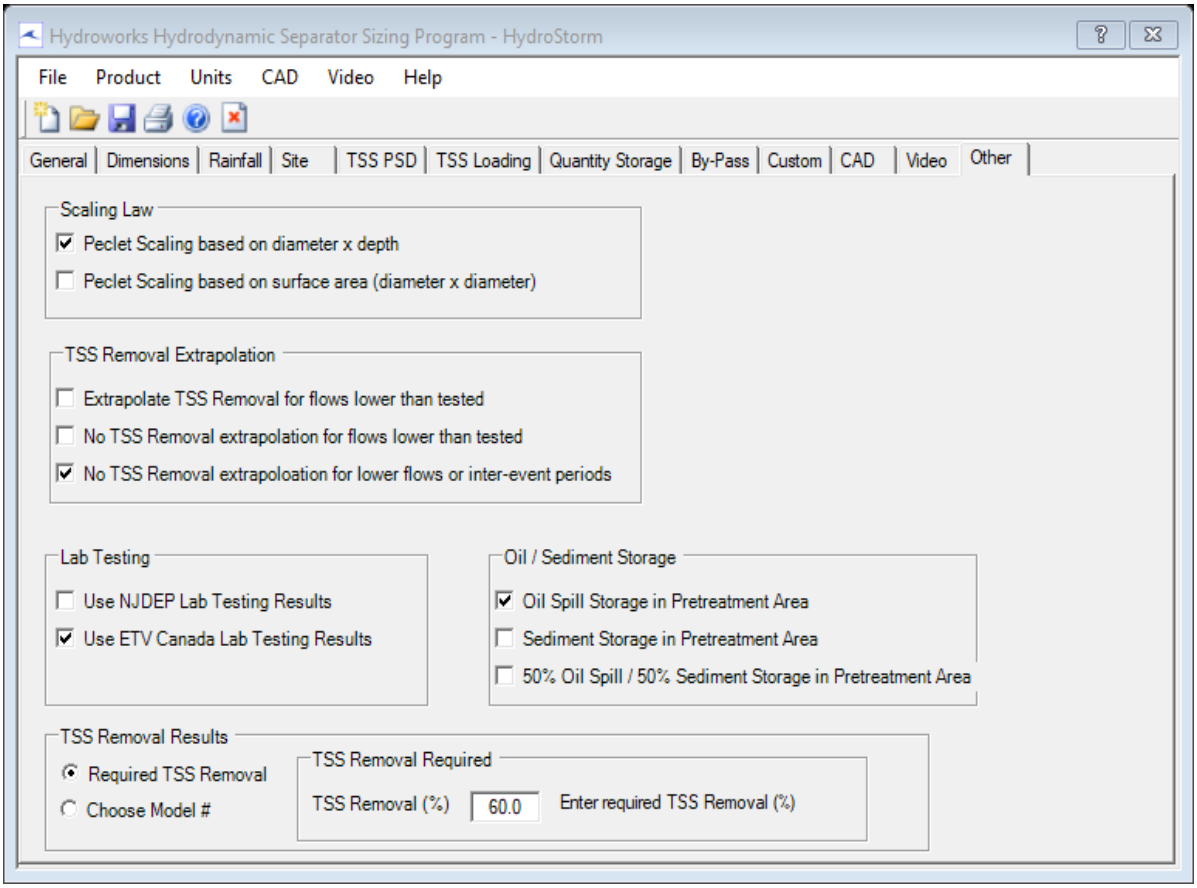
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.6
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1-800-290-7900
www.hydroworks.com

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.

