S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing & Stormwater Management Report

4078 VICTORIA AVENUE

CITY OF NIAGARA FALLS

BUILD UP VICTORIA INC.

FEBRUARY 2023

SLA File: 21120

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1.0 INTRODUCTION AND BACKGROUND

1.1 Overview

S. Llewellyn & Associates Limited has been retained by Build Up Victoria Inc. to provide Consulting Engineering services for the proposed development at 4078 Victoria Avenue in the City of Niagara Falls (see Figure 1.0 for location plan).

The 0.11 ha site is bound by Victoria Avenue to the west, existing residential lands to the east, Leader Lane to the north and vacant land to the south. The proponent proposes to construct an apartment building with 10 units including associated asphalt driveways, concrete curbing and landscaped areas.

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

1.2 Background Information

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

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

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

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

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

Figure 1.0 – Location Plan

2.0 STORMWATER MANAGEMENT

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

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

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

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

2.1 Pre-Development Conditions

In the pre-development condition, the 0.11ha site consists entirely of grassed area. The site sheet drains north-west towards Victoria Avenue and Leader Lane where runoff is captured by the existing 600mmø storm sewer along Leader Lane. There is also 0.045ha of external drainage, for a total drainage area of 0.155ha.

One catchment area, Catchment 101 has been identified in the existing condition. Catchment 101 represents the drainage area from the site, which is captured by the existing 600mmø storm sewer along Leader Lane. See Table 2.1 and the Existing Condition Storm Drainage Area Plan in Appendix A for details.

Table 2.1: Pre-Development Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
101	To Leader Lane	0.155	0%	0.25

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

$Q_{5\text{-yr (Catchment 101)}}$ = 2.78CiA=2.78(0.25)(84.02 mm/hr)(0.155ha)
= **9.0 *l/s (0.0090 m^3/s)***

Table 2.2: Pre-Development Condition Site Discharge

Storm Event	Catchment 101 Runoff (m^3/s)
5-Yr Event	0.0090

2.2 Post-Development Conditions

The proposed development consists of constructing an apartment building with 10 units including asphalt driveways, concrete curbing and landscaped areas. It is proposed to service the site with a private storm sewer system, designed and constructed in according to the City of Niagara Falls standards.

Two (2) catchment areas, Catchment 201 and 202 have been identified in the proposed condition. Catchment 201 represents the drainage area which is captured from the roof of the proposed building, the asphalt driveways, landscaped areas and the external drainage. Catchment 201 will outlet via the proposed storm sewer and discharge to the existing 600mmø storm sewer along Leader Lane. Catchment 202 represents the uncontrolled drainage area, which sheet drains to the municipal right of way and is captured by the existing 600mmø storm sewer along Leader Lane. See Table 2.3 and the Proposed Condition Storm Drainage Area Plan in Appendix A for details.

Table 2.3: Post-Development Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Runoff Coefficient
201	Controlled to Leader Lane	0.138	65%	0.68
202	Uncontrolled to Leader Lane	0.017	60%	0.67

2.2.1 Water Quantity Control

It is required to restrict the 5-year post-development discharge rate from the subject site to the 5-year pre-development discharges rate. Stormwater quantity control for Catchment 201 will function through a combination of an ACO Stormbrixx SD storage tank and an IPEX Tempest LMF ICD Vortex 75 device located within MH3. The control device will restrict discharge from the site to the allowable discharge rate. Details of this design can be found on the Preliminary Site Servicing Plan, prepared by S. Llewellyn and Associates Limited. A summary of the stage-storage-discharge characteristics and proposed discharge rates for the proposed condition can be seen in Table 2.4 and Appendix A.

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

Elevation (m)	Storage (m^3)	Discharge (m^3/s)
175.19 (Orifice Invert)	0	0.0000
175.55 (Bottom of Tank)	0	0.0030
175.75	4	0.0035
175.95	9	0.0040
176.15	13	0.0045
176.35	18	0.0050
176.46 (Top of Tank)	20	0.0055

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

Table 2.5: Proposed Condition Stormwater Discharge (To Leader Lane)

Storm Event	Catchment 201 Controlled Discharge (m^3/s)	Catchment 202 Uncontrolled Discharge (m^3/s)	Total Discharge (m^3/s)	Allowable Discharge (m^3/s)	Required Storage (m^3)
5-Yr	0.0055	0.0027	0.0082	0.0090	15.5

This analysis determined the following:

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

- Sufficient stormwater storage is provided on-site by means of ACO Stormbrixx SD storage tank. A total storage volume of $20m^3$ is provided while only $15.5m^3$ of storage is required during the 5-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 existing storm sewer system along Leader Lane. 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 HS4 will provide 81% TSS removal and 100% 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 roadway. The installation of the Flexstorm Inlet Filters will contribute to the removal of TSS and the capture of floatables within the catchbasins. Technical information regarding the Flexstorm Inlet Filters can be found in Appendix B.

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

2.2.3 Sediment and Erosion Control

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

- Install silt fencing along the outer boundary of the site to ensure that sediment does not migrate to the adjacent properties;

- Install sediment control (silt sacks) in the proposed catchbasins as well as the nearby existing catchbasins to ensure that no untreated runoff enters the existing conveyance system;

- Stabilize all disturbed or landscaped areas with hydro seeding/sodding to minimize the opportunity for erosion.

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

- Inspection of the erosion and sediment controls (e.g. silt fences, sediment traps, outlets, vegetation, etc.) with follow up reports to the governing municipality; and

- The developer and/or their contractor shall be responsible for any costs incurred during the remediation of problem areas.

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

3.0 SANITARY SEWER SERVICING

3.1 Existing Conditions

There is an existing 300mmø sanitary sewer, which flows south along Victoria Avenue.

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 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)**
0.03	0.19	**0.76**	0.22	**0.79**

Population = 10 units x 3 persons/unit = 30 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 = 0.11 ha x 0.28 l/ha/s = 0.03 l/s
[1]RDII (Rain Derived Inflow and infiltration) = Area x 0.286 l/s/ha = 0.11 ha x 0.286 l/s = 0.03 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 30 persons) + 0.03 l/s= 0.19 l/s
[3]Peak DWF = DWF x Peaking Factor = 0.19 x 4.0 =1.04 l/s
[4]WWF (Wet Weather Flow) = DWF + Inflow and All Infiltration (Dry Weather and Rain Derived) = 0.19 l/s + 0.03 l/s = 0.22 l/s
[5] Peak WWF = Peak DWF + RDII = 0.76 l/s + 0.03 l/s = 1.07 l/s

Based on Plan and Profile drawings provided by the City of Niagara Falls, the existing 300mmø sanitary sewer along Victoria Avenue has a slope of 0.35%. At this slope, the existing 300mmø sanitary sewer has a free-flow capacity of 0.057m^3/s (57 l/s). The peak wet weather flow from the proposed site of 0.79 l/s represents 1.4% of the free-flow capacity of the existing 300mmø sanitary sewer.

3.3 Proposed Sanitary Servicing

The proposed site will be serviced by a 200mmø sanitary sewer system, and will be designed and constructed in accordance with the City of Niagara Falls standards. Drainage from the proposed sanitary sewer system will discharge to the existing 300mmø sanitary sewer along Victoria Avenue.

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 300mmø PVC watermain along Victoria Avenue and a 150mmø watermain of unknow material along Leader Lane. There is an existing fire hydrant fronting the site on Leader Lane.

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)**
30 persons	0.13	9.5	14.3	**1.2**	**1.9**

[A] Population (P) = 10 units x 3 persons/unit = 30 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 = 9.5 (refer to Table 3-3 from MOE Manual)
[D] Max. Hourly Peaking Factor = 14.3 (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, 1999), Ontario Building Code (OBC), and various codes and standards published by the National Fire Protection Association (NFPA). The Fire Underwriters Survey - 1999 was used to determine the required flow rate for the proposed development.

There is an existing fire hydrant fronting the site on Leader Lane which meets the required 90m separation to the building face of the proposed buildings (as per Sentence 3.2.5.7 of the 2020 Ontario Building Code). Therefore, no additional private hydrant is proposed for the development.

The proposed building is wood frame construction type (C=1.5), with limited combustible occupancy (15% correction) and no sprinkler system (0% correction). Exposure corrections are based on the following:

North Face: 0% correction (45m+)
South Face: 0% correction (45m+)
East Face: 15% correction (10.1m to 20m)
West Face: 5% correction (30.1m to 45m)
Total: 20%

An estimate of the required flow rate for the proposed building can be found in Appendix C. The flow rate was determined in accordance with the Fire Underwriters Survey – 1999 Water Supply for Public Fire Protection. It has been determined that the required fire flow for the site is **11000 l/min (183 l/s)**.

A hydrant flow test was completed for the existing hydrant adjacent to the site and the data is shown in Table 4.2 and can be found in Appendix C. The hydrant flow test result indicates that the water distribution system can supply **189.4 l/s** at the minimum allowable pressure of 20 psi. Therefore, the water distribution system has adequate pressure and capacity to service the subject site.

Table 4.2: Hydrant Flow Test Data	
Location	Victoria and Leader Lane
Test Date (mm/dd/yyyy)	7/25/2022
Static Pressure	87 psi
Residual Pressure During Test #1	68 psi
Test #1 Flow Rate	1244 USGPM (78.5 l/s)
Residual Pressure During Test #2	60 psi
Test #2 Flow Rate	1838 USGPM (116.0 l/s)
Theoretical Flow @ 20 psi	**3002 USGPM (189.4 l/s)**

4.4 Proposed Water Servicing and Analysis

The proposed development will be serviced with a 100mmø watermain feeding off the existing 150mmø watermain along Leader Lane. The municipal watermain and fire hydrants will supply firefighting water for the development.

5.0 CONCLUSIONS AND RECOMMENDATIONS

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

- The development be graded and serviced in accordance with the Preliminary Grading & Erosion Control Plan and Preliminary Site Servicing Plan prepared by S. Llewellyn & Associates Limited;

- An IPEX Tempest LMF ICD Vortex 75 device be installed within MH3 as per the Preliminary Site Servicing Plan and this report to achieve effective stormwater quantity control for the subject site;

- ACO Stormbrixx SD storage tank be installed on site as per the Preliminary Site Servicing Plan and this report to provide adequate stormwater storage;

- A Hydrostorm HS4 oil/grit separator, or approved equivalent, and Flexstorm Inlet filters be installed as per the Preliminary Site Servicing Plan and this report to provide effective stormwater quality control;

- The proposed sanitary and water servicing system be installed as per the Preliminary Site Servicing Plan and this report to adequately service the proposed development;

- Erosion and sediment controls be installed as described in this report, and as per the standards and specifications of the City of Niagara Falls;

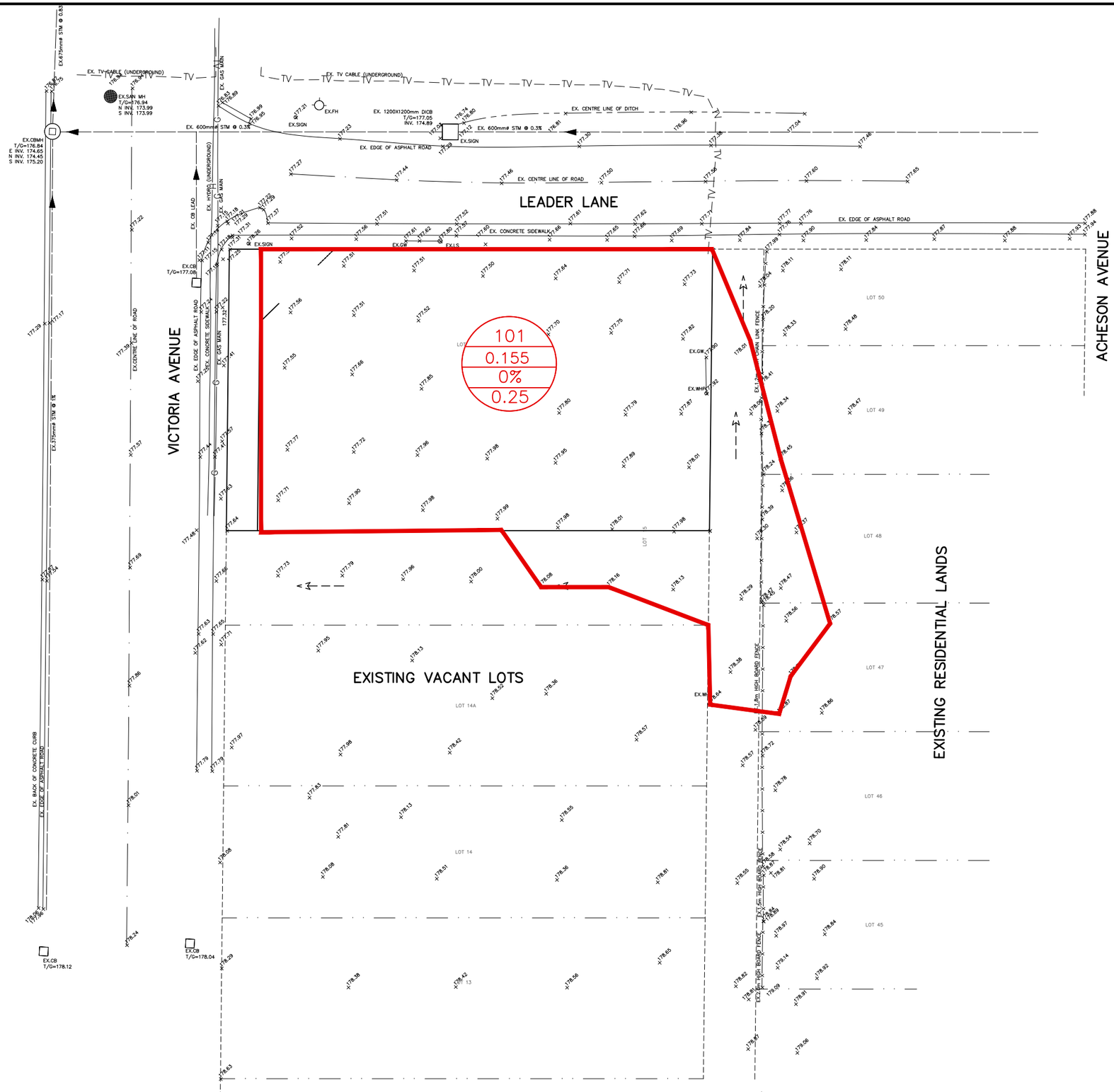
We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Prepared by:

