S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Functional Servicing and Stormwater Management Report

236 PLAINS ROAD EAST

CORAL GABLE HOMES

Revised: March 2024
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SLA File: 23057

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

S. Llewellyn & Associates Limited has been retained by Coral Gable Homes to provide Consulting Engineering services for the proposed development at 236 Plains Road East in the City of Burlington, Region of Halton (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed development.

The proposed residential development consists of constructing one 3-storey townhouse block, consisting of 7 residential units. The proposed development will include a private asphalt roadway, driveways, concrete curb/sidewalk, and landscaped areas.

This Functional Servicing and Stormwater Management Report will provide detailed information on the proposed servicing scheme for the proposed residential development. Please refer to the site engineering plans prepared by S. Llewellyn and Associates Limited and the site plan prepared by MacKay, MacKay & Peters Limited 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: City of Burlington Standard Drawings (City of Burlington, March 2014)

Ref. 3: Halton Region Water and Wastewater Linear Design Manual (Halton Region, May 2014)

Ref. 4: Low Impact Development Stormwater Management Planning and Design Guide (Credit Valley Conservation Authority / Toronto and Region Conservation Authority, 2010)

Ref. 5: Stormwater Management Design Guidelines (City of Burlington, May 2021)

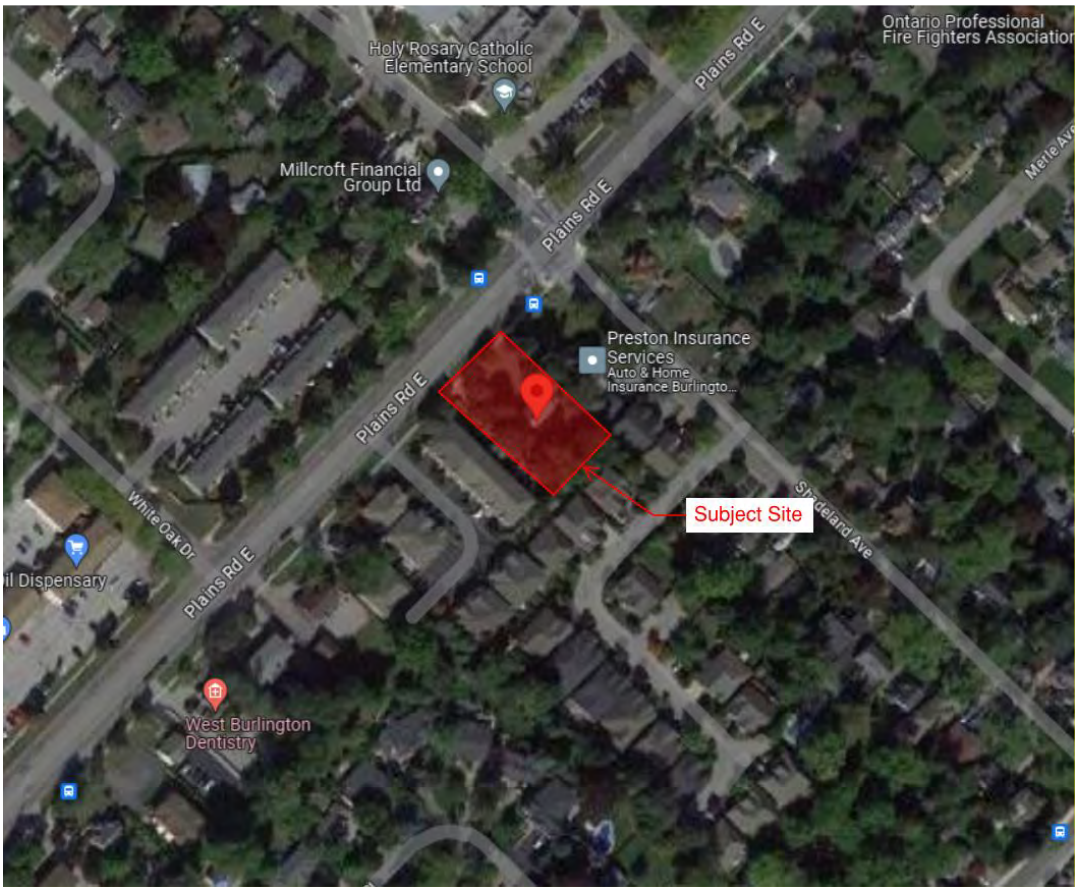


Figure 1.0 – Location Plan

2.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, in accordance with the City of Burlington, Region of Halton and Conservation Halton:

Quantity Control

The proposed condition discharge rates from the site will be controlled to the 5-year existing condition discharge rate during all storm events up to and including the 100-year storm. The existing condition site has been considered to consist of a maximum of 36% impervious areas in accordance with the current City of Burlington Stormwater Management Design Guidelines.

Quality Control

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

Water Balance

It is recommended to retain/infiltrate the first 5mm on site.

Erosion Control

The 25mm storm event is to be retained on site and released over a 24 to 48-hour period.

2.1 EXISTING CONDITIONS

In the existing condition, the 0.15 ha site consists of a residential single-family home with an asphalt driveway, patio area, and landscaped areas. The site is bounded by Plains Road East to the north, and existing residential lands to the east, west, and south. An existing 600mmø and 900mmø storm sewer fronts the subject site, flowing east along Plains Road East. Additionally, there is a 300mmø storm sewer flowing south on Shadeland Avenue fronting the neighboring property, east of the subject site.

Two catchment areas, Catchment 101 and EXT1 have been identified in the existing condition. Catchment 101 represents the catchment area, consisting of the subject site, which sheet drains southeast, through the neighboring property to Shadeland Avenue where stormwater is captured by existing catchbasins within the right-of-way and is conveyed to the existing 300mm diameter storm sewer on Shadeland Ave. See Table 2.1 below and the Pre-Development Storm Drainage Area in Appendix A for details.

Table 2.1 – Existing Conditions Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Runoff Coefficient
101	Uncontrolled to Shadeland Ave.	0.15	27%	0.43

An analysis was performed on Catchment 101 using the SWMHYMO hydrologic modeling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Burlington design storms. A summary of the results can be found in the Table 2.2 and detailed SWMHYMO input/output information can be found in Appendix A.

Table 2.2 – Existing Condition Site Discharge

Storm Event	Catchment 101 Discharge (m^3/s)
2-year	0.009
5-year	0.012
10-year	0.014
25-year	0.017
50-year	0.020
100-year	0.022

Allowable Discharge Rate

The subject site has been accounted for in the design of the existing storm sewer system on Plains Road East, see the West Burlington Storm Sewers plan (D-234-A) in Appendix A. The allowable discharge rate to Plains Road East is determined by the pre-development flow rate in the 5-year storm event. The allowable discharge rate to Plains Road East Avenue was calculated using the Rational Method based on the existing condition site characteristics, as per Catchment 101, a runoff coefficient of 0.43 (C=0.43) and an area of 0.15ha, and the City of Burlington's storm intensities at a time of concentration of 10 minutes (Tc=10min). See calculation below for the allowable discharge rate to Plains Road East.

$Q_{5\text{-yr (Allowable Discharge)}}$ = 2.78CiA=2.78(0.43)(101.31mm/hr)(0.15ha)
= ***18.2 l/s (0.0182 m^3/s)***

2.2 PROPOSED CONDITIONS

The proposed development consists of constructing one 3-storey townhouse block, consisting of 7 residential units. The proposed development will include a private asphalt road, asphalt driveways, concrete curb/sidewalk, and landscaped areas. It is proposed to service the site with a private storm sewer system, designed and constructed in accordance with the City of Burlington and Region of Halton standards.

Two (2) catchment areas, Catchment 201 and 202, have been identified in the proposed condition. Catchment 201 represents controlled drainage from the site to Plains Road East, which will be captured and controlled on site and is conveyed to the existing 600mmø storm sewer flowing east along Plains Road East. Catchment 202 represents the uncontrolled drainage from the site to Shadeland Avenue where it is captured by existing catchbasins within the right-of-way, maintaining the drainage pattern of Catchment 101. See Table 2.3 below and the Post-Development Storm Drainage Area Plan and storm sewer design sheet in Appendix A for details.

Table 2.3 – Proposed Condition Catchment Areas

Catchment ID	Description	Area (ha)	Percent Impervious	Runoff Coefficient
201	Controlled Drainage to Plains Road East	0.11	95%	0.89
202	Uncontrolled to Shadeland Ave.	0.04	0%	0.25

Water Quantity Control

It is proposed to apply quantity control measures to Catchment 201 by means of a 92mm ICD IPEX Vortex structure installed on the north invert of MH1 to restrict discharge from the subject site to the allowable 5-year pre-development discharge rate.

A 1-layer ACO StormBrixx SD stormwater management tank is proposed to provide 25m^3 beneath the proposed parking spaces to provide the required storage. The stage-storage-discharge characteristics can be seen in Table 2.4 below and Appendix A for details.

Table 2.4 – Proposed Condition Stage-Storage-Discharge (Catchment 201)			
Elevation (m)	Storage (m^3)	Discharge (m^3/s)	Comments
98.09	0	0.0000	Orifice Invert
98.45	0	0.0100	Bottom of Tank
98.75	8	0.0130	0.30m Deep
99.05	16	0.0170	0.60m Deep
99.36	25	0.0190	Top of Tank

The maximum discharge rates for Catchments 201 and 202 were calculated using SWMHYMO hydrologic modelling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Burlington 6-hour Chicago Design Storm. The proposed discharge rates and storage volumes are summarized in Tables 2.5 and 2.6, with details provided in Appendix A.

Table 2.5 – Proposed Condition Stormwater Discharge to Plains Road East			
Storm Event	Catchment 201 (Controlled) (m3/s)	Allowable Discharge (m3/s)	Required Storage (m3)
2-Year	0.0120	0.0182	6
5-Year	0.0140		11
10-Year	0.0150		12
25-Year	0.0170		15
50-Year	0.0170		18
100-Year	0.0180		21

Table 2.6 – Proposed Condition Stormwater Discharge to Shadeland Avenue		
Storm Event	Pre-Development Uncontrolled Discharge (Catchment 101) (m^3/s)	Post-Development Uncontrolled Discharge (Catchment 202) (m^3/s)
2-Year	0.0090	0.003
5-Year	0.0120	0.004
10-Year	0.0140	0.005
25-Year	0.0170	0.007
50-Year	0.0200	0.008
100-Year	0.0220	0.009

This analysis determined the following:

- The proposed condition discharge rates to Plains Road East will not exceed the allowable discharge rate in the 2-year to 100-year design storms, with the installation of a 92mm ICD IPEX Vortex structure on the north invert of MH1.

- The proposed condition discharge rates to Shadeland Avenue will not exceed the pre-development condition discharge rates during the 2-year to 100-year design storms.

- Catchment 201 requires 21m^3 of stormwater storage during the 100-year event, which can be accommodated by the proposed ACO StormBrixx SD underground stormwater management tank, having a proposed volume of 25m^3

Water Quality Control

The proposed development is required to achieve an "Enhanced" (90% TSS removal) level of water quality protection. To provide quality control, Catchment 201 will be subject to a treatment train consisting of FlexStorm Pure Inlet Filters within the proposed catchbasins, Enviropod LittaTrap catchbasin inserts, and a Hydroworks oil/grit separator. Runoff from Catchment 202 is considered clean since it only consists of grassed areas, and therefore does not require quality control.

The HydroStorm sizing software was used to determine the appropriate oil-grit separator size to treat the discharge controlled to the existing stormwater management channel. It was determined that a HydroStorm HS6 will provide 90% TSS removal and 99% average annual runoff treatment. See HydroStorm unit sizing procedures in Appendix C for details. The HydroStorm unit (HS6) has been certified under the NJDEP for a 50% removal credit. As such, the HS6 has been designed to achieve an 'Enhanced' (80% TSS Removal) level of stormwater quality control, but only credited for 50% TSS removal within the treatment train.

The treatment train mechanisms have been summarized in Table 2.7 below. In order to calculate the total TSS removal from the proposed development, the weighted average has been taken to calculate the cumulative TSS removal.

Table 2.7 – Proposed Condition Stormwater Treatment Train

Catchment	Drainage Area (ha)	Treatment Train Mechanism #1 (% TSS Removal)	Treatment Train Mechanism #2 (% TSS Removal)	Total TSS Removal [1] (%)
201	0.11	FlexStorm Inlet Fileters (52%)	HydroStorm HS5 (50%) [2]	76%

[1] Total TSS removal calculated using the following formula: R=A+B-[(AxB)/100], where R=total TSS removal rate, A=TSS removal rate for first mechanism, B=TSS removal rate for second mechanism.

The above analysis determined that the proposed development will be subject to a total of 90.0% TSS removal. To provide additional TSS Removal as part of the treatment train approach, the proposed catchbasins should be installed with the Enviropod LittaTrap catchbasin inserts to provide additional quality control.

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

Water Balance

As part of the stormwater management criteria for this development, 5mm of runoff volume from the site must be retained and infiltrated on site using accepted low-impact development practices. The required volume of stormwater storage and infiltration was calculated to be $8m^3$ (see Perforated Pipe System Calculations in Appendix A for details).

A perforated pipe system has been proposed to provide the required storage and infiltration. The design of this low-impact development strategy was undertaken in accordance with the specifications and recommendations provided by the Ministry of the Environment (Ref. 1) and the Credit Valley and Toronto Region Conservation Authorities (Ref. 5).

The perforated pipe system will be incorporated into 38.0m of storm sewer installations, which run from MH2 to MH3. The clear stone reservoir trench which encloses the perforated pipe has been sized to provide storage for the required volume of stormwater for infiltration. It has been determined that a 1.0m wide by 0.5m deep trench will provide $8m^3$ of storage, which meets the requirements for water balance. During larger storm events, runoff not accommodated in the perforated pipe system will overflow into the private storm sewer system and be conveyed downstream. See Perforated Pipe System Calculations in Appendix A and Site Servicing Plan for details.

To help maintain the long-term functionality of the proposed perforated pipe system, it is recommended by the CVC/TRCA to provide pre-treatment for the stormwater entering the system. To provide the above noted pre-treatment, it is proposed to install Enviropod LittaTrap catchbasin inserts within all catchbasins on the subject site to capture debris and sediment before entering the system. Please refer to the LittaTrap operations and maintenance guide included within Appendix C for details.

The soil surrounding the perforated pipe system consists of layers of silty sand based on the borehole information provided within the Geotechnical Investigation Report prepared by Niagara Testing and Inspection Limited for the proposed development. Based on the above noted report, a soil permeability of silty sand is assumed as 0.0017cm/s. See Appendix E for the Geotechnical Investigation.

To ensure a conservative stormwater management design is achieved on site, no quality or quantity control benefits of the perforated pipe system are incorporated into the quality or quantity control calculations.

Based on this information, the subject site has been designed to achieve the City of Burlington's water balance targets.

2.5 Erosion Control

The City of Burlington's criteria is to retain the 25mm storm event and to release it over a 24 to 48-hour period. Catchment 201 has an area of 0.11 ha, which will generate approximately 28m^3 of runoff volume respectively during the 25mm storm event. In order to discharge this volume over a 24 to 48-hour period, the discharge rate would need to be on average approximately 0.02-0.04l/s. An analysis was completed using a 75mmø orifice pipe (smallest recommended orifice size per City guidelines) for Catchment 201 resulting in a drawdown time of 1.1 hours. Given that adding a 75mmø orifice has no added benefit to the proposed storm drainage system, this has not been implemented in the proposed development. See Appendix A for drawdown calculations.

2.6 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 low end of the site to ensure that sediment does not migrate to the adjacent properties;
- Install sediment control (silt sacks) in the proposed catchbasins and area drains as well as the nearby existing catchbasins to ensure that no untreated runoff enters the existing conveyance system;
- Install a mud mat at the proposed construction entrance off of Plains Road East to prevent vehicles from tracking dirt off site.
- Stabilize all disturbed or landscaped areas with hydro seeding/sodding to minimize the opportunity for erosion.
- Dust control measures to prevent off site transport of fugitive dust emissions shall include one or more of the following;
    - Controlled drop height: unload truck beds and loader or excavator buckets slowly and at the lowest possible heights.
    - High winds restriction: where feasible, avoid or reduce earthmoving activities when local sustained wind speeds are in excess of 50km/hr.
    - Wet suppression – apply water to disturbed soil surfaces, backfill material, soil stockpiles and other dust generating operations as necessary and appropriate.
    - Soil retention – stabilize disturbed or exposed soil surface areas where construction is complete, in areas that will be inactive for more than 30 days, or while vegetation is being established.
    - Chemical stabilization – apply chemical stabilizer such as calcium chloride using manufacturer's recommended application rates.

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

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

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

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

3.0 SANITARY SEWER SERVICING

3.1 EXISTING CONDITIONS

There are two existing 250mmø sanitary sewers fronting the subject site, located on the north and south side of Plains Road East. Both sanitary sewers flow east along Plains Road East.

3.2 SANITARY DEMAND

Sanitary discharge from the subject site has been estimated in accordance with the Ontario Building Code (OBC) and Tables 3-1 Residential Dry Weather Flow and 3-2 Commercial, Industrial, and Community Dry Weather Flow of the 2019 Regional Municipality of Halton Water and Wastewater Linear Design Manual. Table 3.1 summarizes the sanitary sewer discharge rates from the proposed site.

Table 3.1 – Proposed Sanitary Sewer Discharge

Site Area (ha)	Population [A]	Avg. Demand [B] (l/s)	Peak Factor [C]	Infiltration [D] (l/s)	Peak Flow [E] (l/s)
0.15	21	0.07	4.4	0.04	**0.35**

[A] Population = 3 persons per unit x 7 units = 21 persons
[B] Based on a unit sewage flow of 275 lpcd (as per Table 3-1 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual).
[C] Based on the modified Harmon Formula (as per section 3.2.3 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual).
Peak Factor, $M = 1 + [14 / (4+P^{0.5})]$, where P is in thousands
[D] Based on an infiltration rate of 0.286 l/ha/s (as per Section 3.2.4 of the Regional Municipality of Halton Water and Wastewater Linear Design Manual).
[E] Peak Flow = (Avg. Demand x Peak Factor) + Infiltration

Based on the above, the estimate of sanitary demand for the townhouse development is: 0.35 l/s.

3.3 PROPOSED SANITARY SERVICING

The proposed site will be serviced by a 200mmø sanitary sewer, designed and constructed in accordance with City of Burlington and Region of Halton standards. Drainage from this sewer will discharge to the existing 250mmø sanitary sewer on the south side of Plains Road East.

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 grade of 1.0% is adequately sized to service the proposed development.

4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of a 300mmø watermain located on the north side of Plains Road East and a 400mmø watermain located on the south side of Plains Road East. There are two existing fire hydrants fronting the subject site off the existing 300mmø watermain on the north side of Plains Road East.

4.2 DOMESTIC WATER DEMAND

Total peak water usage for the site was derived below from the fixture unit count as per Table 7.4.10.5 of the Ontario Building Code. 100 fixture units are estimated for the proposed development, fixture units will be confirmed at the site plan application stage.

Total Fixture Unit Count = 100 FU
Water Usage = 53 IGPM (4.0 L/sec)

4.3 FIRE FLOW DEMAND

Fire flow demands for the proposed 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 Ontario Building Code (OBC) was used to determine the fire flow demand for the proposed development. The result of the OBC fire flow calculation was a minimum flow rate of 6300 L/min (105 L/sec). See Appendix D for OBC fire flow calculation sheet.

A hydrant flow test will be provided at the Site Plan Application stage to confirm the existing system has the required available fire flow to service the proposed development.

4.4 PROPOSED WATER SERVICING AND ANALYSIS

Proposed water servicing for the site consists of providing domestic flows by connecting a 150mmø watermain to the existing 300mmø watermain fronting the site on the north side of Plains Road East. No additional hydrants are proposed for this development. All proposed watermain and water services are to be designed and constructed in accordance with City of Burlington and Region of Halton standards.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development at 236 Plains Road East can be constructed to meet the requirements of the City of Burlington and Region of Halton. Therefore, it is recommended that:

- The development be graded and serviced in accordance with the Grading & Erosion Control Plan and the Site Servicing Plan prepared by S. Llewellyn & Associates Limited;
- A 92mmø ICD IPEX orifice vortex outlet be installed as per the Site Servicing Plan and this report to achieve effective stormwater quantity control;
- The driveway/parking lot be graded as per the Grading & Erosion Control Plan to provide sufficient stormwater surface storage;
- A Hydrostorm HS6, FlexStorm Inlet filters, and Enviropod LittaTrap catchbasin inserts be installed as per the Site Servicing Plan and this report to provide effective stormwater quality control;
- A perforated pipe be installed between MH2 and MH3 to provide satisfy City of Burlington water balance targets.
- Erosion and sediment controls be installed as described in this report and shown on the Grading & Erosion Control Plan prepared by S. Llewellyn & Associates Limited;
- The proposed sanitary and water servicing system be installed as per the Site Servicing Plan and this report to adequately service the proposed development.

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

Prepared by:

S. LLEWELLYN & ASSOCIATES LIMITED



A. Stiletto, E.I.T.

S. Llewellyn, P. Eng.

APPENDIX A

STORMWATER QUANTITY CONTROL INFORMATION

WEST BURLINGTON
STORM SEWERS

D-234-A

COOKE AVENUE
E PARK DR.
GROVE
PARK DRIVE
OLD ORCHARD ROAD
PLUMBTREE DR
MANORWOOD DRIVE
GALLAGHER'S ROAD
WHITE OAK DR.
DALEWOOD AVE.
BEDFORD AVE.
ST MATTHEWS AVENUE
GLENWOOD AVE
SHADELAND AVENUE
PLAINS RD.
PARKING AREA
GREENHOUSES
ORCHARD
OR.
PHASE

S:\23057\WORKING\CURRENT\23057- DAP.dwg

EX. 300ømm WTM (APPROX. LOCATION)

EX. HYD. (APPROX. LOCATION)

EX. 900mmø STORM @ 0.44%

STMMH
T SURVEYED)
PROX. LOCATION)
IV. 97.40±
IV. 97.40±

PLAINS ROAD EAST

EX. CENTRELINE OF ASPHALT

EX. CB
(NOT SURVEYED)
(APPROX. LOCATION)
T/G 99.85±

EX. 400ømm WTM

EX. 600mmø STORM @ 0.33%

EX. EDGE OF ASPHALT

EX. BC

EX. OHW

EX. WHP

EX. BELL

EX. BP

EX. ASPHALT DRIVEWAY

EX. CONCRETE SIDEWALK

EX. ø0.4 TREE

EX. 50mmø GAS MAIN

EX. SIGN

EX. ø0.6 TREE

EX. ø0.8 TREE

EX. GAS SERVICE

EX. STORM

EX. BOARD FENCE

EX. ø1.0 TREE

EX. INTERLOCKING STONE

EX. OL

EX. HYDRO

EX. STEPS

EX. PORCH

EX. 2-STOREY
BRICK BUILDING
F.F.E=100.11
#236

EX. 1-STOREY
VINYL ADDITION

EX. AIR
CONDITIONER

EX. CONCRETE RW

EX. BASEMENT ENTR.

EX. SEPTIC

EX. ø0.9 TREE

EX. METAL FENCE

EX. CONCRETE PAD

EX. WOOD SIDED
GARAGE

EX. ø0.4 TREE

EX. ø0.5 TREE

EX. ø0.25 TREE

EX. GATE

EX. STONE RW

EX. STUCCO
GARAGE

EX. 2-STOREY
BRICK BUILDING
F.F.E=100.16/100.05
#242

MULTIPLE UNIT
2 STOREY
BRICK BUILDING

101
0.15
27
0.43

LEGEND

201 — DRAINAGE AREA I.D.