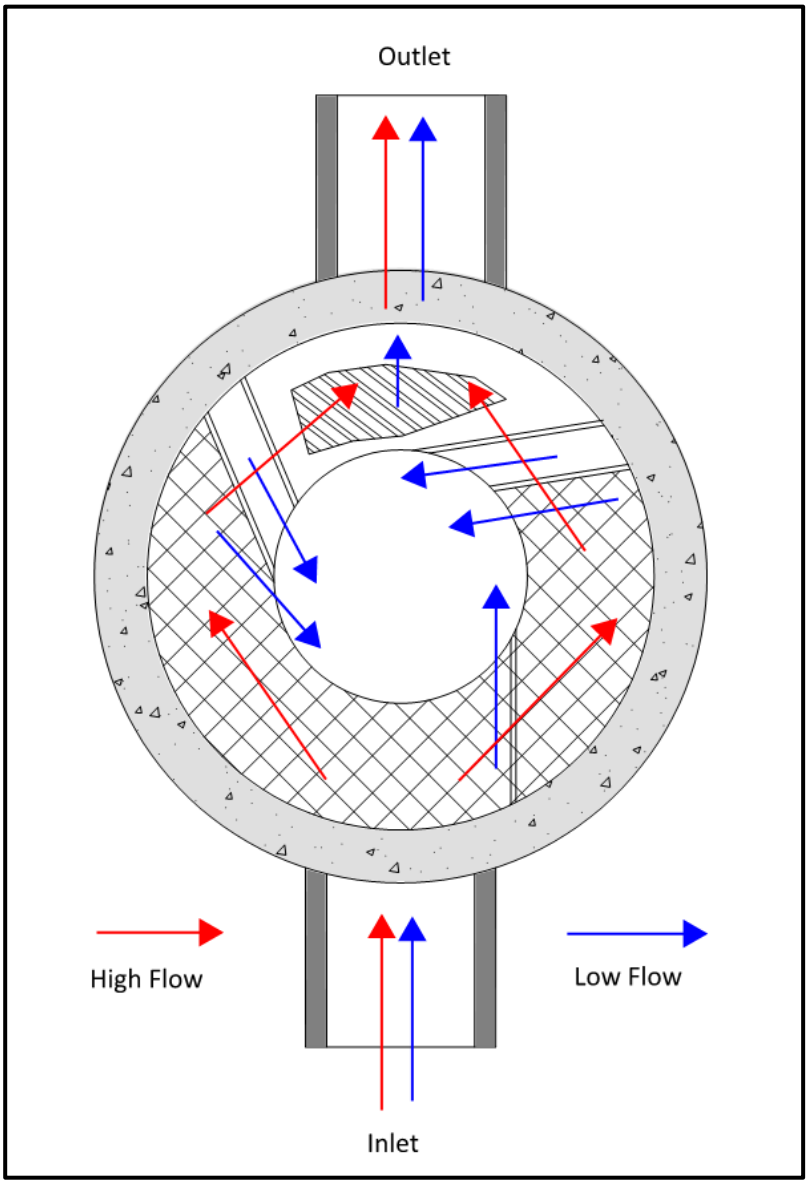


Figure 1. Hydroworks HydroStorm Operation – Plan View

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

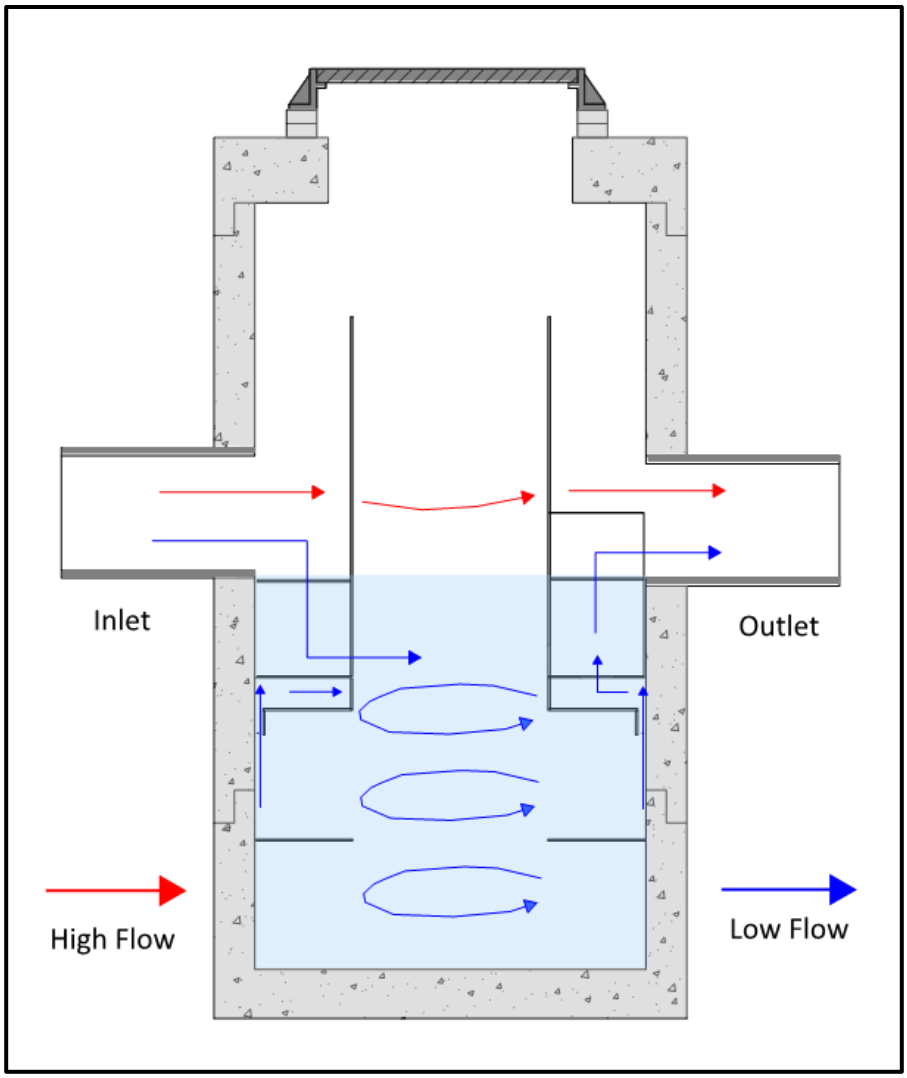


Figure 2. Hydroworks HydroStorm Operation – Profile View

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.