S. LLEWELLYN & ASSOCIATES LIMITED

S. Nelson, P. Eng.

APPENDIX A
STORMWATER QUANTITY INFORMATION



LEGEND

DRAINAGE BOUNDARY

201
14.60
77%
0.75

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

EXISTING CONDITION STORM DRAINAGE AREA PLAN

SCALE: 1:400

PROJECT: 4078 VICTORIA AVENUE,
NIAGARA FALLS, ONTARIO

PROJECT No.: 21120

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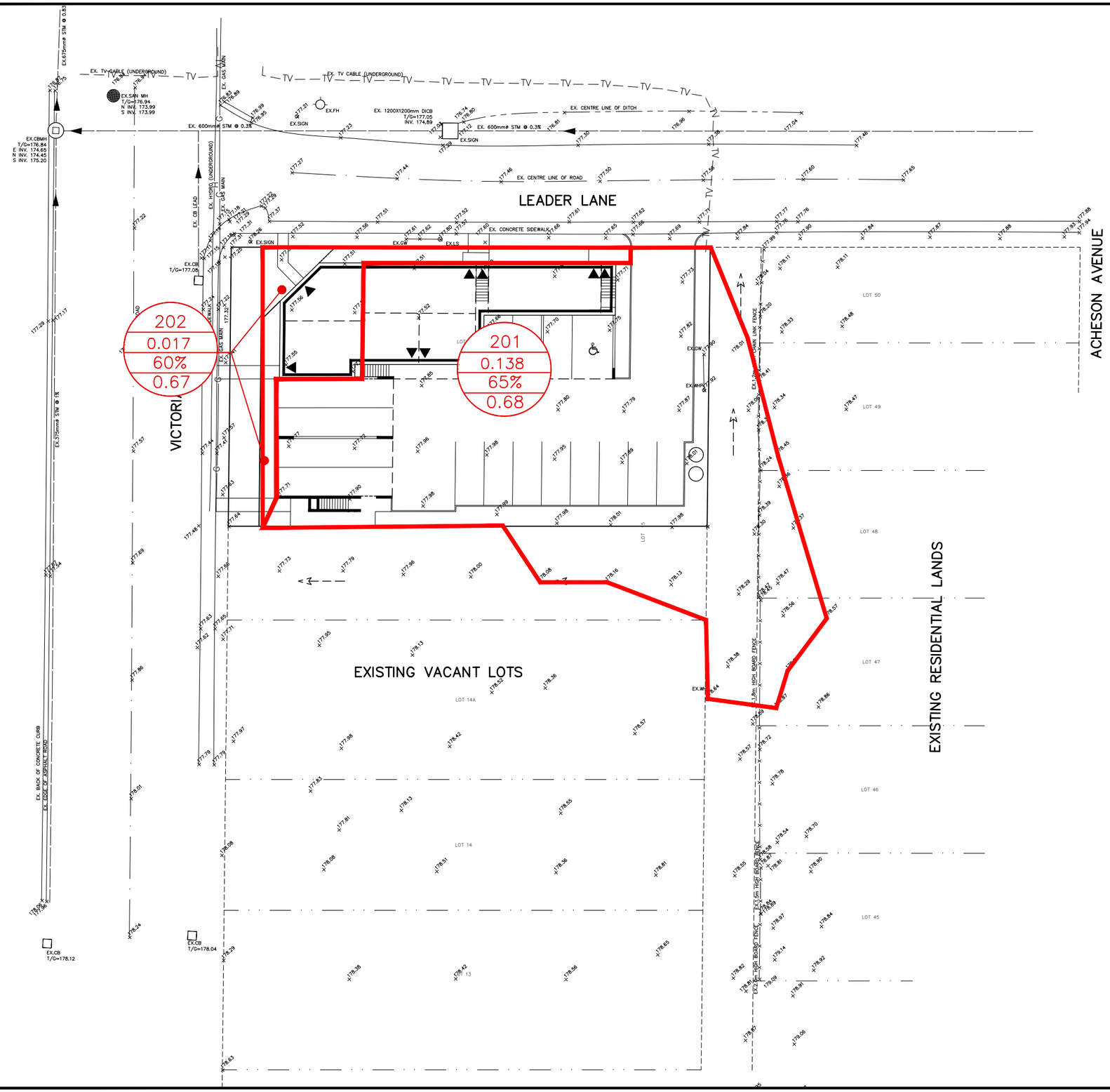

N

LEGEND

DRAINAGE BOUNDARY

201
14.60
77%
0.75

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

PROPOSED CONDITION STORM DRAINAGE AREA PLAN

SCALE: 1:400

PROJECT: 4078 VICTORIA AVENUE, NIAGARA FALLS, ONTARIO

PROJECT No.: 21120

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STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type: IPEX LMF ICD Vortex 75
Discharge (Q) = Refer to the Performance Curve
Number of Orifices: 1

		SWM Pond Volumes			Outlet No. 1	
	Elevation m	Area m^2	Tank Incremental Volume	Active Storage Volume m^3	H m	Discharge m^3/s
Orifice Invert	175.19	0	0	0	0.000	0.0000
Bottom of Tank	175.55	22	0	0	0.360	0.0030
0.20m Deep	175.75	22	4	4	0.560	0.0035
0.40m Deep	175.95	22	4	9	0.760	0.0040
0.60m Deep	176.15	22	4	13	0.960	0.0045
0.80m Deep	176.35	22	4	18	1.160	0.0050
Top of Tank	176.46	22	2	20	1.270	0.0055

5-Year Storm - Modified Rational Method

Stormwater Storage Volume

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

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

Area of site being investigated (ha) = **0.14** (Lot Area)

Composite Runoff Coeff. (C) = **0.68** (Post-development "C")

Release Rate - Q_{ALLOW} (m^3/s) = **0.0055** (Allowable discharge)

Flows from Lot area calculated from area indicated above

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

Duration (T_D)		Rainfall Intensity		Post-Development Runoff			Runoff Volume	Release Volume	Storage Volume
				Site	Roof	Total "Q_{POST}"			
(min)	(sec)	(mm/hr)	(m/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)
5	300	111.263	0.0000309	0.029	0.0	0.0290	8.70	2.48	6.23
10	600	84.024	0.0000233	0.022	0.0	0.0219	13.14	3.30	9.84
15	900	68.435	0.0000190	0.018	0.0	0.0178	16.05	4.13	11.93
20	1200	58.211	0.0000162	0.015	0.0	0.0152	18.21	4.95	13.26
25	1500	50.931	0.0000141	0.013	0.0	0.0133	19.91	5.78	14.14
30	1800	45.453	0.0000126	0.012	0.0	0.0118	21.33	6.60	14.73
35	2100	41.165	0.0000114	0.011	0.0	0.0107	22.53	7.43	15.11
40	2400	37.706	0.0000105	0.010	0.0	0.0098	23.59	8.25	15.34
45	2700	34.850	0.0000097	0.009	0.0	0.0091	24.53	9.08	15.45
50	3000	32.447	0.0000090	0.008	0.0	0.0085	25.37	9.90	15.47
55	3300	30.394	0.0000084	0.008	0.0	0.0079	26.15	10.73	15.42
60	3600	28.618	0.0000079	0.007	0.0	0.0075	26.85	11.55	15.30
65	3900	27.063	0.0000075	0.007	0.0	0.0071	27.51	12.38	15.14
70	4200	25.690	0.0000071	0.007	0.0	0.0067	28.13	13.20	14.93
75	4500	24.467	0.0000068	0.006	0.0	0.0064	28.70	14.03	14.67
80	4800	23.370	0.0000065	0.006	0.0	0.0061	29.24	14.85	14.39
85	5100	22.381	0.0000062	0.006	0.0	0.0058	29.75	15.68	14.08
90	5400	21.482	0.0000060	0.006	0.0	0.0056	30.24	16.50	13.74
95	5700	20.663	0.0000057	0.005	0.0	0.0054	30.70	17.33	13.38
100	6000	19.912	0.0000055	0.005	0.0	0.0052	31.14	18.15	12.99
105	6300	19.221	0.0000053	0.005	0.0	0.0050	31.56	18.98	12.59
110	6600	18.583	0.0000052	0.005	0.0	0.0048	31.97	19.80	12.17
115	6900	17.991	0.0000050	0.005	0.0	0.0047	32.36	20.63	11.73
120	7200	17.441	0.0000048	0.005	0.0	0.0045	32.73	21.45	11.28

Max. required storage volume = **15.47 m^3**

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

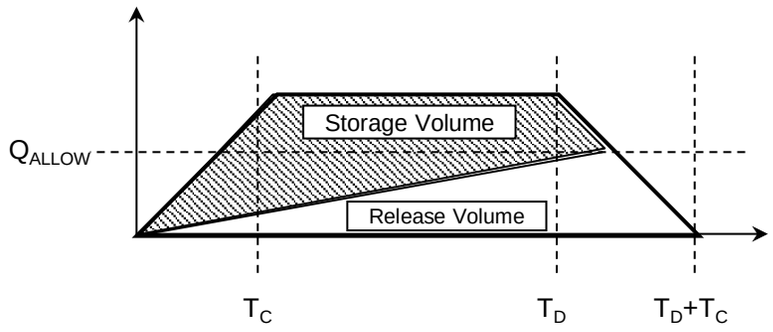
Runoff Volume = Area under trapezoidal hydrograph