14.60 — DRAINAGE AREA (ha)

77 — PERCENT IMPERVIOUS

0.75 — RUNOFF COEFFICENT

DRAINAGE BOUNDARY

PRE-DEVELOPMENT DRAINAGE AREA PLAN

SCALE: 1:300

PROJECT: 236 PLAINS ROAD EAST, BURLINGTON, ON
PROJECT No.: 23057

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11/16/2023 11:37:28 AM - Alyssa Stiletto

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STMMH
T SURVEYED)
PROX. LOCATION)
V. 97.40±
V. 97.40±

EX. HYD. (APPROX. LOCATION)

PLAINS ROAD EAST

EX. CENTRELINE OF ASPHALT

EX. CB
(NOT SURVEYED)
(APPROX. LOCATION)
T/G 99.85±

EX. EDGE OF ASPHALT
EX. BC
EX. BC
EX. ASPHALT DRIVEWAY
EX. OHW
EX. WHP
EX. OHW
EX. BELL
EX. BELL
EX. BP
EX. CONCRETE SIDEWALK
EX. CONCRETE SIDEWALK
EX. 50mmø GAS MAIN
ESTABLISHED AS PUBLIC HIGHWAY BY BY-LAW 130-1980, INST. NO. 530140
EX. SIGN
X. ASPHALT DR
EX. GAS SERVICE
EX. INTERLOCKING STONE
EX. OL
EX. HYDRO
EX. ASPHALT DRIVEWAY
MULTIPLE UNIT
2 STOREY
BRICK BUILDING
201
0.11
95
0.89
#236
EX. 1-STOREY VINYL ADDITION
EX. AIR CONDITIONER
STEPS
EX. BASEMENT ENTRY
EX. CONCRETE RW
EX. ASPHALT DRIVEWAY
EX. SEPTIC
EX. HYDRO
EX. CONCRETE PAD
EX. WOOD SIDED GARAGE
EX. 2-STOREY
BRICK BUILDING
F.F.E=100.16/100.05
#242
EX. OHW
EX. WHP
EX. OHW
EX. STONE RW
EX. CONCRETE PAD
EX. STUCCO GARAGE
202
0.04
0
0.25

LEGEND

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

DRAINAGE BOUNDARY

POST-DEVELOPMENT DRAINAGE AREA PLAN

SCALE: 1:300

PROJECT: 236 PLAINS ROAD EAST, BURLINGTON, ON
PROJECT No.: 23057

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3/28/2024 2:02:05 PM - Alyssa Stiletto

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CONSULTING ENGINEERS

STAGE-STORAGE-DISCHARGE CALCULATIONS

Catchment 201
Outlet Device No. 1 (Quantity)

Type: 92mm ICD IPEX Vortex Structure — See Tempest Flow Curve for Discharge rate
Diameter (mm)
Area (m^2)
Invert Elev. (m) 98.09
C/L Elev. (m) 98.09
Disch. Coeff. (C_d)
Discharge (Q) =
Number of Orifices: 1

		SWM Volumes						Outlet No. 1	
	Elevation m	Area m^2	Tank Incremental Volume	Additional Incremental Underground	Additional Incremental Surface m^3	Cumulative Volume m^3	Active Storage Volume m^3	H m	Discharge m^3/s
Orifice Invert	98.09	0	0	0.0	0	0	0	0.000	0.0000
Bottom of Tank	98.45	28	0	0.0	0	0	0	0.360	0.0100
0.3m deep	98.75	28	8	0.0	0	8	8	0.660	0.0130
0.6m deep	99.05	28	8	0.0	0	16	16	0.960	0.0170
Top of Tank	99.36	28	8	0.0	0	25	25	1.270	0.0190

IPEX

TEMPEST INLET CONTROL DEVICES

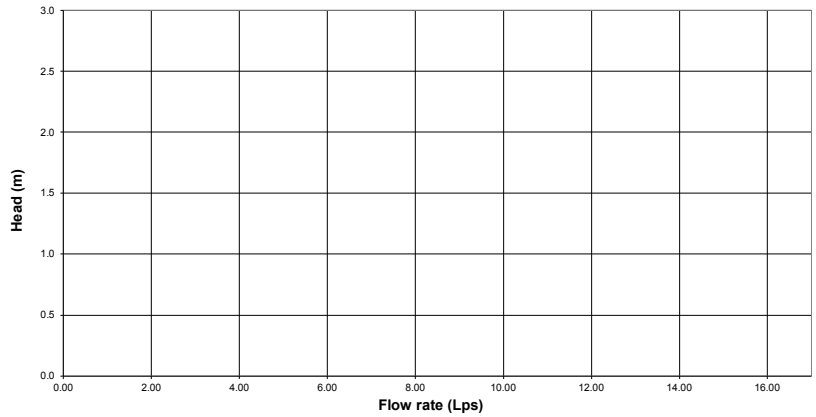
Flow Parameters

Head (m)	1.27
Flow (Lps)	19

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.

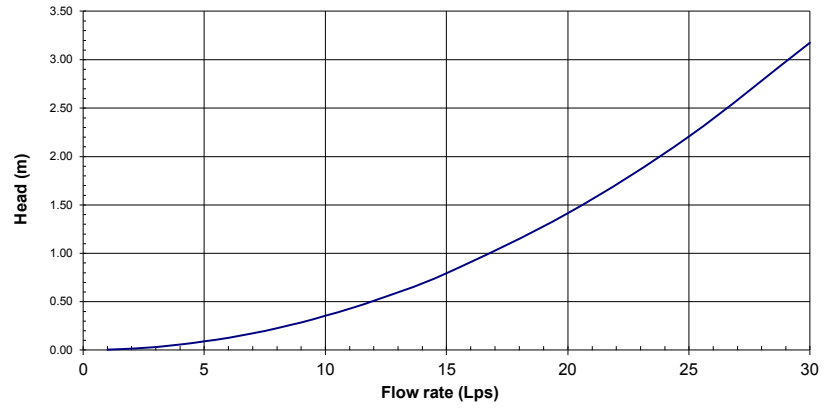
TEMPEST LMF flow curve

#1



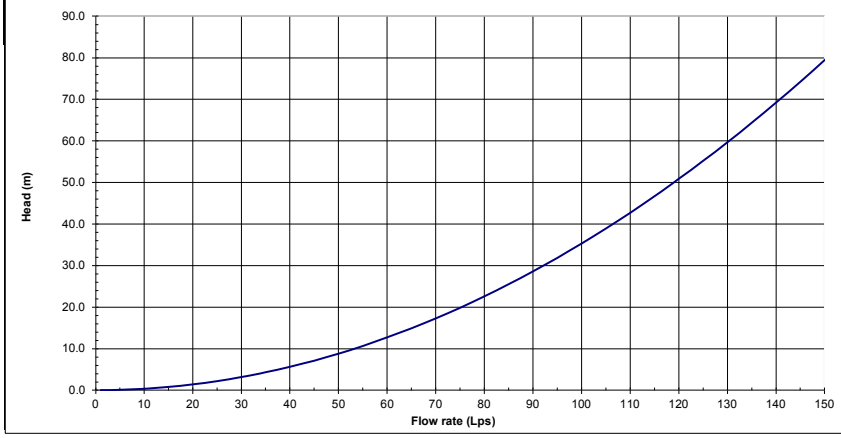
TEMPEST HF, HF Sump & MHF flow curve (For flow rates <30 Lps)

#2



TEMPEST HF flow curve

#3



NOTE: GRAPH #3 IS AN EXPANDED VERSION OF GRAPH #2
TO BE USED FOR FLOW RATES ABOVE 30 Lps.

The following results are best estimates and subject to change upon review by an IPEX design representative.

Volume III: TEMPEST INLET CONTROL DEVICES



Municipal Technical Manual Series

SECOND EDITION

LMF (Low to Medium Flow) ICD

HF (High Flow) ICD

MHF (Medium to High Flow) ICD

IPEX
by aliaxis

IPEX Tempest™ Inlet Control Devices

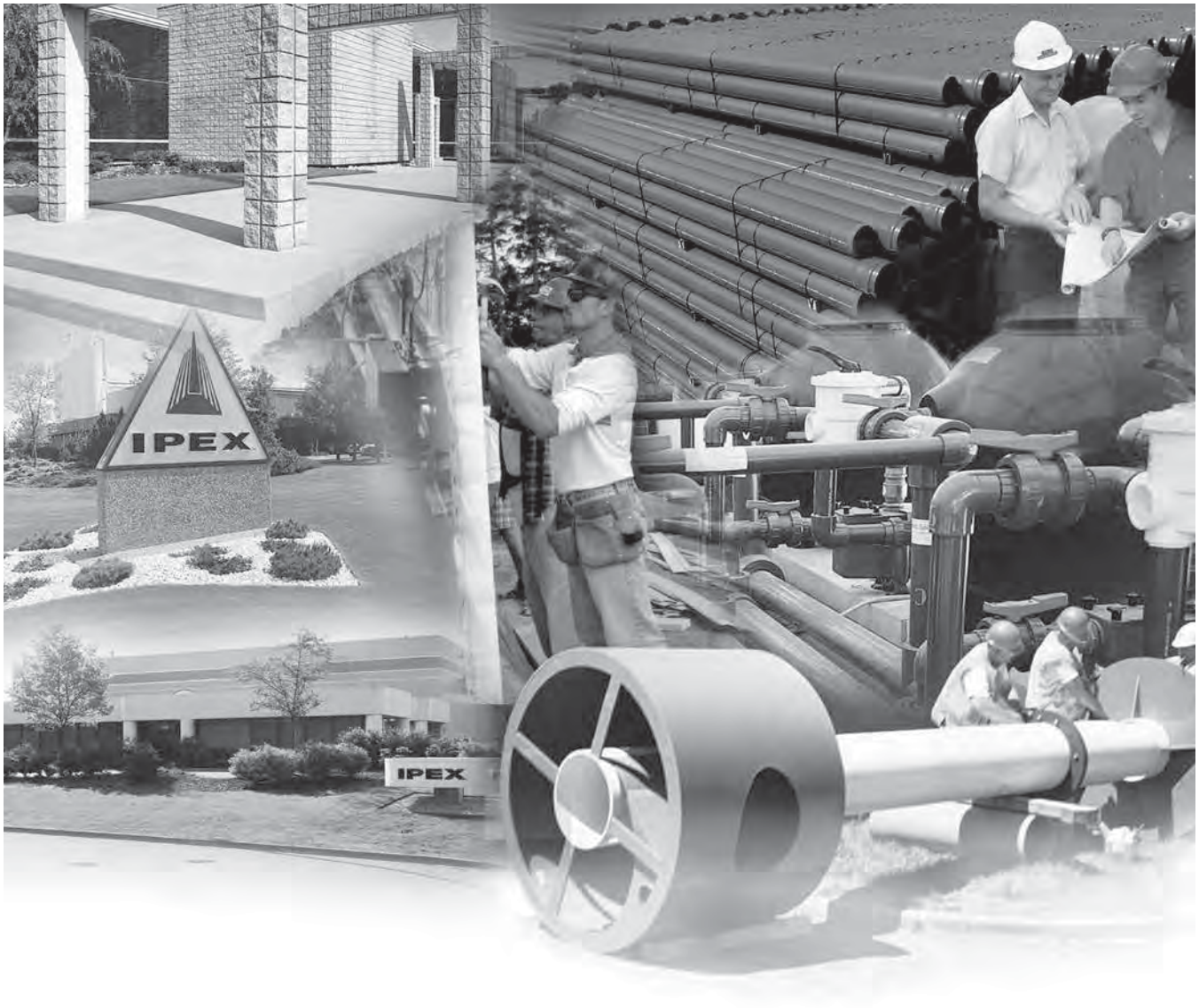
Municipal Technical Manual Series

Vol. I, 2nd Edition

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For information contact: IPEX, Marketing,
1425 North Service Road East, Oakville, Ontario, Canada, L6H 1A7

The information contained here within is based on current information and product design at the time of publication and is subject to change without notification. IPEX does not guarantee or warranty the accuracy, suitability for particular applications, or results to be obtained therefrom.



ABOUT IPEX

At IPEX, we have been manufacturing non-metallic pipe and fittings since 1951. We formulate our own compounds and maintain strict quality control during production. Our products are made available for customers thanks to a network of regional stocking locations throughout North America. We offer a wide variety of systems including complete lines of piping, fittings, valves and custom-fabricated items.

More importantly, we are committed to meeting our customers' needs. As a leader in the plastic piping industry, IPEX continually develops new products, modernizes manufacturing facilities and acquires innovative process technology. In addition, our staff take pride in their work, making available to customers their extensive thermoplastic knowledge and field experience. IPEX personnel are committed to improving the safety, reliability and performance of thermoplastic materials. We are involved in several standards committees and are members of and/or comply with the organizations listed on this page.

For specific details about any IPEX product, contact our customer service department.

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TEMPEST INLET CONTROL DEVICES Technical Manual

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NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

PRODUCT INFORMATION: TEMPEST LOW, MEDIUM FLOW (LMF) ICD

Purpose

To control the amount of storm water runoff entering a sewer system by allowing a specified flow volume out of a catch basin or manhole at a specified head. This approach conserves pipe capacity so that catch basins downstream do not become uncontrollably surcharged, which can lead to basement floods, flash floods and combined sewer overflows.

Product Description

Our LMF ICD is designed to accommodate catch basins or manholes with sewer outlet pipes 6" in diameter and larger. Any storm sewer larger than 12" may require custom modification. However, IPEX can custom build a TEMPEST device to accommodate virtually any storm sewer size.

Available in 14 preset flow curves, the LMF ICD has the ability to provide flow rates: 2lps – 17lps (31gpm – 270gpm)

Product Function

The LMF ICD vortex flow action allows the LMF ICD to provide a narrower flow curve using a larger orifice than a conventional orifice plate ICD, making it less likely to clog. When comparing flows at the same head level, the LMF ICD has the ability to restrict more flow than a conventional ICD during a rain event, preserving greater sewer capacity.

Product Construction

Constructed from durable PVC, the LMF ICD is light weight 8.9 Kg (19.7 lbs).

Product Applications

Will accommodate both square and round applications:

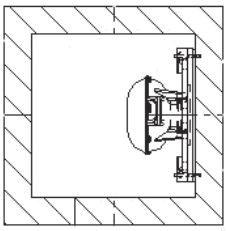


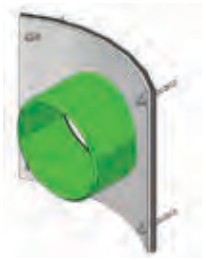
Square Application

Round Application



Universal Mounting Plate





+

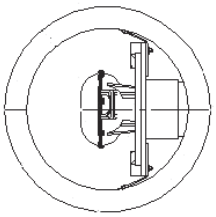


Spigot CB Wall Plate

=



Universal Mounting Plate Hub Adapter



NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

Chart 1: LMF 14 Preset Flow Curves

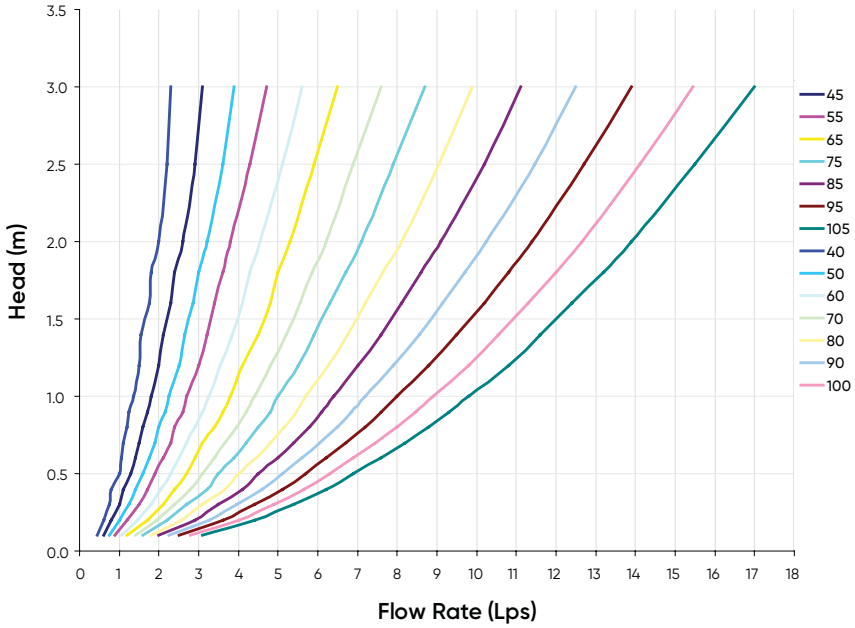
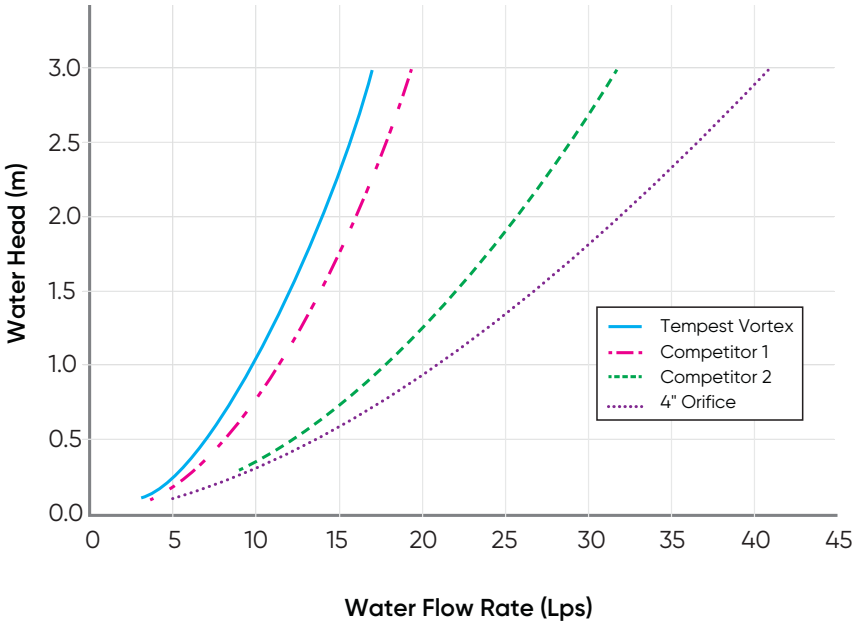


Chart 2: LMF Flow vs. ICD Alternatives



NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

PRODUCT INSTALLATION

Instructions to assemble a TEMPEST LMF ICD into a Square Catch Basin:

STEPS:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers, (4) nuts, universal mounting plate, ICD device.
2. Use the mounting wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a minimum of 1-1/2" depth up to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you hit the anchors with the hammer. Remove the nuts from the ends of the anchors.
5. Install the universal mounting plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the wall mounting plate and the catch basin wall.
6. From the ground above using a reach bar, lower the ICD device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the universal mounting plate and has created a seal.

⚠ WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- Call your IPEX representative for more information or if you have any questions about our products.

Instructions to assemble a TEMPEST LMF ICD into a Round Catch Basin:

STEPS:

1. Materials and tooling verification.
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers and (4) nuts, spigot CB wall plate, universal mounting plate hub adapter, ICD device.
2. Use the spigot catch basin wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a depth between 1-1/2" to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you hit the anchors with the hammer. Remove the nuts from the ends of the anchors.
5. Install the CB spigot wall plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the spigot wall plate and the catch basin wall.
6. Apply solvent cement on the hub of the universal mounting plate, hub adapter and the spigot of the CB wall plate, then slide the hub over the spigot. Make sure the universal mounting plate is at the horizontal and its hub is completely inserted onto the spigot. Normally, the corners of the universal mounting plate hub adapter should touch the catch basin wall.
7. From ground above using a reach bar, lower the ICD device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the mounting plate and has created a seal.

⚠ WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut back the pipe flush to the catch basin wall.
- The solvent cement which is used in this installation is to be approved for PVC.
- The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at ipexna.com.
- Call your IPEX representative for more information or if you have any questions about our products.

NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

PRODUCT TECHNICAL SPECIFICATION

General

Inlet control devices (ICD's) are designed to provide flow control at a specified rate for a given water head level and also provide odour and floatable control. All ICD's will be IPEX Tempest or approved equal.

All devices shall be removable from a universal mounting plate. An operator from street level using only a T-bar with a hook will be able to retrieve the device while leaving the universal mounting plate secured to the catch basin wall face. The removal of the TEMPEST devices listed above must not require any unbolting or special manipulation or any special tools.

High Flow (HF) Sump devices will consist of a removable threaded cap which can be accessible from street level with out entry into the catchbasin (CB). The removal of the threaded cap shall not require any special tools other than the operator's hand.

ICD's shall have no moving parts.

Materials

ICD's are to be manufactured from Polyvinyl Chloride (PVC) or Polyurethane material, designed to be durable enough to withstand multiple freeze-thaw cycles and exposure to harsh elements.

The inner ring seal will be manufactured using a Buna or Nitrile material with hardness between Duro 50 and Duro 70.

The wall seal is to be comprised of a 3/8" thick Neoprene Closed Cell Sponge gasket which is attached to the back of the wall plate.

All hardware will be made from 304 stainless steel.

Dimensioning

The Low Medium Flow (LMF), High Flow (HF) and the High Flow (HF) Sump shall allow for a minimum outlet pipe diameter of 200mm with a 600mm deep Catch Basin sump.

Installation

Contractor shall be responsible for securing, supporting and connecting the ICD's to the existing influent pipe and catchbasin/manhole structure as specified and designed by the Engineer.

NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

PRODUCT INFORMATION: TEMPEST HF & MHF ICD

Product Description

Our HF, HF Sump and MHF ICD's are designed to accommodate catch basins or manholes with sewer outlet pipes 6" in diameter or larger. Any storm sewer larger than 12" may require custom modification. However, IPEX can custom build a TEMPEST device to accommodate virtually any storm sewer size.

Available in 5 preset flow curves, these ICDs have the ability to provide constant flow rates: 9lps (143 gpm) and greater

Product Function



TEMPEST HF (High Flow): designed to manage moderate to higher flows 15 L/s (240 gpm) or greater and prevent the propagation of odour and floatables. With this device, the cross-sectional area of the device is larger than the orifice diameter and has been designed to limit head losses. The HF ICD can also be ordered without flow control when only odour and floatable control is required.



TEMPEST HF (High Flow) Sump: The height of a sewer outlet pipe in a catch basin is not always conveniently located. At times it may be located very close to the catch basin floor, not providing enough sump for one of the other TEMPEST ICDs with universal back plate to be installed. In these applications, the HF Sump is offered. The HF Sump offers the same features and benefits as the HF ICD; however, is designed to raise the outlet in a square or round catch basin structure. When installed, the HF sump is fixed in place and not easily removed. Any required service to the device is performed through a clean-out located in the top of the device which can be often accessed from ground level.



TEMPEST MHF (Medium to High Flow): The MHF plate or plug is designed to control flow rates 9 L/s (143 gpm) or greater. It is not designed to prevent the propagation of odour and floatables.

Product Construction

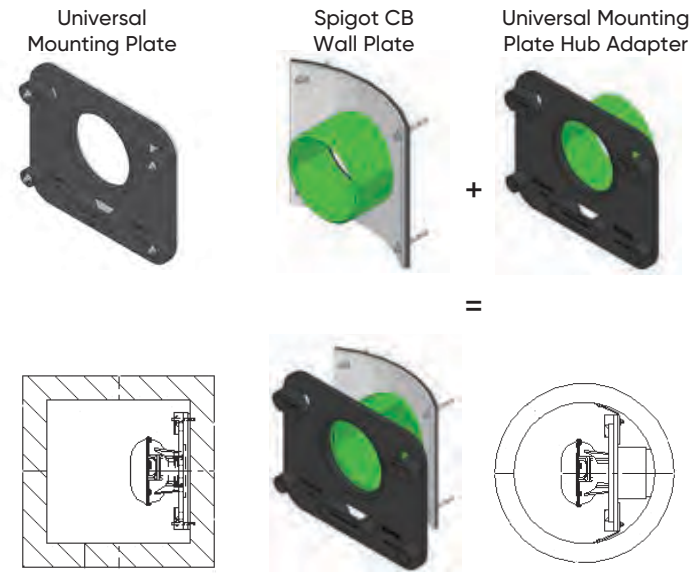
The HF, HF Sump and MHF ICDs are built to be light weight at a maximum weight of 6.8 Kg (14.6 lbs).