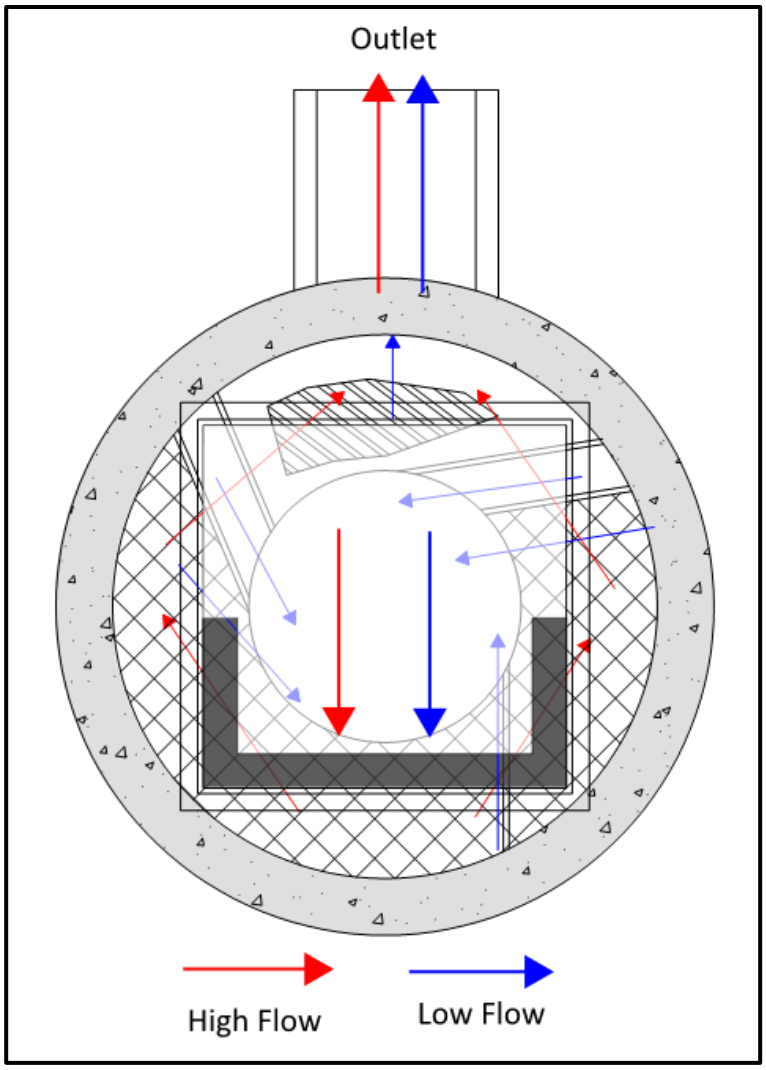


Figure 3. Hydroworks HS 4i Funnel

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).

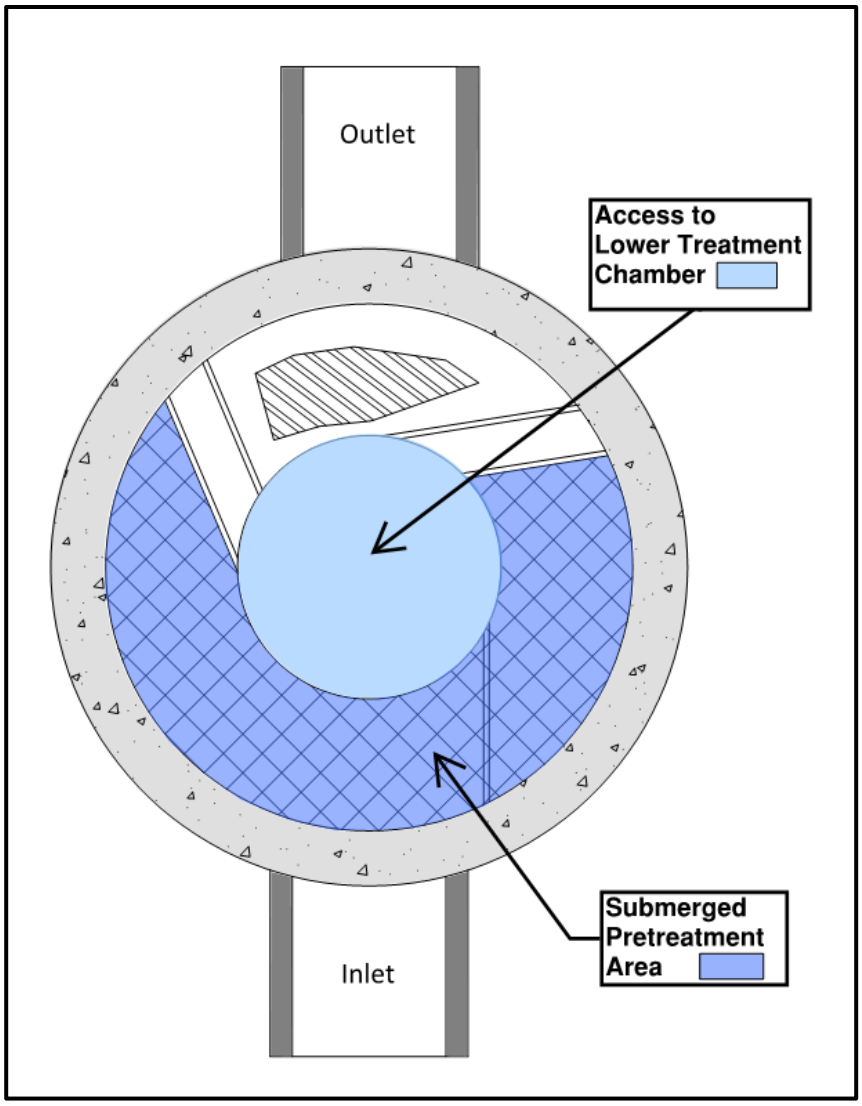


Figure 3. Maintenance Access

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

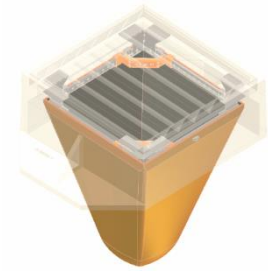
A subsidiary of **Advanced Drainage Systems (ADS)** www.ads-pipe.com

1.0 Description of Work:

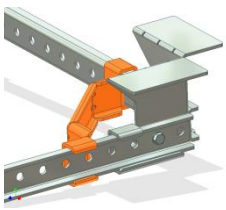
1.1 The work covered shall consist of supplying, installing, and maintaining/cleaning of the FLEXSTORM Inlet Filter assembly. The purpose of the FLEXSTORM Inlet Filter system is to collect silt and sediment from surface storm water runoff at drainage locations shown on the plans or as directed by the 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.