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

Release Volume = Area under triangular outflow hydrograph

= ½ $(T_D + T_C)\, Q_{ALLOW}$

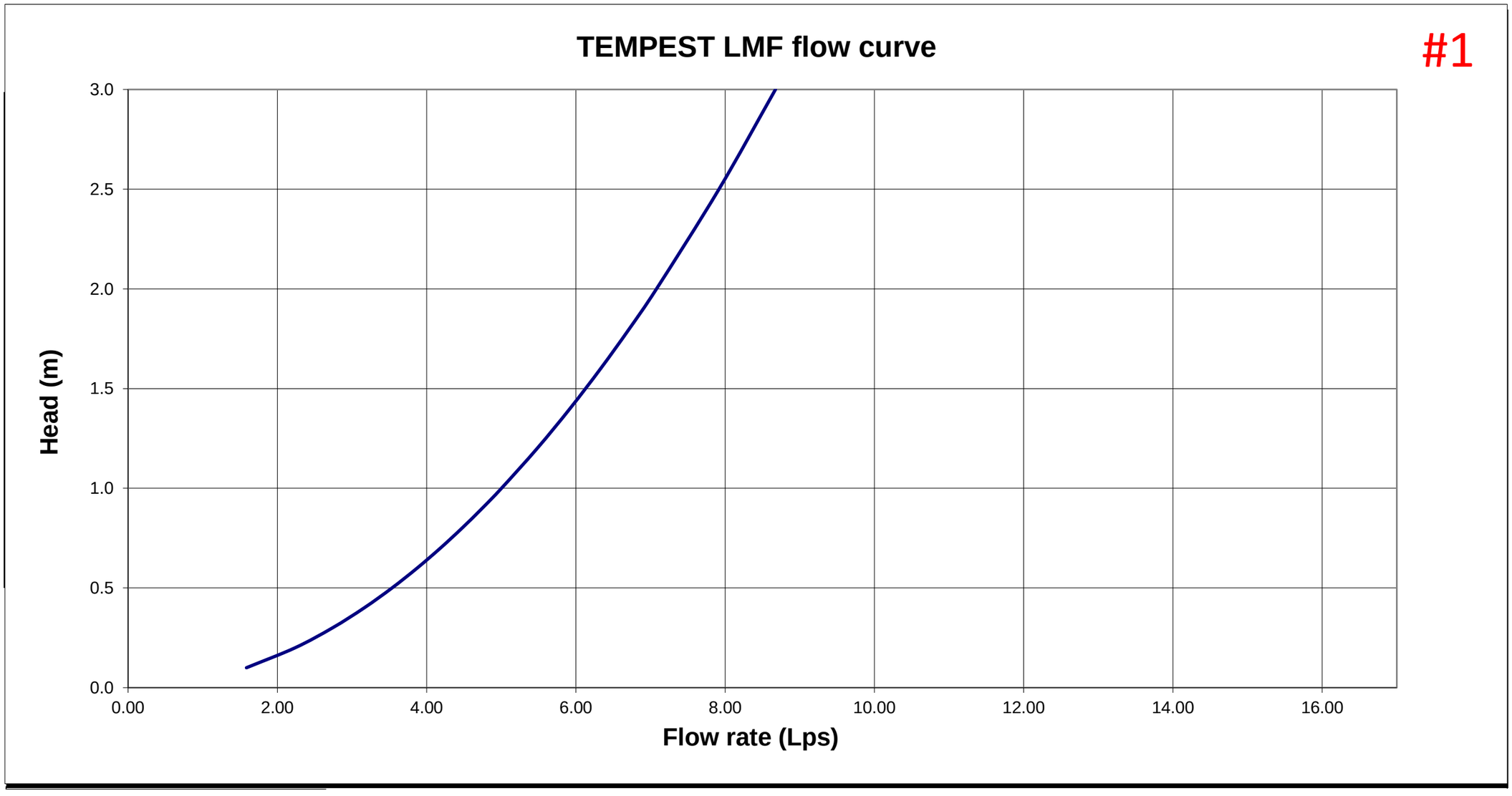
Storage Volume = Runoff Volume - Release Volume



Flow Parameters

Head (m)	1.27
Flow (Lps)	5.5

Input desired parameters in green boxes at left and then refer to graphs below for corresponding flow curves. If your design criteria fall outside the maximum parameters of this flow curve calculator please contact your IPEX representative for your TEMPEST design.



APPENDIX B
STORMWATER QUALITY INFORMATION

Hydroworks Sizing Summary

4078 Victoria Avenue, Niagara Falls

01-31-2023

Recommended Size: HydroStorm HS 4

A HydroStorm HS 4 is recommended to provide 70.0 % annual TSS removal based on a drainage area of 0.138 (ha) with an imperviousness of 65 % and Hamilton Airport, Ontario rainfall for the ETV Canada particle size distribution.

The recommended HydroStorm HS 4 treats 100 % of the annual runoff and provides 81 % annual TSS removal for the Hamilton Airport rainfall records and ETV Canada particle size distribution.

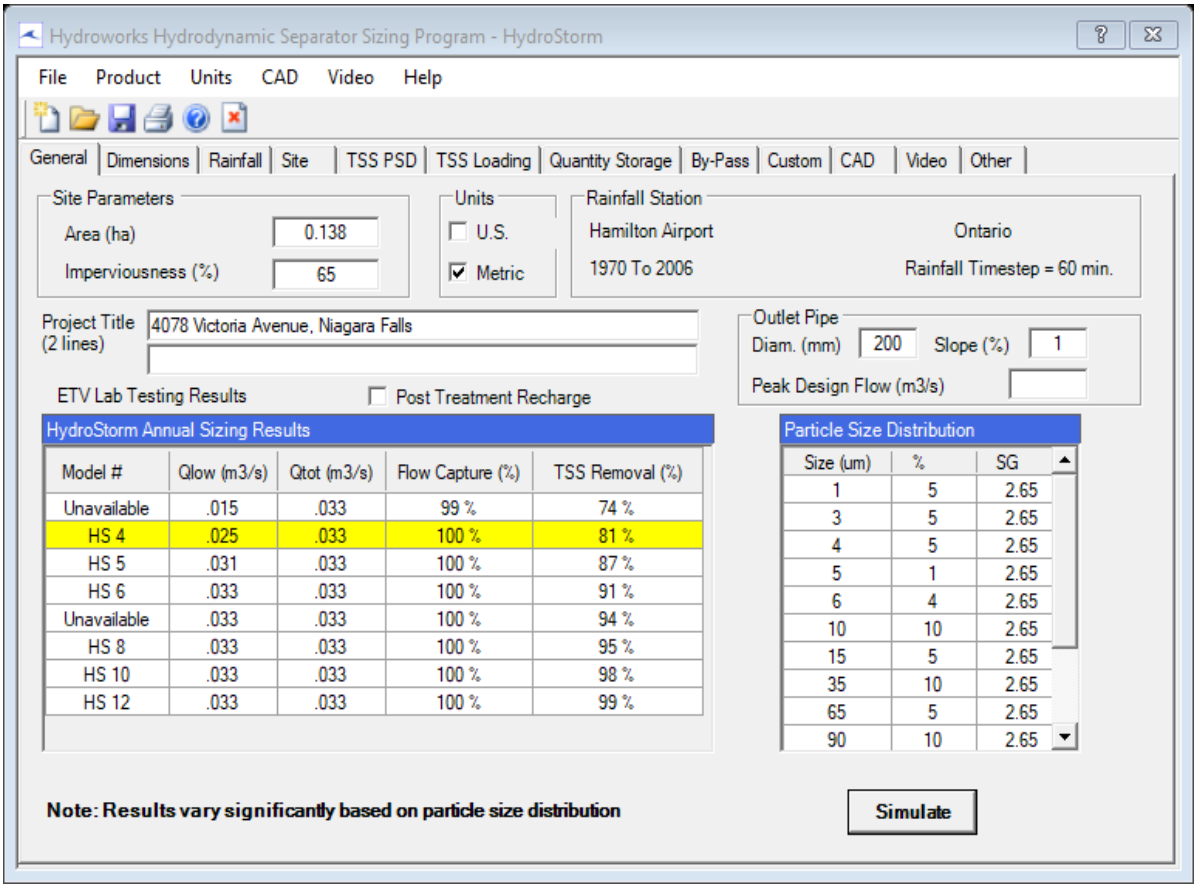
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .03 (m3/s) for the given 200 (mm) pipe diameter at 1% slope. The headloss was calculated to be 58 (mm) based on a flow depth of 200 (mm) (full pipe flow).

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.

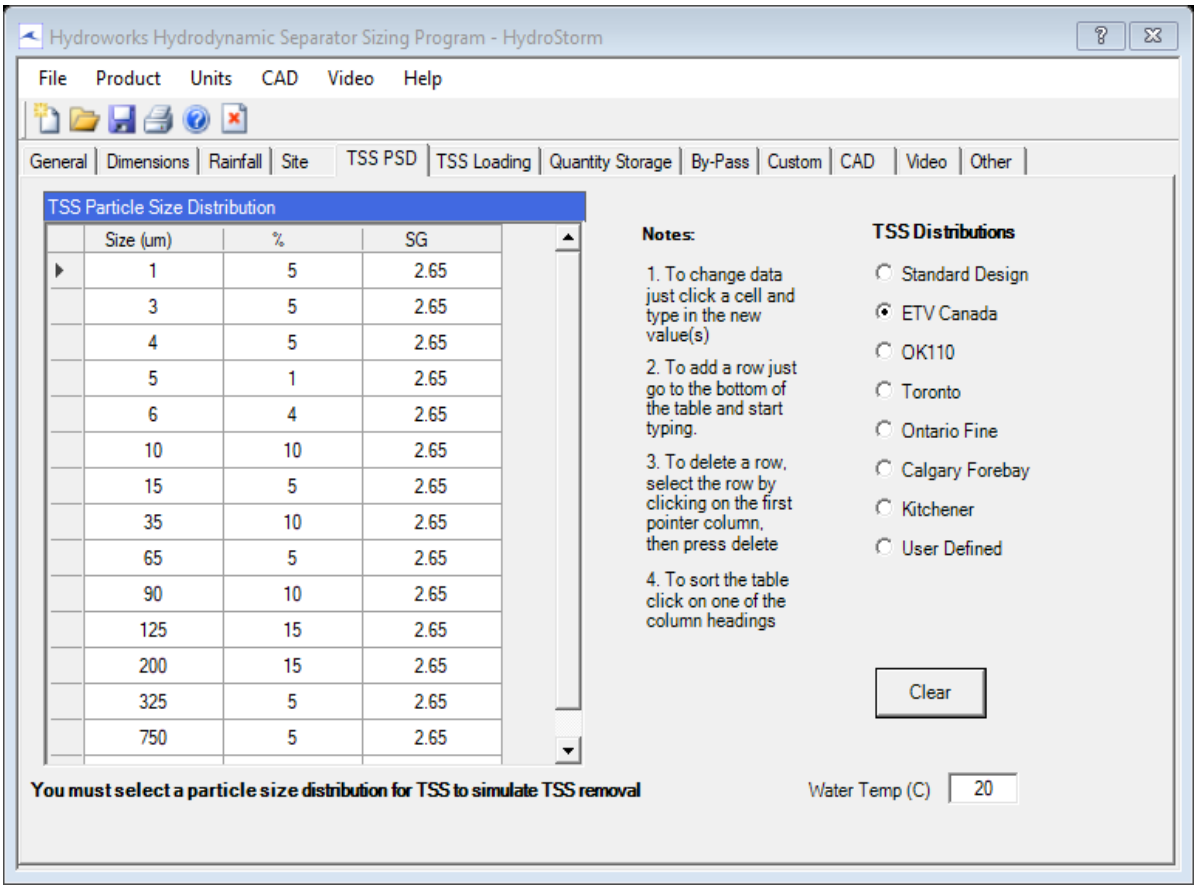
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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 .

