TATHAM ENGINEERING

Enhancing our communities

140 Mountain Road

STORMWATER MANAGEMENT REPORT

2596482 Ontario Ltd.

File 121036-1 | August 30, 2023

Document Control

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Issue	**Date**	**Description**
1	November 28, 2022	Draft for Review
2	December 20, 2022	First Submission
3	August 30, 2023	Second Submission

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1 Introduction

Tatham Engineering Limited (Tatham) has been retained by 2596482 Ontario Ltd. (the Owner) to prepare a Stormwater Management (SWM) Report in support of a Site Plan Application to permit the development of a proposed commercial/industrial use business park at 140 Mountain Road in the Town of Collingwood, County of Simcoe.

1.1 SITE DESCRIPTION

The subject property is approximately 2.02 ha and fronts onto Mountain Road, with 10th Line 575 m to the west and Black Ash Creek 325 m to the east. Currently the site is undeveloped and heavily vegetated with much of the site located within the Nottawasaga Valley Conservation Authority (NVCA) regulated area. The property is zoned industrial (M5). The subject property is bounded by Mountain Road and undeveloped industrial land to the north and east, vacant industrial land to the west which is currently under construction, and Taylor's Creek, a tributary to Black Ash Creek, to the south. Currently there is no existing site access from Mountain Road. The terrain on the subject property has an approximate slope ranging from 2.0% - 3.5% from southwest to northeast corner.

The existing topography, ground cover, and drainage patterns were obtained through a review of available plans and on-site investigations. A detailed topographic and legal survey was completed by Zubek, Emo, Patten & Thomson Ltd. in spring 2012 to confirm existing site features and elevations.

Soils in the immediate area consist of very loose fine sand, silty sand, stiff silty clay till, silty sand till and dense fine to coarse sand. Geotechnical investigations on either side of the subject property at 120 and 180 Mountain Road revealed a relatively shallow silty clay layer which is not conducive to infiltration. The investigations also indicated that some of the existing soils will be highly susceptible to frost and significant loads but could be addressed by either temporarily aerating or wetting depending on the situation. Groundwater was encountered at elevations between 0.5m to 2.6 m below the surface. A permit to take water is not anticipated.

1.2 PROPOSED DEVELOPMENT

The proposed development is as shown on the Engineering Drawings included in the Site Plan application package. The proposed development includes the construction of a proposed multi-unit industrial/commercial building, associated parking areas, on-site amenity areas, as well as two stormwater management facilities (SWMFs) adjacent to each of the site entrances.

Recent rechannelization of Taylor's Creek has been completed to create a stable low flow channel and a confined floodplain to convey peak flows up to and including those produced by the Regional (Timmins) storm with a minimum freeboard of 0.30 m, thereby eliminating any spill on to lands located to the north including the subject property. Therefore, Black Ash Creek does not require peak flow control for flows discharging to the creek, however the peak flow control design criteria will be governed by either post to pre control or the allowable flows for the conveyance capacity of Mountain Road (interim and final). For details of the Taylor's Creek rechannelization, refer to the *Taylor's Creek Rechannelization* design brief prepared by Tatham (2016).

It is noted that the Town of Collingwood will be proceeding with the Mountain Road Reconstruction Project which includes the widening of Mountain Road to 5 lanes, and the construction of a trunk storm sewer which will discharge to Black Ash Creek. The Town has purchased land along the front of the subject property to accommodate the widening.

1.3 OBJECTIVE

The primary objective of this report is to analyze the potential impacts of the development on the local drainage systems and to develop a SWM plan in accordance with all relevant Municipal, Regional and Provincial guidelines to mitigate potential adverse impacts of the development to the downstream drainage systems.

1.4 BACKGROUND AND GUIDANCE DOCUMENTS

The proposed SWM Plan was developed recognizing the pertinent guidelines on municipal design, water resources and the environment, including the following:

- *Black Ash Creek Subwatershed Plan.* Nottawasaga Valley Conservation Authority (April 2000);
- *Stormwater Management Planning and Design Manual*. Ministry of Environment [now Ministry of Environment, Conservation and Parks (MECP)] (2003);
- *Corporation of the Town of Collingwood Development Standards*. Town of Collingwood (July 2007);
- *NVCA Stormwater Technical Guide*. Nottawasaga Valley Conservation Authority (December 2013); and
- *Taylors Creek Rechannelization*. Tatham Engineering Limited (June 2016).

2 Existing Conditions

The existing topography, ground cover, land use and drainage patterns for the subject property were established through interpretation of topographic maps, aerial photography, and a site survey. An Existing Conditions Drainage Plan (Drawing DP-1) illustrating the existing drainage conditions across the subject property is enclosed for reference.

The subject property consists of a vacant scrub and partially regenerating forested area. The adjacent property to the west, 180 Mountain Road, provides on-site SWM controls and intercepts all runoff which would have previously drained through the subject property. Under existing conditions, the site drains from southwest to northeast, collecting along the east property limit and eventually discharging overland northerly across a gravel trail to the Mountain Road south roadside ditch. The roadside ditch conveys flows east and discharges to Black Ash Creek. The adjacent property to the east, 120 Mountain Road, is proposed for development and has been designed with raised grades along the shared property line. This design has been submitted for approval and is currently undergoing review. As construction has not yet been completed, there is potential to work with the adjacent property owner to adjust the existing lot line grades to better suit both of the proposed developments where required.

The Rational Method has been used to quantify pre-development runoff rates from the subject property. The rainfall intensity-duration-frequency parameters specified in the Town's engineering standards were applied to the Rational Method and used to establish the peak flow rates discharging from the subject property for the 1:2-year through 1:100-year design storm events. A summary of the peak flows is provided in Table 1. Supporting calculations are included in Appendix A.

Table 1: Existing Site Peak Flow Summary

STORM	CATCHMENT 101 (m^3/s)
1:2-Year	0.053
1:5-Year	0.070
1:10-Year	0.081
1:25-Year	0.105
1:50-Year	0.128
1:100-Year	0.146

3 Proposed SWM Plan

The proposed SWM plan has been prepared in accordance with the MECP *Stormwater Management Planning and Design Manual*, *Town of Collingwood Development Standards* and the *NVCA Stormwater Technical Guide* and is presented in the following sections. A Proposed Conditions Drainage Plan (Drawing DP-2) illustrating the proposed drainage conditions for the subject property is enclosed for reference.

3.1 DESIGN CRITERIA

Based on previous reports and analysis of the background information collected, the following design criteria were established to be satisfied by the proposed SWM Plan:

- The stormwater management plan must maintain existing stormwater runoff rates at the site outlet by restricting post development peak flow rates to pre-development levels for the 1:2-Year through 1:100-Year design storms;
- The stormwater management plan must achieve the required Enhanced Level water quality treatment to Provincial standards in the form of 80% total suspended solids (TSS) removal for the site effluent;
- the stormwater management plan must consider the 5 mm erosion control criteria, phosphorus budget, and water budget as required through the *NVCA Stormwater Technical Guide*;
- Safe conveyance of the Regulatory storm event peak flows through the site to the downstream drainage system must be provided for surface runoff generated within the development; and
- The stormwater management plan must consider not only the existing condition but also take into account the ultimate road cross-section and drainage system for Mountain Road once the proposed widening is completed.

3.2 STORMWATER MANAGEMENT PLAN

The proposed development consists of one multi-unit building containing 36 individual units with a total floor area of 6,821 m^2, two paved parking areas complete with two access lanes to Mountain Road, two rear loading areas, sidewalks, and two amenity and waste collection areas with a total combined paved area of 7,740 m^2. The remainder of the development area is to be landscaped or treed. A 230 m^2 area at the south portion of the subject property will remain undisturbed to maintain a treed buffer between the site and the Black Ash Creek tributary to the south known as Black Ash Creek.

Runoff from the majority of proposed impervious areas will be collected and conveyed to one of the two proposed SWMFs at the northeast or northwest corners of the subject property.

The proposed storm sewer system will convey flows generated by minor storms up to the 1:5-year design storm to the SWMFs. Major storm flows will be conveyed overland through the subject property to the proposed SWMF. Runoff for a small portion of the site entrance will drain uncontrolled to Mountain Road and will be composed mostly of landscaped area. Storm sewer sizing calculations and overland conveyance checks are included in Appendix B. The proposed SWMFs will discharge to the Mountain Road south roadside ditch in the interim (existing) condition and will ultimately discharge to the future Mountain Road storm sewer when reconstruction of the road has been completed.

The Mountain Road south roadside ditch will be regraded along the subject property frontage and tie into the proposed regrading for 120 Mountain Road and 180 Mountain Road. Regrading will also include the installation of two 600mm diameter HDPE driveway culverts at the site entrances. Ditch and driveway culvert capacity calculations are included in Appendix B for reference. The site outlets will be adjusted as required to connect into the future storm sewers along Mountain Road as part of the Mountain Road Reconstruction project.

3.3 STORMWATER QUANTITY CONTROL

Stormwater quantity control for the subject property will be provided by the proposed SWMFs located at the northeast and northwest corners of the subject property. An area of approximately 0.92 ha will drain to the northeast SWMF, an area of 1.03 ha will drain to the northwest SWMF, and an area of approximately 0.07 ha will drain uncontrolled to the Mountain Road south roadside ditch. Outlet control structures have been designed for both of the proposed SWMFs to control the combined peak discharge rates from the subject property to pre-development rates with the exception of 1:2-year storm event. The discharge from the 1:2-year storm event exceeds the pre-development discharge rate by 0.005 m^3/s. It is our opinion that this additional discharge should have no negative impacts on the municipal system downstream as the south Mountain Road ditch is an altered conveyance system and will be replaced in the near future as part of the Mountain Road Reconstruction project. The Modified Rational Method was used to quantify the post development peak flows for the subject development. The combined controlled and uncontrolled discharge rates are summarized in Table 2. Supporting calculations are included in Appendix A for reference.

Table 2: Proposed Site Peak Flow Summary

STORM	CONTROLLED (m^3/s)	UNCONTROLLED (m^3/s)	TOTAL SITE DISCHARGE (m^3/s)
1:2-Year	0.052	0.006	0.058 *(0.053)*
1:5-Year	0.059	0.007	0.066 *(0.070)*
1:10-Year	0.064	0.009	0.072 *(0.081)*
1:25-Year	0.072	0.011	0.084 *(0.105)*
1:50-Year	0.080	0.013	0.093 *(0.128)*
1:100-Year	0.086	0.015	0.101 *(0.146)*

Note: *(0.146)* denotes existing condition peak discharge

Comparing the proposed combined peak flows to the existing peak flows confirms that the SWMF provide the requisite water quantity control for the subject property attached. A summary of the operating conditions of the proposed SWMF is provided in the following section.

3.3.1 SWMF Details

Two SWMFs with a combined footprint area of approximately 700 m^2 will provide a combined total of 1,086 m^3 of active storage volume.

Discharge from SWMF-1 will be controlled by a series of engineered outlets as follows:

- A 300 mm diameter PVC pipe in SWMF-1 (located in the northwest corner of the site) with a 125 mm diameter orifice will act as the primary outlet from the SWMF and convey discharge to the south Mountain Road ditch. The orifice will have an invert of 182.35 m and will control discharge from the 1:2-year to the 1:100-year design storm;
- A 300 mm diameter perforated riser sections designed with 13, 25.4 mm diameter perforations per linear 0.10 m, extends 1.6 m up from the base of SWMF-1 to collect and convey flow to the orifice for discharge; and
- A rectangular emergency overflow weir is located at the outlet of SWMF-1, with a bottom width of 3.6 m and sill elevation of 183.80 m and will discharge through a trapezoidal conveyance swale designed to convey flows from storm events exceeding the 100-year event to the Mountain Road south side ditch.