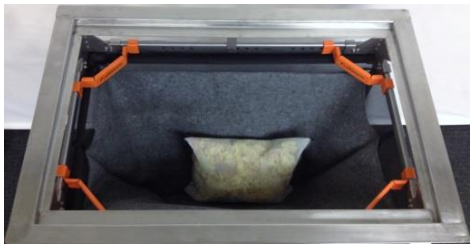



2.2 The FLEXSTORM Inlet Filter frame includes lifting handles in addition to the standard overflow feature. A FLEXSTORM Removal Tool engages the lifting bars or handles to allow manual removal of the assembly without machine assistance. The frame suspension system on most rectangular designs is adjustable 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):

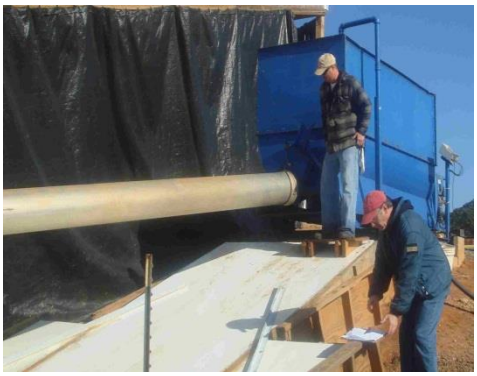
FLEXSTORM FILTER BAGS	(22" depth) STD Bag P/N	(12" depth) Short Bag P/N	Clean Water Flow Rate (GPM/SqFt)	Min A.O.S. (US Sieve)
FX: Standard Woven Bag	FX	FX-S	200	40
FX+: Woven w/ Oil Skimmer	FXP	FXP-S	200	40
FXO: Woven w/ Oil Boom	FXO	FXO-S	200	40
PC: Post Construction Bag	PC	PC-S	137	140
PC+: PC w/ 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§	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.

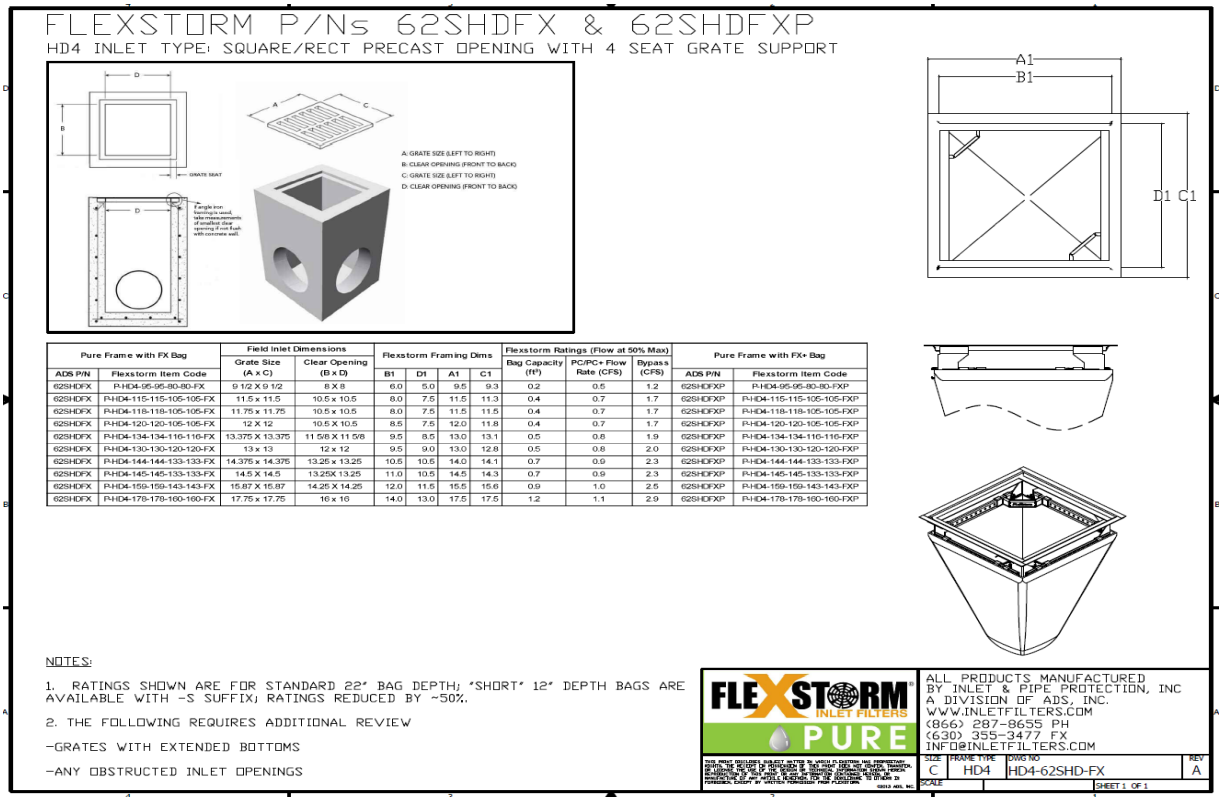
Product Tested	110 micron Sediment Load	Ave Flow Rate GPM	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	1750 mg/L using OK-110 Silica Sand and Clean Water	23	**99.28%**	98.96%
		48	**99.32%**	99.25%
		70	**98.89%**	98.80%

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.