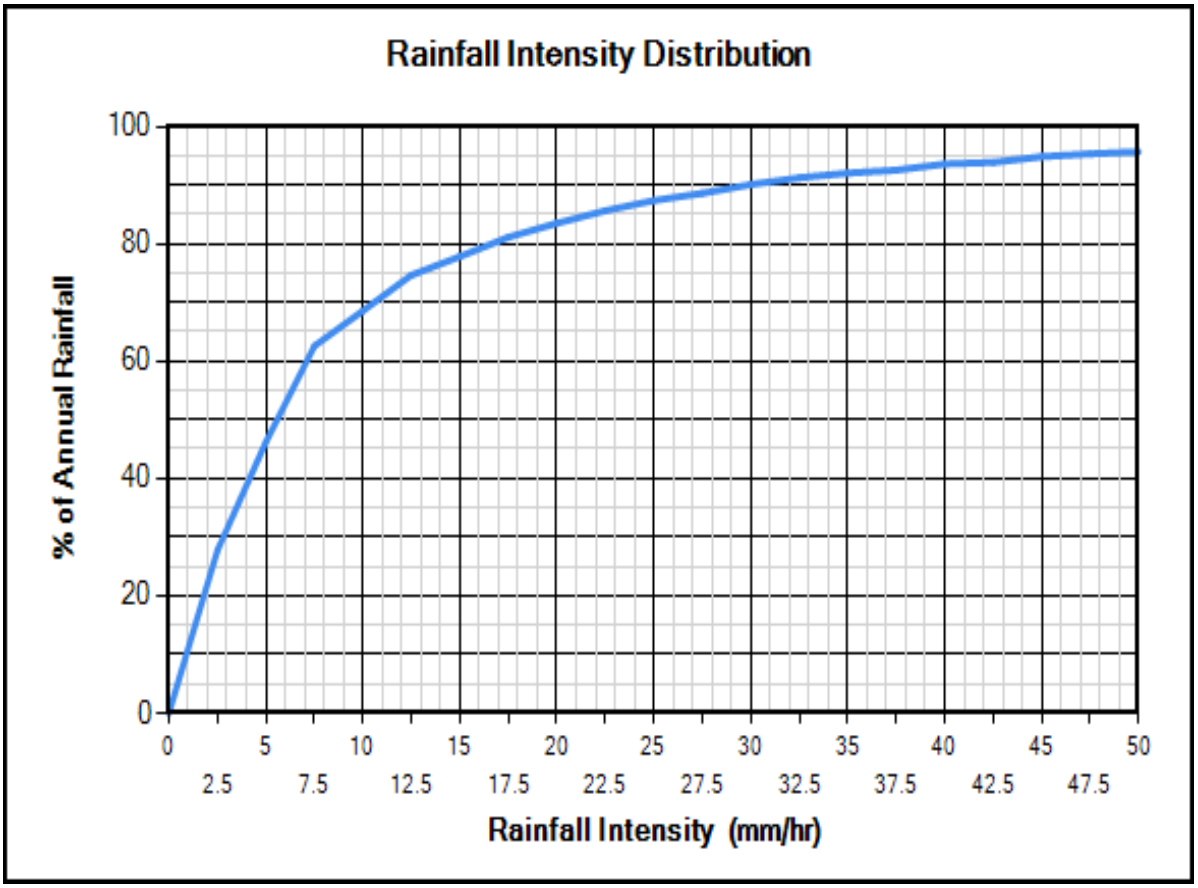
TSS Removal Sizing Summary



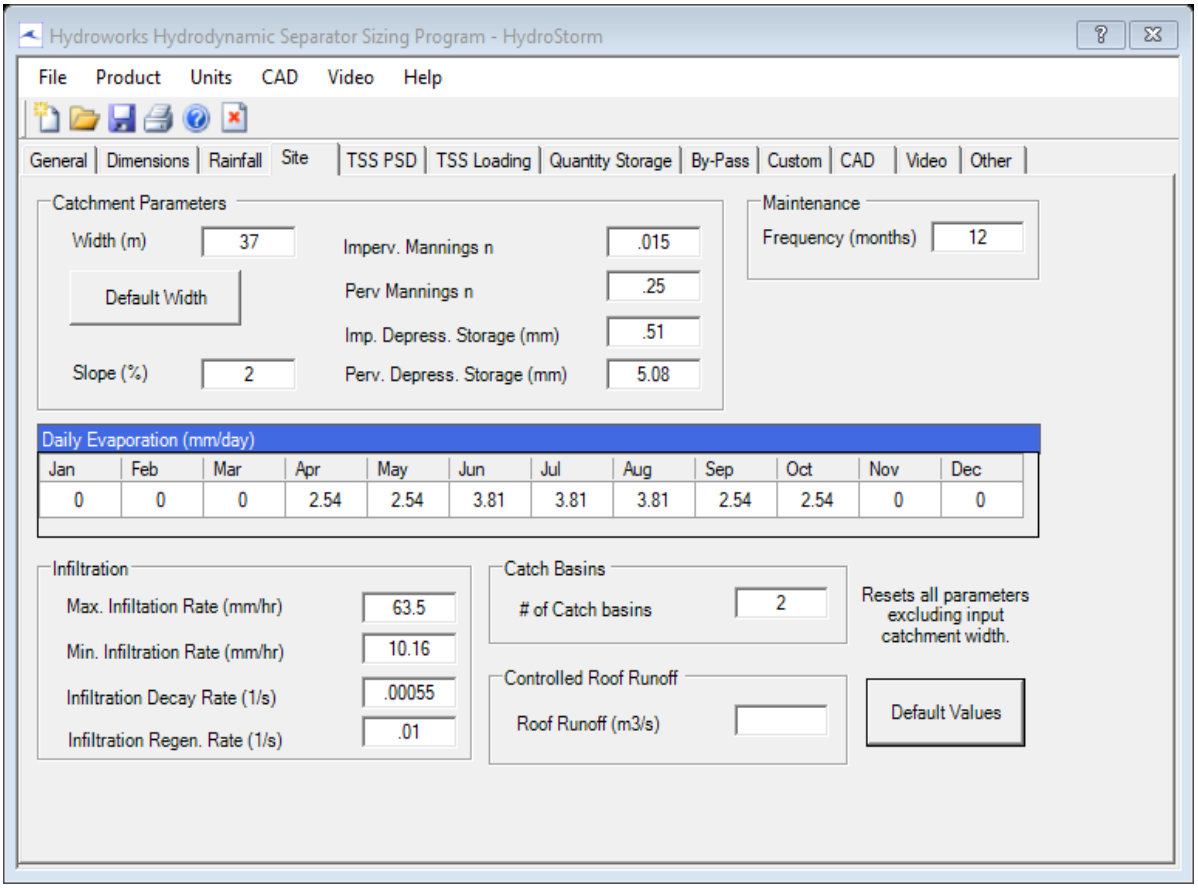
TSS Particle Size Distribution



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



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - HydroStorm

File Product Units CAD Video Help

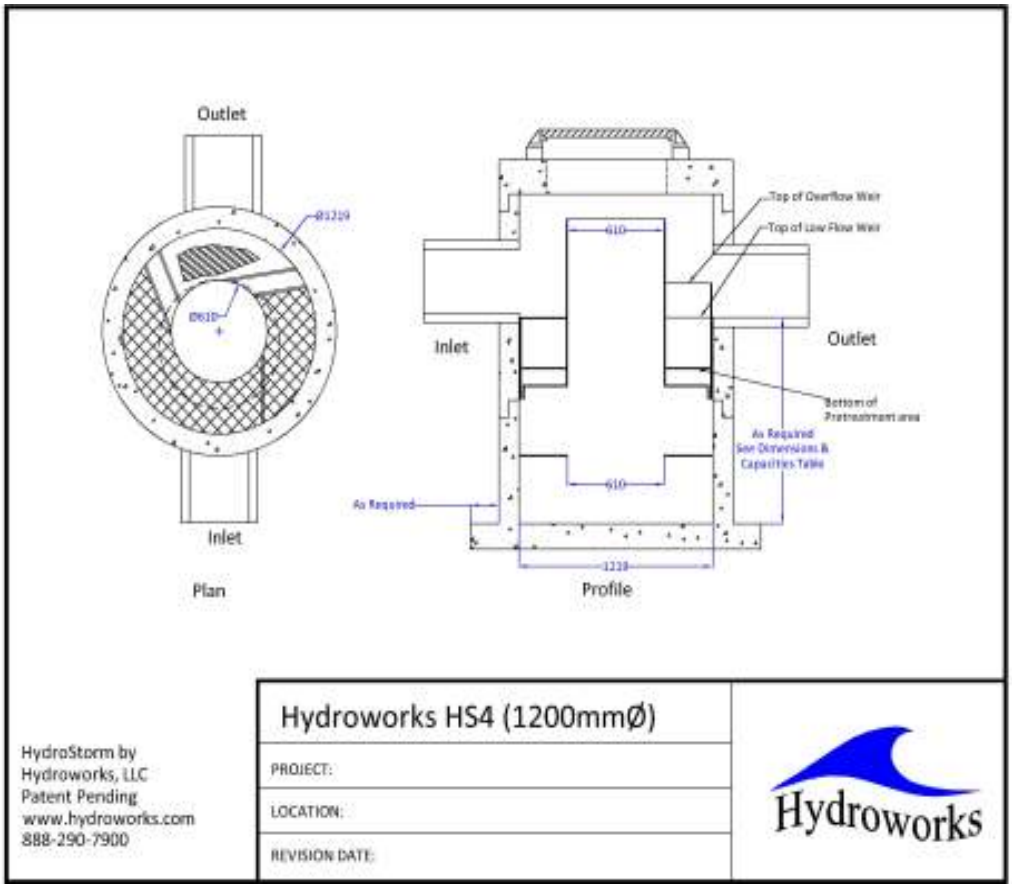
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

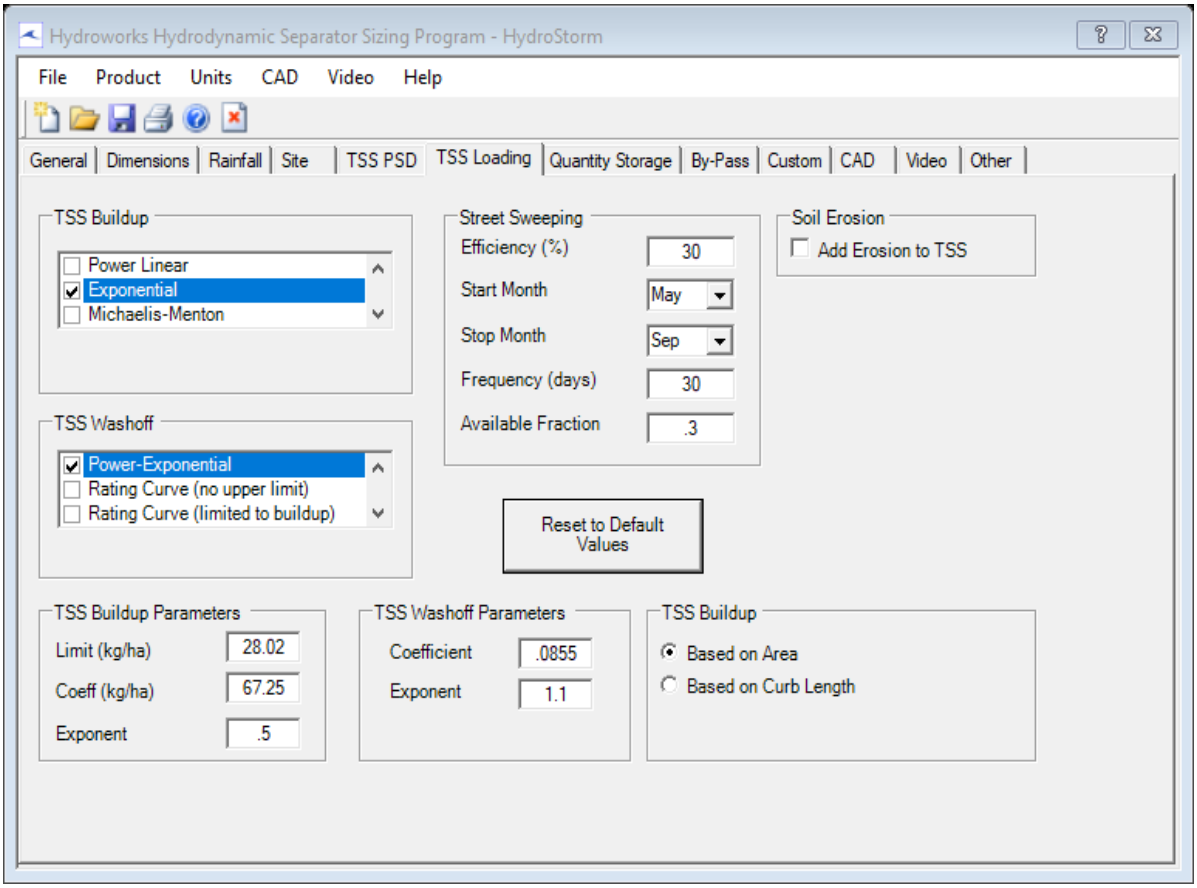
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