Discharge from SWMF 2 will be controlled by a series of engineered outlets as follows:

- A 375 mm diameter PVC pipe in SWMF-2 (located in the northeast corner of the site) with a 135 mm diameter orifice will act as the primary outlet from the SWMF and convey discharge to the south Mountain Road ditch. The orifice will have an invert of 182.35 m and will control discharge from the 1:2-year to the 1:100-year design storm;
- 300 mm diameter perforated riser sections designed with 13, 25.4 mm diameter perforations per linear 0.10 m, extends 1.6 m up from the base of SWMF-2 to collect and convey flow to the orifice for discharge; and
- A rectangular emergency overflow weir is located at the outlet of SWMF-2, with a bottom width of 3.6 m and sill elevation of 183.80 m and will discharge through a trapezoidal conveyance swale designed to convey flows from storm events exceeding the 100-year event to the Mountain Road south side ditch.

Details of the SWMFs and the engineered outlets are illustrated on the Site Grading Plan (Drawing SG-1) included in the Engineering Drawings package. The combined SWMF stage-storage-discharge summary is shown below in Table 3 and the detailed stage-storage-discharge calculations are provided in Appendix C for reference.

Table 3: Combined SWMF Stage-Storage-Discharge Summary

STORM	DISCHARGE (m^3/s)	STORAGE VOLUME (m^3)	AVE WATER SURFACE ELEV (m)
1:2-year	0.058	255	182.91
1:5-year	0.066	358	183.06
1:10-year	0.072	427	183.16
1:25-year	0.084	572	183.37
1:50-year	0.093	722	183.58
1:100-year	0.101	841	183.75

3.4 STORMWATER QUALITY CONTROL

Enhanced Level stormwater quality protection will be provided for the subject property in the form of 80% total suspended solids (TSS) removal. Water quality treatment for the development will be provided by two oil-grit-separator (OGS) units which will remove sediment and provide an Enhanced Level of treatment for flows prior to entering the SWMF.

To provide an Enhanced Level water quality treatment for runoff discharging to each SWMF, the use of Stormceptor EFO6 OGS (or approved equivalent) is recommended. It was determined that the EFO6 OGS will provide the required minimum of 80% removal efficiency of TSS in these conditions. A detailed OGS sizing report is included in Appendix D for reference. The OGS units will be cleaned out regularly to ensure the provided sediment storage capacity is not overwhelmed.

3.5 PHOSPHORUS LOADING, WATER BUDGET AND NVCA EROSION CONTROL

Pre and post development phosphorus loading calculations have been prepared for the subject property using the NVCA's online tool. The pre-development loading was determined to be 0.12 kg/ha/yr and the post development loading 2.12 kg/ha/yr. There are no mitigative measures proposed. The phosphorous tool report is included in Appendix E for reference.

A water budget calculation has been prepared for the subject property and is included in Appendix E for reference. It was determined the subject property will reduce infiltration by 4,861 m^3/yr when developed. Geotechnical investigations completed for both adjacent properties at 120 and 180 Mountain Road have identified a relatively shallow silty clay layer which is not conducive to infiltration, making recharge measures impractical for the subject property.

The *NVCA Stormwater Technical Guide* recommends that a minimum of 5 mm of rainfall should be retained on-site for new developments to minimize downstream erosion due to increased runoff volume. However, the guide recognizes in some cases the site conditions make retention of 5 mm impractical and encourages a best-efforts approach to meet this goal. Due to the shallow silty clay layer present in the area, the infiltration of the 5 mm runoff through the use of Low-Impact Development (LID) is not feasible.

4 Siltation and Erosion Control

4.1 DURING CONSTRUCTION

Erosion and sediment control will be implemented for all construction activities within the development site, including vegetation clearing, topsoil stripping, road construction, and stockpiling of materials. The basic principles considered to minimize erosion and sedimentation and resultant negative environmental impacts include:

1. minimize disturbance activities where possible;
2. expose the smallest possible land area to erosion for the shortest possible time;
3. institute erosion control measures as required immediately;
4. implement sediment control measures before the outset of construction activities; and
5. carry out regular inspections of erosion/sediment control measures and repair or maintain as necessary.

The proposed grading, servicing and building construction should be carried out in such a manner that a minimum amount of erosion occurs and such that sedimentation facilities control any erosion that does occur. Additional erosion, sediment, and pollution control measures should include the following:

1. placement of a temporary swale and check dams to control runoff and lower velocities promoting settling of solids;
2. erection of silt control fence below any grading operations to control sediment movement;
3. provision of a stone mud mat at the construction vehicle entrance to minimize off-site tracking of material; and
4. revegetate disturbed areas to enhance long-term siltation and erosion control.

The proposed Erosion and Sediment Control Plan for the site is illustrated on Drawing SC-1 included with the Site Plan Application package.

A temporary sediment trap has been designed in a best-efforts approach to comply with the *Erosion and Sediment Control Guideline for Urban Construction* (December 2006). The proposed temporary sediment trap is located at the outlet of the perimeter interceptor swale for a drainage area of 2.02 ha. The temporary sediment trap is required to provide 125 m^3/ha (252.5 m^3) of storage volume and provides 260 m^3 of storage as shown on drawing SC-1.

4.2 PERMANENT EROSION TREATMENTS

It is also important to consider the necessity of sediment and erosion control beyond the construction phase with permanent treatments for SWMF inlets/outlets and overland spillways. Proposed erosion control end treatments to be installed on-site are described as shown on the Engineering Drawings included in the Site Plan application package.

5 Summary

This report has been prepared in support of the proposed development located at 140 Mountain Road in the Town of Collingwood. This report presents the recommended SWM plan for the development and demonstrates potential impacts on the local drainage systems caused by the proposed development are mitigated through the implementation of the proposed SWM plan in accordance with the applicable municipal, Regional and Provincial guidelines.

Two SWMFs will provide the requisite active storage volume to attenuate post development peak flow rates to pre-development levels for the 1:2-year through 1:100-year design storms. Water quality treatment to Enhanced Level 80% TSS removal will also be provided by two oil-grit separators.

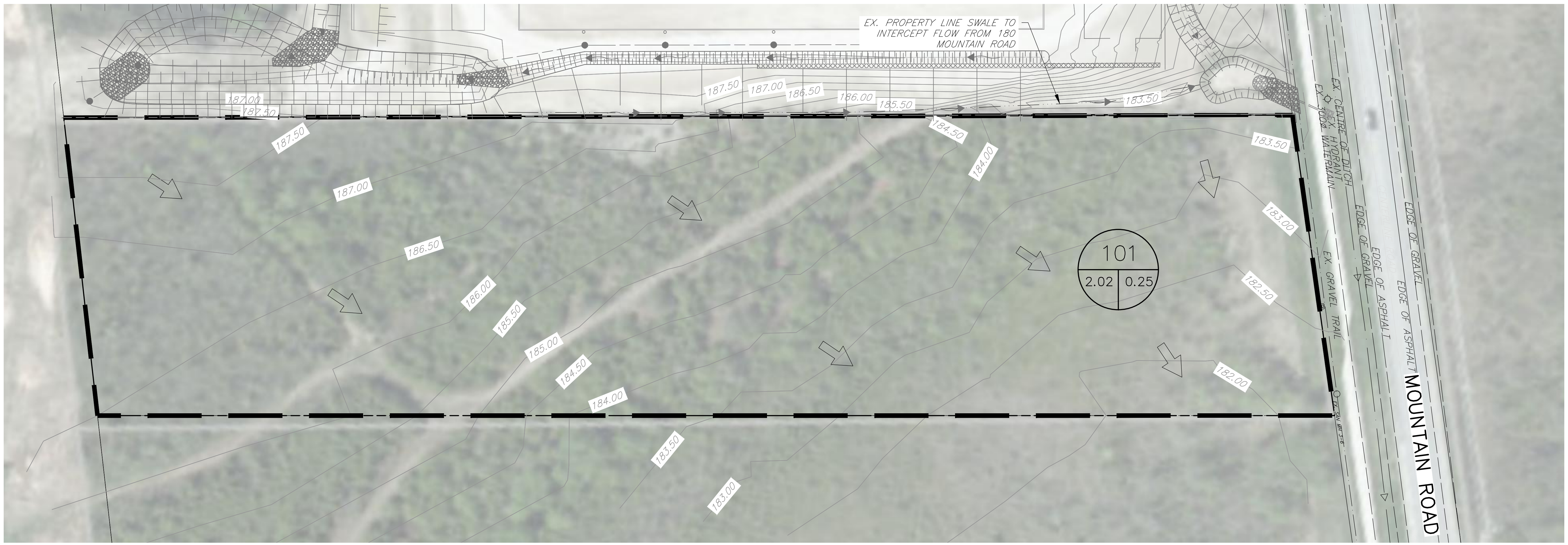
Throughout construction, siltation and erosion control measures will be inspected and maintained to reduce erosion and the transportation of sediment off-site. These measures will mitigate the environmental impacts downstream during construction.

In conclusion, the proposed stormwater management plan supports the concept of an environmentally sustainable development. The proposed plan will mitigate anticipated stormwater impacts associated with the self storage development.

LEGEND

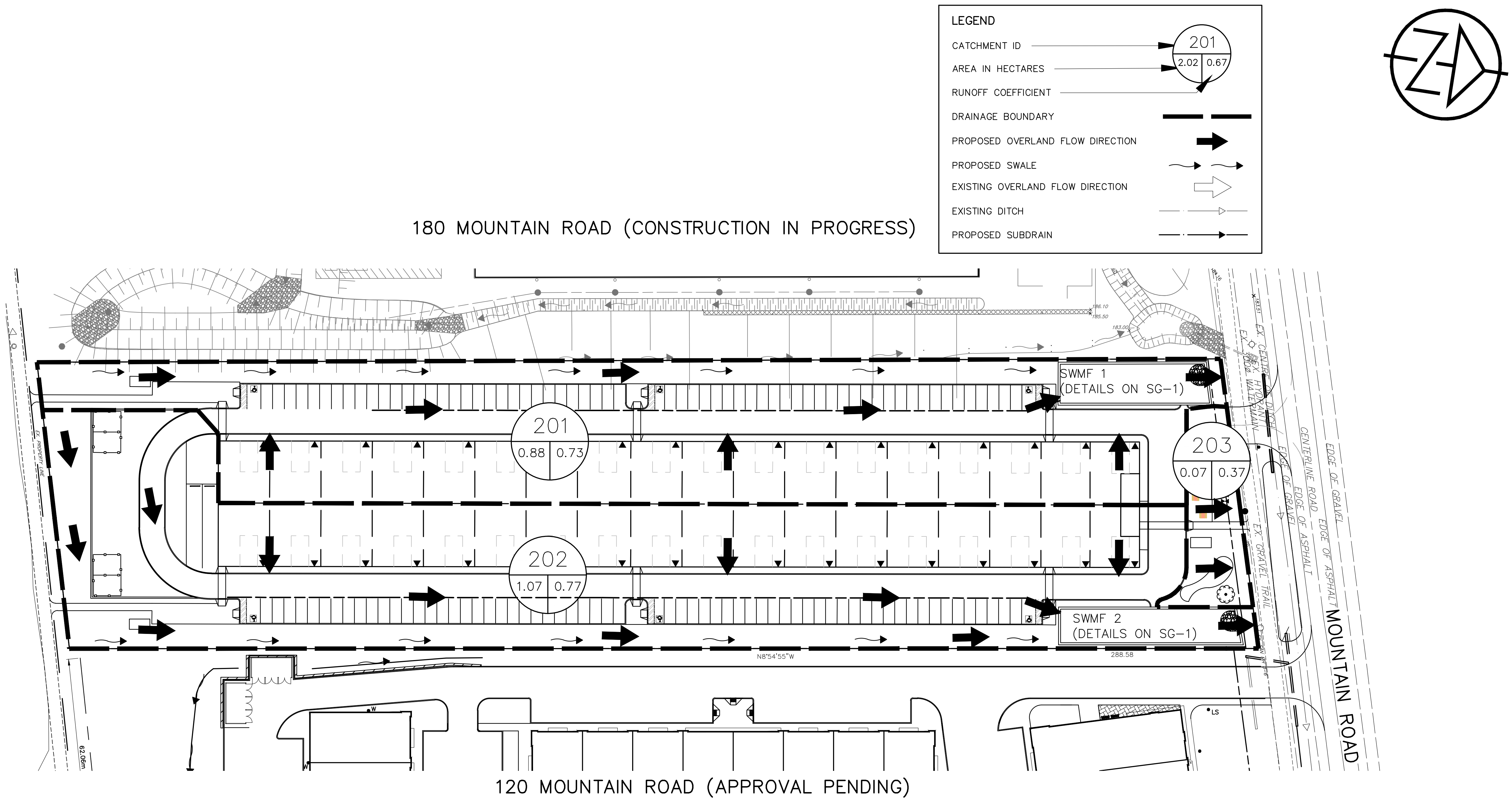
CATCHMENT ID	101
AREA IN HECTARES	2.02
RUNOFF COEFFICIENT	0.25
PRE–DEVELOPMENT CATCHMENT AREA	
EXISTING FLOW DIRECTION	
EXISTING DITCH	