Pure Frame with FX Bag		Field Inlet Dimensions		Flexstorm Framing Dims				Flexstorm Ratings (Flow at 50% Max)			Pure Frame with FX+ Bag	
		Grate Size (A x C)	Clear Opening (B x D)					Bag Capacity (ft³)	PC/PC+ Flow Rate (CFS)	Bypass (CFS)		
ADS P/N	Flexstorm Item Code			B1	D1	A1	C1				ADS P/N	Flexstorm Item Code
62SHDFX	P-HD4-95-95-80-80-FX	9 1/2 X 9 1/2	8 X 8	6.0	5.0	9.5	9.3	0.2	0.5	1.2	62SHDFXP	P-HD4-95-95-80-80-FXP
62SHDFX	P-HD4-115-115-105-105-FX	11.5 x 11.5	10.5 x 10.5	8.0	7.5	11.5	11.3	0.4	0.7	1.7	62SHDFXP	P-HD4-115-115-105-105-FXP
62SHDFX	P-HD4-118-118-105-105-FX	11.75 x 11.75	10.5 x 10.5	8.0	7.5	11.5	11.5	0.4	0.7	1.7	62SHDFXP	P-HD4-118-118-105-105-FXP
62SHDFX	P-HD4-120-120-105-105-FX	12 X 12	10.5 X 10.5	8.5	7.5	12.0	11.8	0.4	0.7	1.7	62SHDFXP	P-HD4-120-120-105-105-FXP
62SHDFX	P-HD4-134-134-116-116-FX	13.375 X 13.375	11 5/8 X 11 5/8	9.5	8.5	13.0	13.1	0.5	0.8	1.9	62SHDFXP	P-HD4-134-134-116-116-FXP
62SHDFX	P-HD4-130-130-120-120-FX	13 x 13	12 x 12	9.5	9.0	13.0	12.8	0.5	0.8	2.0	62SHDFXP	P-HD4-130-130-120-120-FXP
62SHDFX	P-HD4-144-144-133-133-FX	14.375 x 14.375	13.25 x 13.25	10.5	10.5	14.0	14.1	0.7	0.9	2.3	62SHDFXP	P-HD4-144-144-133-133-FXP
62SHDFX	P-HD4-145-145-133-133-FX	14.5 X 14.5	13.25X 13.25	11.0	10.5	14.5	14.3	0.7	0.9	2.3	62SHDFXP	P-HD4-145-145-133-133-FXP
62SHDFX	P-HD4-159-159-143-143-FX	15.87 X 15.87	14.25 X 14.25	12.0	11.5	15.5	15.6	0.9	1.0	2.5	62SHDFXP	P-HD4-159-159-143-143-FXP
62SHDFX	P-HD4-178-178-160-160-FX	17.75 x 17.75	16 x 16	14.0	13.0	17.5	17.5	1.2	1.1	2.9	62SHDFXP	P-HD4-178-178-160-160-FXP

6.0 Installation Into Standard Grated Drainage Structures:

6.1 Remove the grate from the casting or concrete drainage structure. Clean the ledge (lip) of the casting frame or drainage structure to ensure it is free of stone and dirt. Drop in the FLEXSTORM Inlet Filter through the clear opening and be sure the suspension hangers rest firmly on the inside ledge (lip) of the casting. Replace the grate and confirm it is elevated no more than 1/8", which is the thickness of the steel hangers. For Curb Box Inlet Filters: Insert FLEXSTORM CATCH IT Inlet Filter as described above, pull the rear curb guard flap up and over the open curb box until tight, align magnets to ensure firm attachment to the top portion of the curb box casting. If the curb back opening is not magnetic, slide a typical rock sack or 2 x 4 through the 2-ply rear curb box flap to create a dam which will direct runoff into the sediment bag.




7.0 Maintenance Guidelines: The frequency of maintenance will vary depending on the application (during construction, post construction, or industrial use), the area of installation (relative to grade and runoff exposure), and the time of year relative to the geographic location (infrequent rain, year round rain, rain and snow conditions). The FLEXSTORM Operation & Maintenance Plan (as shown in 7.5) or other maintenance log should be kept on file.

7.1 Frequency of Inspections: Construction site inspection should occur following each ½" or more rain event. Post Construction inspections should occur three times per year (every four months) in areas with year round rainfall and three times per year (every three months) in areas with rainy seasons before and after snowfall season. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than three times per year.

7.2 General Maintenance for standard sediment bags: Upon inspection, the FLEXSTORM Inlet Filter should be emptied if the sediment bag is more than half filled with sediment and debris, or as directed by the Engineer. Remove the grate, engage the lifting bars or handles with the FLEXSTORM Removal Tool, and lift the FLEXSTORM Inlet Filter from the drainage structure. Machine assistance is not required. Dispose of the sediment or debris as directed by the Engineer. As an alternative, an industrial vacuum may be used to collect the accumulated sediment if available. Remove any caked on silt from the sediment bag and reverse flush the bag for optimal filtration. Replace the bag if the geotextile is torn or punctured to ½" diameter or greater on the lower half of the bag. If properly maintained, the Woven sediment bag will last a minimum of 4 years in the field.

7.3 Inspection and Handling of the FLEXSTORM PC / PC+ post construction sediment bag: The PC+ sediment bags will collect oil until saturated. Both the Adsorb-it filter liner and the skimmer pouch will retain oil. The volume of oils retained will depend on sediment bag size. Unlike other passive oil sorbent products, Adsorb-it filter fabric has the ability to remove hydrocarbons at high flow rates while retaining 10- 20 times its weight in oil (weight of fabric is 12.8 oz / sq yd). The average 2' x 2' PC Bag contains approx .8 sq yds, or 10 oz of fabric. At 50% saturation, the average Adsorb-it lined PC filter will retain approximately 75 oz (4.2 lbs) of oil. Once the bag has become saturated with oils, it can be centrifuged or passed through a wringer to recover the oils, and the fabric reused with 85% to 90% efficacy. If it is determined, per Maintenance Contracts or Engineering Instructions, that the saturated PC sediment bags will be completely replaced, it is the responsibility of the service technician to place the filter medium and associated debris in an approved container and dispose of in accordance with EPA regulations. Spent Adsorb-it can be recycled for its fuel value through waste to energy incineration with a higher BTU per pound value than coal. The oil skimmers start white in color and will gradually turn brown/black as they become saturated, indicating time for replacement. The average skimmer pouch will absorb approximately 62 oz (4 lbs) of oil before requiring replacement. To remove the pouch simply unclip it from the swivel strap sewn to the bottom of the bag. Dispose of all oil contaminated products in accordance to EPA guidelines. The ClearTec Rubberizer media used in the pouch, since a solidifier, will not leach under pressure and can be disposed of in most landfills, recycled for industrial applications, or burned as fuel.