Product Applications

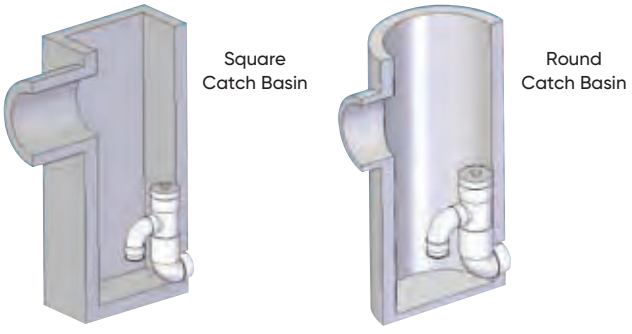
The HF and MHF ICD's are available to accommodate both square and round applications:



Square Application **Round Application**

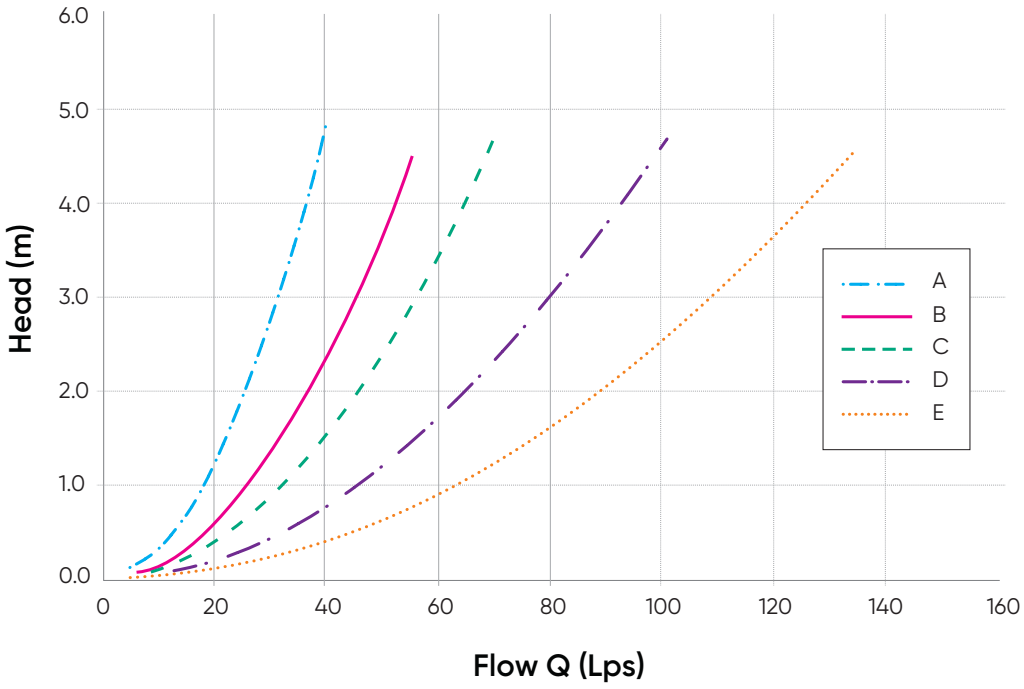


The HF Sump is available to accommodate low to no sump applications in both square and round catch basins:



NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

Chart 3: HF & MHF Preset Flow Curves



NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

PRODUCT INSTALLATION

Instructions to assemble a TEMPEST HF or MHF ICD into a Square Catch Basin:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers, (4) nuts, universal mounting plate, ICD device
2. Use the mounting wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a minimum of 1-1/2" depth up to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you hit the anchors with the hammer. Remove the nuts from the ends of the anchors.
5. Install the universal wall mounting plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the wall mounting plate and the catch basin wall.
6. From the ground above using a reach bar, lower the device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the universal wall mounting plate and has created a seal.

⚠ WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- Call your IPEX representative for more information or if you have any questions about our products.

Instructions to assemble a TEMPEST HF or MHF ICD into a Round Catch Basin:

STEPS:

1. Materials and tooling verification.
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers and (4) nuts, spigot CB wall plate, universal mounting plate hub adapter, ICD device.
2. Use the round catch basin spigot adaptor to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a depth between 1-1/2" to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you hit the anchors with the hammer. Remove the nuts from the ends of the anchors.
5. Install the spigot CB wall plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the spigot CB wall plate and the catch basin wall.
6. Put solvent cement on the hub of the universal mounting plate, hub adapter and the spigot of the CB wall plate, then slide the hub over the spigot. Make sure the universal mounting plate is at the horizontal and its hub is completely inserted onto the spigot. Normally, the corners of the hub adapter should touch the catch basin wall.
7. From ground above using a reach bar, lower the device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the wall mounting plate and has created a seal.

⚠ WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- The solvent cement which is used in this installation is to be approved for PVC.
- The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at www.ipexinc.com.
- Call your IPEX representative for more information or if you have any questions about our products.

NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

Instructions to assemble a TEMPEST HF Sump into a Square or Round Catch Basin:

STEPS:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, mastic tape and metal strapping
   - Material: (2) concrete anchor 3/8 x 3-1/2, (2) washers, (2) nuts, HF Sump pieces (2).
2. Apply solvent cement to the spigot end of the top half of the sump. Apply solvent cement to the hub of the bottom half of the sump. Insert the spigot of the top half of the sump into the hub of the bottom half of the sump.
3. Install the 8" spigot of the device into the outlet pipe. Use the mastic tape to seal the device spigot into the outlet pipe. You should use a level to be sure that the fitting is standing at the vertical.
4. Use an impact drill with a 3/8" concrete bit to make a series of 2 holes along each side of the body throat. The depth of the hole should be between 1-1/2" to 2-1/2". Clean the concrete dust from the 2 holes.
5. Install the anchors (2) in the holes by using a hammer. Put the nuts on the top of the anchors to protect the threads when you hit the anchors. Remove the nuts from the ends of the anchors.
6. Cut the metal strapping to length and connect each end of the strapping to the anchors. Screw the nuts in place with a maximum torque of 40 N.m (30 lbf-ft). The device should be completely flush with the catch basin wall.

⚠ WARNING

- **Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.**
- **The solvent cement which is used in this installation is to be approved for PVC.**
- **The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at www.ipexinc.com.**
- **Call your IPEX representative for more information or if you have any questions about our products.**

PRODUCT TECHNICAL SPECIFICATION

General

Inlet control devices (ICD's) are designed to provide flow control at a specified rate for a given water head level and also provide odour and floatable control where specified. All ICD's will be IPEX Tempest or approved equal.

All devices shall be removable from a universal mounting plate. An operator from street level using only a T-bar with a hook shall be able to retrieve the device while leaving the universal mounting plate secured to the catch basin wall face. The removal of the TEMPEST devices listed above shall not require any unbolting or special manipulation or any special tools.

High Flow (HF) Sump devices shall consist of a removable threaded cap which can be accessible from street level with out entry into the catchbasin (CB). The removal of the threaded cap shall not require any special tools other than the operator's hand.

ICD's shall have no moving parts.

Materials

ICD's are to be manufactured from Polyvinyl Chloride (PVC) or Polyurethane material, designed to be durable enough to withstand multiple freeze-thaw cycles and exposure to harsh elements.

The inner ring seal will be manufactured using a Buna or Nitrile material with hardness between Duro 50 and Duro 70.

The wall seal is to be comprised of a 3/8" thick Neoprene Closed Cell Sponge gasket which is attached to the back of the wall plate.

All hardware will be made from 304 stainless steel.

Dimensioning

The Low Medium Flow (LMF), High Flow (HF) and the High Flow (HF) Sump shall allow for a minimum outlet pipe diameter of 200mm with a 600mm deep Catch Basin sump.

Installation

Contractor shall be responsible for securing, supporting and connecting the ICD's to the existing influent pipe and catchbasin/manhole structure as specified and designed by the Engineer.

NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

NOTES

NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

SALES AND CUSTOMER SERVICE

IPEX Inc.
Toll Free: (866) 473-9462
ipexna.com

About the IPEX Group of Companies

As leading suppliers of thermoplastic piping systems, the IPEX Group of Companies provides our customers with some of the largest and most comprehensive product lines. All IPEX products are backed by more than 50 years of experience. With state-of-the-art manufacturing facilities and distribution centers across North America, we have established a reputation for product innovation, quality, end-user focus and performance.

Markets served by IPEX group products are:

- Electrical systems
- Telecommunications and utility piping systems
- PVC, CPVC, PP, ABS, PEX, FR-PVDF and PE pipe and fittings (1/4" to 48")
- Industrial process piping systems
- Municipal pressure and gravity piping systems
- Plumbing and mechanical piping systems
- PE Electrofusion systems for gas and water
- Industrial, plumbing and electrical cements
- Irrigation systems

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A policy of ongoing product improvement is maintained. This may result in modifications of features and/or specifications without notice.

IPEX by aliaxis

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236 Plains Road East
Burlington, ON

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

PERFORATED PIPE SYSTEM CALCULATIONS

Required Storage/Infiltration

Site Area (m^2)	1500
Rainfall Depth (mm)	5
Required Storage/Infiltration (m^3)	**8**

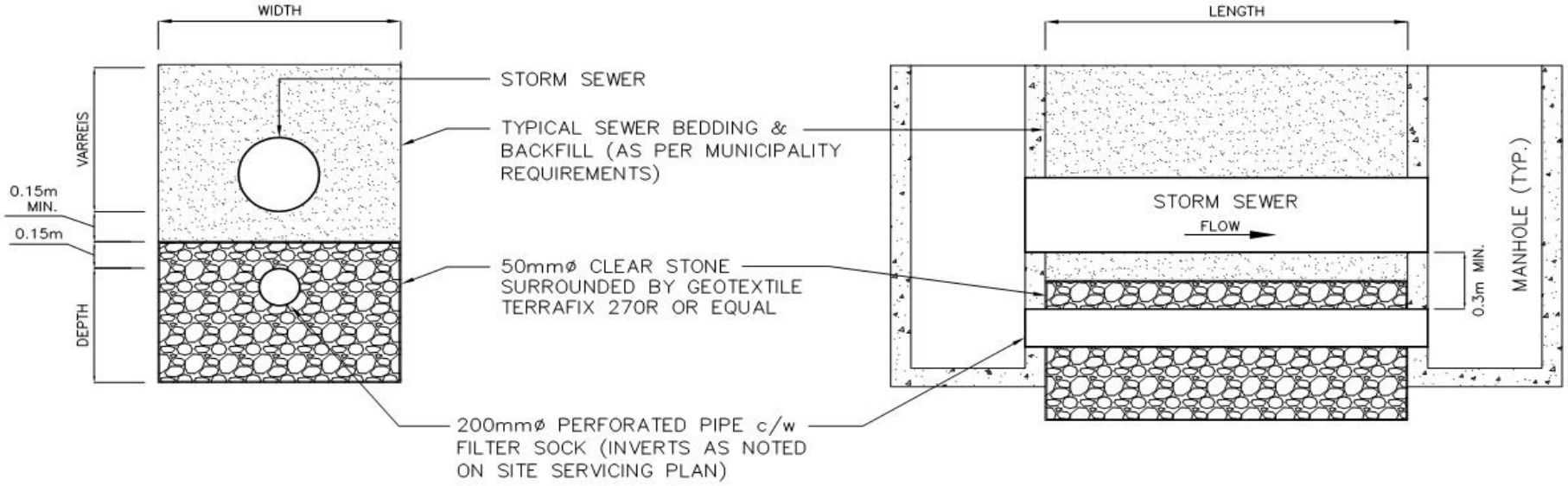
Stone Resevoir Trench Dimensions

Void Ratio (0.4 Typ.)	0.4
Length (m)	38.0
Width (m)	1.00
Depth (m)	0.50
Provided Storage/Infiltration (m^3)	**8**

Infiltration Rate

Permeability (K) (cm/s)	0.0017
Surface Area (A) (m^2)	76.0
Infiltration Rate (K*A) (m^3/hr)	4.65
Drawdown Time (hrs)	**1.63**

Typical Detail



S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

DRAWDOWN CALCULATION

Drawdown time can be estimated using Equation 4.10
(MOEE SWMP Planning & Design Manual)

$$t = \frac{2A_p}{CA_o(2g)^{0.5}}\left(h_1^{0.5} - h_2^{0.5}\right)$$

t	= drawdown time in seconds	=	to be calculated	
Ap	= surface area of the tank (m^2)	=	**28**	(Avg. Surface Area between h_1 & h_2)
C	= discharge coefficient	=	0.80	
D	= diameter of controlling orifice (m)	=	**0.075**	
Ao	= cross-sectional area of orifice (m^2)	=	0.00442	
g	= acceleration due to gravity (m/s^2)	=	9.81	
	Orifice invert elevation (m)	=	***98.090***	(Permanent Pool Elev.)
	Orifice centreline elevation (m)	=	***98.128***	
	Extended detention elevation (m)	=	***99.360***	(Live Ponding Elev.)
h_1	= starting water level above orifice (m)	=	1.2325	
h_2	= ending water level above orifice (m)	=	0.00	