180 MOUNTAIN ROAD (CONSTRUCTION IN PROGRESS)



120 MOUNTAIN ROAD (APPROVAL PENDING)

TATHAM ENGINEERING	**140 MOUNTAIN ROAD** **EXISTING CONDITIONS DRAINAGE PLAN**		DWG. No. **DP-1**
SCALE: 1:1000	DRAWN: MR	DATE: 2022/12/19	JOB NO. 121036

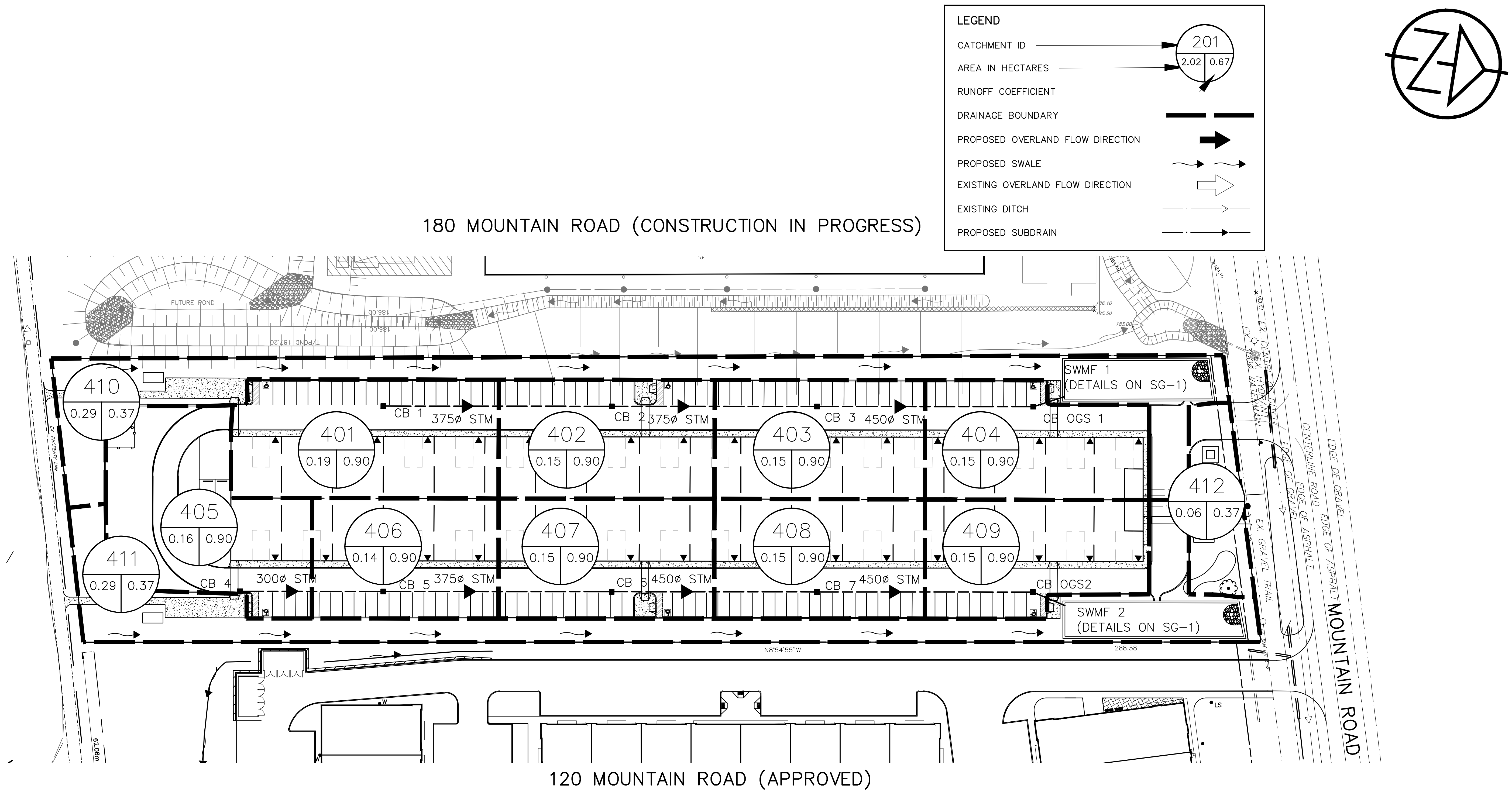


TATHAM ENGINEERING

140 MOUNTAIN ROAD
PROPOSED CONDITIONS DRAINAGE PLAN

DWG. No. **DP-2**

SCALE: 1:1000	DRAWN: KRL	DATE: 2023/08/30	JOB NO. 121036



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140 MOUNTAIN ROAD
STORM SEWER DRAINAGE PLAN

DWG. No. **STM-1**

SCALE: 1:1000 | DRAWN: MR | DATE: 2022/12/19 | JOB NO. 121036

Appendix A: Hydrologic Analysis

PROJECT	140 Mountain Road	FILE	121036
		DATE	August 30, 2023
SUBJECT	Catchment Area Calculations	NAME	K.Sansom
		PAGE	1 OF 1

Existing Conditions

				Runoff Coeffcient
Catchment 101	=	**2.02**	ha	**0.25**
Impervious Area	=	0.00	ha	0.90
Wooded Area	=	2.02	ha	0.25
Grass Area	=	0.00	ha	0.28

Proposed Conditions

				Runoff Coeffcient
Catchment 201	=	**0.88**	ha	**0.73**
Impervious Area	=	0.64	ha	0.90
Landscaped Area	=	0.24	ha	0.28
Catchment 202	=	**1.07**	ha	**0.77**
Impervious Area	=	0.84	ha	0.90
Landscaped Area	=	0.23	ha	0.28
Catchment 203 (uncontrolled)	=	**0.07**	ha	**0.37**
Impervious Area	=	0.01	ha	0.90
Landscaped Area	=	0.06	ha	0.28

TATHAM ENGINEERING

Rational Method Calculation

Project Details

140 Mountain Road	121036

Prepared By

M.Ray	November 2, 2022

Municipality

Town of Collingwood

Pre-Development Condition

Catchment ID:	101	
Catchment Area (ha):	2.02	
Runoff Coefficient:	0.25	
Time of Concentration (min):	33.60	(Airport Method Equation)

Design Storm	2YR	5YR	10YR	25YR	50YR	100YR
A	807	1135	1387	1676	1973	2193
B	6.75	7.50	7.97	8.30	9.00	9.04
C	0.83	0.84	0.85	0.86	0.87	0.87
i (mm/hr)	38	50	58	68	76	83
Runoff C	0.25	0.25	0.25	0.28	0.30	0.31
Q (m^3/s)	0.05	0.07	0.08	0.10	0.13	0.15

Peak Runoff Rate (m^3/s) - Rational Method (Q=CiA/360)

Storm	$Q_{EXISTING}$	
2YR	0.053	m^3/s
5YR	0.070	m^3/s
10YR	0.081	m^3/s
25YR	0.105	m^3/s
50YR	0.128	m^3/s
100YR	0.146	m^3/s

TATHAM ENGINEERING

Modified Rational Method Calculation

Project Details

140 Mountain Road	121036

Prepared By

M. Ray	August 30, 2023

Municipality

Town of Collingwood

Pre-Development Analysis

Catchment ID:	101
Catchment Area (ha):	0.95
Runoff Coefficient:	0.25
Time of Concentration (mi	33.60

Design Storm	2YR	5YR	10YR	25YR	50YR	100YR
A	807	1135	1387	1676	1973	2193
B	6.75	7.50	7.97	8.30	9.00	9.04
C	0.83	0.84	0.85	0.86	0.87	0.87
i (mm/hr)	38	50	58	68	76	83
Runoff C	0.25	0.25	0.25	0.28	0.30	0.31
Q (m^3/s)	0.02	0.03	0.04	0.05	0.06	0.07

Post-Development Analysis

	Controlled	Uncontrolled
Catchment ID:	201	203
Catchment Area (ha):	0.88	0.03
Runoff Coefficient:	0.73	0.37
Time of Concentration (min):	10.00	10.00

	Design Storm	2YR	5YR	10YR	25YR	50YR	100YR
	i (mm/hr)	78	102	118	138	153	168
201	Runoff C	0.73	0.73	0.73	0.80	0.88	0.91
	Q (m^3/s)	0.14	0.18	0.21	0.27	0.33	0.38
	i (mm/hr)	78	102	118	138	153	168
203	Runoff C	0.37	0.37	0.37	0.41	0.44	0.46
	Q (m^3/s)	0.00	0.00	0.00	0.00	0.01	0.01

Peak Runoff Rate (m^3/s) - Rational Method (Q=CiA/360)

Storm	$Q_{EXISTING}$	$Q_{NO\ CONTROLS}$	$Q_{UNCONTROLLED}$	$Q_{CONTROLLED}$	Q_{TOTAL}	$Q_{REDUCTION}$	
2YR	0.025	0.142	0.002	0.024	0.026	0.118	m^3/s
5YR	0.033	0.186	0.003	0.027	0.030	0.159	m^3/s
10YR	0.038	0.215	0.004	0.029	0.033	0.186	m^3/s
25YR	0.049	0.276	0.005	0.033	0.038	0.243	m^3/s
50YR	0.060	0.334	0.006	0.037	0.043	0.297	m^3/s
100YR	0.068	0.382	0.006	0.039	0.045	0.343	m^3/s

Required Storage Volumes (m^3) - Modified Rational Method ($V_p = Q_p \times D - Q_o \times ((D + t_c)/2)$)

Dur. (min)	2YR	5YR	10YR	25YR	50YR	100YR
40	107	149	176	234	290	337
50	109	153	181	242	301	350
60	**110**	154	184	247	308	359
70	109	**154**	184	249	311	363
80	107	153	**184**	**249**	312	365
90	105	151	182	248	**312**	366
100	102	149	179	246	310	**364**

Modified Rational Method Calculation

Project Details

140 Mountain Road	121036

Prepared By

M. Ray	August 30, 2023

Municipality

Town of Collingwood

Pre-Development Analysis

Catchment ID:	101
Catchment Area (ha):	1.07
Runoff Coefficient:	0.25
Time of Concentration (mi	33.60