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:

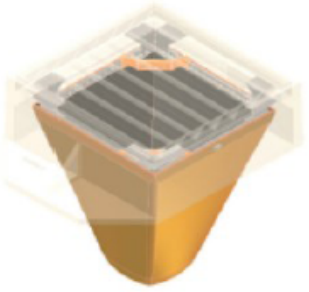
1. Empty the sediment bag if more than half filled with sediment and debris, or as directed.
2. Remove the grate, engage the lifting bars with the FLEXSTORM Removal Tool, and lift from drainage structure.
3. Dispose of sediment or debris as directed by the Engineer or Maintenance contract.
4. An industrial 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.

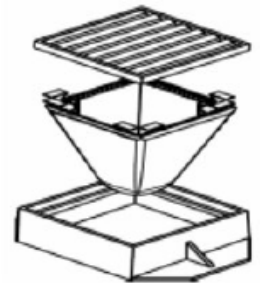
Post Construction PC Bag Maintenance:

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
FIRE FLOW CALCULATIONS

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

Project Number: **23036**
Project Name: **650 Main Street West**
Date: **Jun-23**

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)**
6-Storey Building	**6222.0**	**1**	**6222**	**0.8**	14000	233.3	**-15**	-2100.0	**11900.0**	**-50**	-5950.0	20	2380.0	**8000**	**133**

(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%.

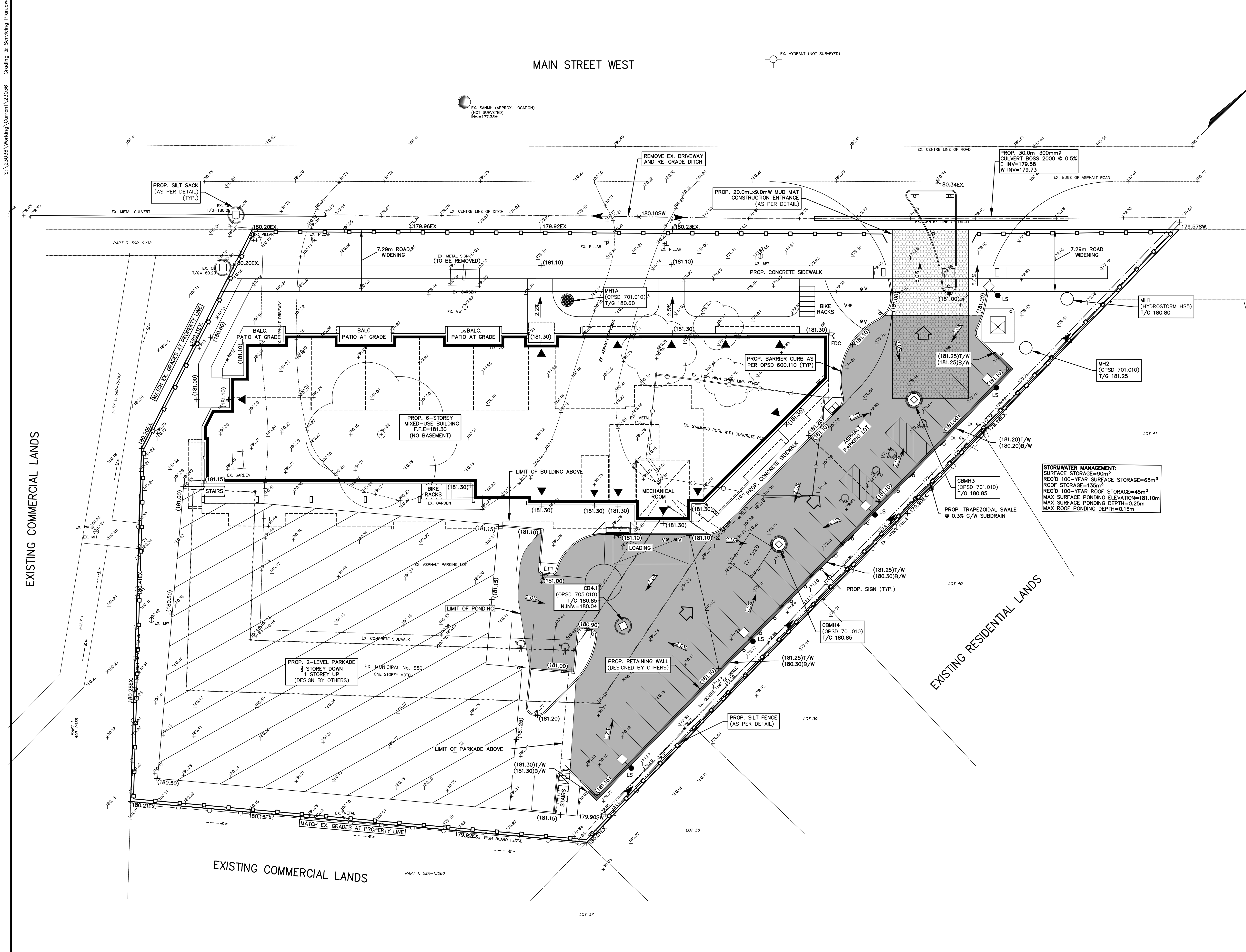
If the sprinkler system is fully supervised (ie. annunciator panel that alerts the Fire Dept., such as a school), then an additional 10% can be taken. Maximum credit = 50%.