t = 3971.27 seconds =

1.1 hours
0.0 days

APPENDIX B

SWMHYMO INPUT/OUTPUT FILE

```
2     Metric units
*#************************************************************************|
*#  Project Name: 236 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23057
*#       Date   : NOVEMEBR 2023
*#    Revised   : MARCH 2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   :
23057.DAT
*#************************************************************************|
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
                    BUR6_002.stm
*
READ STORM          STORM_FILENAME "STORM.001"
*
*#************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#************************************************************************|
*# CATCHMENT 101 -  UNCONTROLLED TO SHADELAND AVE.
*
CALIB STANDHYD      ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.15](ha),
                    XIMP=[0.27], TIMP=[0.27], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[75],
                    Pervious   surfaces: IAper=[8.47](mm), SLPP=[1.0](%),
                                         LGP=[50](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[50](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|------------------------------------------------------------|
*#************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD EAST
*
CALIB STANDHYD      ID=[1], NHYD=["201"], DT=[1](min), AREA=[0.11](ha),
                    XIMP=[0.95], TIMP=[0.95], DWF=[0](cms), LOSS=[2],
                    SCS curve number CN=[75],
                    Pervious   surfaces: IAper=[8.47](mm), SLPP=[2.0](%),
                                         LGP=[10](m), MNP=[0.250], SCP=[0](min),
                    Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                         LGI=[25](m), MNI=[0.013], SCI=[0](min),
                    RAINFALL=[ ,  ,  ,  , ](mm/hr) ,  END=-1
*%-----------------|------------------------------------------------------------|
*# CATCHMENT 202 -  UNCONTROLLED TO SHADELAND AVE.

DESIGN NASHYD       ID=[2],NHYD=["202"], DT=[1]min, AREA=[0.04](ha),
                    DWF=[0](cms), CN/C=[75], TP=[0.04]hrs,
                    RAINFALL=[ ,  ,  ,  , ](mm/hr), END=-1
*%-----------------|------------------------------------------------------------|
ROUTE RESERVOIR     IDout=[3],   NHYD=["ORIFICE"],  IDin=[1],
                    RDT=[1](min)
                          TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                   [   0.0 ,  0.0 ]
                                   [   0.0100 , 0.0000  ]
                                   [   0.0130 , 0.0008  ]
                                   [   0.0170 , 0.0016  ]
                                   [   0.0190 , 0.0025  ]
                                   [   -1  ,  -1  ]  (max twenty pts)
                          IDovf=[4], NHYDovf=["OVF"]
*%-----------------|------------------------------------------------------------|
```

```
ADD HYD             IDsum=[ 4], NHYD=["TOTAL"], IDs to add=[3+4]
*%-----------------|-------------------------------------------------------------|
**#*************************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
                    BUR6_002.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[005]
                    BUR6_005.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[010]
                    BUR6_010.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[025]
                    BUR6_025.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[050]
                    BUR6_050.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                    BUR6_100.stm
*
START               TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[200]
                    25MM.stm
*%-----------------|-------------------------------------------------------------|
FINISH
```

```
================================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9    =========
                                                        9   9  9   9   # 3902680
        StormWater Management HYdrologic Model           999    999    =========

 ********************************************************************************
 ****************************** SWMHYMO Ver/4.05  *******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: S. Llewellyn & Associates Ltd                +++++++++
 +++++++++                Burlington           SERIAL#:3902680        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********           ++++++ PROGRAM ARRAY DIMENSIONS ++++++             *********
 *********           Maximum value for ID numbers  :     10            *********
 *********           Max. number of rainfall points: 105408            *********
 *********           Max. number of flow points    : 105408            *********
 ********************************************************************************


 **********************   D E T A I L E D   O U T P U T   **********************
 ********************************************************************************
 *         DATE: 2024-03-26     TIME: 11:07:23     RUN COUNTER: 000967          *
 ********************************************************************************
 * Input   filename: T:\PROJECTS\23057\SWMHYMO\23057.dat                        *
 * Output  filename: T:\PROJECTS\23057\SWMHYMO\23057.out                        *
 * Summary filename: T:\PROJECTS\23057\SWMHYMO\23057.sum                        *
 * User comments:                                                               *
 * 1:_____________________________________________________________________      *
 * 2:_____________________________________________________________________      *
 * 3:_____________________________________________________________________      *
 ********************************************************************************

--------------------------------------------------------------------------------
001:0001--------------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 236 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23057
*#       Date   : NOVEMEBR 2023
*#    Revised   : MARCH
2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   :
23057.DAT
*#*****************************************************************************|
*
  ** END OF RUN :   1

********************************************************************************
```

```
68
69   -------------------
70   | START           |  Project  dir.: T:\PROJECTS\23057\SWMHYMO\
71   -------------------  Rainfall dir.: T:\PROJECTS\23057\SWMHYMO\
72       TZERO =   .00 hrs on        0
73       METOUT=   2 (output = METRIC)
74       NRUN  = 002
75       NSTORM=   1
76             #  1=BUR6_002.stm
77   ----------------------------------------------------------------------------------------
78   002:0002-------------------------------------------------------------------------------
79   *#*************************************************************************|
80   *#  Project Name: 236 PLAINS ROAD EAST
81   *#                BURLINGTON, ONTARIO
82   *#  JOB NUMBER  : 23057
83   *#       Date   : NOVEMEBR 2023
84   *#    Revised   : MARCH
     2024
85   *#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
86   *#       File   :
     23057.DAT
87   *#*************************************************************************|
88   *
89   ----------------------------------------------------------------------------------------
90   002:0002-------------------------------------------------------------------------------
91   *
92   --------------------
93   | READ STORM       |    Filename: Burlington 2-yr 6hr CHICAGO  (A=681.52,
94   | Ptotal=  40.93 mm|    Comments: Burlington 2-yr 6hr CHICAGO  (A=681.52,
95   --------------------
96                 TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
97                  hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
98                  .17   1.715 |   1.67   8.325 |   3.17   4.467 |   4.67   2.213
99                  .33   1.858 |   1.83  19.646 |   3.33   3.978 |   4.83   2.105
100                 .50   2.032 |   2.00  78.391 |   3.50   3.595 |   5.00   2.008
101                 .67   2.247 |   2.17  25.776 |   3.67   3.286 |   5.17   1.920
102                 .83   2.522 |   2.33  13.777 |   3.83   3.030 |   5.33   1.841
103                1.00   2.888 |   2.50   9.511 |   4.00   2.815 |   5.50   1.769
104                1.17   3.399 |   2.67   7.331 |   4.17   2.632 |   5.67   1.703
105                1.33   4.172 |   2.83   6.005 |   4.33   2.474 |   5.83   1.642
106                1.50   5.492 |   3.00   5.111 |   4.50   2.335 |   6.00   1.586
107
108  ----------------------------------------------------------------------------------------
109  002:0003-------------------------------------------------------------------------------
110  *
111  *#*************************************************************************|
112  *#
113  *#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
114  *#        ==============================================
115  *#
116  *#*************************************************************************|
117  *# CATCHMENT 101 -  UNCONTROLLED TO SHADELAND AVE.
118  *
119  ----------------------
120  | CALIB STANDHYD     |   Area    (ha)=     .15
121  | 01:101    DT= 1.00 |   Total Imp(%)=   27.00   Dir. Conn.(%)=   27.00
122  ----------------------
123                                IMPERVIOUS    PERVIOUS (i)
124       Surface Area     (ha)=        .04          .11
125       Dep. Storage     (mm)=       1.00         8.47
126       Average Slope     (%)=       2.00         1.00
127       Length            (m)=      50.00        50.00
128       Mannings n           =       .013         .250
129
130       Max.eff.Inten.(mm/hr)=      78.39         7.99
131                 over (min)        2.00        29.00
132       Storage Coeff.  (min)=       1.51 (ii)   28.80 (ii)
```

```
      Unit Hyd. Tpeak (min)=       2.00        29.00
      Unit Hyd. peak  (cms)=        .66          .04
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .01          .00          .009 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.58         2.000
      RUNOFF VOLUME    (mm)=      39.93         9.00        17.350
      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
      RUNOFF COEFFICIENT   =        .98          .22          .424

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0004----------------------------------------------------------------------
*#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*****************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD EAST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .11
| 01:201    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                            IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .10          .01
      Dep. Storage     (mm)=       1.00         8.47
      Average Slope     (%)=       2.00         2.00
      Length             (m)=      25.00        10.00
      Mannings n            =       .013         .250

      Max.eff.Inten.(mm/hr)=      78.39        13.34
                over (min)        1.00         8.00
      Storage Coeff.  (min)=       1.00 (ii)    7.87 (ii)
      Unit Hyd. Tpeak (min)=       1.00         8.00
      Unit Hyd. peak  (cms)=       1.08          .14
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .02          .00          .023 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.12         2.000
      RUNOFF VOLUME    (mm)=      39.93         9.00        38.386
      TOTAL RAINFALL   (mm)=      40.93        40.93        40.933
      RUNOFF COEFFICIENT   =        .98          .22          .938

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0005----------------------------------------------------------------------
*# CATCHMENT 202 -  UNCONTROLLED TO SHADELAND AVE.
----------------------
| DESIGN NASHYD      |   Area    (ha)=     .04   Curve Number   (CN)=75.00
| 02:202    DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .040

      Unit Hyd Qpeak  (cms)=     .038

      PEAK FLOW       (cms)=     .003 (i)
      TIME TO PEAK    (hrs)=    2.000
      RUNOFF VOLUME    (mm)=   12.527
      TOTAL RAINFALL   (mm)=   40.933
      RUNOFF COEFFICIENT   =     .306
```

```
     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
002:0006----------------------------------------------------------------------
--------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<03:(ORIFIC)   |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .017  .1600E-02
                           .010  .0000E+00   |     .019  .2500E-02
                           .013  .8000E-03   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .11      .023     2.000     38.386
     OUTFLOW<03: (ORIFIC)        .11      .012     2.017     38.459
    OVERFLOW<04: (OVF   )        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   54.332
                  TIME SHIFT OF PEAK FLOW         (min)=     1.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.6429E-03

--------------------------------------------------------------------------------
002:0007----------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                    ID1 03:ORIFICE          .11      .012    2.02  38.46    .000
                   +ID2 04:TOTAL            .00      .000     .00    .00    .000  **DRY**
                    ============================================================
                    SUM 04:TOTAL            .11      .012    2.02  38.46    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
002:0008----------------------------------------------------------------------
**#*****************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
--------------------------------------------------------------------------------
002:0002----------------------------------------------------------------------
*
  ** END OF RUN :   4

********************************************************************************




--------------------
| START            |  Project  dir.: T:\PROJECTS\23057\SWMHYMO\

-------------------  Rainfall dir.: T:\PROJECTS\23057\SWMHYMO\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 005
    NSTORM=   1
           #  1=BUR6_005.stm
--------------------------------------------------------------------------------
```

```
005:0002-------------------------------------------------------------------------------
*#*****************************************************************************|
*#  Project Name: 236 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23057
*#       Date   : NOVEMEBR 2023
*#    Revised   : MARCH
2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   :
23057.DAT
*#*****************************************************************************|
*
-------------------------------------------------------------------------------------------
005:0002-------------------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 5-yr 6hr CHICAGO    (A=802.04
| Ptotal=  53.05 mm|    Comments: Burlington 5-yr 6hr CHICAGO    (A=802.04
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   2.348 |   1.67  10.690 |   3.17   5.897 |   4.67   3.004
               .33   2.537 |   1.83  24.479 |   3.33   5.279 |   4.83   2.862
               .50   2.766 |   2.00 101.312 |   3.50   4.790 |   5.00   2.734
               .67   3.048 |   2.17  31.941 |   3.67   4.394 |   5.17   2.619
               .83   3.407 |   2.33  17.333 |   3.83   4.065 |   5.33   2.514
              1.00   3.881 |   2.50  12.145 |   4.00   3.788 |   5.50   2.419
              1.17   4.539 |   2.67   9.469 |   4.17   3.550 |   5.67   2.331
              1.33   5.523 |   2.83   7.826 |   4.33   3.344 |   5.83   2.251
              1.50   7.185 |   3.00   6.709 |   4.50   3.164 |   6.00   2.176

-------------------------------------------------------------------------------------------
005:0003-------------------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*****************************************************************************|
*# CATCHMENT 101 -  UNCONTROLLED TO SHADELAND AVE.
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   27.00   Dir. Conn.(%)=   27.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .04          .11
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         1.00
     Length             (m)=     50.00        50.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     101.31        16.39
               over (min)         1.00        22.00
     Storage Coeff.  (min)=       1.36 (ii)   21.84 (ii)
     Unit Hyd. Tpeak (min)=       1.00        22.00
     Unit Hyd. peak  (cms)=        .88          .05
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .012 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.38         2.000
     RUNOFF VOLUME    (mm)=      52.05        15.38        25.280
     TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
     RUNOFF COEFFICIENT   =        .98          .29          .477

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
005:0004---------------------------------------------------------------------------
*#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*****************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD EAST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .11
| 01:201    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .01
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      25.00        10.00
     Mannings n             =      .013         .250

     Max.eff.Inten.(mm/hr)=     101.31        28.13
               over (min)        1.00         6.00
     Storage Coeff.  (min)=        .90 (ii)    6.00 (ii)
     Unit Hyd. Tpeak (min)=       1.00         6.00
     Unit Hyd. peak  (cms)=       1.14          .19
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .03          .00          .030 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.07         2.000
     RUNOFF VOLUME    (mm)=      52.05        15.38        50.219
     TOTAL RAINFALL   (mm)=      53.05        53.05        53.053
     RUNOFF COEFFICIENT   =        .98          .29          .947

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
005:0005---------------------------------------------------------------------------
*# CATCHMENT 202 -  UNCONTROLLED TO SHADELAND AVE.
----------------------
| DESIGN NASHYD      |   Area    (ha)=     .04   Curve Number   (CN)=75.00
| 02:202    DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .040

     Unit Hyd Qpeak  (cms)=     .038

     PEAK FLOW       (cms)=     .004 (i)
     TIME TO PEAK    (hrs)=    2.000
     RUNOFF VOLUME    (mm)=   19.508
     TOTAL RAINFALL   (mm)=   53.053
     RUNOFF COEFFICIENT   =     .368

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
005:0006---------------------------------------------------------------------------
--------------------
| ROUTE RESERVOIR  |    Requested routing time step =  1.0 min.
|  IN>01:(201   )  |
| OUT<03:(ORIFIC)  |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .017  .1600E-02
```

```
                            .010  .0000E+00   |     .019  .2500E-02
                            .013  .8000E-03   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .11      .030     2.000     50.219
     OUTFLOW<03: (ORIFIC)        .11      .014     2.017     50.387
    OVERFLOW<04: (OVF   )        .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   47.239
                    TIME SHIFT OF PEAK FLOW         (min)=     1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1006E-02

--------------------------------------------------------------------------------
005:0007----------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 03:ORIFICE         .11     .014    2.02  50.39    .000
                     +ID2 04:TOTAL           .00     .000     .00    .00    .000  **DRY**
                      ============================================================
                      SUM 04:TOTAL           .11     .014    2.02  50.39    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
005:0008----------------------------------------------------------------------
**#*****************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
--------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*
--------------------------------------------------------------------------------
005:0002----------------------------------------------------------------------
*
  ** END OF RUN :   9

*************************************************************************




--------------------
| START            |  Project  dir.: T:\PROJECTS\23057\SWMHYMO\

-------------------  Rainfall dir.: T:\PROJECTS\23057\SWMHYMO\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 010
    NSTORM=   1
           #  1=BUR6_010.stm
--------------------------------------------------------------------------------
010:0002----------------------------------------------------------------------
*#*****************************************************************|
*#  Project Name: 236 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23057
*#       Date   : NOVEMEBR 2023
*#    Revised   : MARCH
2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
```

```
*#       File   :
23057.DAT
*#*************************************************************************|
*
-------------------------------------------------------------------------------
010:0002---------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 10-yr 6hr CHICAGO     (A=918.
| Ptotal=  61.10 mm|    Comments: Burlington 10-yr 6hr CHICAGO     (A=918.
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   2.714 |   1.67  12.326 |   3.17   6.808 |   4.67   3.472
               .33   2.933 |   1.83  28.176 |   3.33   6.095 |   4.83   3.308
               .50   3.197 |   2.00 116.310 |   3.50   5.532 |   5.00   3.161
               .67   3.523 |   2.17  36.748 |   3.67   5.075 |   5.17   3.027
               .83   3.937 |   2.33  19.967 |   3.83   4.696 |   5.33   2.907
              1.00   4.483 |   2.50  14.001 |   4.00   4.376 |   5.50   2.796
              1.17   5.242 |   2.67  10.921 |   4.17   4.102 |   5.67   2.695
              1.33   6.377 |   2.83   9.030 |   4.33   3.864 |   5.83   2.602
              1.50   8.291 |   3.00   7.743 |   4.50   3.656 |   6.00   2.516

-------------------------------------------------------------------------------
010:0003---------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*************************************************************************|
*# CATCHMENT 101 -  UNCONTROLLED TO SHADELAND AVE.
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   27.00   Dir. Conn.(%)=   27.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .04          .11
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         1.00
     Length            (m)=      50.00        50.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     116.31        23.92
               over (min)         1.00        19.00
     Storage Coeff.  (min)=       1.29 (ii)   18.89 (ii)
     Unit Hyd. Tpeak (min)=       1.00        19.00
     Unit Hyd. peak  (cms)=        .92          .06
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .014 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.30         2.000
     RUNOFF VOLUME    (mm)=      60.10        20.18        30.955
     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
     RUNOFF COEFFICIENT   =        .98          .33          .507

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
010:0004---------------------------------------------------------------------
*#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
```

```
*#
*#**********************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD EAST
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .11
| 01:201    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
---------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .01
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      25.00        10.00
     Mannings n             =       .013         .250

     Max.eff.Inten.(mm/hr)=     116.31        39.45
               over (min)        1.00         5.00
     Storage Coeff.  (min)=        .85 (ii)    5.31 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.17          .22
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .03          .00          .034 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.05         2.000
     RUNOFF VOLUME    (mm)=      60.10        20.18        58.105
     TOTAL RAINFALL   (mm)=      61.10        61.10        61.101
     RUNOFF COEFFICIENT   =        .98          .33          .951

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
010:0005----------------------------------------------------------------------
*# CATCHMENT 202 -  UNCONTROLLED TO SHADELAND AVE.
---------------------
| DESIGN NASHYD      |   Area    (ha)=     .04   Curve Number   (CN)=75.00
| 02:202    DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .040

     Unit Hyd Qpeak  (cms)=     .038

     PEAK FLOW       (cms)=     .005 (i)
     TIME TO PEAK    (hrs)=    2.000
     RUNOFF VOLUME    (mm)=   24.620
     TOTAL RAINFALL   (mm)=   61.101
     RUNOFF COEFFICIENT   =     .403

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
010:0006----------------------------------------------------------------------
---------------------
| ROUTE RESERVOIR    |    Requested routing time step =  1.0 min.
|  IN>01:(201    )   |
| OUT<03:(ORIFIC)    |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .017  .1600E-02
                            .010  .0000E+00   |     .019  .2500E-02
                            .013  .8000E-03   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201    )       .11      .034     2.000     58.105
     OUTFLOW<03: (ORIFIC)       .11      .015     2.033     58.177
    OVERFLOW<04: (OVF    )       .00      .000      .000       .000
```

```
                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   44.501
                    TIME SHIFT OF PEAK FLOW         (min)=     2.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1243E-02

--------------------------------------------------------------------------------
010:0007--------------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:ORIFICE         .11     .015    2.03  58.18    .000
                    +ID2 04:TOTAL           .00     .000     .00    .00    .000  **DRY**
                     ============================================================
                     SUM 04:TOTAL           .11     .015    2.03  58.18    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
010:0008--------------------------------------------------------------------------
**#*************************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
--------------------------------------------------------------------------------
010:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
010:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
010:0002--------------------------------------------------------------------------
*
  ** END OF RUN :  24

********************************************************************************




--------------------
| START            |  Project  dir.: T:\PROJECTS\23057\SWMHYMO\

-------------------  Rainfall dir.: T:\PROJECTS\23057\SWMHYMO\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 025
    NSTORM=   1
           #  1=BUR6_025.stm
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 236 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23057
*#       Date   : NOVEMEBR 2023
*#    Revised   : MARCH
2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   :
23057.DAT
*#*************************************************************************|
*
--------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------------
```

```
*
--------------------
| READ STORM       |    Filename: Burlington 25-yr 6hr CHICAGO      (A=106
| Ptotal=  71.35 mm|    Comments: Burlington 25-yr 6hr CHICAGO      (A=106
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   3.182 |   1.67  14.410 |   3.17   7.968 |   4.67   4.068
               .33   3.437 |   1.83  32.881 |   3.33   7.135 |   4.83   3.876
               .50   3.746 |   2.00 135.380 |   3.50   6.477 |   5.00   3.704
               .67   4.128 |   2.17  42.866 |   3.67   5.943 |   5.17   3.548
               .83   4.612 |   2.33  23.321 |   3.83   5.499 |   5.33   3.407
              1.00   5.251 |   2.50  16.365 |   4.00   5.125 |   5.50   3.278
              1.17   6.138 |   2.67  12.771 |   4.17   4.805 |   5.67   3.160
              1.33   7.465 |   2.83  10.563 |   4.33   4.527 |   5.83   3.051
              1.50   9.700 |   3.00   9.061 |   4.50   4.284 |   6.00   2.950

--------------------------------------------------------------------------------
025:0003----------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*************************************************************************|
*# CATCHMENT 101 -  UNCONTROLLED TO SHADELAND AVE.
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   27.00   Dir. Conn.(%)=   27.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .04          .11
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         1.00
     Length             (m)=     50.00        50.00
     Mannings n            =       .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        34.70
               over (min)         1.00        16.00
     Storage Coeff.  (min)=       1.21 (ii)   16.38 (ii)
     Unit Hyd. Tpeak (min)=       1.00        16.00
     Unit Hyd. peak  (cms)=        .95          .07
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .02          .01          .017 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.25         2.000
     RUNOFF VOLUME    (mm)=      70.35        26.79        38.554
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .38          .540

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
025:0004----------------------------------------------------------------------
*#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD EAST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .11
```

```
| 01:201    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .01
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      25.00        10.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     135.38        53.39
               over (min)        1.00         5.00
     Storage Coeff.  (min)=       .80 (ii)    4.75 (ii)
     Unit Hyd. Tpeak (min)=       1.00         5.00
     Unit Hyd. peak  (cms)=       1.21          .23
                                                      *TOTALS*
     PEAK FLOW       (cms)=        .04          .00          .040 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.03         2.000
     RUNOFF VOLUME    (mm)=      70.35        26.80        68.169
     TOTAL RAINFALL   (mm)=      71.35        71.35        71.347
     RUNOFF COEFFICIENT   =        .99          .38          .955

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
025:0005--------------------------------------------------------------------------
*# CATCHMENT 202 -  UNCONTROLLED TO SHADELAND AVE.
---------------------
| DESIGN NASHYD      |   Area    (ha)=     .04   Curve Number   (CN)=75.00
| 02:202    DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
---------------------   U.H. Tp(hrs)=    .040

     Unit Hyd Qpeak  (cms)=     .038

     PEAK FLOW       (cms)=     .007 (i)
     TIME TO PEAK    (hrs)=    2.000
     RUNOFF VOLUME    (mm)=   31.572
     TOTAL RAINFALL   (mm)=   71.347
     RUNOFF COEFFICIENT   =     .443

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
025:0006--------------------------------------------------------------------------
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<03:(ORIFIC)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .017  .1600E-02
                            .010  .0000E+00   |     .019  .2500E-02
                            .013  .8000E-03   |     .000  .0000E+00

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     -------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (201   )        .11      .040     2.000     68.169
     OUTFLOW<03: (ORIFIC)        .11      .017     2.033     68.248
    OVERFLOW<04: (OVF   )        .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   41.897
```

```
                    TIME SHIFT OF PEAK FLOW         (min)=     2.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1542E-02

------------------------------------------------------------------------------
025:0007--------------------------------------------------------------------
-----------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
-----------------------                    (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:ORIFICE         .11      .017    2.03  68.25    .000
                    +ID2 04:TOTAL           .00      .000     .00    .00    .000  **DRY**
                     ============================================================
                     SUM 04:TOTAL           .11      .017    2.03  68.25    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
025:0008--------------------------------------------------------------------
**#*****************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------
*
------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------
*
------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------
*
------------------------------------------------------------------------------
025:0002--------------------------------------------------------------------
*
  ** END OF RUN :  49

*******************************************************************************




--------------------
| START            |  Project  dir.: T:\PROJECTS\23057\SWMHYMO\

-------------------  Rainfall dir.: T:\PROJECTS\23057\SWMHYMO\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 050
    NSTORM=   1
           #  1=BUR6_050.stm
------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------
*#*****************************************************************|
*#  Project Name: 236 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23057
*#       Date   : NOVEMEBR 2023
*#    Revised   : MARCH
2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   :
23057.DAT
*#*****************************************************************|
*
------------------------------------------------------------------------------
050:0002--------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 50-yr 6hr CHICAGO     (A=1172
```

```
| Ptotal=  78.93 mm|    Comments: Burlington 50-yr 6hr CHICAGO     (A=1172
-------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   3.533 |   1.67  15.961 |   3.17   8.836 |   4.67   4.516
               .33   3.817 |   1.83  36.356 |   3.33   7.913 |   4.83   4.304
               .50   4.160 |   2.00 149.296 |   3.50   7.185 |   5.00   4.113
               .67   4.582 |   2.17  47.374 |   3.67   6.593 |   5.17   3.940
               .83   5.119 |   2.33  25.806 |   3.83   6.102 |   5.33   3.783
              1.00   5.827 |   2.50  18.121 |   4.00   5.688 |   5.50   3.640
              1.17   6.809 |   2.67  14.149 |   4.17   5.333 |   5.67   3.509
              1.33   8.278 |   2.83  11.707 |   4.33   5.025 |   5.83   3.388
              1.50  10.753 |   3.00  10.045 |   4.50   4.755 |   6.00   3.277

------------------------------------------------------------------------------
050:0003----------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*************************************************************************|
*# CATCHMENT 101 -  UNCONTROLLED TO SHADELAND AVE.
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   27.00   Dir. Conn.(%)=   27.00
----------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .04          .11
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         1.00
     Length            (m)=      50.00        50.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     149.30        43.36
               over (min)         1.00        15.00
     Storage Coeff.  (min)=       1.17 (ii)   15.04 (ii)
     Unit Hyd. Tpeak (min)=       1.00        15.00
     Unit Hyd. peak  (cms)=        .98          .08
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .02          .01          .020 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.22         2.000
     RUNOFF VOLUME    (mm)=      77.93        32.00        44.405
     TOTAL RAINFALL   (mm)=      78.93        78.93        78.932
     RUNOFF COEFFICIENT   =        .99          .41          .563

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
050:0004----------------------------------------------------------------------
*#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD EAST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .11
| 01:201    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                            IMPERVIOUS    PERVIOUS (i)
```

```
      Surface Area     (ha)=        .10          .01
      Dep. Storage     (mm)=       1.00         8.47
      Average Slope     (%)=       2.00         2.00
      Length            (m)=      25.00        10.00
      Mannings n           =       .013         .250

      Max.eff.Inten.(mm/hr)=     149.30        66.26
                over (min)        1.00         4.00
      Storage Coeff.  (min)=        .77 (ii)     4.39 (ii)
      Unit Hyd. Tpeak (min)=       1.00         4.00
      Unit Hyd. peak  (cms)=       1.24          .27
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .04          .00           .044 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.03          2.000
      RUNOFF VOLUME    (mm)=      77.93        32.00         75.636
      TOTAL RAINFALL   (mm)=      78.93        78.93         78.932
      RUNOFF COEFFICIENT   =        .99          .41           .958

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
050:0005-----------------------------------------------------------------------------
*# CATCHMENT 202 -  UNCONTROLLED TO SHADELAND AVE.
----------------------
| DESIGN NASHYD      |   Area    (ha)=     .04   Curve Number   (CN)=75.00
| 02:202    DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .040

      Unit Hyd Qpeak  (cms)=     .038

      PEAK FLOW       (cms)=     .008 (i)
      TIME TO PEAK    (hrs)=    2.000
      RUNOFF VOLUME    (mm)=   36.986
      TOTAL RAINFALL   (mm)=   78.932
      RUNOFF COEFFICIENT   =     .469

      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
050:0006-----------------------------------------------------------------------------
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(201   )   |
| OUT<03:(ORIFIC)   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .017  .1600E-02
                            .010  .0000E+00   |     .019  .2500E-02
                            .013  .8000E-03   |     .000  .0000E+00

      ROUTING RESULTS           AREA     QPEAK     TPEAK       R.V.
      --------------------      (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (201   )       .11      .044     2.000     75.636
      OUTFLOW<03: (ORIFIC)       .11      .017     2.033     75.693
     OVERFLOW<04: (OVF   )       .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   39.511
                    TIME SHIFT OF PEAK FLOW         (min)=     2.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.1786E-02
```

```
---------------------------------------------------------------------------
050:0007-----------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 03:ORIFICE         .11     .017    2.03  75.69    .000
                     +ID2 04:TOTAL           .00     .000     .00    .00    .000  **DRY**
                      ============================================================
                      SUM 04:TOTAL           .11     .017    2.03  75.69    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------
050:0008-----------------------------------------------------------------------
**#*************************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
---------------------------------------------------------------------------
050:0002-----------------------------------------------------------------------
*
---------------------------------------------------------------------------
050:0002-----------------------------------------------------------------------
*
---------------------------------------------------------------------------
050:0002-----------------------------------------------------------------------
*
---------------------------------------------------------------------------
050:0002-----------------------------------------------------------------------
*
---------------------------------------------------------------------------
050:0002-----------------------------------------------------------------------
*
  ** END OF RUN :  99

*****************************************************************************




--------------------
| START            |  Project  dir.: T:\PROJECTS\23057\SWMHYMO\

-------------------  Rainfall dir.: T:\PROJECTS\23057\SWMHYMO\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
           #  1=BUR6_100.stm
---------------------------------------------------------------------------
100:0002-----------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 236 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23057
*#       Date   : NOVEMEBR 2023
*#    Revised   : MARCH
2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   :
23057.DAT
*#*************************************************************************|
*
---------------------------------------------------------------------------
100:0002-----------------------------------------------------------------------
*
--------------------
| READ STORM       |    Filename: Burlington 100-yr 6hr CHICAGO       (A=
```

```
| Ptotal=  86.27 mm|    Comments: Burlington 100-yr 6hr CHICAGO        (A=
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   3.862 |   1.67  17.445 |   3.17   9.657 |   4.67   4.936
               .33   4.172 |   1.83  39.736 |   3.33   8.649 |   4.83   4.704
               .50   4.546 |   2.00 163.177 |   3.50   7.853 |   5.00   4.495
               .67   5.008 |   2.17  51.779 |   3.67   7.206 |   5.17   4.306
               .83   5.595 |   2.33  28.205 |   3.83   6.670 |   5.33   4.135
              1.00   6.369 |   2.50  19.806 |   4.00   6.217 |   5.50   3.979
              1.17   7.443 |   2.67  15.465 |   4.17   5.829 |   5.67   3.835
              1.33   9.048 |   2.83  12.795 |   4.33   5.492 |   5.83   3.703
              1.50  11.752 |   3.00  10.979 |   4.50   5.197 |   6.00   3.581

-------------------------------------------------------------------------------
100:0003----------------------------------------------------------------------
*
*#*************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*************************************************************************|
*# CATCHMENT 101 -  UNCONTROLLED TO SHADELAND AVE.
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   27.00   Dir. Conn.(%)=   27.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .04          .11
     Dep. Storage     (mm)=      1.00         8.47
     Average Slope     (%)=      2.00         1.00
     Length            (m)=     50.00        50.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    163.18        52.99
               over (min)        1.00        14.00
     Storage Coeff.  (min)=      1.13 (ii)   13.93 (ii)
     Unit Hyd. Tpeak (min)=      1.00        14.00
     Unit Hyd. peak  (cms)=      1.00          .08
                                                    *TOTALS*
     PEAK FLOW       (cms)=       .02          .01          .022 (iii)
     TIME TO PEAK    (hrs)=      2.00         2.20         2.000
     RUNOFF VOLUME    (mm)=     85.27        37.25        50.220
     TOTAL RAINFALL   (mm)=     86.27        86.27        86.271
     RUNOFF COEFFICIENT   =       .99          .43          .582

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
100:0004----------------------------------------------------------------------
*#*************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD EAST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .11
| 01:201    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                           IMPERVIOUS    PERVIOUS (i)
```

```
      Surface Area     (ha)=        .10          .01
      Dep. Storage     (mm)=       1.00         8.47
      Average Slope     (%)=       2.00         2.00
      Length             (m)=      25.00        10.00
      Mannings n            =       .013         .250

      Max.eff.Inten.(mm/hr)=     163.18        77.71
                over (min)        1.00         4.00
      Storage Coeff.  (min)=        .74 (ii)     4.14 (ii)
      Unit Hyd. Tpeak (min)=       1.00         4.00
      Unit Hyd. peak  (cms)=       1.26          .28
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .05          .00           .048 (iii)
      TIME TO PEAK    (hrs)=       2.00         2.02          2.000
      RUNOFF VOLUME    (mm)=      85.27        37.26         82.870
      TOTAL RAINFALL   (mm)=      86.27        86.27         86.271
      RUNOFF COEFFICIENT   =        .99          .43           .961

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
100:0005-----------------------------------------------------------------------
*# CATCHMENT 202 -  UNCONTROLLED TO SHADELAND AVE.
----------------------
| DESIGN NASHYD      |   Area    (ha)=     .04   Curve Number   (CN)=75.00
| 02:202    DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .040

      Unit Hyd Qpeak  (cms)=     .038

      PEAK FLOW       (cms)=     .009 (i)
      TIME TO PEAK    (hrs)=    2.000
      RUNOFF VOLUME    (mm)=   42.409
      TOTAL RAINFALL   (mm)=   86.271
      RUNOFF COEFFICIENT   =     .492

      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
100:0006-----------------------------------------------------------------------
--------------------
| ROUTE RESERVOIR  |    Requested routing time step =  1.0 min.
|  IN>01:(201   )  |
| OUT<03:(ORIFIC)  |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .017  .1600E-02
                           .010  .0000E+00   |     .019  .2500E-02
                           .013  .8000E-03   |     .000  .0000E+00

      ROUTING RESULTS           AREA     QPEAK     TPEAK       R.V.
      --------------------      (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (201   )       .11      .048     2.000     82.870
      OUTFLOW<03: (ORIFIC)       .11      .018     2.033     82.956
     OVERFLOW<04: (OVF   )       .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   37.313
                    TIME SHIFT OF PEAK FLOW         (min)=     2.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.2052E-02
```

```
---------------------------------------------------------------------------------
100:0007---------------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                   (ha)     (cms)   (hrs)   (mm)   (cms)
                     ID1 03:ORIFICE          .11     .018    2.03  82.96    .000
                    +ID2 04:TOTAL            .00     .000     .00    .00    .000  **DRY**
                     ============================================================
                     SUM 04:TOTAL            .11     .018    2.03  82.96    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------
100:0008---------------------------------------------------------------------------
**#*************************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
---------------------------------------------------------------------------------
100:0002---------------------------------------------------------------------------
*
---------------------------------------------------------------------------------
100:0002---------------------------------------------------------------------------
*
---------------------------------------------------------------------------------
100:0002---------------------------------------------------------------------------
*
---------------------------------------------------------------------------------
100:0002---------------------------------------------------------------------------
*
---------------------------------------------------------------------------------
100:0002---------------------------------------------------------------------------
*
---------------------------------------------------------------------------------
100:0002---------------------------------------------------------------------------
*
  ** END OF RUN : 199

********************************************************************************




--------------------
| START            |  Project  dir.: T:\PROJECTS\23057\SWMHYMO\

-------------------  Rainfall dir.: T:\PROJECTS\23057\SWMHYMO\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 200
    NSTORM=   1
           #  1=25MM.stm
---------------------------------------------------------------------------------
200:0002---------------------------------------------------------------------------
*#*************************************************************************|
*#  Project Name: 236 PLAINS ROAD EAST
*#                BURLINGTON, ONTARIO
*#  JOB NUMBER  : 23057
*#       Date   : NOVEMEBR 2023
*#    Revised   : MARCH
2024
*#    Company   : S. LLEWELLYN AND ASSOCIATES LTD.
*#       File   :
23057.DAT
*#*************************************************************************|
*
---------------------------------------------------------------------------------
200:0002---------------------------------------------------------------------------
```

```
*
--------------------
| READ STORM       |    Filename: 25mm 4-HOUR (A=555 B=5.89 C=0.813)
| Ptotal=  25.27 mm|    Comments: 25mm 4-HOUR (A=555 B=5.89 C=0.813)
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   1.491 |   1.17  13.390 |   2.17   3.748 |   3.17   1.810
               .33   1.720 |   1.33  58.584 |   2.33   3.156 |   3.33   1.675
               .50   2.045 |   1.50  17.849 |   2.50   2.734 |   3.50   1.560
               .67   2.542 |   1.67   9.118 |   2.67   2.417 |   3.67   1.460
               .83   3.408 |   1.83   6.129 |   2.83   2.170 |   3.83   1.374
              1.00   5.319 |   2.00   4.638 |   3.00   1.973 |   4.00   1.299

--------------------------------------------------------------------------------
200:0003----------------------------------------------------------------------------
*
*#*****************************************************************************|
*#
*#        PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ==============================================
*#
*#*****************************************************************************|
*# CATCHMENT 101 -  UNCONTROLLED TO SHADELAND AVE.
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .15
| 01:101    DT= 1.00 |   Total Imp(%)=   27.00   Dir. Conn.(%)=   27.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .04          .11
     Dep. Storage     (mm)=       1.00         8.47
     Average Slope     (%)=       2.00         1.00
     Length            (m)=      50.00        50.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=      58.58         6.70
               over (min)        2.00        31.00
     Storage Coeff.  (min)=       1.70 (ii)   30.99 (ii)
     Unit Hyd. Tpeak (min)=       2.00        31.00
     Unit Hyd. peak  (cms)=        .62          .04
                                                    *TOTALS*
     PEAK FLOW       (cms)=        .01          .00          .007 (iii)
     TIME TO PEAK    (hrs)=       1.33         2.03         1.333
     RUNOFF VOLUME    (mm)=      24.27         2.78         8.582
     TOTAL RAINFALL   (mm)=      25.27        25.27        25.268
     RUNOFF COEFFICIENT   =        .96          .11          .340

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
200:0004----------------------------------------------------------------------------
*#*****************************************************************************|
*#
*#        POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#        ===============================================
*#
*#*****************************************************************************|
*# CATCHMENT 201 -  CONTROLLED TO PLAINS ROAD EAST
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .11
| 01:201    DT= 1.00 |   Total Imp(%)=   95.00   Dir. Conn.(%)=   95.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
```

```
      Surface Area     (ha)=        .10          .01
      Dep. Storage     (mm)=       1.00         8.47
      Average Slope     (%)=       2.00         2.00
      Length             (m)=      25.00        10.00
      Mannings n            =       .013         .250

      Max.eff.Inten.(mm/hr)=      58.58         3.66
                over (min)        1.00        13.00
      Storage Coeff.  (min)=       1.12 (ii)   12.66 (ii)
      Unit Hyd. Tpeak (min)=       1.00        13.00
      Unit Hyd. peak  (cms)=       1.00          .09
                                                          *TOTALS*
      PEAK FLOW       (cms)=        .02          .00          .017 (iii)
      TIME TO PEAK    (hrs)=       1.33         1.65         1.333
      RUNOFF VOLUME    (mm)=      24.27         2.78        23.193
      TOTAL RAINFALL   (mm)=      25.27        25.27        25.268
      RUNOFF COEFFICIENT   =        .96          .11          .918

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
200:0005----------------------------------------------------------------------
*# CATCHMENT 202 -  UNCONTROLLED TO SHADELAND AVE.
----------------------
| DESIGN NASHYD      |   Area    (ha)=     .04   Curve Number   (CN)=75.00
| 02:202    DT= 1.00 |   Ia      (mm)=   1.500   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .040

      Unit Hyd Qpeak  (cms)=     .038

      PEAK FLOW       (cms)=     .001 (i)
      TIME TO PEAK    (hrs)=    1.333
      RUNOFF VOLUME    (mm)=    5.207
      TOTAL RAINFALL   (mm)=   25.268
      RUNOFF COEFFICIENT   =     .206

      (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
200:0006----------------------------------------------------------------------
--------------------
| ROUTE RESERVOIR  |    Requested routing time step =  1.0 min.
|  IN>01:(201   )  |
| OUT<03:(ORIFIC)  |    =========  OUTLFOW STORAGE TABLE  =========
--------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                          (cms)    (ha.m.)   |    (cms)    (ha.m.)
                           .000  .0000E+00   |     .017  .1600E-02
                           .010  .0000E+00   |     .019  .2500E-02
                           .013  .8000E-03   |     .000  .0000E+00

      ROUTING RESULTS           AREA     QPEAK     TPEAK       R.V.
      --------------------      (ha)     (cms)     (hrs)       (mm)
      INFLOW >01: (201   )       .11      .017     1.333     23.193
      OUTFLOW<03: (ORIFIC)       .11      .011     1.350     23.274
     OVERFLOW<04: (OVF   )       .00      .000      .000       .000

                    TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                    CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                    PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=   66.030
                    TIME SHIFT OF PEAK FLOW         (min)=     1.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=.3318E-03
```

```
--------------------------------------------------------------------------------
200:0007--------------------------------------------------------------------------
------------------------
| ADD HYD (TOTAL     ) | ID: NHYD         AREA     QPEAK   TPEAK   R.V.    DWF
------------------------                  (ha)     (cms)   (hrs)   (mm)   (cms)
                      ID1 03:ORIFICE         .11     .011    1.35  23.27    .000
                     +ID2 04:TOTAL           .00     .000     .00    .00    .000  **DRY**
                      ============================================================
                      SUM 04:TOTAL           .11     .011    1.35  23.27    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
200:0008--------------------------------------------------------------------------
**#*************************************************************************|
* RUN REMAINING DESIGN STORMS (CITY OF BURLINGTON 2 TO 100-YR)
*
--------------------------------------------------------------------------------
200:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
200:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
200:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
200:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
200:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
200:0002--------------------------------------------------------------------------
*
--------------------------------------------------------------------------------
200:0002--------------------------------------------------------------------------
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2024-03-26     at 11:07:24
================================================================================
```