Design Storm	2YR	5YR	10YR	25YR	50YR	100YR
A	807	1135	1387	1676	1973	2193
B	6.75	7.50	7.97	8.30	9.00	9.04
C	0.83	0.84	0.85	0.86	0.87	0.87
i (mm/hr)	38	50	58	68	76	83
Runoff C	0.25	0.25	0.25	0.28	0.30	0.31
Q (m^3/s)	0.03	0.04	0.04	0.06	0.07	0.08

Post-Development Analysis

	Controlled	Uncontrolled
Catchment ID:	202	203
Catchment Area (ha):	1.07	0.04
Runoff Coefficient:	0.77	0.37
Time of Concentration (min):	10.00	10.00

Design Storm		2YR	5YR	10YR	25YR	50YR	100YR
	i (mm/hr)	78	102	118	138	153	168
202	Runoff C	0.77	0.77	0.77	0.85	0.92	0.96
	Q (m^3/s)	0.18	0.23	0.27	0.35	0.42	0.48
	i (mm/hr)	78	102	118	138	153	168
203	Runoff C	0.37	0.37	0.37	0.41	0.44	0.46
	Q (m^3/s)	0.00	0.00	0.00	0.01	0.01	0.01

Peak Runoff Rate (m^3/s) - Rational Method (Q=CiA/360)

Storm	$Q_{EXISTING}$	$Q_{NO\ CONTROLS}$	$Q_{UNCONTROLLED}$	$Q_{CONTROLLED}$	Q_{TOTAL}	$Q_{REDUCTION}$	
2YR	0.028	0.182	0.003	0.028	0.031	0.154	m^3/s
5YR	0.037	0.238	0.004	0.032	0.036	0.206	m^3/s
10YR	0.043	0.276	0.005	0.034	0.039	0.242	m^3/s
25YR	0.056	0.355	0.006	0.040	0.046	0.315	m^3/s
50YR	0.068	0.428	0.008	0.043	0.051	0.385	m^3/s
100YR	0.078	0.491	0.009	0.047	0.056	0.444	m^3/s

Required Storage Volumes (m^3) - Modified Rational Method ($V_p = Q_p \times D - Q_o \times ((D + t_c)/2)$)

Dur. (min)	2YR	5YR	10YR	25YR	50YR	100YR
40	142	195	231	304	379	437
50	145	201	238	315	395	455
60	**146**	204	243	321	404	466
70	146	**204**	**244**	324	410	473
80	145	204	244	**325**	412	477
90	142	202	243	325	**413**	**478**
100	140	200	241	323	412	477

Modified Rational Method Calculation

TATHAM ENGINEERING

Project Details

140 Mountain Road	121036

Prepared By

M. Ray	August 30, 2023

Municipality

Town of Collingwood

Pre-Development Analysis

Catchment ID:	101
Catchment Area (ha):	2.02
Runoff Coefficient:	0.25
Time of Concentration (mi	33.60

Post-Development Analysis

	Controlled	Uncontrolled
Catchment ID:	201 + 202	203
Catchment Area (ha):	1.95	0.07
Runoff Coefficient:	0.75	0.37
Time of Concentration (min):	10.00	10.00

Design Storm	2YR	5YR	10YR	25YR	50YR	100YR
A	807	1135	1387	1676	1973	2193
B	6.75	7.50	7.97	8.30	9.00	9.04
C	0.83	0.84	0.85	0.86	0.87	0.87
i (mm/hr)	38	50	58	68	76	83
Runoff C	0.25	0.25	0.25	0.28	0.30	0.31
Q (m^3/s)	0.05	0.07	0.08	0.10	0.13	0.15

	Design Storm	2YR	5YR	10YR	25YR	50YR	100YR
201 + 202	i (mm/hr)	78	102	118	138	153	168
	Runoff C	0.75	0.75	0.75	0.83	0.90	0.94
	Q (m^3/s)	0.32	0.42	0.48	0.62	0.75	0.86
203	i (mm/hr)	78	102	118	138	153	168
	Runoff C	0.37	0.37	0.37	0.41	0.44	0.46
	Q (m^3/s)	0.01	0.01	0.01	0.01	0.01	0.02

Peak Runoff Rate (m^3/s) - Rational Method (Q=CiA/360)

Storm	$Q_{EXISTING}$	$Q_{NO\ CONTROLS}$	$Q_{UNCONTROLLED}$	$Q_{CONTROLLED}$	Q_{TOTAL}	$Q_{REDUCTION}$	
2YR	0.053	0.324	0.006	0.052	0.058	0.272	m^3/s
5YR	0.070	0.423	0.007	0.059	0.066	0.364	m^3/s
10YR	0.081	0.489	0.009	0.064	0.072	0.426	m^3/s
25YR	0.105	0.629	0.011	0.072	0.083	0.557	m^3/s
50YR	0.128	0.760	0.013	0.080	0.093	0.680	m^3/s
100YR	0.146	0.871	0.015	0.086	0.101	0.785	m^3/s

Required Storage Volumes (m^3) - Modified Rational Method ($V_p = Q_p \times D - Q_o \times ((D + t_c)/2)$)

Dur. (min)	2YR	5YR	10YR	25YR	50YR	100YR
50	254	352	417	556	694	803
60	**255**	357	424	567	710	822
70	254	**358**	**426**	573	718	833
80	251	356	425	**574**	722	839
90	246	352	422	572	**722**	**841**
100	240	347	417	568	720	839
110	233	340	410	562	715	834

Appendix B:
Conveyance Calculations

TATHAM ENGINEERING

Storm Sewer Design Sheet

Version Number: 1 **Version Date:** August 30 2023

Project Information

140 Mountain Road	121036

Drawing Reference

SS-1	November 28 2022

Prepared By

Matt Ray, M.A.Sc., EIT	November 28 2022

Reviewed By

Kevin Sansom, B.A.Sc., P.Eng	November 28 2022

Municipality

Town of Collingwood

Runoff Coefficient Adjustment

Year	A	B
10	1.00	0.00
25	1.10	0.00
50	1.20	0.00
100	1.25	0.00

Manning's Coefficient

Pipe	Value
CSP	0.024
Concrete	0.013
PVC	0.013

Time of Concentration

10 mins

IDF Curve Coefficients

Year	A	B	C
2	807.44	6.75	0.83
5	1135.40	7.50	0.84
10	1387.00	7.97	0.85
25	1676.20	8.30	0.86
50	1973.10	9.00	0.87
100	2193.10	9.04	0.87

Engineer Stamp

Street Name	Area ID / Label	Upstream Maintenance Hole	Downstream Maintenance Hole	Area (ha)	5 Year Runoff Coefficient (C)	Design Storm (Year)	Adjusted Runoff Coefficient (C)	Area × Runoff Coefficient	Cumulative Area (ha)	Cumulative Area × Adjusted Runoff Coefficient	Time of Concentration (min)	Rainfall Intensity (mm/hr)	Peak Flow (m^3/s)	Manning's Roughness Coefficient	Sewer Length (m)	Sewer Slope (%)	Actual Sewer Diameter (mm)	Full Flow Velocity (m/s)	Full Flow Capacity (m^3/s)	Actual Velocity (m/s)	Travel Time (min)	Calculated Sewer Diameter (mm)	Percentage of Full Flow Capacity (%)	Total Time of Travel (min)
Internal - North Parking Lot	401	CB 1	CB 2	0.19	0.90	5	0.90	0.17	0.19	0.17	10.00	102.27	0.049	0.013	56.0	0.5%	375	1.12	0.124	0.98	0.95	264	39.2%	10.95
Internal - North Parking Lot	402	CB 2	CB 3	0.15	0.90	5	0.90	0.14	0.34	0.31	10.95	97.82	0.083	0.013	53.2	0.5%	375	1.12	0.124	1.12	0.79	323	67.1%	11.74
Internal - North Parking Lot	403	CB 3	CB OGS 1	0.15	0.90	5	0.90	0.14	0.49	0.44	11.74	94.43	0.116	0.013	56.0	0.5%	450	1.27	0.202	1.23	0.76	365	57.4%	12.50
Internal - North Parking Lot	404	CB OGS 1	SWMF 1	0.15	0.90	5	0.90	0.14	0.64	0.58	12.50	91.40	0.146	0.013	6.6	0.6%	450	1.39	0.221	1.39	0.08	385	66.2%	12.58
Internal- North Parking Lot Swale	410			0.29	0.37	100	0.46	0.13	0.29	0.13	10.00	168.45	0.063											
Internal - South Parking Lot	405	CB 4	CB 5	0.16	0.90	5	0.90	0.14	0.16	0.14	10.00	102.27	0.041	0.013	42.0	0.5%	300	0.97	0.068	0.95	0.74	247	59.8%	10.74
Internal - South Parking Lot	406	CB 5	CB 6	0.14	0.90	5	0.90	0.13	0.30	0.27	10.74	98.78	0.074	0.013	56.0	0.5%	375	1.12	0.124	1.10	0.85	309	59.8%	11.59
Internal - South Parking Lot	407	CB 6	CB 7	0.15	0.90	5	0.90	0.14	0.45	0.41	11.59	95.07	0.107	0.013	53.2	0.5%	450	1.27	0.202	1.20	0.74	355	53.0%	12.33
Internal - South Parking Lot	408	CB 7	CB OGS 2	0.15	0.90	5	0.90	0.14	0.60	0.54	12.33	92.08	0.138	0.013	64.4	0.5%	450	1.27	0.202	1.27	0.85	390	68.5%	13.17
Internal - South Parking Lot	409	CB OGS 2	SWMF 2	0.15	0.90	5	0.90	0.14	0.75	0.68	13.17	88.90	0.167	0.013	7.3	0.6%	450	1.39	0.221	1.39	0.09	405	75.5%	13.26
Internal - South Parking Lot Swale	411			0.29	0.37	100	0.46	0.13	0.29	0.13	10.00	168.45	0.063											
Internal - Front Yard	412			0.06	0.37	5	0.37	0.02	0.06	0.02	10.00	102.27	0.006											

TATHAM ENGINEERING	PROJECT	140 Mountain Road	FILE	121036
			DATE	November 22, 2022
	SUBJECT	Manning's Equation Flow Calculations	NAME	M.Ray
			PAGE	1 OF 1

Manning's Equation

Channel capacity calculations using Manning's Equation

$$Q = \frac{1}{n} A R^{2/3} s^{1/2}$$

Existing Mountain Road Ditch - 140 Mountain Road

CHANNEL PROPERTIES

MANNING'S COEFF	0.060		Grassed Channels and Swales - Fair stand, any grass. Length 0.30m (MTO Drainage Management Manual Design Chart 2.01)
SLOPE	0.013	m/m	
BOTTOM WIDTH	0.0		
RIGHT SIDE SLOPE	3.0	:1 H:V	
LEFT SIDE SLOPE	3.0	:1 H:V	
AVE FLOW DEPTH	0.50	m	
AREA	0.750	m^2	
WETTED PERIMETER	3.162	m	
HYDRAULIC RADIUS	0.237	m	
FLOW CAPACITY	0.546	m^3/s	
EX 5-YR DISCHARGE	0.070	m^3/s	

Proposed Regraded Mountain Road Ditch - 140 Mountain Road

CHANNEL PROPERTIES

MANNING'S COEFF	0.060		Grassed Channels and Swales - Fair stand, any grass. Length 0.30m (MTO Drainage Management Manual Design Chart 2.01)
SLOPE	0.005	m/m	
BOTTOM WIDTH	0.0		
RIGHT SIDE SLOPE	3.0	:1 H:V	
LEFT SIDE SLOPE	3.0	:1 H:V	
AVE FLOW DEPTH	0.8	m	
AREA	1.920	m^2	
WETTED PERIMETER	5.060	m	
HYDRAULIC RADIUS	0.379	m	
FLOW CAPACITY	1.186	m^3/s	
PROP 100-YR DISCHARGE	0.101	m^3/s	