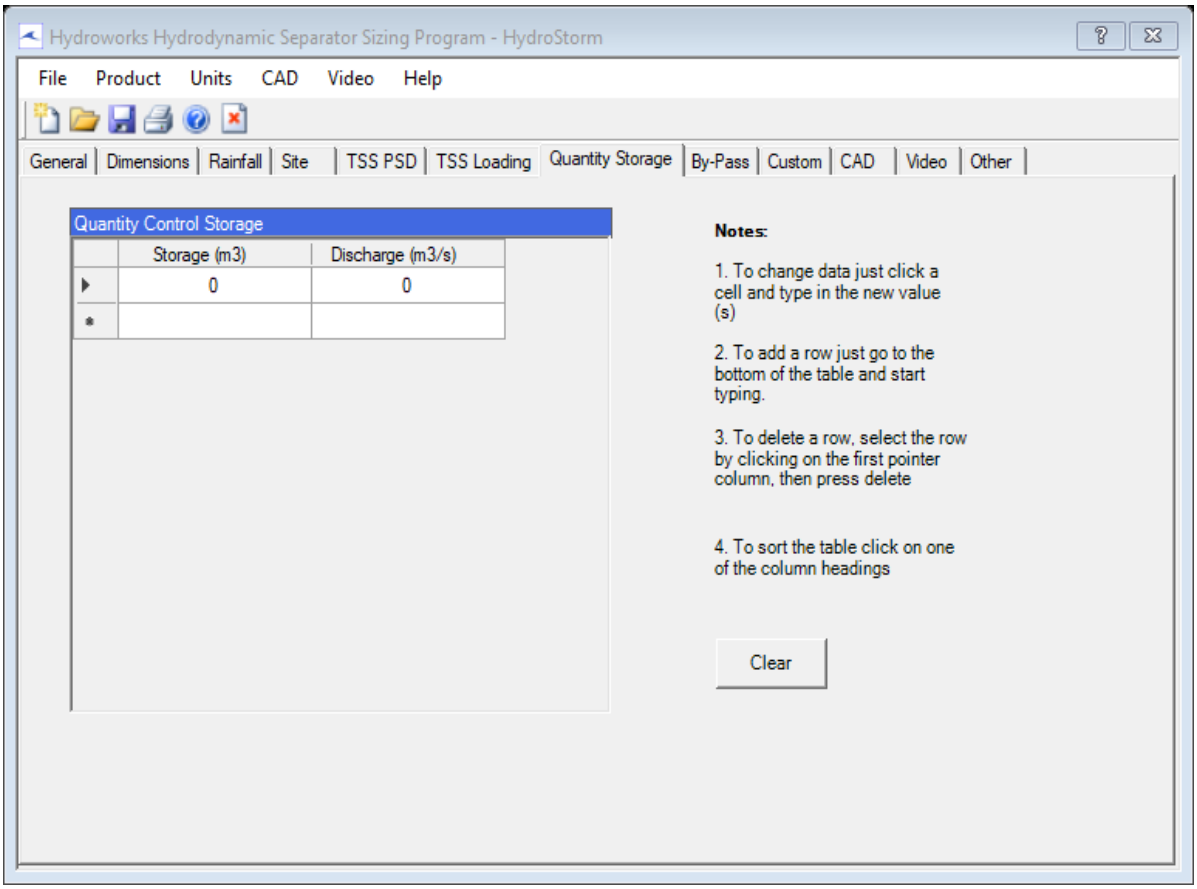
Generic HS 4 CAD Drawing



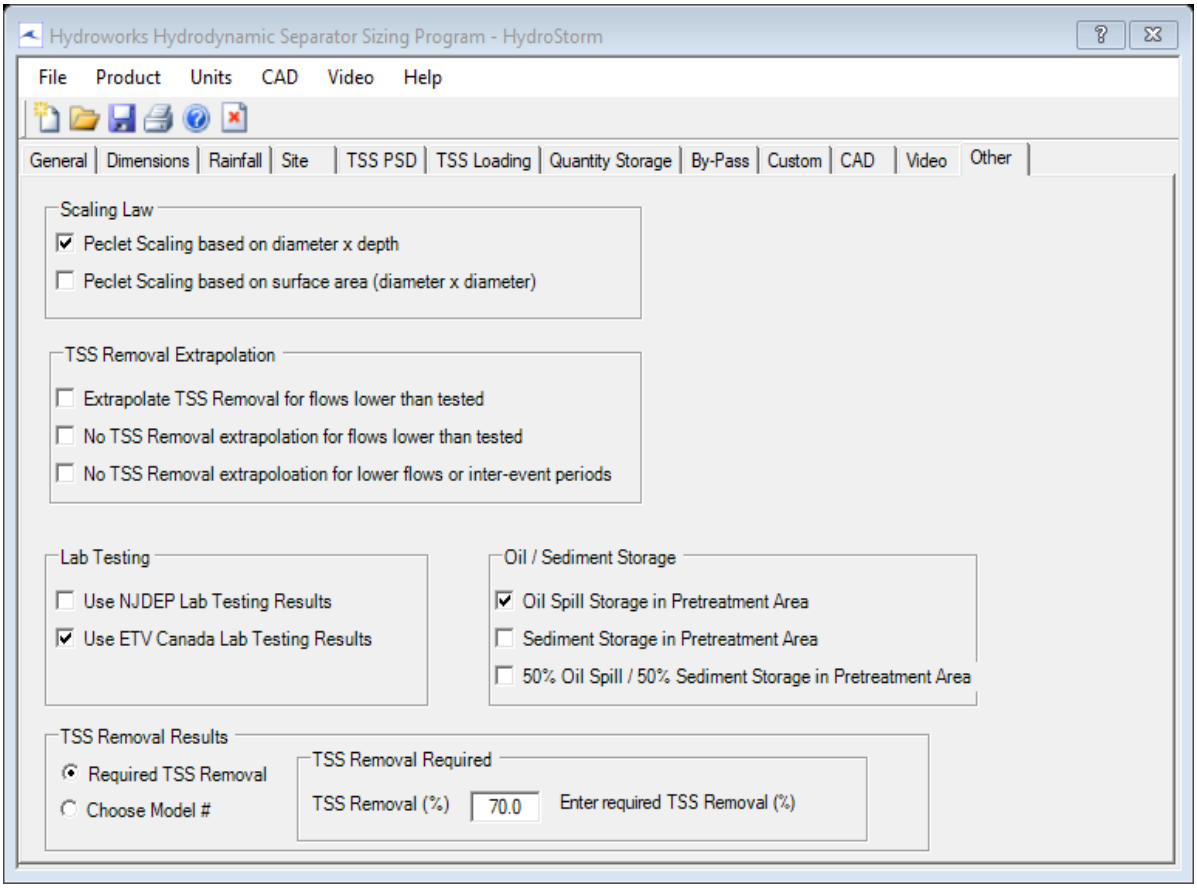
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.6

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.