APPENDIX C

STORMWATER QUALITY CONTROL INFORMATION

Hydroworks Sizing Summary

236 Plains Road East

03-26-2024

Recommended Size: HydroStorm HS 6

A HydroStorm HS 6 is recommended to provide 90 % annual TSS removal based on a drainage area of 0.11 (ha) with an imperviousness of 95 % and Hamilton RBG, Ontario rainfall for the ETV/NJDEP particle size distribution.

The recommended HydroStorm HS 6 treats 99 % of the annual runoff and provides 90 % annual TSS removal for the Hamilton RBG rainfall records and ETV/NJDEP particle size distribution.

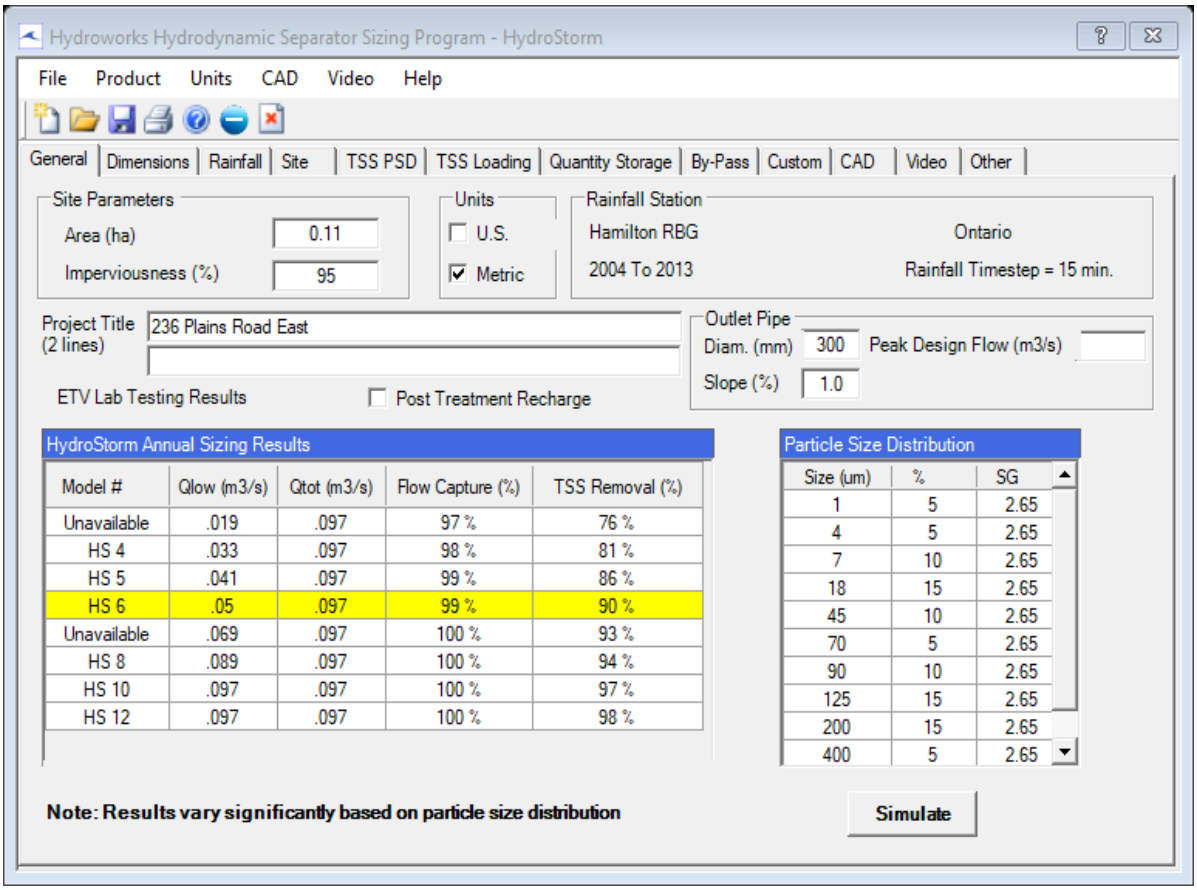
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .1 (m3/s) for the given 300 (mm) pipe diameter at 1% slope. The headloss was calculated to be 99 (mm) based on a flow depth of 300 (mm) (full pipe flow).

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

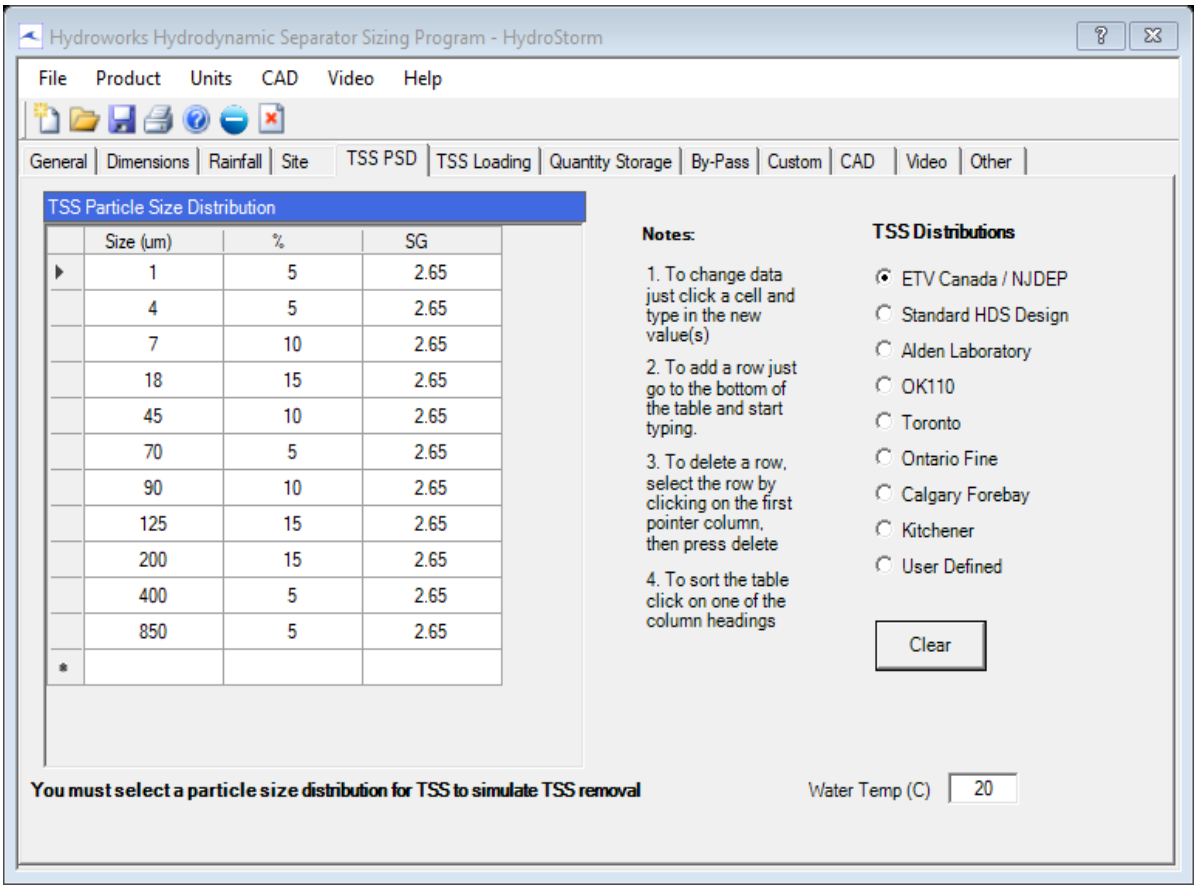
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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

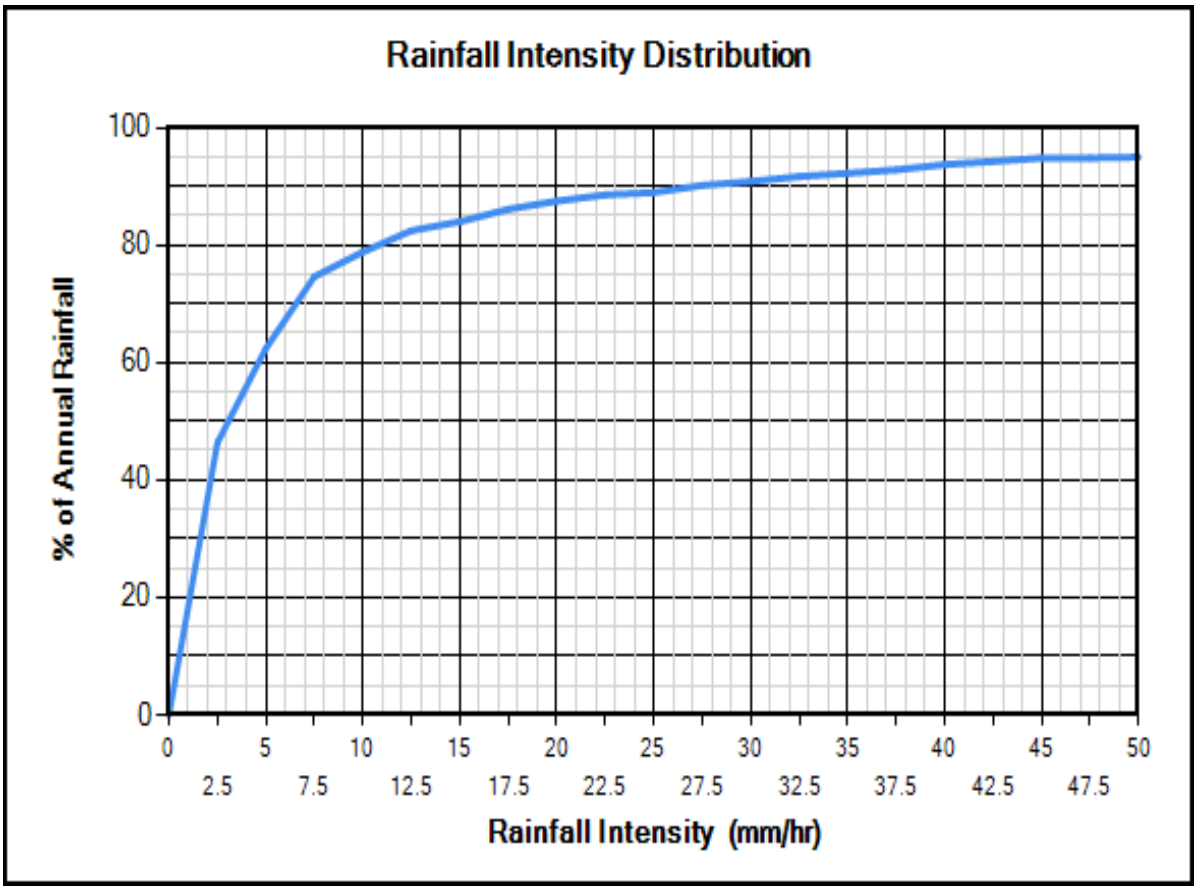
TSS Removal Sizing Summary



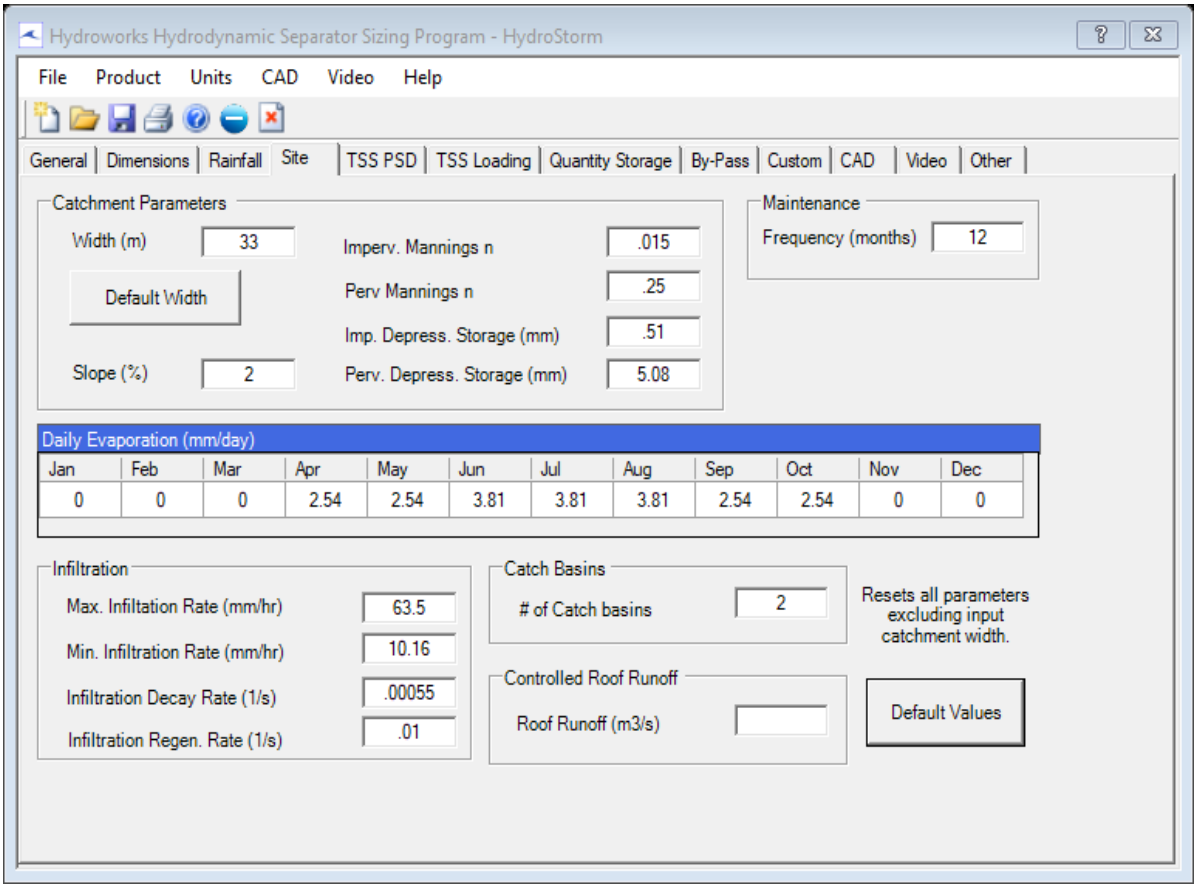
TSS Particle Size Distribution



Rainfall Station - Hamilton RBG, Ontario(2004 To 2013)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - HydroStorm