Channel Report

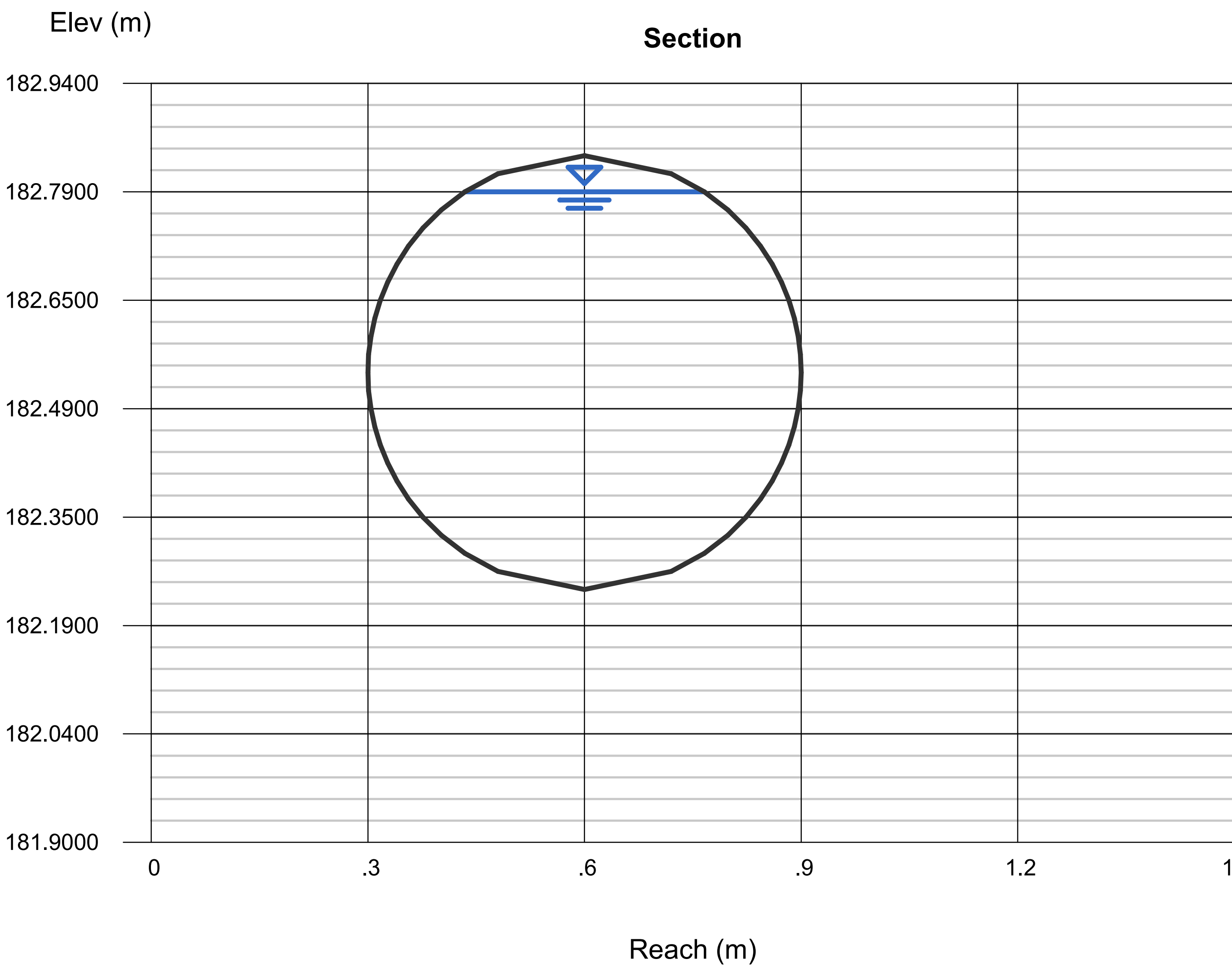
121036 - 600mm HDPE D/W Culvert Capacity

Circular
Diameter (m) = 0.6000

Invert Elev (m) = 182.2500
Slope (%) = 0.9000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.5500

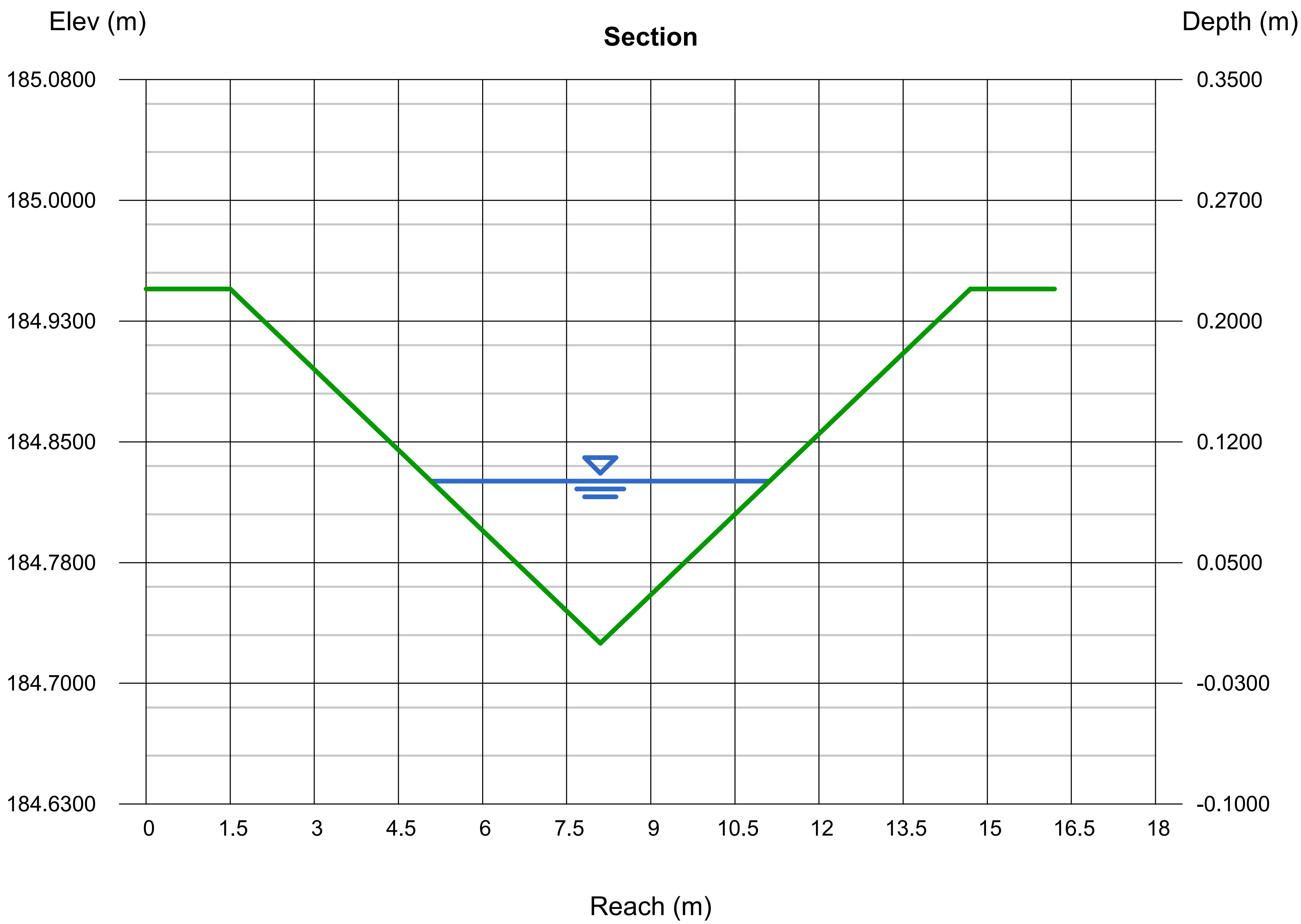
Highlighted
Depth (m) = 0.5500
Q (cms) = 0.6248
Area (sqm) = 0.2717
Velocity (m/s) = 2.2993
Wetted Perim (m) = 1.5360
Crit Depth, Yc (m) = 0.5121
Top Width (m) = 0.3296
EGL (m) = 0.8197



Channel Report

North Aisle Overland - 100yr Flow 403 HP

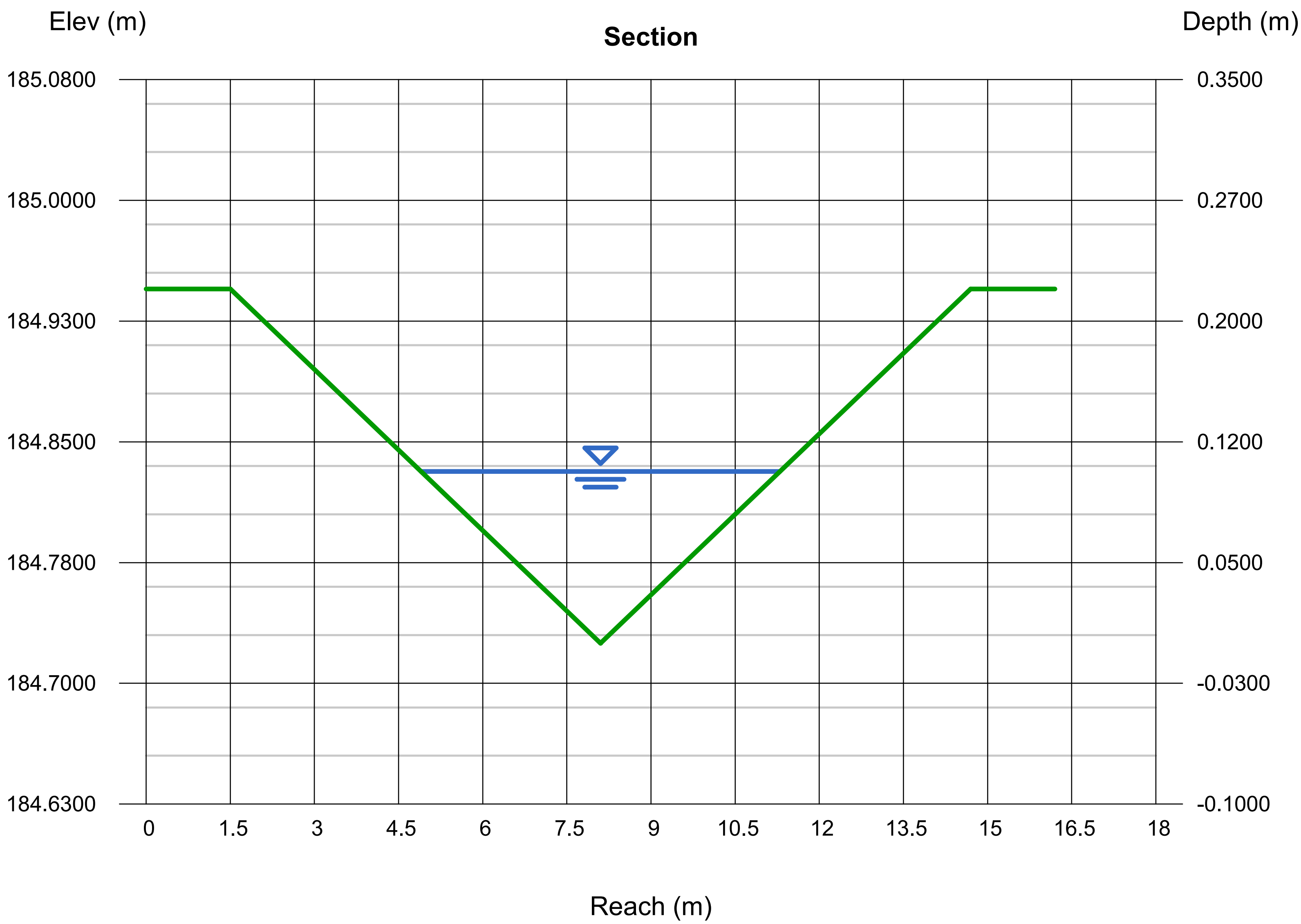
Triangular		**Highlighted**	
Side Slopes (z:1)	= 30.0000, 30.0000	Depth (m)	= 0.1006
Total Depth (m)	= 0.2200	Q (cms)	= 0.214
		Area (sqm)	= 0.3035
Invert Elev (m)	= 184.7300	Velocity (m/s)	= 0.7051
Slope (%)	= 0.5000	Wetted Perim (m)	= 6.0384
N-Value	= 0.013	Crit Depth, Yc (m)	= 0.1036
		Top Width (m)	= 6.0350
Calculations		EGL (m)	= 0.1259
Compute by:	Known Q		
Known Q (cms)	= 0.2140		