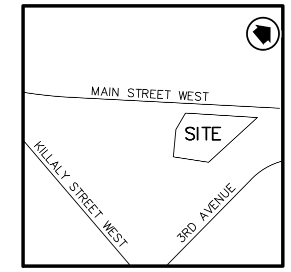
(4) Exposure

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 =	**> 30m**	**0**
East =	**20.1 to 30m**	**10**
West =	**20.1 to 30m**	**10**
Total Exposure =		***20***

APPENDIX D
ENGINEERING PLANS





KEY MAP
N.T.S.

LEGEND:

- EXISTING GROUND ELEVATION
- PROPOSED GROUND ELEVATION
- PROPOSED ELEVATION TO MATCH EXISTING
- PROPOSED DIRECTION OF SHEET FLOW
- EXISTING CATCHBASIN
- EXISTING STORM/SANITARY MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED STORM/SANITARY MANHOLE
- PROPOSED CURB STOP/GATE VALVE
- EMERGENCY OVERLAND FLOW ROUTE
- PROPOSED DRAINAGE BREAK LINE
- PROPOSED SILTATION CONTROL FENCE
- PROPOSED CATCHBASIN SILT SACK

BENCH MARK NOTE:
379-69: ONE STOREY RED BRICK HOUSE SITUATED ON THE S.W. CORNER OF FIRST AVE AND THIRD AVE IN THE CITY OF PORT CORBORNE, 1.3 KM WEST OF JCT OF HWY 3 (MAIN ST) AND ELM ST, 0.3 KM WEST OF JCT OF HWYS 3 AND 58, AND 93.6 M SOUTH OF CENTRELINE OF HWY 3. TABLET IS SET HORIZONTALLY IN NORTH FACE OF CONCRETE FOUNDATION, 2.44 M WEST OF N.E. CORNER AND 73 CM BELOW BRICKWORK.

NO.	DATE	BY	REVISIONS

NOTES TO CONTRACTOR:
1. CONTRACTORS AND SUBCONTRACTORS SHALL NOT SCALE FROM THIS DRAWING.
2. ANY INCONSISTENCIES AND OMISSIONS FOUND ON THE DRAWINGS MUST BE REPORTED TO THE ENGINEER FOR CLARIFICATION BEFORE COMMENCING THE WORK.
3. PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS AND ELEVATIONS AND REPORT ALL FINDINGS TO THE ENGINEER. ONCE CONSTRUCTION HAS COMMENCED, THE CONTRACTOR ACCEPTS RESPONSIBILITY FOR ALL DIMENSIONS, ELEVATIONS, AND SITE CONDITIONS.
4. THE POSITIONS OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVER-GROUND UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE DRAWINGS. WHERE SHOWN ON THE DRAWING, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM THEMSELVES OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
5. ALL DRAWINGS REMAIN THE PROPERTY OF THE ENGINEER AND SHALL NOT BE REPRODUCED, REUSED, OR REVISED WITHOUT THE WRITTEN CONSENT OF S. LLEWELLYN AND ASSOCIATES LIMITED.

DESIGN	MT	CHK'D	SN	DATE
DRAWN	MT	CHK'D	SN	Jun. 29, 23

SCALE 1:200 (0, 5, 10, 20)

APPROVALS

STAMP

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS
Tel. (905) 631-6978
Website: www.sla.on.ca
email: info@sla.on.ca
3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

CLIENT
M5V 650 MAIN LP

PROJECT NAME
650 MAIN STREET WEST
PORT COLBORNE, ON

TITLE
PRELIMINARY GRADING AND EROSION CONTROL PLAN

PROJECT No.	DRAWING No.
23036	C101

S:\23036\Working\Current\23036 - Grading & Servicing Plan.dwg

MAIN STREET WEST

CONNECT PROP. 23.0m–200mmø SAN @ 1.0% TO EX. 450mmø SAN
PROP. INV= 177.75
EX. INV=177.30±
(AS PER CITY OF PORT COLBORNE STANDARDS)

CONNECT PROP. 200mmø WTM TO EX. 250mmø WTM
(AS PER CITY OF PORT COLBORNE STANDARDS)

EX. HYDRANT (NOT SURVEYED)

EX. 250mmø WTM (APPROX. LOCATION)

EX. 450mmø SAN @ 0.22% (APPROX. LOCATION)

EX. SANMH (APPROX. LOCATION)
(NOT SURVEYED)
INV.=177.33±

EX. 450mmø SAN @ 0.22% (APPROX. LOCATION)

PROP. 200mmø WTM

EX. CENTRE LINE OF ROAD

PROP. 30.0m–300mmø
CULVERT BOSS 2000 @ 0.5%
E INV=179.58
W INV=179.73

EX. EDGE OF ASPHALT ROAD

EX. METAL CULVERT

EX. CB
T/G=180.08

EX. CB
T/G=180.20

EX. PILLAR

PART 3, 59R-9938

7.29m ROAD WIDENING

EX. METAL SIGN
(TO BE REMOVED)

EX. PILLAR

EX. PILLAR

EX. MH

PROP. CONCRETE SIDEWALK

PROP. WATER METER CHAMBER
(AS PER WMC-STD-01)

7.29m ROAD WIDENING

12.0m–300mmø STM @ 0.5%
INV.=179.60
(C/W RIP-RAP PAD AT OUTLET)

EX. GARDEN

MH1A
T/G 180.60
(OPSD 701.010)
N INV. 177.98
S INV. 178.01

BIKE RACKS

MH1
(HYDROSTORM HS5)
T/G 180.80
N.INV.=179.66
S.INV.=179.67

8.0m–300mmø STM @ 0.5%

135mmø ORIFICE PLATE

MH2
(OPSD 701.010)
T/G 181.25
N.INV.=179.71
SW.INV.=179.74

BALC.
PATIO AT GRADE

BALC.
PATIO AT GRADE

BALC.
PATIO AT GRADE

EX. ASPHALT DRIVEWAY

LOT 32

PROP. 4.0m–200mmø SAN @ 1.0%
INV=178.05

PROP. BARRIER CURB AS
PER OPSD 600.110 (TYP)

EX. 1.2m HIGH CHAIN LINK FENCE

FDC

PROP. 14.0m–375mmø STM @ 0.5%

PROP. 6–STOREY
MIXED–USE BUILDING
F.F.E=181.30
(NO BASEMENT)

PROP. ZURN Z105 CONTROL–FLO
ROOF DRAIN (TYP.)