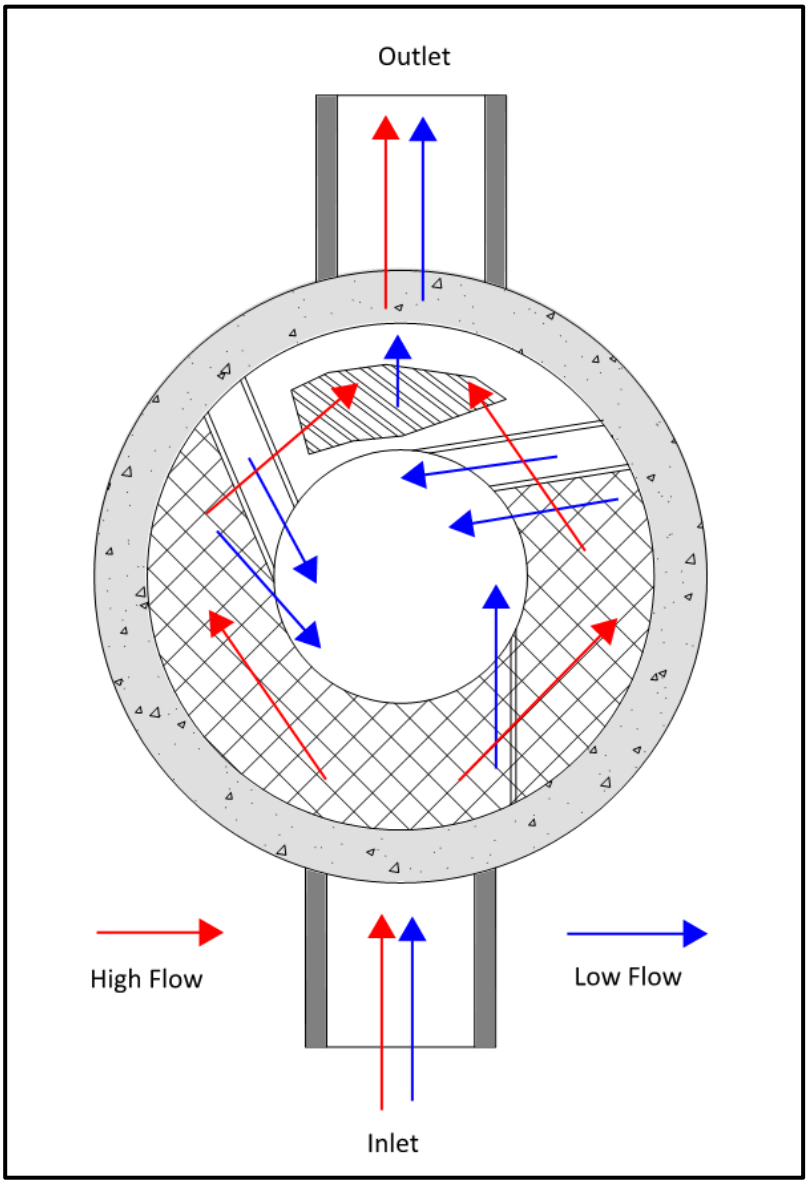


Figure 1. Hydroworks HydroStorm Operation – Plan View

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

Hydroworks

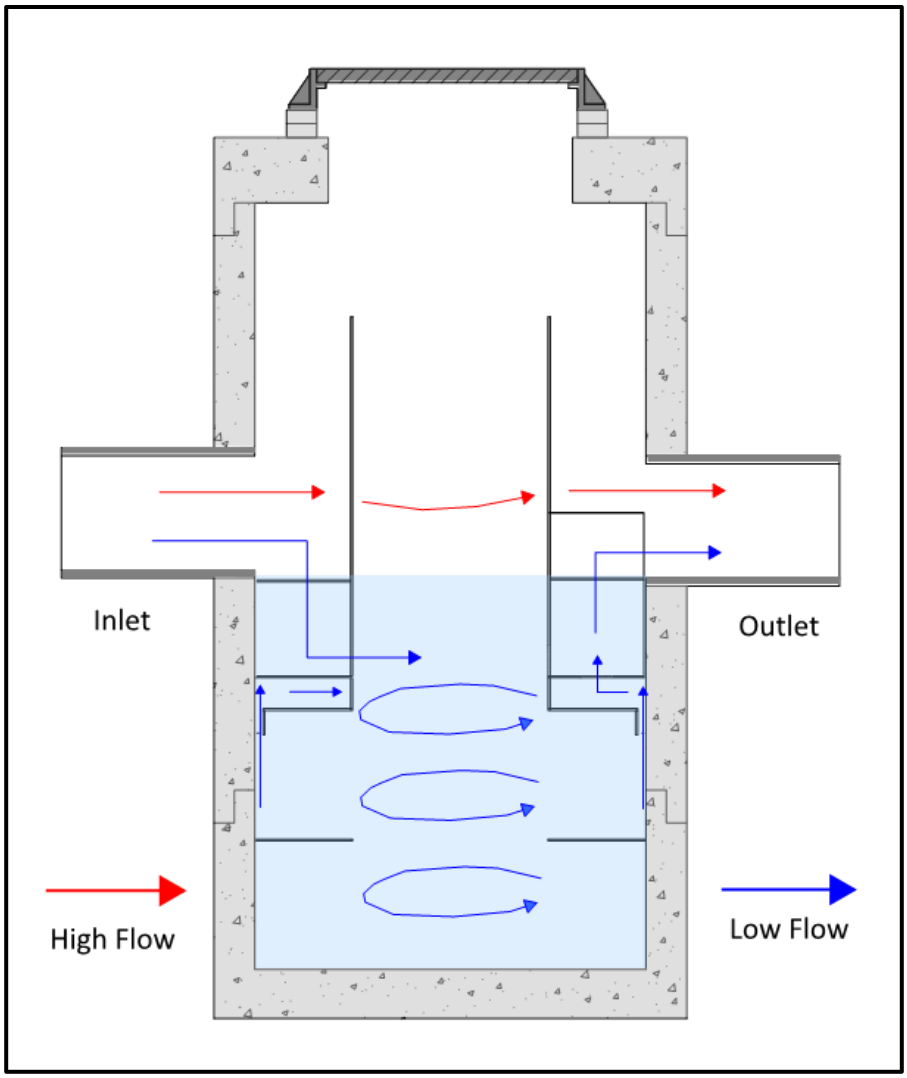


Figure 2. Hydroworks HydroStorm Operation – Profile View

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

Hydroworks

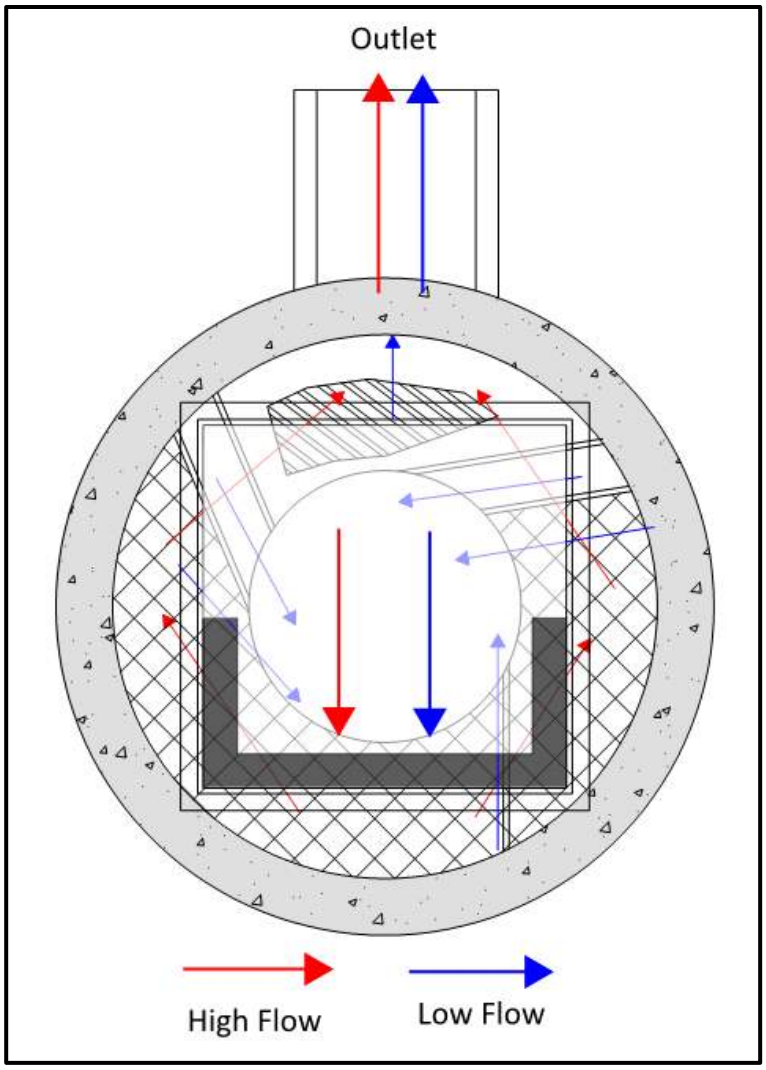


Figure 3. Hydroworks HS 4i Funnel

Inspection

Procedure

Floatables

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

Hydroworks

TSS/Sediment

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

Frequency

Construction Period

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

Post-Construction Period

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

Reporting

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

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

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

Maintenance

Procedure

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

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

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

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

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

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

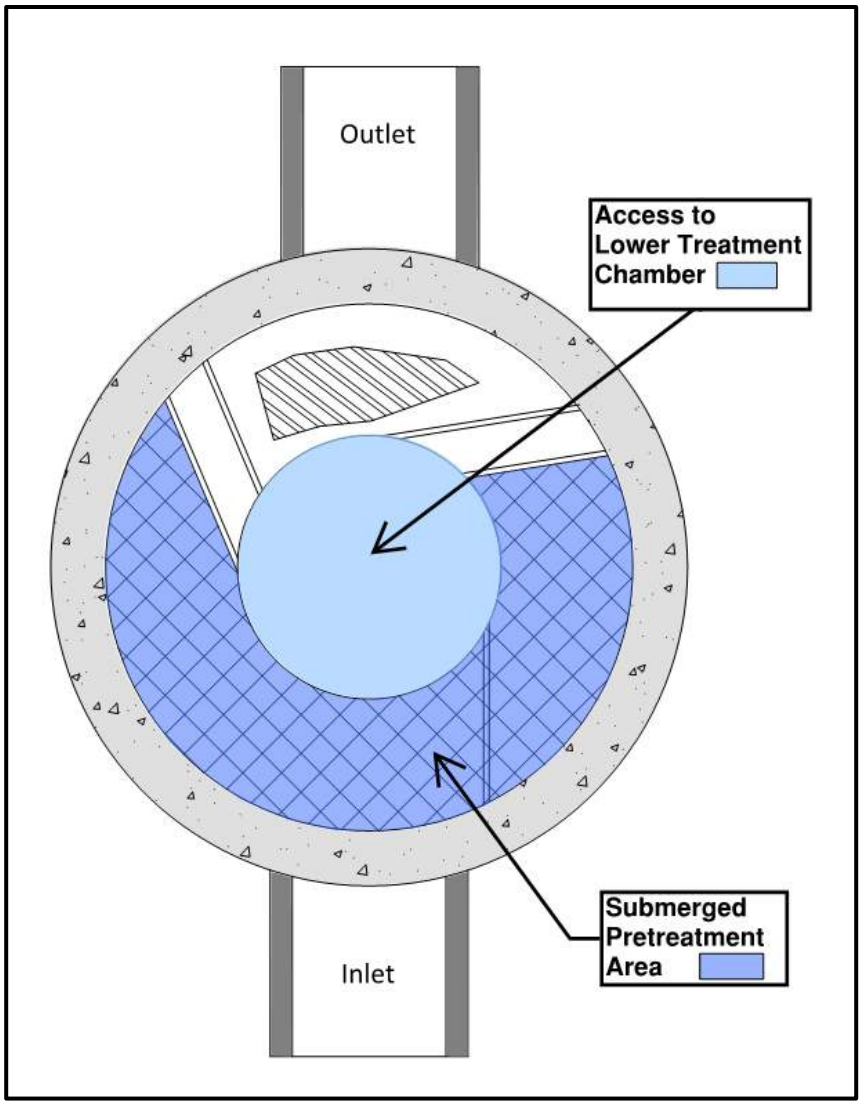


Figure 3. Maintenance Access

Frequency

Construction Period

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

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

Post-Construction Period

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

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

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

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

Table 1 Standard Dimensions for Hydroworks HydroStorm Models

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

HYDROSTORM INSPECTION SHEET

Date _____
Date of Last Inspection _____

Site _____
City _____
State _____
Owner _____

GPS Coordinates _____

Date of last rainfall _____

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

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

Water level depth below outlet pipe invert _____"

Routine Measurements

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

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

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroStorm

One Year Limited Warranty

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

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

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

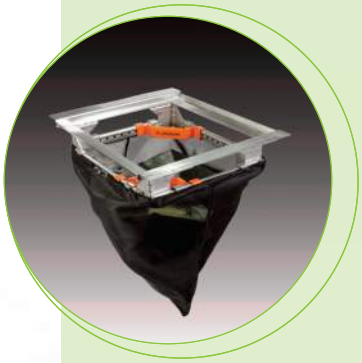
The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by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

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

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

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

FLEXSTORM® PURE PERMANENT INLET PROTECTION



SPECIFY WITH CONFIDENCE

State DOTs and municipalities across the country now have a universal structural BMP to address the issue of storm sewer inlet protection: FLEXSTORM PURE Inlet Filters.

The FLEXSTORM PURE system is the preferred choice for permanent inlet protection and storm water runoff control. Constructed of versatile stainless steel, FLEXSTORM PURE Inlet Filters will fit any drainage structure and are available with site-specific filter bags providing various levels of filtration. Whether you're the specifier or the user, it's clear to see how FLEXSTORM PURE Inlet Filters outperform the competition.

APPLICATIONS:

Car Washes	Gas Stations
Commercial	Parking Lots
Loading Ramps	Dock Drains
Industrial	Maintenance

FEATURES:

- Stainless Steel filter framing is custom configured to fit perfectly into any drainage structure, whether a standard design or obstructed inlet opening
- Filtered Flow Rates and Ultimate Bypass Rates are designed to meet your specific inlet requirements
- Multiple Filter Bags are available targeting site specific removal of trash, litter, leaves, or small particles, oil and grease
- Filters work below grade with an ultimate bypass allowing inlet area to drain with a full bag
- Units install in seconds and are easily maintained with the FLEXSTORM Universal Removal Tool (no heavy machinery required)

FEATURES:

- Receive payback on your investment: durable stainless steel framing provides extended service life while replaceable filter bags handle loads with a safety factor of 5
- Meets stringent removal requirements:
  - FX filter bags are rated for >80% removal efficiency of street sweep-size particles
  - PC/PC+ filter bags have been tested to 99% TSS removal of OK-110 US Silica Sand and 97% TPH (total petroleum hydrocarbon) removal
- Help prevent fines: FLEXSTORM Inlet Filters comply with EPA NPDES initiatives as a temporary or permanent BMP
- If not in stock, orders up to 100 pieces can ship within 48 hours

ADS Service: ADS representatives are committed to providing you with the answers to all your questions, including selecting the proper filter, specifications, installation and more. Also try the ADS FLEXSTORM Online Product Configurator at www.inletfilters.com

FLEXSTORM PURE INLET FILTERS SPECIFICATION

IDENTIFICATION

The installer shall inspect the plans and/or worksite to determine the quantity of each drainage structure casting type. The foundry casting number, exact grate size and clear opening size, or other information will be necessary to finalize the FLEXSTORM part number and dimensions. The units are shipped to the field configured precisely to fit the identified drainage structure.

MATERIAL AND PERFORMANCE

The FLEXSTORM Inlet Filter system is comprised of a corrosion resistant steel frame and a replaceable geotextile filter bag attached to the frame with a stainless steel locking band. The filter bag hangs suspended at a distance below the grate that shall allow full water flow into the drainage structure if the bag is completely filled with sediment. The standard Woven Polypropylene FX filter bags are rated for 200 gpm/sqft with a removal efficiency of 82% when filtering a USDA Sandy Loam sediment load. The Post Construction PC filter bags are rated for 137 gpm/sqft and have been 3rd party tested at 99% TSS removal to 110 micron and 97% TPH removal of used motor oil hydrocarbon mix.

INSTALLATION

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 wall mount units, follow instructions for attaching the stainless steel mounting brackets using the provided concrete fasteners.

INSPECTION FREQUENCY

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 mild year round rainfall and four times per year (every three months Feb–Nov) in areas with summer rains and before and after the winter 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.

MAINTENANCE GUIDELINES

Empty the filter bag if 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 from the drainage structure. Dispose of the sediment or debris as directed by the engineer or maintenance contract in accordance with EPA guidelines.

As an alternative, an industrial vacuum may be used to collect the accumulated sediment. Remove any caked-on silt from the sediment bag and reverse flush the bag with medium spray for optimal filtration. Replace the bag if torn or punctured to ½" diameter or greater on the lower half of the bag. Post Construction PC/PC+ Bags should be maintained prior to 50% oil saturation. The average 2' x 2' PC filter bag will retain approx. 96 oz (5.4 lbs) of oil at which time it should be serviced or replaced. It can be centrifuged or passed through a wringer to recover the oils, and the fabric reused with 85% to 90% efficacy. It may also be recycled for its fuel value through waste to energy incineration. When utilizing the Cleartec Rubberizer Pouches in the + bags, note that these oil skimmers will gradually turn brown and solidify as they become saturated, indicating time for replacement. Each pouch will absorb approximately 62 oz (4 lbs) of oil before requiring replacement. The spent media may also be recycled for its fuel value through waste to energy incineration. Dispose of all oil contaminated products in accordance with EPA guidelines.

FILTER BAG REPLACEMENT

Remove the bag by loosening or cutting off the clamping band. Take the new filter bag, which is equipped with a stainless steel worm drive clamping band, and use a 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.

Lift Handles ease installation and maintenance

Replaceable Sediment Bag

1/8" thick steel hangers & channels; precision stampings **configured to fit each individual casting**

CAD drawings, work instructions and test reports on website: ***www.inletfilters.com***

For more information on FLEXSTORM Inlet Filters and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710
Try the ADS FLEXSTORM Online Product Configurator at www.inletfilters.com.

FLEXSTORM™ Inlet Filter Specifications and Work Instructions

Product: **FLEXSTORM Inlet Filters**

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

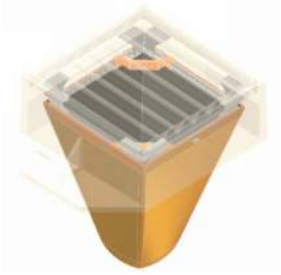
A subsidiary of **Advanced Drainage Systems (ADS)** www.ads-pipe.com

1.0 Description of Work:

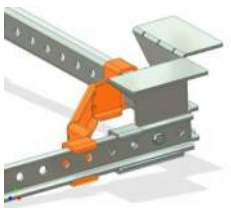
1.1 The work covered shall consist of supplying, installing, and maintaining/cleaning of the FLEXSTORM Inlet Filter assembly. The purpose of the FLEXSTORM Inlet Filter system is to collect silt and sediment from surface storm water runoff at drainage locations shown on the plans or as directed by the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

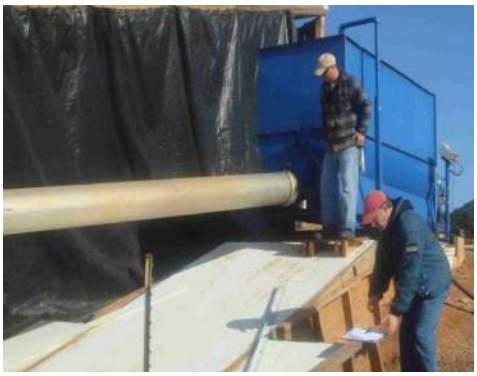
FLEXSTORM FILTER BAGS	(22" depth) STD Bag P/N	(12" depth) Short Bag P/N	Clean Water Flow Rate (GPM/SqFt)	Min A.O.S. (US Sieve)
FX: Standard Woven Bag	FX	FX-S	200	40
FX+: Woven w/ Oil Skimmer	FXP	FXP-S	200	40
FXO: Woven w/ Oil Boom	FXO	FXO-S	200	40
PC: Post Construction Bag	PC	PC-S	137	140
PC+: PC w/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