File Product Units CAD Video Help

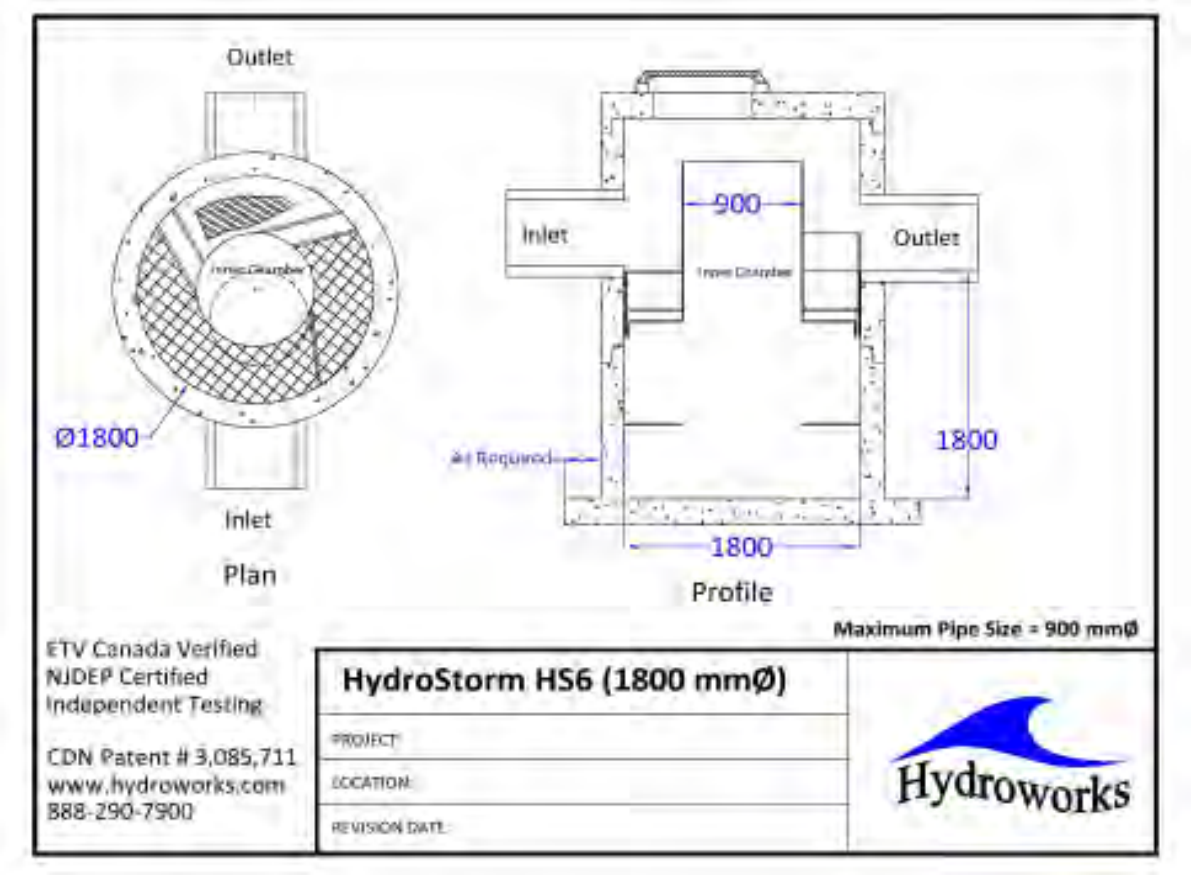
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

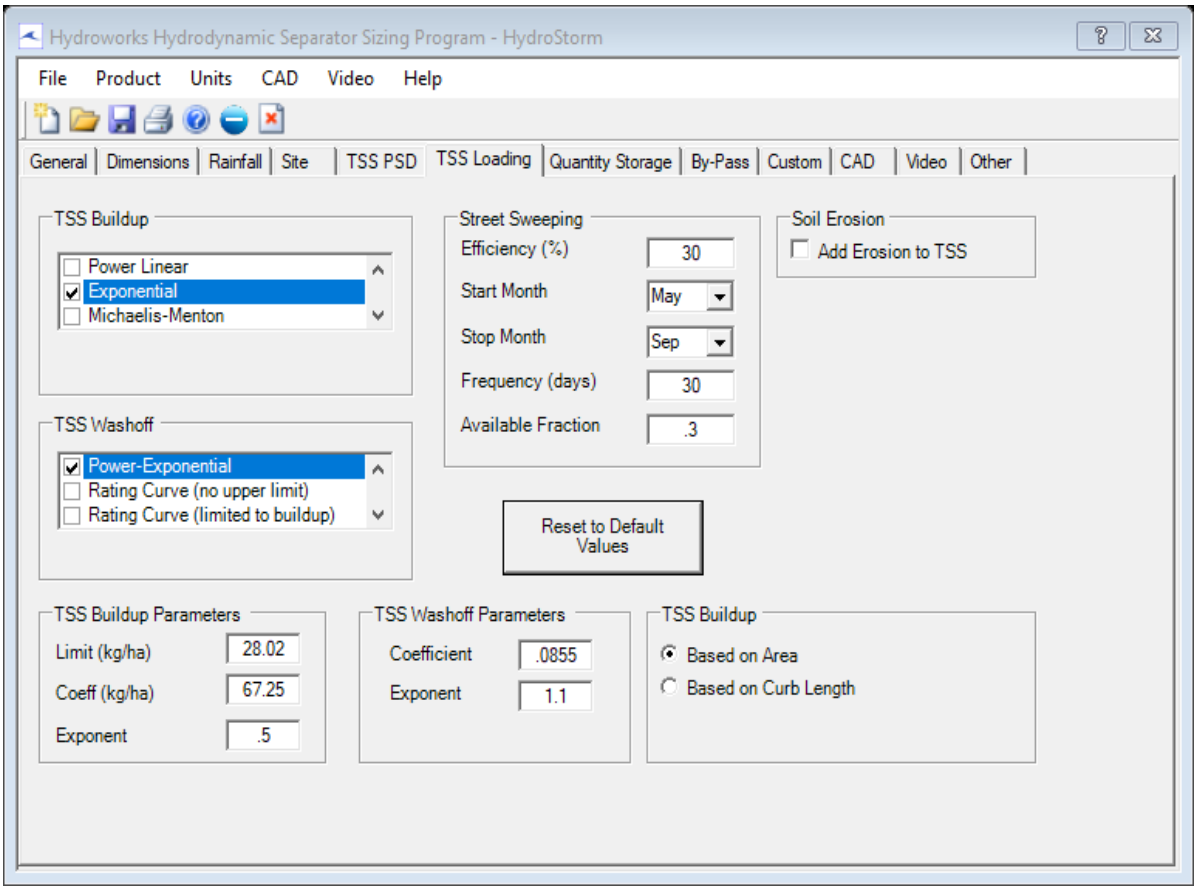
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

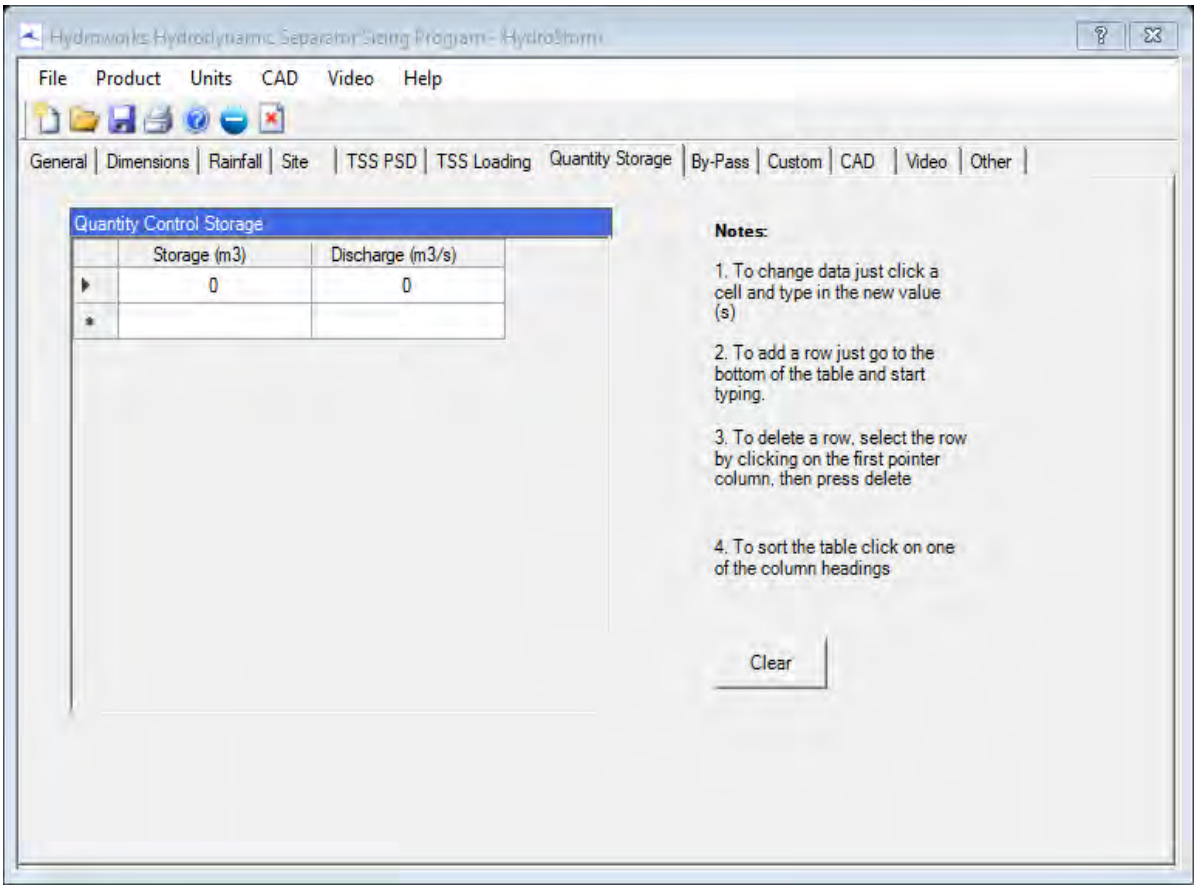
Generic HS 6 CAD Drawing



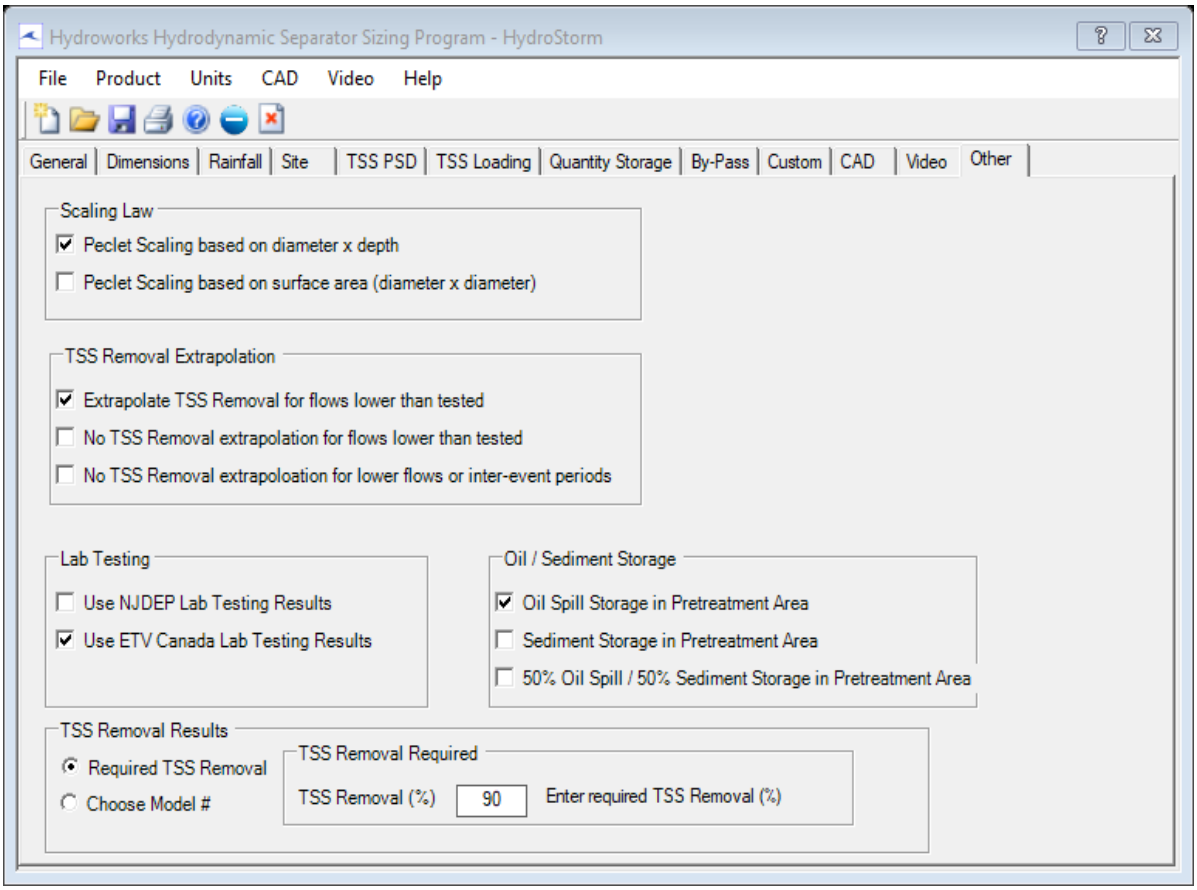
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.7
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1-800-290-7900
www.hydroworks.com

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Hydroworks® HydroStorm (HS) Hydrodynamic Separator

Developed by Hydroworks, LLC
Clark, NJ, USA

In accordance with

ISO 14034:2016

Environmental management —
Environmental technology verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

May 15, 2018
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

The Hydroworks® HydroStorm (HS) Hydrodynamic Separator is a concrete cylindrical device with an annular pre-treatment channel, an inner chamber, and lower collection sump. A schematic of the HS 4 test unit is shown in Figure 1. The pre-treatment channel extends below the outlet pipe invert and contains three intermediate low-flow weirs (flush with the outlet invert), and two downstream higher bypass weirs that extend above the outlet invert. The higher weirs bypass high flows to prevent oil and solids from being scoured out of the separator.

As water enters the unit through one or more inlets, coarser solids immediately start to settle below a horizontal grate extending from the inlet to two sets of lower weirs near the outlet pipe. The grating is positioned over the pre-treatment channel to help displace the inflow turbulence and protect the captured sediment from scour. Openings are located on the horizontal plate upstream of each weir to allow the flow to be conveyed into the inner chamber and lower sump. The weirs are positioned to create a counter clockwise rotation of water in the inner chamber to minimize turbulence and maximize settling. After water spirals down the inner chamber to the main settling chamber towards the floor of the separator where it deposits suspended sediments, it flows upwards between the wall of the unit and the outer edge of the disk extended from the inner chamber and through an arced opening at the bottom of the pre-treatment disk, downstream of the bypass weirs, where it is conveyed into the outlet pipe. An annular secondary horizontal plate with 32% of open-perforations is located within the lower sump to protect the collected sediment from scour. Oil and light liquids enter the inner chamber through the holes, reaching the bottom of the pre-treatment area and rises to the top of the water level where they are trapped.

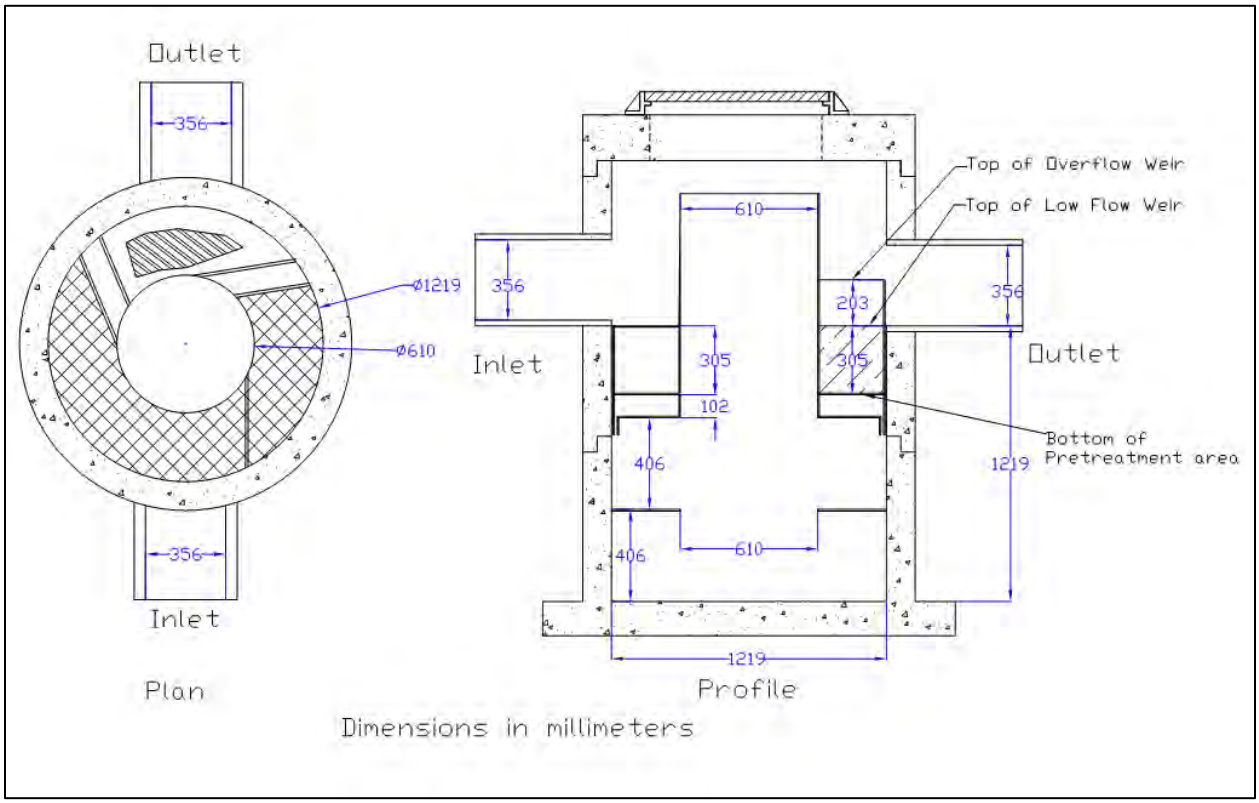


Figure 1: Schematic of the Hydroworks® HS4 Hydrodynamic Separator treatment unit tested as part of this verification.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Hydroworks® HS4 Hydrodynamic Separator, in accordance with the *Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014)*. The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for the Canadian Environmental Technology Verification Program. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test[1]:

During the capture test, the Hydroworks® HS Hydrodynamic Separator, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 69, 64, 60, 56, 46, 41, and 36 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Scour test[1]:

During the scour test, the Hydroworks® HS Hydrodynamic Separator, with 10.2 cm (4 inches) of test sediment pre-loaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment sump storage depth and sediment loaded onto the pre-treatment channel emulating depositional pattern of the 40 L/min/m^2 capture test, generate corrected effluent concentrations of 22.4, 28.5, 20.0, 19.1, and 24.4 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test[1]:

During the light liquid re-entrainment test, the Hydroworks® HS Hydrodynamic Separator with surrogate low-density polyethylene beads preloaded within the inner chamber, representing a floating light liquid volume equal to a depth of 50.8 mm over the sedimentation area, retains 100, 99.9, 95.4, 95.7, and 97.5 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Performance results

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure. The *Procedure for Laboratory Testing of Oil Grit Separators* requires that the three sample average of the test sediment particle size distribution (PSD) meet the specified PSD percent less than values within a boundary threshold of 6%. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 2indicates that the test sediment used for the capture and scour tests met this condition.

[1] The claim can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)

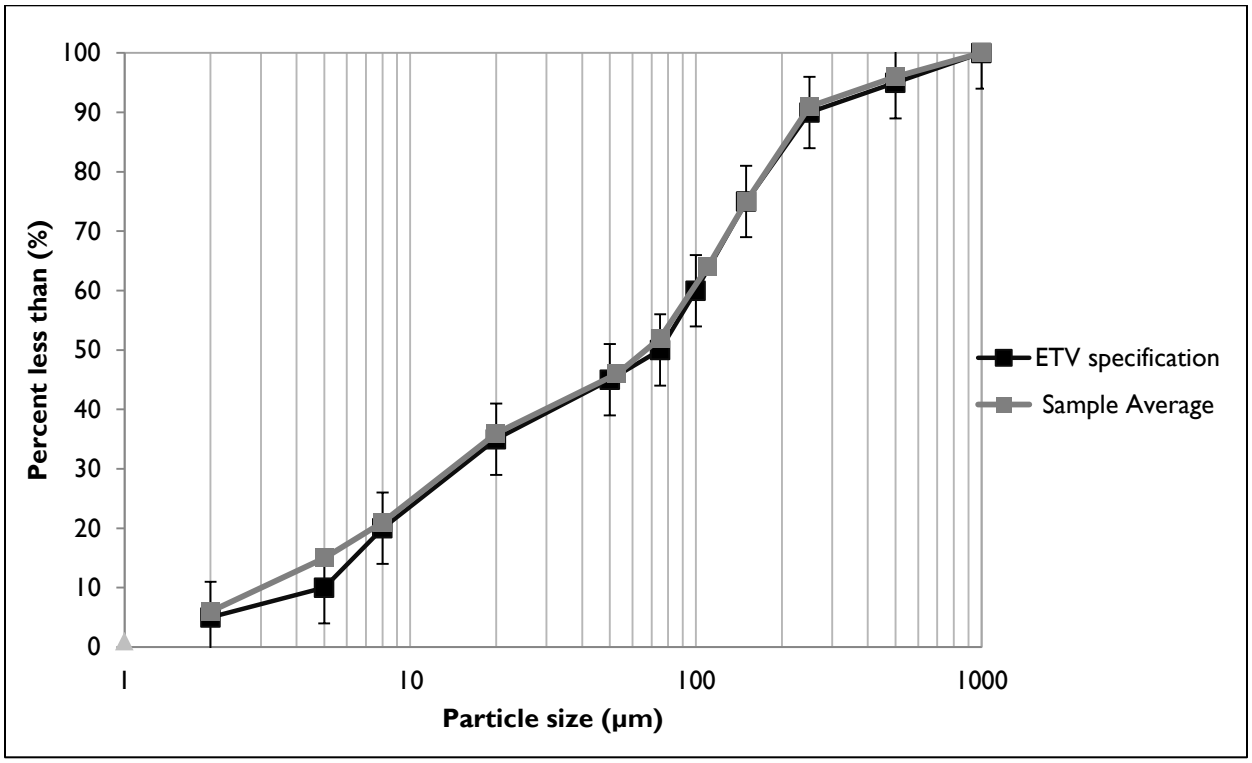


Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

The capacity of the device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor at 0.15 m from the bottom, simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1).

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and may be attributed to errors relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001). The results for "all particle sizes by mass balance" (see Table 1 and 2) are based on measurements of the total injected and retained sediment mass, and are therefore not subject to blending, sampling or PSD analysis errors.

Table 1. Removal efficiencies (%) of the HS4 unit at specified surface loading rates.

Particle size fraction (µm)	Surface loading rate (L/min/m²)						
	40	80	200	400	600	1000	1400
>500	73	100*	98	67	100*	100*	26
250 - 500	100	100*	92	64	100*	98	48
150 - 250	100*	75	89	72	89	60	69
105 - 150	94	100*	100*	100*	78	99	91
75 - 105	96	76	79	95	68	54	46
53 - 75	87	100*	100*	100*	56	69	65
20 - 53	71	54	46	44	19	14	10
8 - 20	38	23	15	8	2	2	2
5 – 8	13	6	1	1	0	0	0
<5	8	0	0	0	0	0	0
All particle sizes by mass balance	**68.6**	**64.0**	**60.0**	**56.1**	**46.1**	**41.2**	**35.7**

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 103 and 194% (average 128%). See text and Bulletin # CETV 2016-11-0001 for more information.

Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the sediment retained by the HS4 unit at each of the tested surface loading rates. As expected, the capture efficiency for fine particles in the unit was generally found to decrease as surface loading rates increased.