Channel Report

121036 - South Aisle Overland - 100yr Flow 408 HP

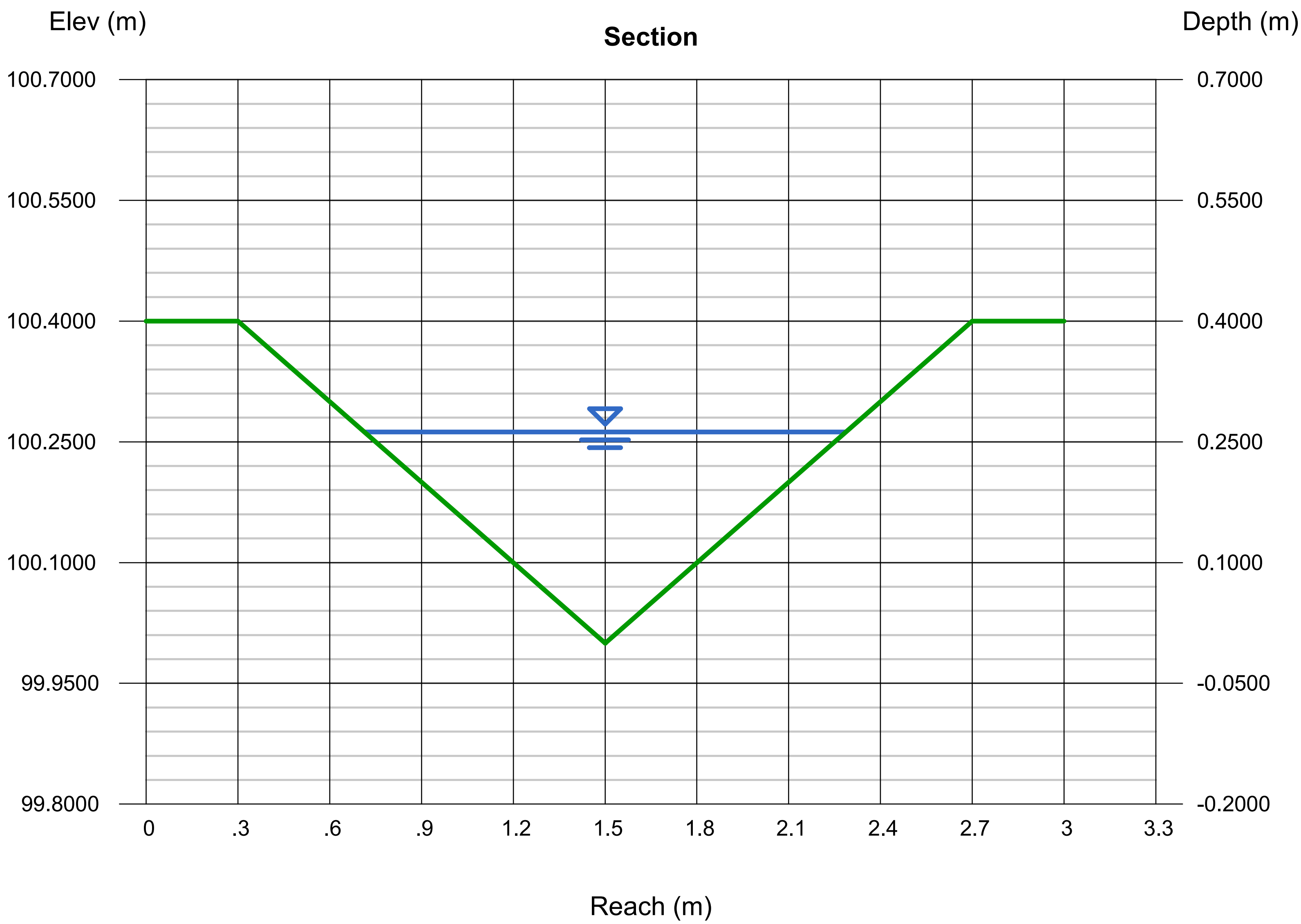
Triangular		**Highlighted**	
Side Slopes (z:1)	= 30.0000, 30.0000	Depth (m)	= 0.1067
Total Depth (m)	= 0.2200	Q (cms)	= 0.256
		Area (sqm)	= 0.3414
Invert Elev (m)	= 184.7300	Velocity (m/s)	= 0.7498
Slope (%)	= 0.5000	Wetted Perim (m)	= 6.4044
N-Value	= 0.013	Crit Depth, Yc (m)	= 0.1097
		Top Width (m)	= 6.4008
Calculations		EGL (m)	= 0.1354
Compute by:	Known Q		
Known Q (cms)	= 0.2560		



Channel Report

Rear Yard Conveyance Channel 100yr - 410 & 411

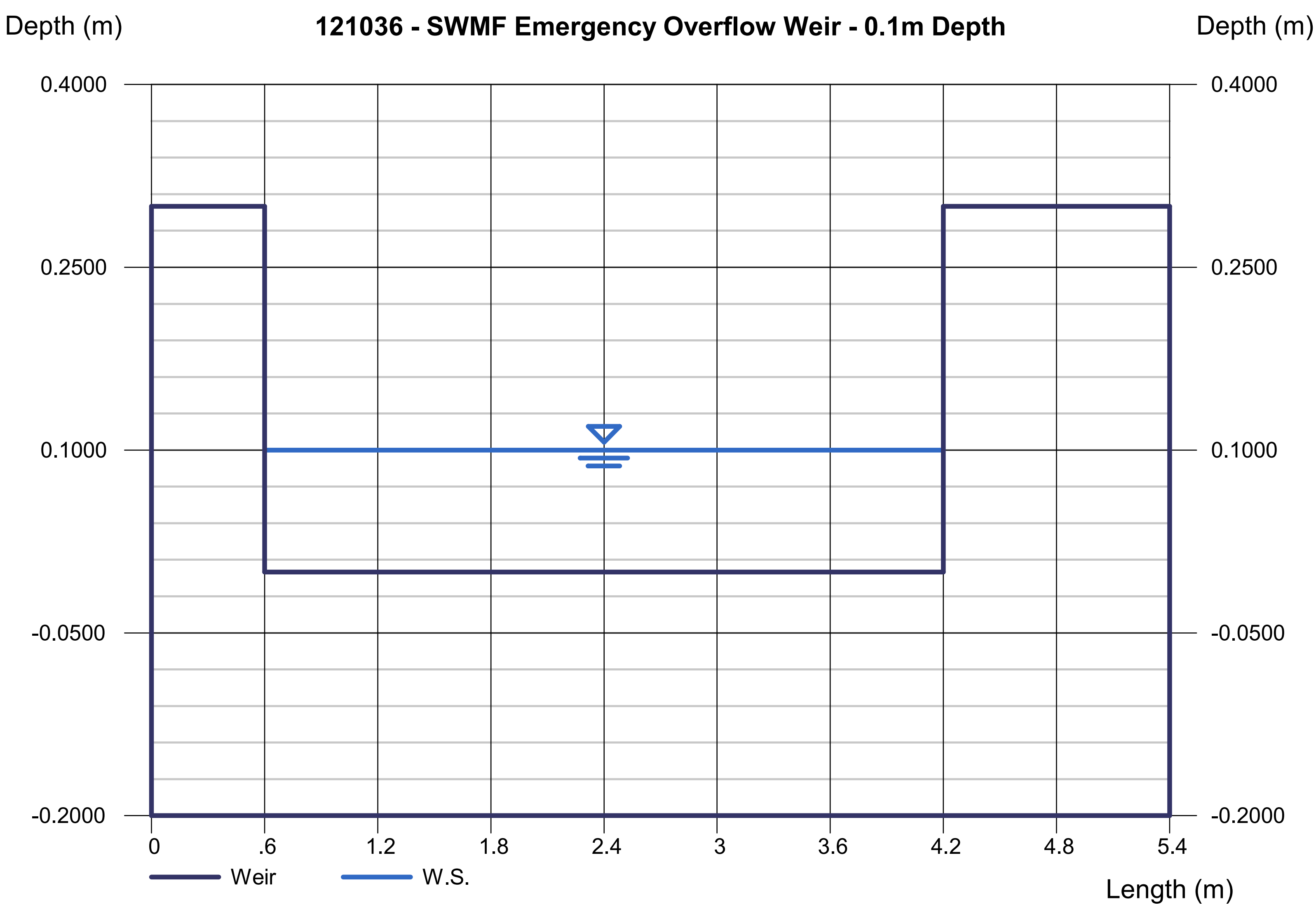
Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.0000, 3.0000	Depth (m)	= 0.2621
Total Depth (m)	= 0.4000	Q (cms)	= 0.080
		Area (sqm)	= 0.2061
Invert Elev (m)	= 100.0000	Velocity (m/s)	= 0.3881
Slope (%)	= 0.5000	Wetted Perim (m)	= 1.6578
N-Value	= 0.045	Crit Depth, Yc (m)	= 0.1737
		Top Width (m)	= 1.5728
Calculations		EGL (m)	= 0.2698
Compute by:	Known Q		
Known Q (cms)	= 0.0800		



Weir Report

121036 - SWMF Emergency Overflow Weir - 0.1m Depth

Rectangular Weir		**Highlighted**	
Crest	= Sharp	Depth (m)	= 0.1000
Bottom Length (m)	= 3.6000	Q (cms)	= 0.3791
Total Depth (m)	= 0.3000	Area (sqm)	= 0.3600
		Velocity (m/s)	= 1.0530
Calculations		Top Width (m)	= 3.6000
Weir Coeff. Cw	= 3.3300		
Compute by:	Known Depth		
Known Depth (m)	= 0.1000		