ROOF DRAINS TO OUTLET
TO 200mmø STM SERVICE

EX. METAL POLE

EX. SWIMMING POOL WITH CONCRETE DECK

PROP. 9.5m–200mmø STM @ 0.5%
INV=179.96

PROP. CONCRETE SIDEWALK

ASPHALT PARKING LOT

PROP. 23.0m–300mmø STM @ 0.5%

EX. GW

LOT 41

NOTE:
CATCHBASINS AND CATCHBASIN MANHOLES TO BE FITTED WITH FLEXSTORM INLET FILTERS

CBMH3
(OPSD 701.010)
T/G 180.85
NE.INV.=179.81
S.INV.=179.84

LIMIT OF BUILDING ABOVE

PROP. 200mmø FIRE WTM

MECHANICAL ROOM

STAIRS

BIKE RACKS

EX. GARDEN

PROP. 150mmø DOM. WTM

EX. INV

EX. MH

LOADING

EX. ASPHALT PARKING LOT

CB4.1
(OPSD 705.010)
T/G 180.85
N.INV.=179.99

PROP. 21.0m–250mmø STM @ 0.5%

PROP. SIGN (TYP.)

LOT 40

EX. CONCRETE SIDEWALK

PROP. 2–LEVEL PARKADE
½ STOREY DOWN
1 STOREY UP
(DESIGN BY OTHERS)

EX. MUNICIPAL No. 650
ONE STOREY MOTEL

PROP. RETAINING WALL
(DESIGNED BY OTHERS)

CBMH4
(OPSD 701.010)
T/G 180.85
NE.INV.=179.85
S.INV.=179.88
N INV.=179.91

EXISTING RESIDENTIAL LANDS

LOT 39

LIMIT OF PARKADE ABOVE

5TH FFE STAIRS

EX. METAL POLE

EX. 2.6m HIGH BOARD FENCE

LOT 38

EXISTING COMMERCIAL LANDS

PART 1, 59R-13260

LOT 37

EXISTING COMMERCIAL LANDS

EX. 1.8m HIGH BOARD FENCE

PART 1
59R-9938

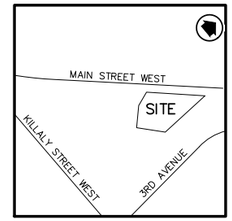
PART 2, 59R-16447

PART 1

EX. MH

EX. INV

EX. MH



KEY MAP
N.T.S.

LEGEND:

- EXISTING CATCHBASIN
- EXISTING STORM/SANITARY MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED STORM/SANITARY MANHOLE
- PROPOSED GATE VALVE
- PROPOSED CATCHBASIN MANHOLE

BENCH MARK NOTE:
379–69: ONE STOREY RED BRICK HOUSE SITUATED ON THE S.W. CORNER OF FIRST AVE AND THIRD AVE IN THE CITY OF PORT COBORNE, 1.3 KM WEST OF JCT OF HWY 3 (MAIN ST) AND ELM ST, 0.3 KM WEST OF JCT OF HWYS 3 AND 58, AND 93.6 M SOUTH OF CENTRELINE OF HWY 3. TABLET IS SET HORIZONTALLY IN NORTH FACE OF CONCRETE FOUNDATION, 2.44 M WEST OF N.E. CORNER AND 73 CM BELOW BRICKWORK.

NO.	DATE	BY	REVISIONS

NOTES TO CONTRACTOR:
1. CONTRACTORS AND SUBCONTRACTORS SHALL NOT SCALE FROM THIS DRAWING.
2. ANY INCONSISTENCIES AND OMISSIONS FOUND ON THE DRAWINGS MUST BE REPORTED TO THE ENGINEER FOR CLARIFICATION BEFORE COMMENCING THE WORK.
3. PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR MUST CHECK AND VERIFY ALL DIMENSIONS AND ELEVATIONS AND REPORT ALL FINDINGS TO THE ENGINEER. ONCE CONSTRUCTION HAS COMMENCED, THE CONTRACTOR ACCEPTS RESPONSIBILITY FOR ALL DIMENSIONS, ELEVATIONS, AND SITE CONDITIONS.
4. THE POSITIONS OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVER–GROUND UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE DRAWINGS. WHERE SHOWN ON THE DRAWING, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM THEMSELVES OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
5. ALL DRAWINGS REMAIN THE PROPERTY OF THE ENGINEER AND SHALL NOT BE REPRODUCED, REUSED, OR REVISED WITHOUT THE WRITTEN CONSENT OF S. LLEWELLYN AND ASSOCIATES LIMITED.

DESIGN	MT	CHK'D	SN	DATE
DRAWN	MT	CHK'D	SN	Jun. 29, 23

SCALE 1:200 (0, 5, 10, 20)

APPROVALS

STAMP

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CLIENT
M5V 650 MAIN LP

PROJECT NAME
650 MAIN STREET WEST
PORT COLBORNE, ON

TITLE
PRELIMINARY SITE SERVICING PLAN

PROJECT No. 23036

DRAWING No. C102

S:\23036\Working\Current\23036 – Grading & Servicing Plan.dwg
Plotted: Thursday, June 29, 2023 4:06:54 PM By: Scott Nelson