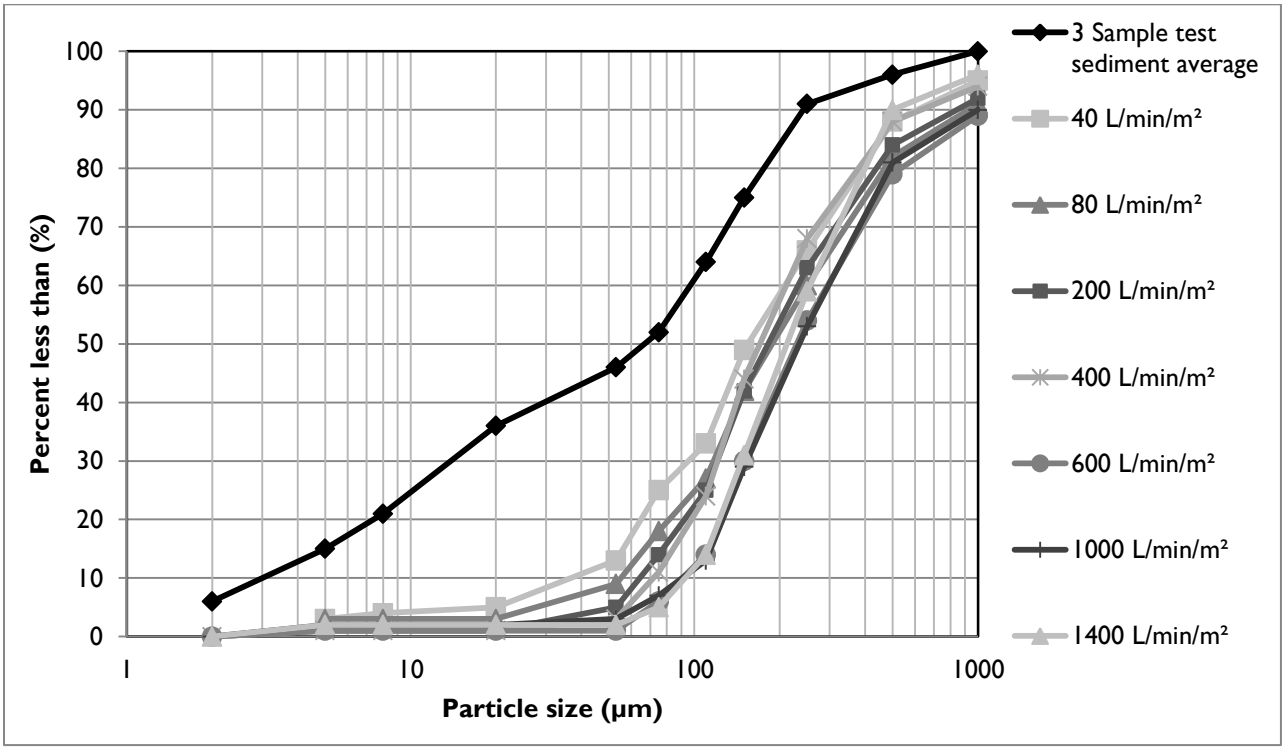


Figure 3. Particle size distribution of sediment retained in the HS4 unit in relation to the injected test sediment average.

For the sediment scour and re-suspension test, two tests were conducted. The first test was conducted with the secondary plate used in the capture tests. The second used a perforated secondary plate. Since sediment during the capture tests was found to settle in the pre-treatment channel, and in roughly the same quantities on the secondary plate and collection sump, all three of these surfaces were preloaded with sediment during the first test. The pre-treatment channel only captures coarse sediment. Therefore, this area was pre-loaded with sediment having a PSD similar to the PSD of the sediment that settled in this area during the 40 L/min/m^2 SLR sediment capture test. The pre-loaded sediment in the pre-treatment channel was shaped and leveled to correspond with sedimentation patterns and depths observed by the laboratory technician during the 40 L/min/m^2 SLR capture test. It should be noted that the actual sediment preloaded in this area was finer than the PSD of sediment captured in the same area during the 40 L/min/m^2 SLR capture test, particularly for particle sizes less than the median size. Both the sump and secondary plate were pre-loaded with the 1-1000 µm sediment mix to a depth of 10.2 cm. The preloaded sediment in the lower sump was placed on a false floor to mimic a device filled to 50% of the manufacturer's maximum recommended sediment storage depth.

After pre-loading the sediment, clean water was run through the device at five SLRs over a 25 minute period. At each SLR, five effluent samples were collected over a four minute interval (one per minute) with the first sample collected at the beginning of each flow rate, and the last collected just prior to the one minute transition to the next flow rate or end of the test. Effluent samples were analyzed for Suspended Sediment Concentration (SSC) and PSD by methods prescribed in the *Procedure*. The effluent samples were subsequently adjusted based on the background concentration of the influent water and the smallest 5% of particles captured during the 40 L/min/m^2 sediment capture test (7 um), as per the method described in Bulletin # CETV 2016-09-0001.

Measurements of sediment depths in the sump after the first test showed that most of the sediment from the secondary plate was carried into the lower sump. During this process, the fine sediment was likely re-suspended and carried out of the unit with the flow. The average adjusted effluent suspended sediment concentrations for each SLR ranged from 11.3 mg/L at the 200 L/min/m2 SLR to 196.7 mg/L at the 1400 L/min/m2 SLR. Effluent SSCs declined after the 1400 L/min/m2 SLR because the unit begins to bypass flow at this rate. It should be noted that this was a very conservative test as sediment was preloaded in three areas, rather than in the lower sump alone, and the preloaded sediment on the pre-treatment channel and secondary plate had a finer PSD than the sediment found to settle in these areas during the lowest SLR capture test.

The second sediment scour test was conducted on an identical unit but with a 32% open-area perforated secondary plate of the same size and orientation as the solid plate used in the first test. The perforated plate was intended to allow most of the sediment to settle in the lower sump, while still protecting against sediment scour, and not affecting the capacity of the unit to capture sediment. A second capture test was run at the 600 L/min/m^2 SLR to confirm that the perforated plate would have the same flow characteristics and removal efficiencies as the solid plate. Results of this comparison presented in Table 2 show that removal efficiencies were not affected and that the collection sump was receiving the majority of sediment transported into the lower chamber. Based on the observed sediment deposition zones, the second repeat test with the perforated plate had sediment preloaded in the pre-treatment channel and the lower collection sump only (*i.e.* the major deposition zones). The collection sump was preloaded with 10.2 cm of the 1- 1000 µm test sediment mix, as in the first test, and the pre-treatment channel was preloaded in much the same way as the first test, but with a sediment PSD that more closely mimicked the PSD of sediment observed to settle in this area during the 40 L/min/m^2 sediment capture test.

Table 2: Injected mass captured at the 600 L/min/m^2 SLR for two different configurations of the secondary plate

Secondary Plate type	Target Surface Loading Rate (L/min/m^2)	Tested Flow Rate (L/min)	Removal Efficiency (%)	Pre-treatment Channel (%)	Secondary Plate (%)	Outlet Dispersion Plate (%)	Collection Sump (%)
Solid Plate	600	736.2	46.1	24.7	8.5	3.1	9.9
Perforated Plate	600	740.9	45.9	25.8	2.7	3.0	14.5

Results of the second test are presented in Table 3. Background concentrations were maintained below 10.5 mg/L. The average adjusted effluent suspended sediment concentrations ranged from 19.1 to 28.5 mg/L. Since the commercially available unit will have a perforated secondary plate, these concentrations are the appropriate values to consider for approvals. The verifier acknowledges that the sediment capture removal efficiencies were not all tested with the perforated plate (see variance notes below), but that the repeat test results at the 600 L/min/m^2 SLR and a statement from the independent test laboratory were sufficient to provide reasonable confidence that the added perforations in the secondary plate would have negligible influence on sediment removal efficiencies.

Table 3. Scour test adjusted effluent sediment concentrations

Run	Surface loading rate (L/min/m^2)	Run time (min)	Background sample concentration (mg/L)[a]	Average adjusted effluent suspended sediment concentration (mg/L)[b]
1	200	5	3.6	22.4
2	800	5	8.9	28.5
3	1400	5	7.6	20.0
4	2000	5	10.4	19.1
5	2600	5	6.0	24.4

[a] Background concentrations shown here are approximate values based on graphical interpolation

[b] The adjusted effluent suspended sediment concentration represents the actual measured effluent concentration minus the background concentration. For more information see Bulletin # CETV 2016-09-0001. Adjusted concentrations were only calculated for the average of the five samples collected per surface loading rate.

The results of the light liquid re-entrainment test used to evaluate the unit's capacity to prevent re-entrainment of light liquids are reported in Table 4. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m^2) of surrogate low-density polyethylene beads (Dow Chemical Dowlex™ 2517) within the inner chamber and running clean water through the device continuously at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m^2). Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates (30 minutes total). The effluent flow was screened to capture all re-entrained pellets throughout the test. Results showed maximum re-entrainment of 4.6% at 1400 L/min/m^2, which is the highest SLR without bypass. Re-entrainment decreased at subsequent SLRs as bypass volumes increased.

Table 4. Light liquid re-entrainment test results for the HS4

Surface Loading Rate (L/min/m²)	Time Stamp (min)	Amount of Beads Re-entrained			
		Mass (g)	Volume (L)	% of Pre-loaded Mass Re-entrained	% of Pre-loaded Mass Retained
200	1:00 – 6:00	0	0	0.00	100
800	7:00 – 12:00	49	0.1	0.1	99.9
1400	13:00 – 18:00	1523	2.7	4.6	95.4
2000	19:00 – 24:00	1445	2.5	4.3	95.7
2600	25:00 – 30:00	847	1.5	2.5	97.5
Interim Collection Net		39	0.1	0.1	99.9
Total Re-entrained		3902	6.8	11.7	--
Total Retained		29,497	51.5	--	88.3
Total Loaded		33,399	58.3	--	--

Variances from testing Procedure

The following deviations from the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014) have been noted:

1. The Procedure stipulates that the tested device "must be a full scale, commercially available device with the same configuration and components that would be typical for an actual installation." As noted above, the sediment capture tests were conducted with a solid secondary plate. The solid secondary plate was later modified to a 32% open area perforated plate to reduce sediment settling on the plate, while continuing to provide scour prevention. As described above, the scour test was repeated with the perforated secondary plate, but the sediment capture test was only repeated at the 600 L/min/m² SLR (i.e. one of seven tested SLRs). Removal efficiency results for the repeat test showed very close correspondence with the earlier test using the solid plate and much of the sediment that previously settled on the secondary plate was deposited in the lower collection sump (see Table 2). The independent laboratory provided the following statement regarding the potential for the added perforations to affect sediment removal efficiencies: "Taking into account the close proximity of the plate to the collection sump, as well as our knowledge of sediment transport, it is expected that the deposited sediment would have settled in the lower sump, with no impact on removal efficiency, if the plate was removed." While the verifier acknowledges that stronger evidence would have been provided by additional repeat testing at a lower and higher SLR, the close correlation between the original and repeat test, combined with the statement from the lab were sufficient to provide reasonable confidence that adding the perforations would not likely have changed the capture test results significantly.

2. The repeat test at the 600 L/min/m² SLR had background concentrations exceeding the 20 mg/L threshold during the last half of the test. The exceedances occurred in 4 of the 8 samples collected, reaching a maximum of 28.4 mg/L. The experimental apparatus is a closed loop system. Therefore, the sediment in the background samples consists of fine particles not captured by the device, and would therefore not likely bias the mass balance results.

3. It was necessary to change flow meters during the sediment scour and light liquid re-entrainment test, as the required flows exceeded the minimum and/or maximum range of any single meter. When the flow capacity of the selected meter was reached, the flow was shut down over a period of approximately 10 seconds and all flow data saved. The next data acquisition file was executed and flow increased at a rate that corresponded to reaching each previous target flow after a period of 1-minute. This procedure was approved by CETV prior to testing, in recognition that most particles susceptible to scour at low flows would not be in the sump at higher flows. Similarly, re-entrainment of the oil beads was not expected to be significantly affected by the flow meter change.

4. As part of the capture test, evaluation of the 40 and 80 L/min/m^2 surface loading rate was split into 3 and 2 parts, respectively, due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit. At the end of the first and second parts of the test, the flow rates were gradually shutdown to prevent capture of particles that would have been washed out under normal circumstances. The amended procedure was reviewed and approved by the verifier prior to testing.

Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Hydroworks, LLC to support the performance claim included the following: Performance test report prepared by Alden Research Laboratory, Inc., and dated February 2018. This report is based on testing completed in accordance with the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Hydroworks® HS Hydrodynamic Separator please contact:

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Limitation of verification
GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.



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.

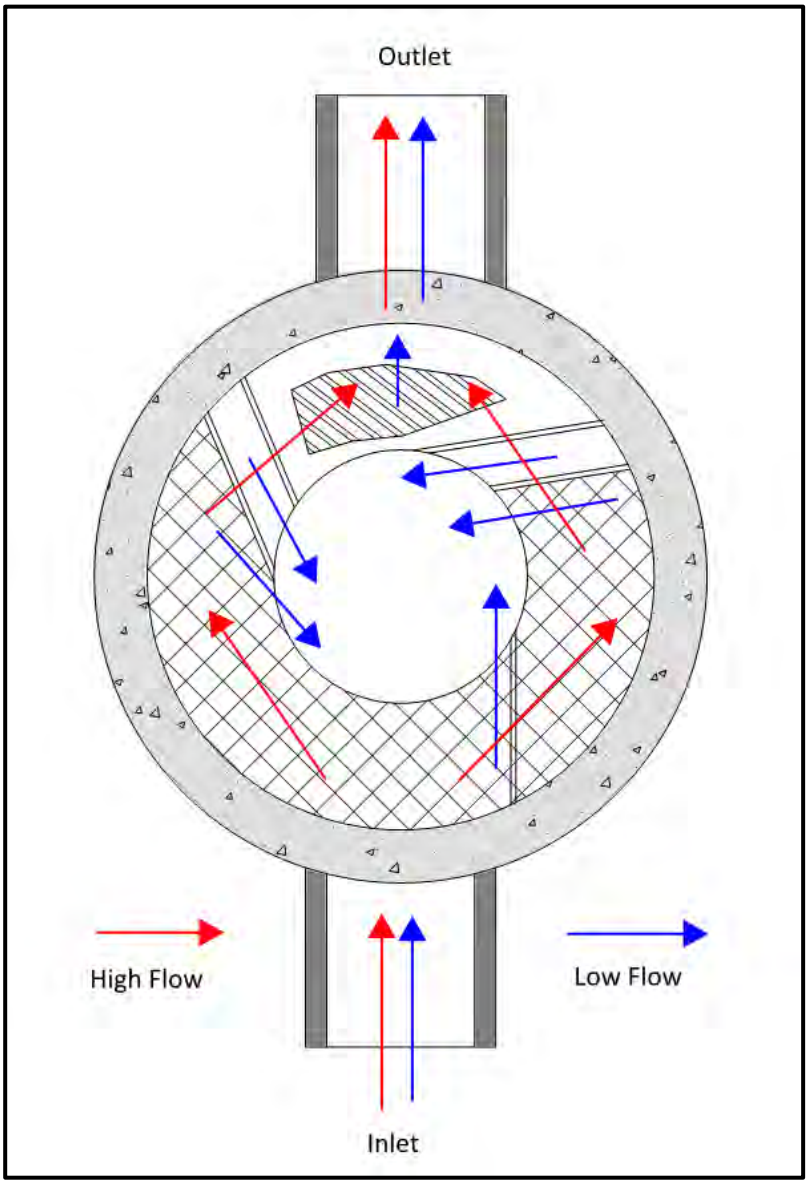


Figure 1. Hydroworks HydroStorm Operation – Plan View

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

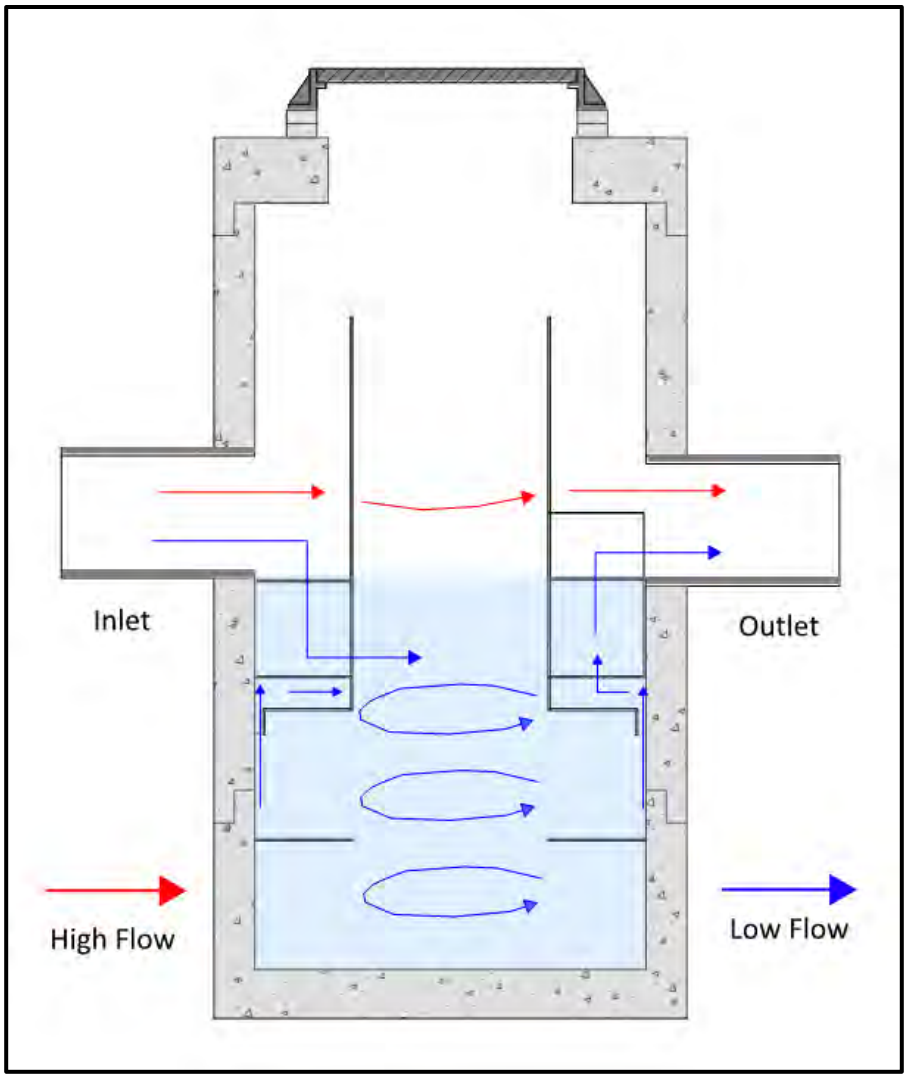


Figure 2. Hydroworks HydroStorm Operation – Profile View

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.

Hydroworks

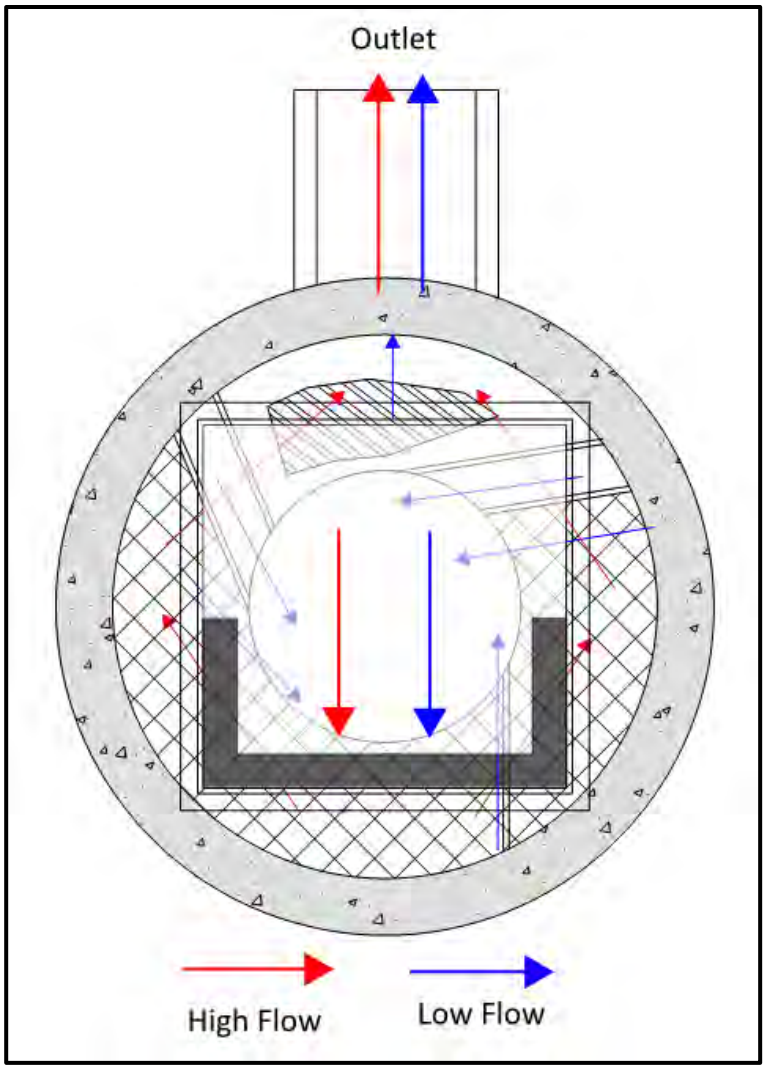


Figure 3. Hydroworks HS 4i Funnel

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).

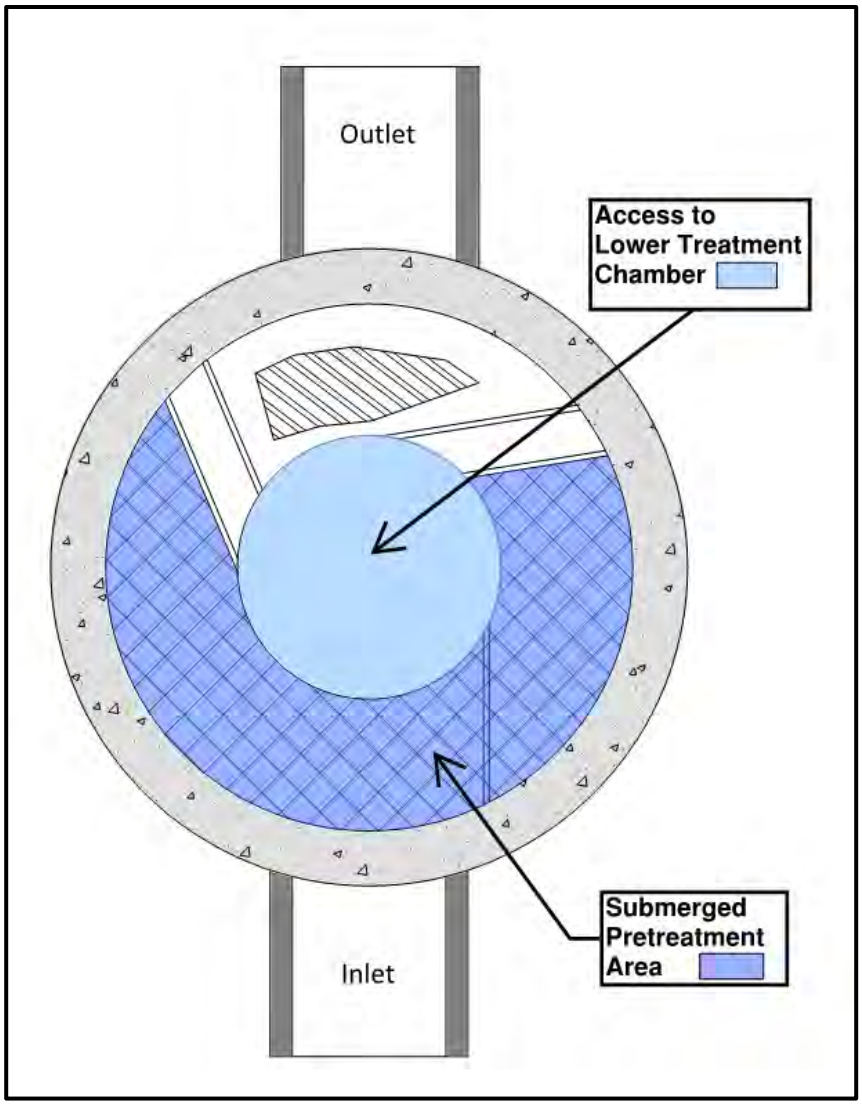


Figure 3. Maintenance Access

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.