Weir Report

121036 - SWMF Emergency Overflow Weir - 0.2m Depth

Rectangular Weir

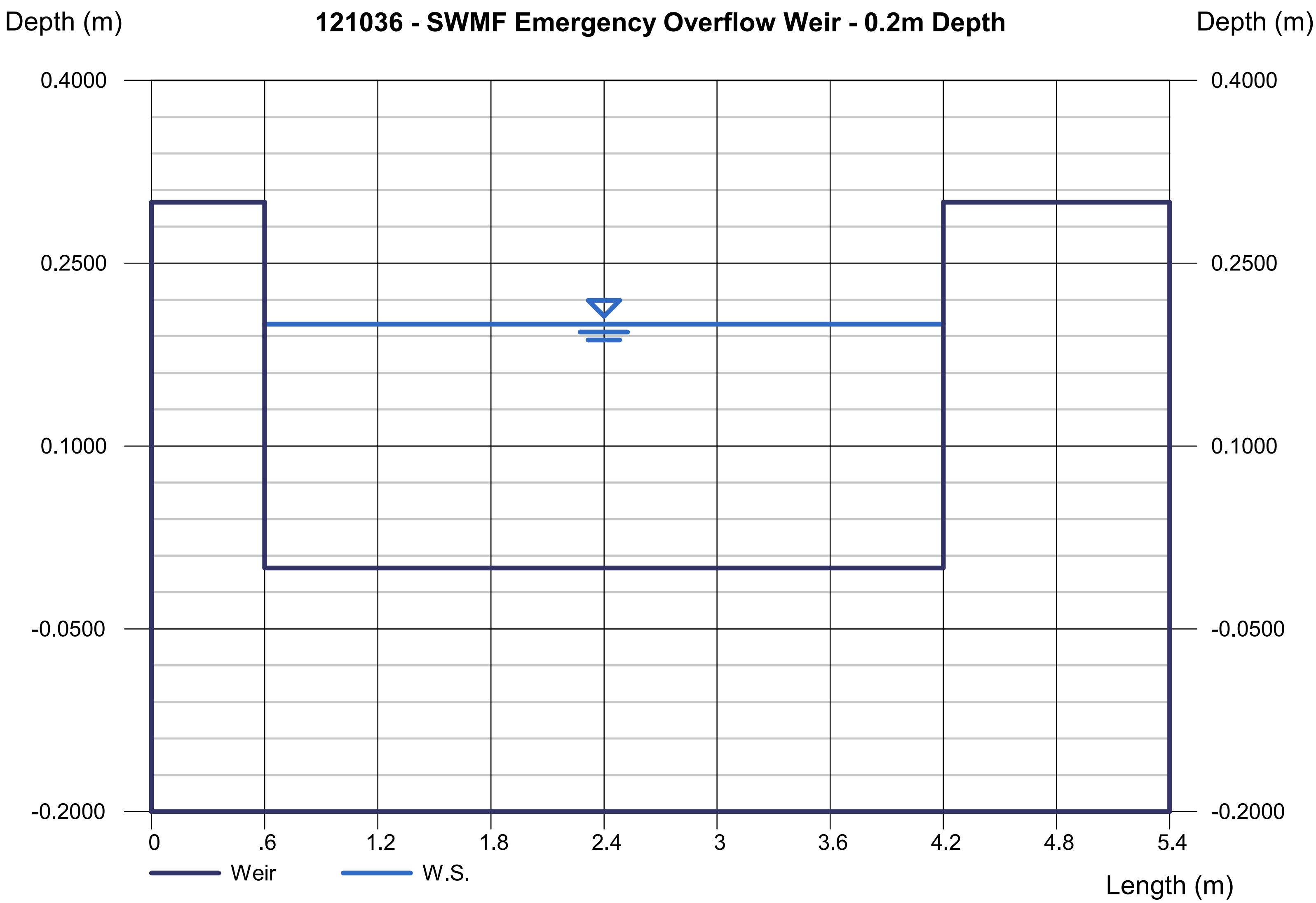
Crest	= Sharp
Bottom Length (m)	= 3.6000
Total Depth (m)	= 0.3000

Calculations

Weir Coeff. Cw	= 3.3300
Compute by:	Known Depth
Known Depth (m)	= 0.2000

Highlighted

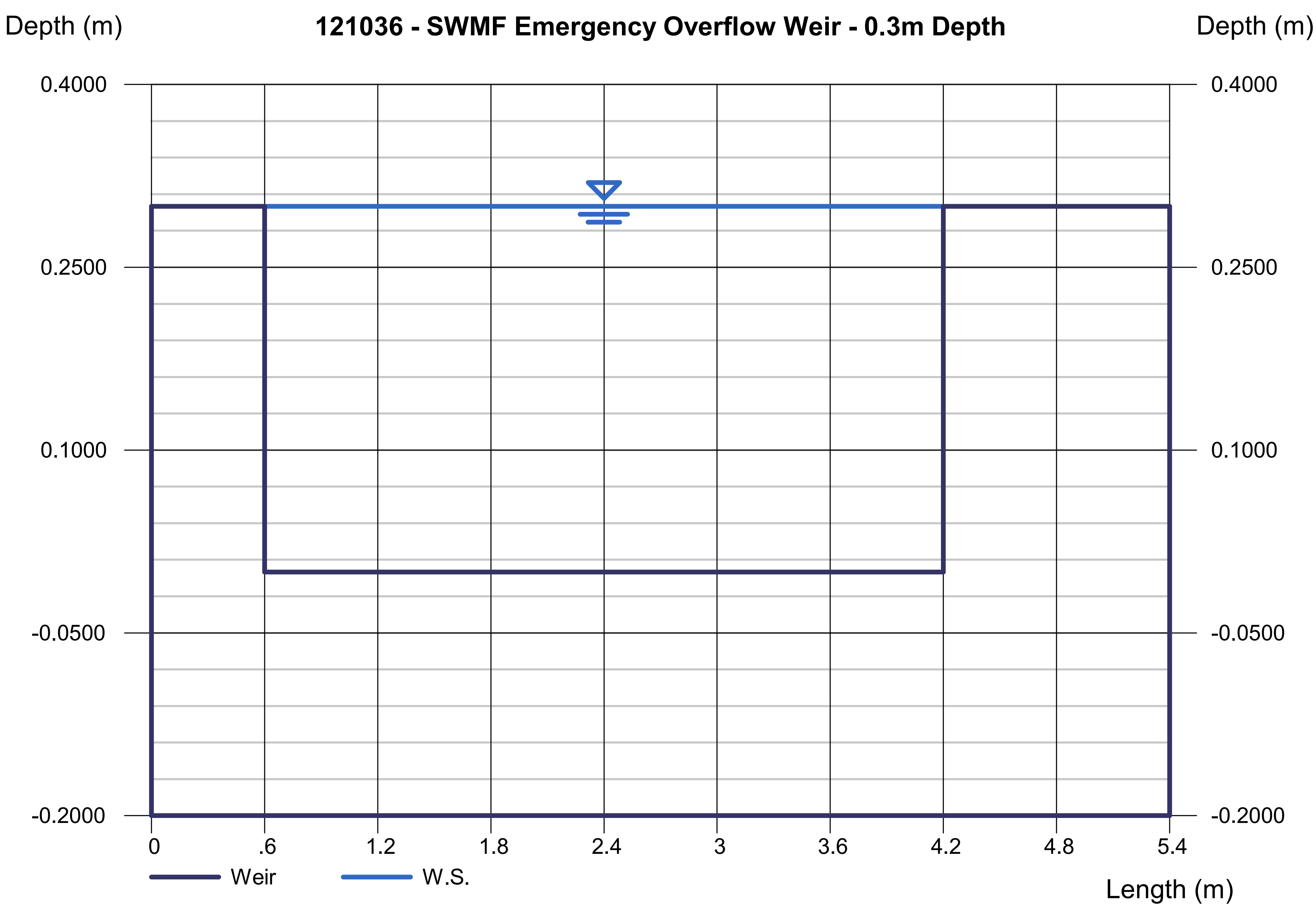
Depth (m)	= 0.2000
Q (cms)	= 1.0722
Area (sqm)	= 0.7200
Velocity (m/s)	= 1.4892
Top Width (m)	= 3.6000



Weir Report

121036 - SWMF Emergency Overflow Weir - 0.3m Depth

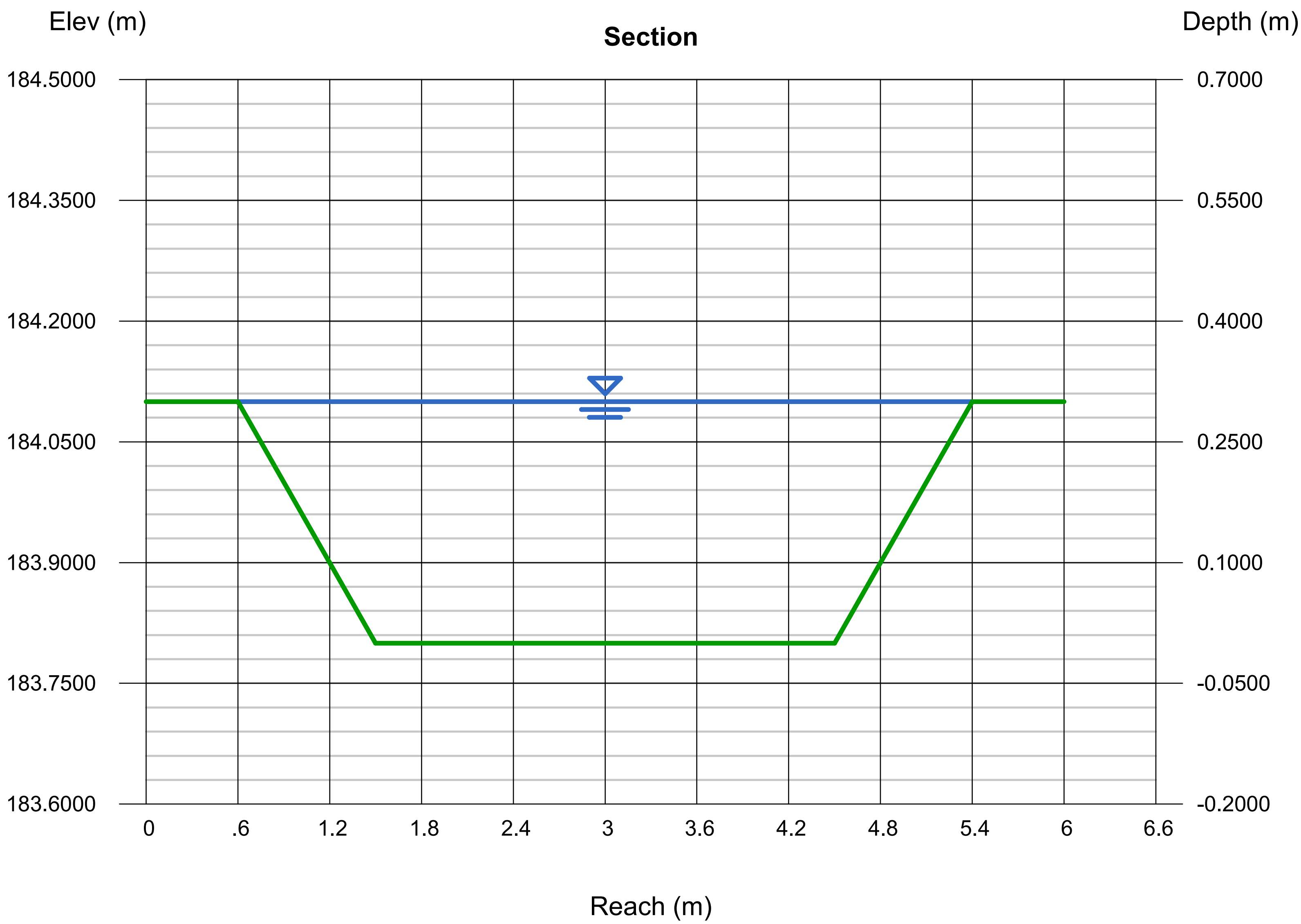
Rectangular Weir		**Highlighted**	
Crest	= Sharp	Depth (m)	= 0.3000
Bottom Length (m)	= 3.6000	Q (cms)	= 1.9698
Total Depth (m)	= 0.3000	Area (sqm)	= 1.0800
		Velocity (m/s)	= 1.8239
Calculations		Top Width (m)	= 3.6000
Weir Coeff. Cw	= 3.3300		
Compute by:	Known Depth		
Known Depth (m)	= 0.3000		



Channel Report

121036 - Emergency SWMF Outlet Channel

Trapezoidal		**Highlighted**	
Bottom Width (m)	= 3.0000	Depth (m)	= 0.3000
Side Slopes (z:1)	= 3.0000, 3.0000	Q (cms)	= 2.0145
Total Depth (m)	= 0.3000	Area (sqm)	= 1.1700
Invert Elev (m)	= 183.8000	Velocity (m/s)	= 1.7218
Slope (%)	= 5.0000	Wetted Perim (m)	= 4.8974
N-Value	= 0.050	Crit Depth, Yc (m)	= 0.3000
		Top Width (m)	= 4.8000
Calculations		EGL (m)	= 0.4512
Compute by:	Known Depth		
Known Depth (m)	= 0.3000		