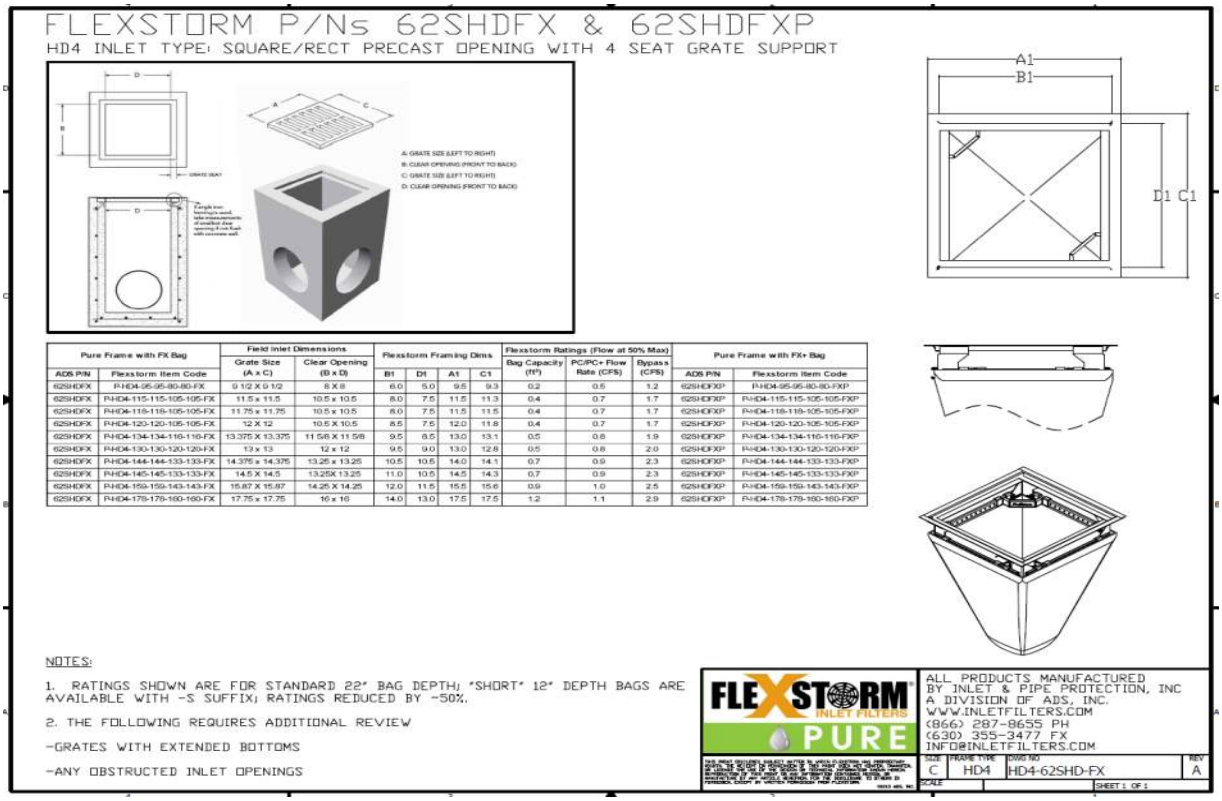
Product Tested	110 micron Sediment Load	Ave Flow Rate GPM	% TSS Removal	Soil Retention Efficiency
FLEXSTORM PC Sediment Bag	1750 mg/L using OK-110 Silica Sand and Clean Water	23	**99.28%**	98.96%
		48	**99.32%**	99.25%
		70	**98.89%**	98.80%

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	
ADS P/N	Flexstorm Item Code	Grate Size (A x C)	Clear Opening (B x D)	B1	D1	A1	C1	Bag Capacity (ft³)	PC/PC+ Flow Rate (CFS)	Bypass (CFS)	ADS P/N	Flexstorm Item Code
62SHDFX	FHD4-95-95-80-80-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	FHD4-95-95-80-80-FXP
62SHDFX	FHD4-115-115-105-105-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	FHD4-115-115-105-105-FXP
62SHDFX	FHD4-118-118-105-105-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	FHD4-118-118-105-105-FXP
62SHDFX	FHD4-120-120-105-105-FX	12 X 12	10.5 X 10.5	8.5	7.5	12.0	11.8	0.4	0.7	1.7	62SHDFXP	FHD4-120-120-105-105-FXP
62SHDFX	FHD4-134-134-116-116-FX	13.375 X 13.375	11.58 X 11.58	9.5	8.5	13.0	13.1	0.5	0.8	1.9	62SHDFXP	FHD4-134-134-116-116-FXP
62SHDFX	FHD4-130-130-120-120-FX	13 x 13	12 x 12	9.5	9.0	13.0	12.8	0.5	0.8	2.0	62SHDFXP	FHD4-130-130-120-120-FXP
62SHDFX	FHD4-144-144-133-133-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	FHD4-144-144-133-133-FXP
62SHDFX	FHD4-145-145-133-133-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	FHD4-145-145-133-133-FXP
62SHDFX	FHD4-159-159-143-143-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	FHD4-159-159-143-143-FXP
62SHDFX	FHD4-178-178-160-160-FX	17.75 x 17.75	16 x 16	14.0	13.0	17.5	17.5	1.2	1.1	2.9	62SHDFXP	FHD4-178-178-160-160-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:

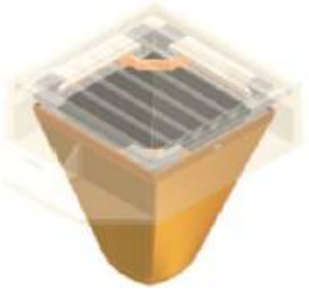
1. Empty the sediment bag if more than half filled with sediment and debris, or as directed.
2. Remove the grate, engage the lifting bars with the FLEXSTORM Removal Tool, and lift from drainage structure.
3. Dispose of sediment or debris as directed by the Engineer or Maintenance contract.
4. An industrial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

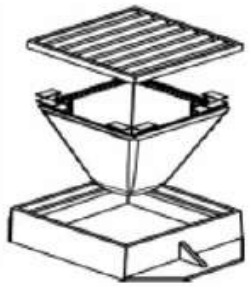
Post Construction PC Bag Maintenance:

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: **21120**
Project Name: **4078 Victoria Avenue**
Date: **25-Jan-23**

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

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 wood frame construction (structure essentially all combustible).
= 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 Area				(1)		(2)			(3)		(4)		Final Adjusted Fire Flow	
Building / Location	Footprint Area (m^2)	# of Storeys	**Total GFA (m^2)**	Type of Construction	***Fire Flow "F"*** (l/min)	(l/s)	***Occupancy*** %	Adjustment (l/min)	**Adjusted Fire Flow (l/min)**	***Sprinkler*** %	Adjustment (l/min)	***Exposure*** %	Adjustment (l/min)	**(l/min)**	**(l/s)**
Townhouse Block	**1045.0**	**1**	**1045**	**1.5**	11000	183.3	**-15**	-1650.0	**9350.0**	**0**	0.0	20	1870.0	**11000**	**183**

(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
30.1 to 45m	5%	exceed 75%

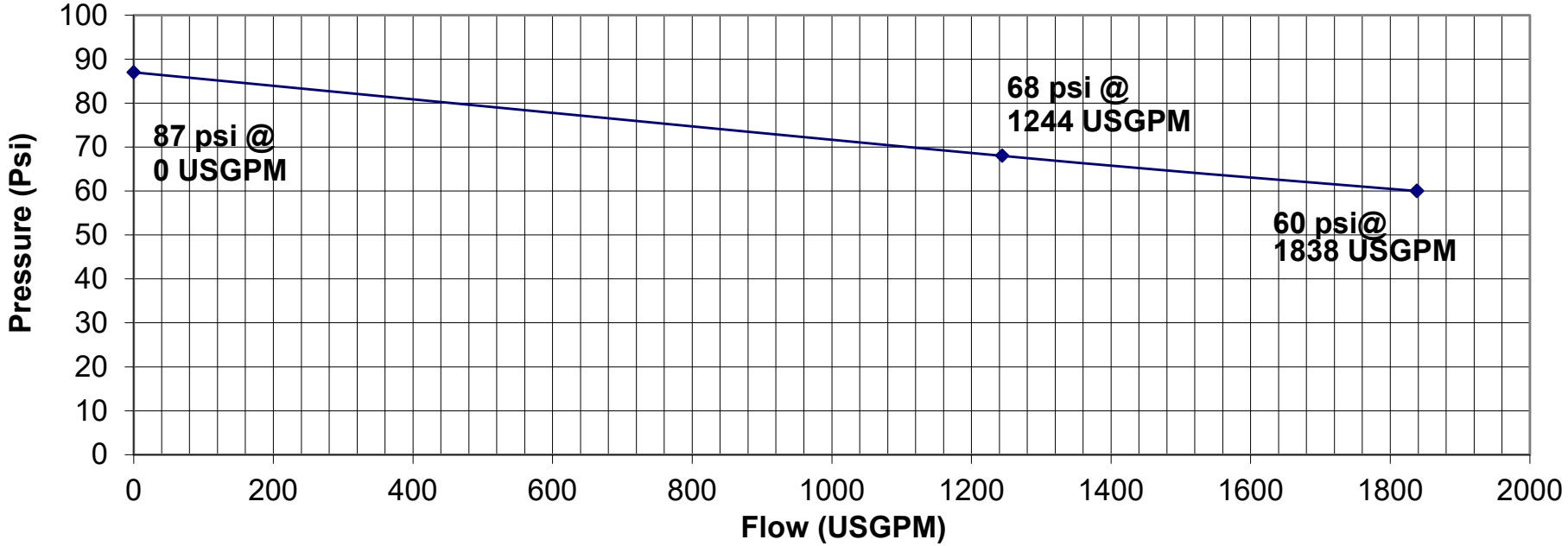
Side	Exposure (m)	Charge (%)
North =	**45m+**	**0**
South =	**45m+**	**0**
East =	**10.1 to 20m**	**15**
West =	**30.1 to 45m**	**5**
Total Expoure =		***20***

NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: Victoria & Leaders Lane

Static Pressure (Psi)		**Pitot Reading 1**	55	**# of Outlets Flowed 1**	1
	87	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	30	**# of Outlets Flowed 3**	2
	68	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	30	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	60	**Outlet Size 3**	2.5	87	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		68	1244
	60		1244.4	60	1838
		Flow 2 Calculated		60	1838
			1838.1	**Date & Time of Test :**	**July 25/2022**
Coefficient value		**Flow 3 Calculated**			**1:00pm**
	0.9		1838.1	**Performed by:**	Cam & Alex

Water Graph

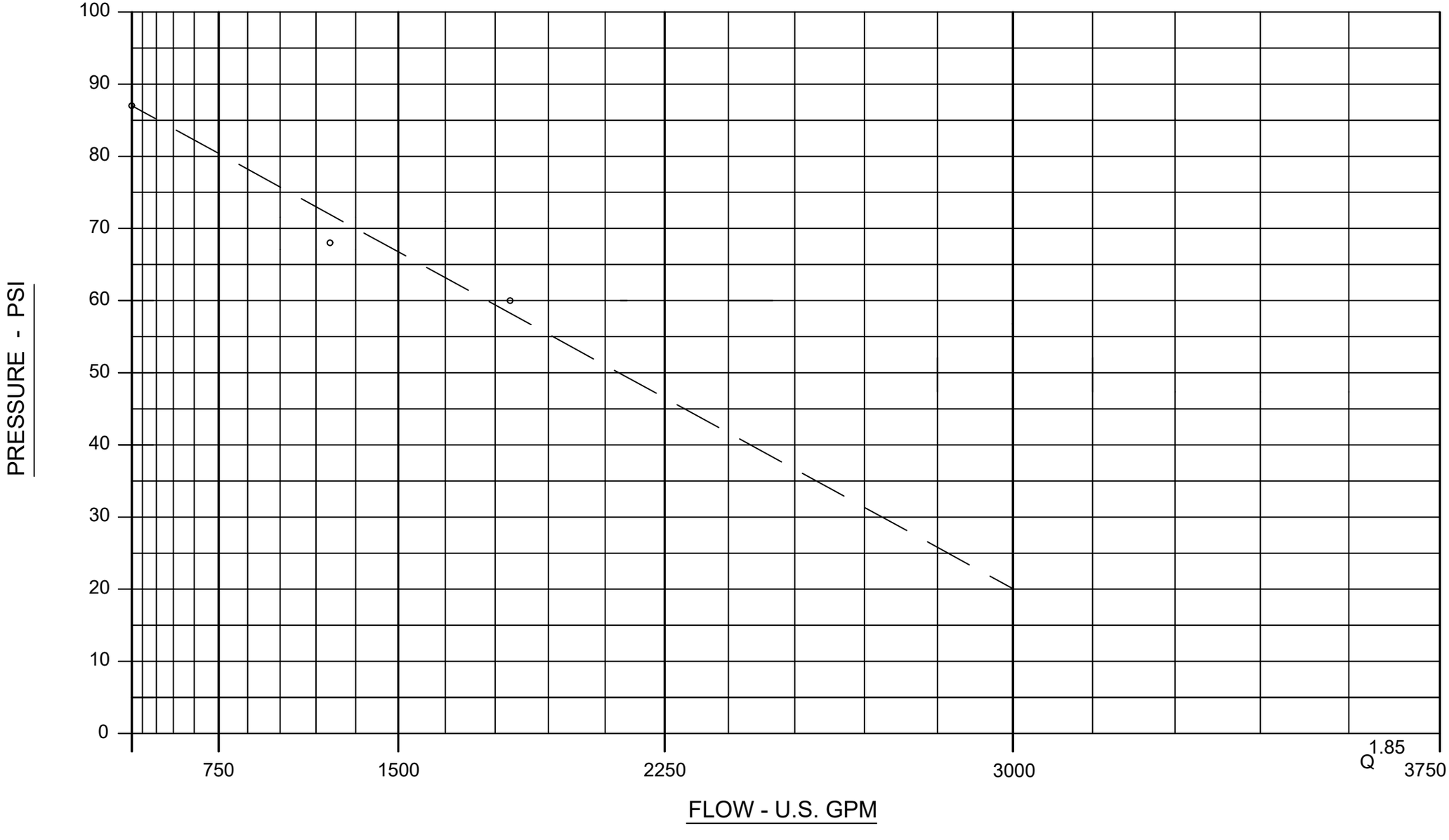


NRFP
Niagara Regional Fire Protection

NRFP FLOW TEST	DATE: 2022-07-25	TIME: 1:00PM
VICTORA & LEADERS LANE	OFFICE : NRFP	
MUNICIPALITY:	TEST BY : CAM & ALEX	
	HYDRANT COEFFICIENT: 0.9	