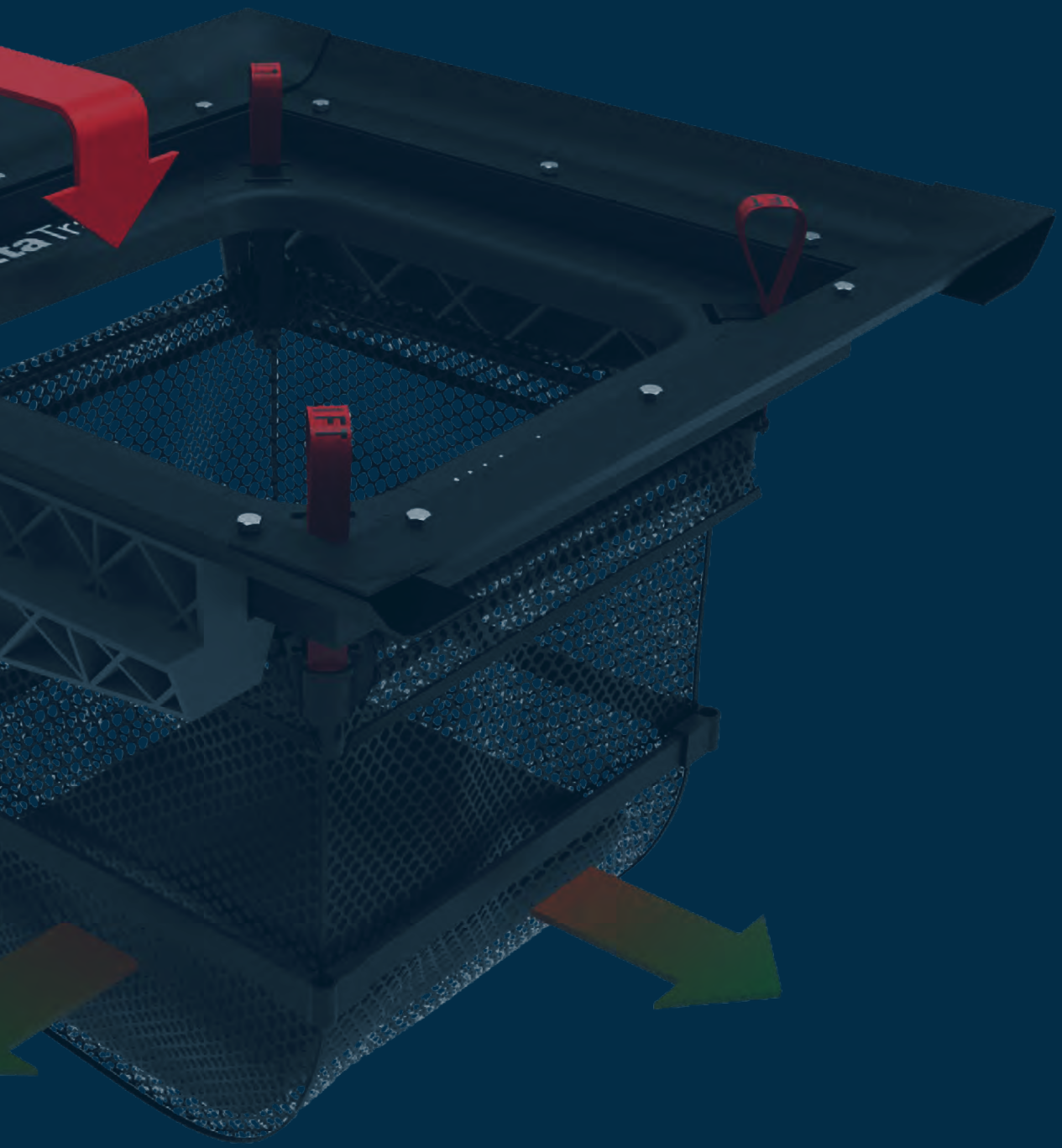
The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by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

ENVIROPOD.COM



LittaTrap™ Operations and Maintenance Guide

ENVIROPOD™
A STORMWATER360™ COMPANY

The Enviropod LittaTrap™

The Enviropod® LittaTrap™ is an innovative catch basin inlet filter (insert) device designed to be easily installed into new and existing stormwater catch basins of any size or configuration. The Enviropod® LittaTrap™ can be installed in grate (drop) inlets, curb inlets, combination grate/curb inlets, or round manhole catch basins. Figure 1: Enviropod® LittaTrap™ example catch basin applications shows these types of installations.

The Enviropod® LittaTrap™ is an effective stormwater treatment technology that is designed to capture and remove a variety of stormwater pollutants conveyed in runoff, such as trash, debris, sediment, macro or micro plastic debris and other pollutants of concern. In addition, the Enviropod® LittaTrap™ maintains catch basin hydraulic capacity and allows for easy maintenance when completely full of trash and debris. The Enviropod® LittaTrap™ is available in a range of standard model sizes and configurations.

The Enviropod LittaTrap FC model is also approved for use by numerous State and local agencies throughout the USA as well as certified by the California State Water Resources Control Board, Trash Implementation Program.

The Enviropod LittaTrap FC model is fitted with a "full capture" liner that insures 100% of particles 5mm and over are captured in the trap.

The Enviropod® LittaTrap™ FC also includes an optional hinged vector port seal (HVPS) when installed in a grated inlet or combination inlet catch basin, if required. The HVPS allows visual inspection under the basket for access by local or State Vector Control field personnel. In addition, the design of the HPVS has been approved by the Mosquito Vector Control Association of California (MVCAC) for California certified full trash capture applications.

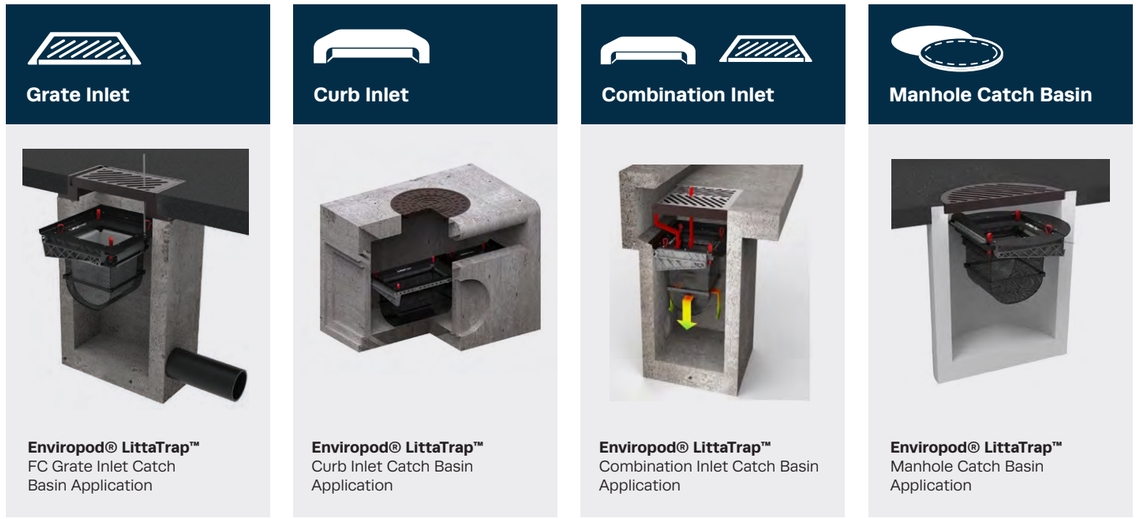


Figure 1: Enviropod® LittaTrap™ example catch basin applications

Components and Operation

During a storm event, stormwater runoff flows enter a catch basin through a grate (drop) inlet, curb inlet, combination inlet or manhole type structure. The downward flow is intercepted and captured by the Enviropod® LittaTrap™ device that is placed inside the entry portion of these catch basin types. Once flow enters the Enviropod® LittaTrap™, the Enviropod® LittaTrap™ seals and basket collar direct the flow over the bypass slots and into the basket and optional liner (as applicable). The LittaTrap™ seals are adjustable to ensure all particles diverted into the basket and liner will not cause "short-circuiting" or create early bypass of the design volume of runoff or treatment flows.

The LittaTrap™ filter box sits on a support bracket that cantilevers off a single wall of the catch basin. The support bracket is located approximately 8 inches below the surface level creating a driving head to increase the maximum bypass flow rate without causing surface ponding. The support bracket has been structurally designed to take the load of the basket that is filled with sediment, while the peak bypass flow is conveyed into the catch basin.

The patented Enviropod LittaTrap™ gross pollutant basket incorporates a structural batten that has three functions:

1. Constrains the basket preventing the expansion or "bulging" so the basket can be easily removed when full of material.
2. Maintains a secondary flow path around the basket for bypass flows; and
3. Maximizes the screen area and material storage volume of the basket.

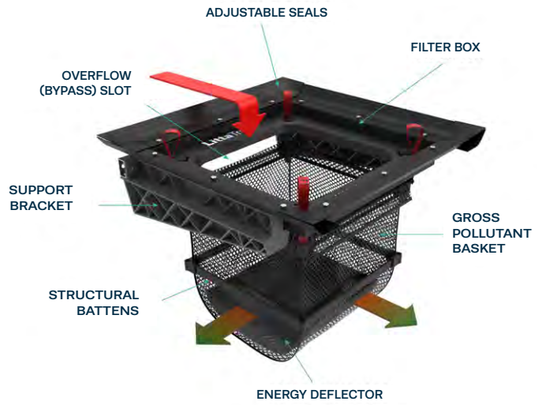


Figure 2: Enviropod® LittaTrap™ FC Operation

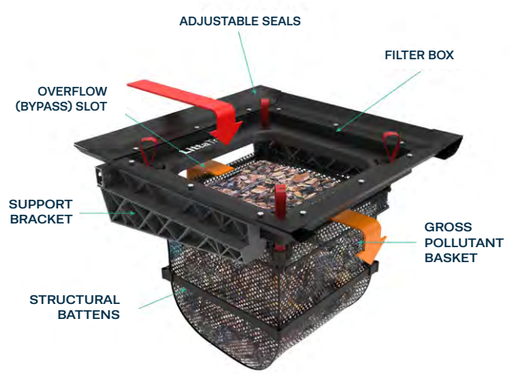


Figure 3: Enviropod® LittaTrap™ FC Bypass Operation

Inspection and Maintenance Procedures

HEALTH AND SAFETY:

Enviropod recommends that owners check and utilize any applicable State and local regulatory requirements for applying a Site-Specific Safety Plan before undertaking any installation, inspection, or maintenance service. Personal Protection Equipment (PPE) is required when installing, inspecting, or maintaining a Enviropod® LittaTrap™. Field personnel shall utilize personal protection equipment (PPE) as required, including gloves, long sleeve shirts or outwear, long pants, Hi-Viz clothing as well as steel toe shoes. For additional advice on the relevant health and safety requirements, we recommend that you consult the local health and safety regulator.

INSPECTIONS:

All stormwater inlet filter devices require routine inspection and maintenance service to ensure continued functionality of the device as well as identify and remove trapped contaminants and to minimize bypass. Due to the variable nature of stormwater pollution, annual rainfall characteristics and localized site pollutant loadings, maintenance service frequencies can vary for any catch basin location.



Figure 4: LittaTrap seen with 1mm liner installed to target micro-plastics such as plastic pellets. Hand maintenance shown.

It is recommended to inspect the LittaTrap Enviropod® LittaTrap™ at least four times per year during the first year of operation to determine seasonal and annual maintenance requirements.
First year inspection service frequency is recommended by conducting one inspection visit for every three months after a LittaTrap™ Inlet Filter device is installed and is placed in operation. However, if there is a presence of a high potential loading activity within the drainage area, it's recommended that catch basin inspection frequency be revised. High loading activity in the upstream drainage area may include the following:

- A high number of trees or vegetation.
- Construction activity.
- Uncovered or unsealed roadways

Additional inspections are recommended after major storm events. The LittaTrap™ should be inspected after a major storm event to check for any unforeseen damage or to find evidence of illicit discharge.

MAINTENANCE FREQUENCY

Maintenance of the Enviropod® LittaTrap™ is recommended when more than 75% of the maximum trash capture volume of the LittaTrap™ model size installed. Maintenance frequency is typically conducted 1 or 2 times per year, depending on pollutant load conditions within a particular drainage area. If applicable, maintenance frequency shall be conducted as per any local municipal or State stormwater permit requirements.

MAINTENANCE PROCEDURES

The Enviropod® LittaTrap™ maintenance service involves two activities. These activities are as follows:

1. Routine removal and emptying of the gross pollutant basket and liner (if used); and
2. Inspection for any structural damage or flow impedance.

The recommended maintenance procedure for grate (drop) inlets or combination grate/curb inlet catch basins is for the end-user or maintenance service contractor to conduct maintenance service by "hand" to reduce operational cost. Each Enviropod® LittaTrap™ basket is fitted with lifting handles on four sides of the basket, so that maintenance personnel will have no personal contact with the captured and retained pollutants.

Enviropod also recommends the use of a vacuum induction truck (ie; vactor truck or heavy industrial vacuum equipment) for the maintenance of curb entry catch basin LittaTrap inlet filter devices.

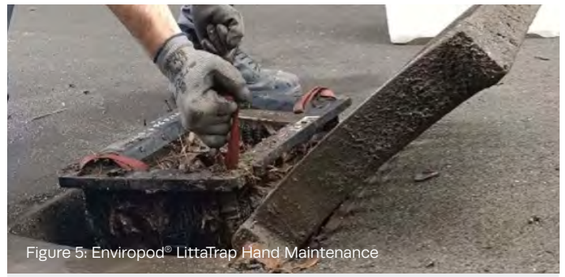


Figure 5: Enviropod® LittaTrap Hand Maintenance

Enviropod® LittaTrap™ FC Hand Maintenance

It is recommended that the Enviropod® LittaTrap™ FC basket and liner be emptied when 75% Full. To empty the Enviropod® LittaTrap™ FC, it is a simple one-minute exercise "Lift, Tip, Replace". The following steps detail hand maintenance:

1. Establish a safe working area per typical catch basin service activity.
2. Remove grate/access cover.
3. Remove the basket and liner with two lifting hooks or lift by hand through the loops on the top of the basket. Excess debris should be scooped out first if the basket is over half full.
4. Pour contents of the basket and liner into a disposal container.
5. Replace grate.



Figure 6: LittaTrap Vactor Maintenance

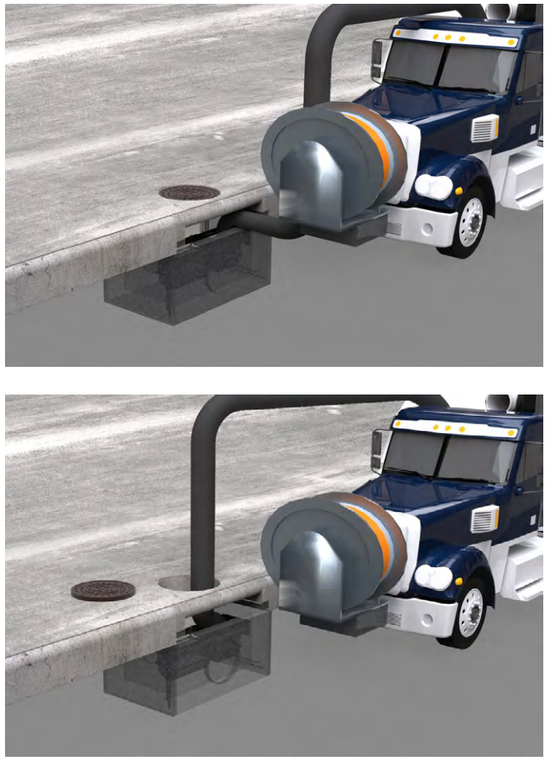
Enviropod® LittaTrap™ FC Vactor Maintenance

The steps for induction maintenance are detailed below:

1. Establish a safe working area per typical catch pit service activity.
2. Remove grate/access cover.
3. Vacuum accumulated debris from the basket.
4. Vacuum contents from the base of the catch basin (if required).
5. Inspect basket, filter box, and seals for any damage.
6. Replace grate/access cover.

CURB ENTRY CATCH BASIN MAINTENANCE

For curb entry catch basins, the geometry of the Enviropod® LittaTrap™ basket allows a vactor hose to enter the basket through the curb opening, as shown in the figure below. Alternatively, baskets can be accessed through the catch basin access manhole.



ENVIROPOD LITTATRAP BASKET AND FULL CAPTURE LINER CLEANING.

Material trapped in the Enviropod® LittaTrap™ basket and or full capture liner is easily removed by shaking the basket or tapping the basket against a hard surface. If required a power washer can used to remove excess sediment or debris trapped in the screen

RECORD-KEEPING MAINTENANCE PROCEDURES

- Following maintenance and/or inspection, Enviropod recommends that the owner or maintenance service contractor prepare a maintenance/inspection record. The record shall include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.
- The owner shall retain the maintenance/inspection records in accordance with local and/or state requirements.

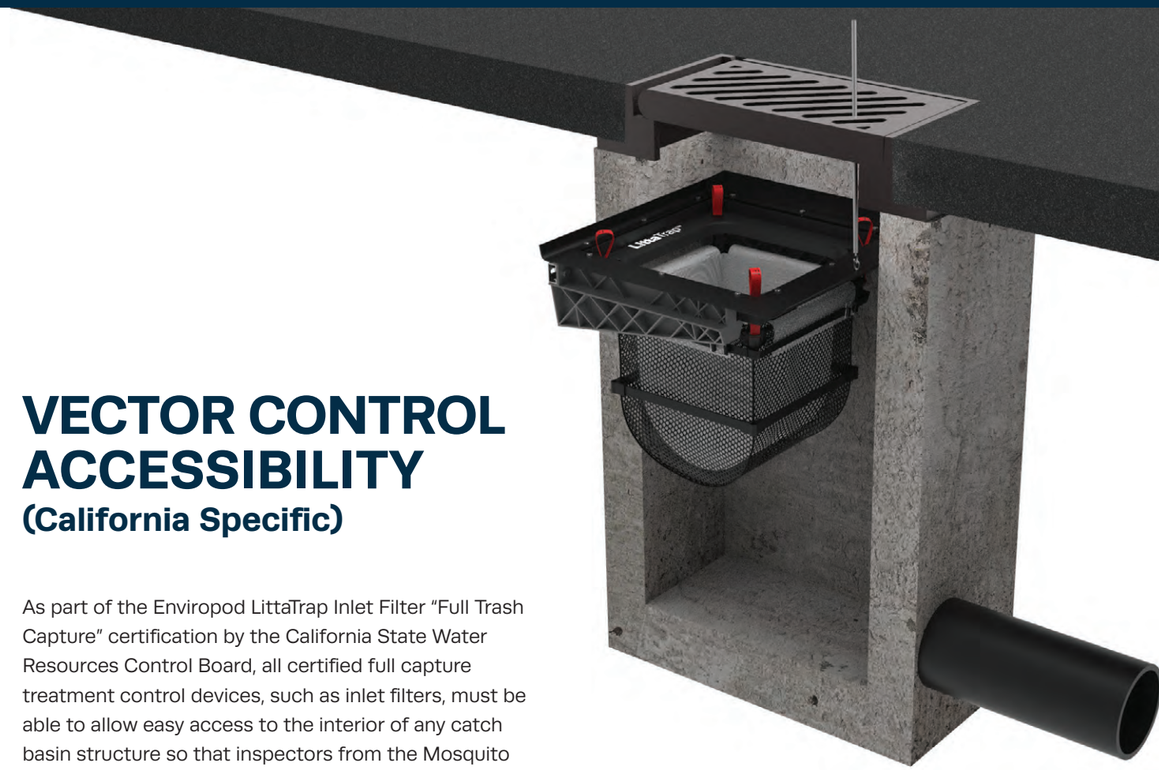
REQUIRED EQUIPMENT AND MATERIALS FOR MAINTENANCE ACTIVITIES.

The following equipment is helpful when conducting Enviropod® LittaTrap™ Grate Inlet and Curb Inlet inspections and maintenance:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Personal protection equipment (protective footwear, gloves, hardhat, safety glasses, high visibility clothing, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Vacuum truck (optional)
- Pressure washer (optional)
- Replacement oil absorbent pouches (Optional)

REPAIR OR REPLACEMENT PROCEDURES.

In the unlikely event of an Enviropod® LittaTrap™ FC structural component requiring repair, the system can be easily uninstalled by reversing the installation procedure. Once uninstalled, any faulty part or component can be replaced.



VECTOR CONTROL ACCESSIBILITY
(California Specific)

As part of the Enviropod LittaTrap Inlet Filter “Full Trash Capture” certification by the California State Water Resources Control Board, all certified full capture treatment control devices, such as inlet filters, must be able to allow easy access to the interior of any catch basin structure so that inspectors from the Mosquito Vector Control Association of California (MVCAC) may inspect, observe and treat any potential mosquito activity or biological growth occurring inside a catch basin structure. Therefore, the Enviropod® LittaTrap™ FC grate (drop) inlet device can be equipped with a “Hinged Vector Port Seal” (HPVS) component that will allow full visual access of the catch basin floor or other internal areas beneath the Enviropod LittaTrap FC model. In the event that a HVPS component is required anywhere in the State of California, an HVAC component shall be included and installed in any Enviropod LittaTrap Grate Inlet Filter device application.

The HVPS takes the form of a spring-loaded hinged rubber seal. The inspection seal is easily lifted to 90 degrees with a J hook inserted into the lifting eye attached to the seal. This action provides a clear opening for inspection across the front face of the catch basin. Upon release the hinged seal automatically closes ensuring no gaps of 5mm or larger exist between the seal and the catch basin wall. The hinged vector port seal can be opened with the catch basin grate closed with the use of a J Hook.



Inspection and Maintenance Form

ADDRESS:

OWNER/LOCATION NAME:

DATE:

INSPECTOR NAME/COMPANY

Catch Basic Name/Number	Percentage Full of Trash/Debris (Mark X in appropriate box)				Condition of the LittaTrap Good/Poor (Requires Attached?)	Annual Weighting factor	Comments
	0–25%	25–50%	50–75%	75–100%			

COMMENTS:

Please include 3 photographs of each catch basin with the grate closed, grate open and upstream catchment.

Is the LittaTrap more than 75% full?

>75%: Proceed with maintenance.

If 50–75%: Maintenance recommended in the next 2 months.

QR CODE FOR THE ONLINE SURVEY

Download the ArcGIS Survey123 app on Android or Apple. No sign-in required, simply scan the QR code and complete. Enviropod will send you the Inspection or maintenance report.

ABOUT ENVIROPOD

EnviroPod is Australasia's leading catch basin insert technology provider. The company has over 25,000 installs of its technology worldwide, including catchment wide retrofits. The LittaTrap is a result of 25 years' of research, implementation and operation of source treatment solutions.

For further information please see www.enviropod.com

International patent numbers for : CA– 2,810,974 ; USA – 9,642,658 ; AU – 2011302712 ;NZ – 588049 . Other patents pending.

ENVIROPOD™
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APPENDIX D

FIRE FLOW ANALYSIS

OBC FIRE FLOW WATER SUPPLY

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS

Project: **236 Plains Road**
Project Number: 23057
Date: Mar-24

Type of Development: **Residential**

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

Where:

Q = Minimim supply of water in litres
K = Water suppy coefficient from Table 1
V = total building volume in cubic meters
S_{tot} = total of spatial coefficient values from property line exposures on all sides

$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + ...]$ from Figure 1. Max. 2.0

Water Supply Coefficient (K)

Building Group/Division Classification: **C (Residential occupancy, building that exceeds 600m^3)**

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

Building Volume (V)

Building Footprint Area: **491** m^2
Building Height: **21** m (basement floor to underside of roof deck)
Building Volume (V): ***10311*** **m^3** (conservatively assume attic has same footprint)

Spatial Coefficient (S)

See Figure 1 for Spatial Coefficients

Side	Dist (m)	S_{coeff}
North	**>10m**	**0**
South	**9m**	**0.4**
East	**>10m**	**0**
West	**>10m**	**0**
	Total	**0.4**

Therefore, S_{tot} = **1.4**

Required Water Supply

$Q = K\ V\ S_{tot}$ = 230966.4 L

From Table 2, the minimum required water supply flow rate = ***6300*** ***l/min*** ***or*** 105 l/s

OBC Tables and Figures

Table 1

Water Supply Coefficient - K

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

Table 2

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

Figure 1
Spatial Coefficient vs Exposure Distance