STATIC : 87 PSI
RES 1 : 68 PSI @ 1244 GPM
RES 2 : 60 PSI @ 1838 GPM

WATER SUPPLY MAX PROVEN FLOW: 1838 GPM
NOTE: GRAPH HAS BEEN EXTRAPOLATED
TO A RESIDUAL PRESSURE OF 20 PSI AT
3002 GPM AS PER NFPA 291 RECOMMENDATIONS



APPENDIX D
ENGINEERING PLANS

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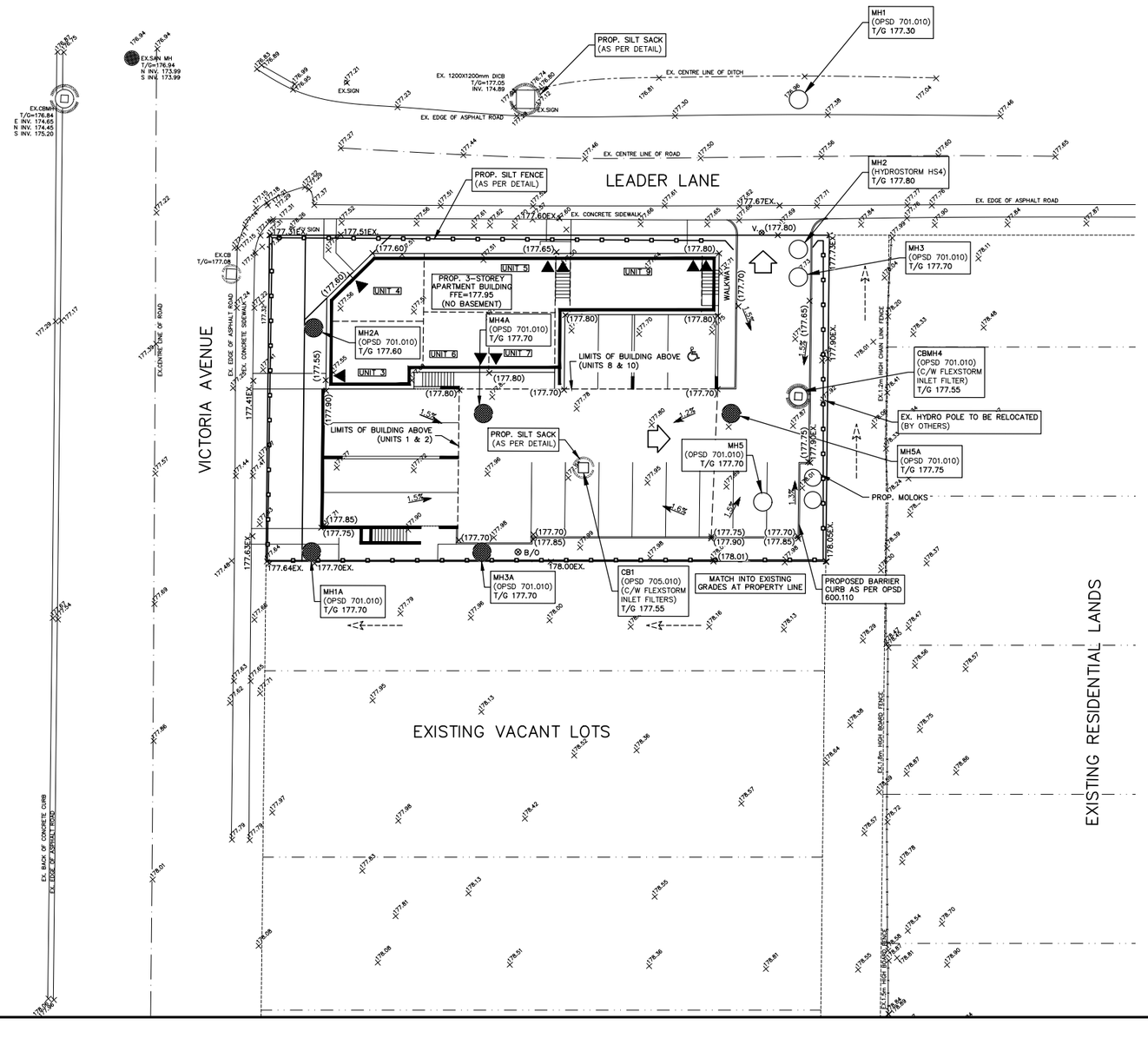
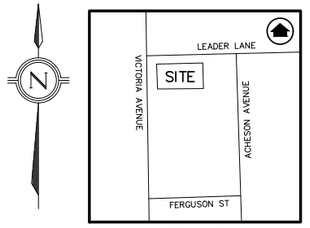




KEY MAP
N.T.S.

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
- EXISTING DIRECTION OF DRAINAGE
- PROPOSED OVERLAND FLOW ROUTE
- PROPOSED SILTATION CONTROL FENCE
- PROPOSED CATCHBASIN SILT SACK

BENCH MARK NOTE:
BENCHMARK: 001192202557

TOWNSHIP: NIAGARA FALLS CONCRETE RETAINING WALL AT WEST SIDE OF RIVER ROAD, IMMEDIATELY SOUTH OF GLEN VIEW AVENUE, 0.8 KM NORTH OF C.N.R STEEL ARCH BRIDGE, BOLT IN EAST FACE OF WALL, 9.14 M FROM NORTH END, 30 CM ABOVE SIDEWALK.

ELEVATION=162.412 CGVD28:78

NOTE:
1. CONCRETE BARRIER CURB AS PER OPSD 600.110.
2. CONCRETE SIDEWALK AS PER OPSD 310.020.

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	SN	CHK'D	SN	DATE
DRAWN	MT	CHK'D	SN	Feb. 1, 2023

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

BUILD UP VICTORIA INC.
1101 QUEEN STREET WEST
TORONTO, ON M6J 1J1

PROJECT NAME

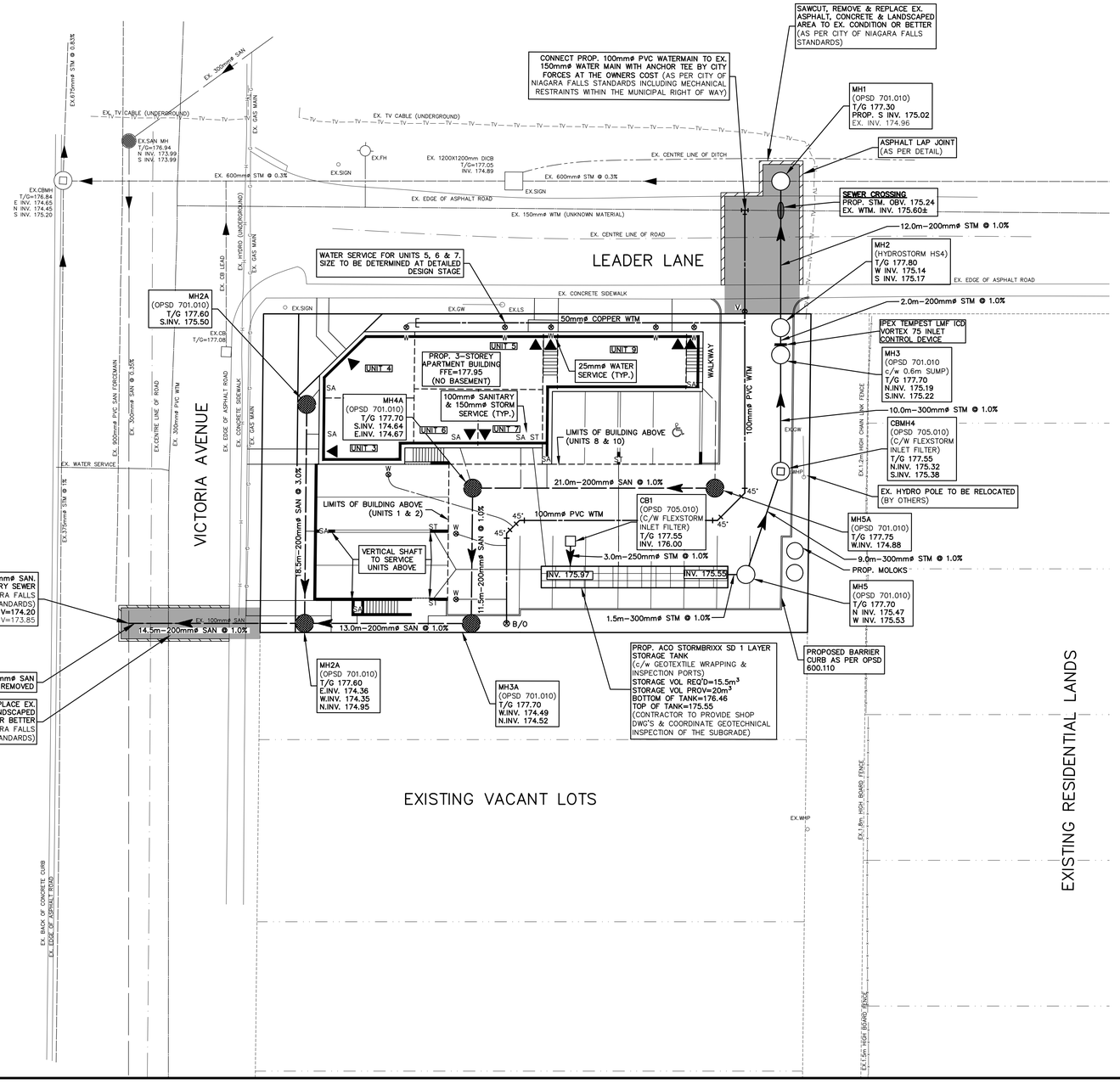
4078 VICTORIA AVENUE
NIAGARA FALLS, ON

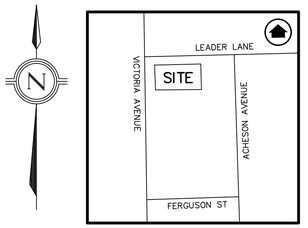
TITLE

PRELIMINARY GRADING AND EROSION CONTROL PLAN

PROJECT No.	DRAWING No.
21120	C101

S:\21120\WORKING\CURRENT\21120-Grading & Servicing Plan.dwg
Plotted: Wednesday, February 1, 2023 9:52:33 AM By: Scott Nelson





KEY MAP
N.T.S.

LEGEND:

- EXISTING CATCHBASIN
- EXISTING STORM/SANITARY MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED STORM/SANITARY MANHOLE
- PROPOSED CURB STOP/GATE VALVE
- PROPOSED ROAD RESTORATION
- SA —— 100mmø SANITARY SERVICE
- ST —— 150mmø STORM SERVICE
- W —— 25mmø WATER SERVICE

BENCH MARK NOTE:
BENCHMARK: 001192202557

TOWNSHIP: NIAGARA FALLS CONCRETE RETAINING WALL AT WEST SIDE OF RIVER ROAD, IMMEDIATELY SOUTH OF GLEN VIEW AVENUE, 0.8 KM NORTH OF C.N.R STEEL ARCH BRIDGE, BOLT IN EAST FACE OF WALL, 9.14 M FROM NORTH END, 30 CM ABOVE SIDEWALK.

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NOTE:
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2. CONCRETE SIDEWALK AS PER OPSD 310.020.

NOTE:
ROOF LEADERS FOR UNITS 3 & 4 TO SPLASH TO GRADE AT GRASSED AREA

DESIGN	SN	CHK'D	SN
DRAWN	MT	CHK'D	SN

DATE: Feb. 1, 2023

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

APPROVALS

STAMP

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CLIENT
BUILD UP VICTORIA INC.
1101 QUEEN STREET WEST
TORONTO, ON M6J 1J1

PROJECT NAME
4078 VICTORIA AVENUE
NIAGARA FALLS, ON

TITLE
PRELIMINARY SITE SERVICING PLAN

PROJECT No. 21120
DRAWING No. C102