Appendix C:
SWMF Design Calculations

SWMF 1 DETAILS

SWMF Invert 182.35 m
Top of SWMF 183.80 m

FRONT SWMF 1 - STAGE-STORAGE TABLE

Stage (m)	Depth (m)	Area (m^2)	Average Area (m^2)	Inc. Volume (m^3)	Cum. Volume (m^3)	Active Storage (m^3)
182.50	0.00	18.8	9.4	0.0	0.0	0.0
182.60	0.10	346.8	182.8	18.3	18.3	18.3
182.70	0.20	346.8	346.8	34.7	53.0	53.0
182.80	0.30	346.8	346.8	34.7	87.6	87.6
182.90	0.40	346.8	346.8	34.7	122.3	122.3
183.00	0.50	346.8	346.8	34.7	157.0	157.0
183.10	0.60	346.8	346.8	34.7	191.7	191.7
183.20	0.70	346.8	346.8	34.7	226.4	226.4
183.30	0.80	346.8	346.8	34.7	261.0	261.0
183.40	0.90	346.8	346.8	34.7	295.7	295.7
183.50	1.00	346.8	346.8	34.7	330.4	330.4
183.60	1.10	346.8	346.8	34.7	365.1	365.1
183.70	1.20	346.8	346.8	34.7	399.8	399.8
183.80	1.30	346.8	346.8	34.7	434.4	434.4
183.90	1.40	346.8	346.8	34.7	469.1	469.1
184.00	1.50	346.8	346.8	34.7	503.8	503.8
184.10	1.60	346.8	346.8	34.7	538.5	538.5

SWMF 2 DETAILS

SWMF Invert 182.35 m
Top of SWMF 183.80 m

FRONT SWMF 2 - STAGE-STORAGE TABLE

Stage (m)	Depth (m)	Area (m^2)	Average Area (m^2)	Inc. Volume (m^3)	Cum. Volume (m^3)	Active Storage (m^3)
182.50	0.00	16.7	8.4	0.0	0.0	0.0
182.60	0.10	352.7	184.7	18.5	18.5	18.5
182.70	0.20	352.7	352.7	35.3	53.7	53.7
182.80	0.30	352.7	352.7	35.3	89.0	89.0
182.90	0.40	352.7	352.7	35.3	124.3	124.3
183.00	0.50	352.7	352.7	35.3	159.6	159.6
183.10	0.60	352.7	352.7	35.3	194.8	194.8
183.20	0.70	352.7	352.7	35.3	230.1	230.1
183.30	0.80	352.7	352.7	35.3	265.4	265.4
183.40	0.90	352.7	352.7	35.3	300.6	300.6
183.50	1.00	352.7	352.7	35.3	335.9	335.9
183.60	1.10	352.7	352.7	35.3	371.2	371.2
183.70	1.20	352.7	352.7	35.3	406.4	406.4
183.80	1.30	352.7	352.7	35.3	441.7	441.7
183.90	1.40	352.7	352.7	35.3	477.0	477.0
184.00	1.50	352.7	352.7	35.3	512.3	512.3
184.10	1.60	352.7	352.7	35.3	547.5	547.5

TATHAM ENGINEERING	PROJECT 140 Mountain Road	FILE 121036
		DATE 11/28/2022
	SUBJECT Perforated Riser Discharge Calculations	NAME M.Ray
		PAGE 1 OF 1

Perforated Riser Details

Riser Diameter	300	mm
# perforations per vertical foot	39	
# perforations per vert 0.10 m	13	
Perforation Size	25.4	mm
Cross-sectional Area	0.000507	m^2
Orifice Coefficient	0.63	
Bottom Perforation Row	0.00	m
Top of Riser	0.70	m

Water Level	AVERAGE CSP RISER PERFORMANCE				
	# of openings	Perforation Opening Dia.	Cross-sectional Area	Head **	Discharge
(m)		(mm)	(sq.m)	(m)	(cms)
0.00	0	25.4	0.000	0	0
0.10	13	25.4	0.007	0.05	0.004
0.20	26	25.4	0.013	0.10	0.012
0.30	39	25.4	0.020	0.15	0.021
0.40	52	25.4	0.026	0.20	0.033
0.50	65	25.4	0.033	0.25	0.046
0.60	78	25.4	0.040	0.30	0.060
0.70	91	25.4	0.046	0.35	0.076
0.80	104	25.4	0.053	0.40	0.093
0.90	117	25.4	0.059	0.45	0.111
1.00	130	25.4	0.066	0.50	0.130
1.10	143	25.4	0.072	0.55	0.150
1.20	156	25.4	0.079	0.60	0.171
1.30	169	25.4	0.086	0.65	0.193
1.40	182	25.4	0.092	0.70	0.215
1.50	195	25.4	0.099	0.75	0.239
1.60	208	25.4	0.105	0.80	0.263

** Head is averaged across all submerged perforations

TATHAM ENGINEERING

PROJECT	140 Mountain Road	FILE	121036
		DATE	11/28/2022
SUBJECT	SWMF 1 Stage-Discharge Table	NAME	M.Ray
		PAGE	1 OF 1

	Orifice Outlets			Rectangular Weir Outlet		
	Orifice 1	*Perforated Riser*		*Overflow*		
Diameter	125	25.4	mm	Weir Length	3.6	m
Area	0.012	0.001	m^2	Sill Elevation	183.80	m
Coefficient	0.63	0.63				
Invert	182.35	182.50	m			

SWMF 1 STAGE-DISCHARGE TABLE

Water Level	Primary Outlet				Secondary Outlet		Total Pond Discharge
	Orifice 1		Perforated Riser		Overflow Weir		
	Head	Disch.	Head	Disch.	Head	Disch.	
(m)	(m)	(cms)	(m)	(cms)	(m)	(cms)	(cms)
182.50	0.09	0.010	0.00	0.000	-	-	0.000
182.60	0.19	0.015	0.10	0.004	-	-	0.004
182.70	0.29	0.018	0.20	0.012	-	-	0.012
182.80	0.39	0.021	0.30	0.021	-	-	0.021
182.90	0.49	0.024	0.40	0.033		-	0.024
183.00	0.59	0.026	0.50	0.046		-	0.026
183.10	0.69	0.028	0.60	0.060		-	0.028
183.20	0.79	0.030	0.70	0.076	-	-	0.030
183.30	0.89	0.032	0.80	0.093	-	-	0.032
183.40	0.99	0.034	0.90	0.111	-	-	0.034
183.50	1.09	0.036	1.00	0.130	-	-	0.036
183.60	1.19	0.037	1.10	0.150	-	-	0.037
183.70	1.29	0.039	1.20	0.171	-	-	0.039
183.80	1.39	0.040	1.30	0.193	-	-	0.040
183.90	1.49	0.042	1.40	0.215	0.10	0.379	0.421
184.00	1.59	0.043	1.50	0.239	0.20	1.072	1.115
184.10	1.69	0.044	1.60	0.263	0.30	1.970	2.014

Note: Flows for water levels below orifice centroid calculated using the weir equation per NVCA Stormwater Technical Guide (see excerpt below)

When calculating orifice discharge, the orifice equation is only to be applied for water levels above the centroid of the orifice. Flows for water levels below the orifice centroid should be calculated using the weir equation.

$$Q_w = 1.65([(pi*(D^2)/4)(2*cos^{-1}[(((D/2)-d)/(D/2))*(180/pi)]/360)-((D/2-d)(Dd-d^2)^{0.5})]/d)d^{1.5}$$

Where:

Q_w is weir flow (m^3/s)

D is orifice diameter (m)

d is depth of flow above the invert (m)

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	SUBJECT: SWMF 2 Stage-Discharge Table	NAME: M.Ray
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Orifice Outlets | **Rectangular Weir Outlet**

	Orifice 1	*Perforated Riser*			*Overflow*	
Diameter	135	25.4	mm	Weir Length	3.6	m
Area	0.014	0.001	m^2	Sill Elevation	183.80	m
Coefficient	0.63	0.63				
Invert	182.35	182.50	m			

SWMF 2 STAGE-DISCHARGE TABLE

Water Level	Primary Outlet				Secondary Outlet		Total Pond Discharge
	Orifice 1		Perforated Riser		Overflow Weir		
	Head	Disch.	Head	Disch.	Head	Disch.	
(m)	(m)	(cms)	(m)	(cms)	(m)	(cms)	(cms)
182.50	0.08	0.011	0.00	0.000	-	-	0.000
182.60	0.18	0.017	0.10	0.004	-	-	0.004
182.70	0.28	0.021	0.20	0.012	-	-	0.012
182.80	0.38	0.025	0.30	0.021	-	-	0.021
182.90	0.48	0.028	0.40	0.033	-	-	0.028
183.00	0.58	0.030	0.50	0.046	-	-	0.030
183.10	0.68	0.033	0.60	0.060	-	-	0.033
183.20	0.78	0.035	0.70	0.076	-	-	0.035
183.30	0.88	0.038	0.80	0.093	-	-	0.038
183.40	0.98	0.040	0.90	0.111	-	-	0.040
183.50	1.08	0.042	1.00	0.130	-	-	0.042
183.60	1.18	0.043	1.10	0.150	-	-	0.043
183.70	1.28	0.045	1.20	0.171	-	-	0.045
183.80	1.38	0.047	1.30	0.193	-	-	0.047
183.90	1.48	0.049	1.40	0.215	0.10	0.379	0.428
184.00	1.58	0.050	1.50	0.239	0.20	1.072	1.122
184.10	1.68	0.052	1.60	0.263	0.30	1.970	2.022

Note: Flows for water levels below orifice centroid calculated using the weir equation per NVCA Stormwater Technical Guide (see excerpt below)

When calculating orifice discharge, the orifice equation is only to be applied for water levels above the centroid of the orifice. Flows for water levels below the orifice centroid should be calculated using the weir equation.

$Q_w = 1.65([(pi*(D^2)/4)(2*cos^{-1}[(((D/2)-d)/(D/2))*(180/pi)]/360)-((D/2-d)(Dd-d^2)^{0.5})]/d)d^{1.5}$

Where:

Q_w is weir flow (m^3/s)

D is orifice diameter (m)

d is depth of flow above the invert (m)

SWMF 1 DETAILS

SWMF Outlet Invert	182.35 m
Overflow Sill	183.80 m
Top of SWMF	184.10 m

SWMF 1 STAGE-STORAGE-DISCHARGE TABLE

Stage (m)	Depth (m)	Active Storage (m^3)	Total Pond Discharge (m^3/s)
182.50	0.00	0	0.000
182.60	0.10	18	0.004
182.70	0.20	53	0.012
182.80	0.30	88	0.021
182.90	0.40	122	0.024
183.00	0.50	157	0.026
183.10	0.60	192	0.028
183.20	0.70	226	0.030
183.30	0.80	261	0.032
183.40	0.90	296	0.034
183.50	1.00	330	0.036
183.60	1.10	365	0.037
183.70	1.20	400	0.039
183.80	1.30	434	0.040
183.90	1.40	469	0.421
184.00	1.50	504	1.115
184.10	1.60	538	2.014

SWMF 2 DETAILS

SWMF Outlet Invert	182.35	m
Overflow Sill	183.80	m
Top of SWMF	184.10	m

SWMF 2 STAGE-STORAGE-DISCHARGE TABLE

Stage (m)	Depth (m)	Active Storage (m^3)	Total Pond Discharge (m^3/s)
182.50	0.00	0	0.000
182.60	0.10	18	0.004
182.70	0.20	54	0.012
182.80	0.30	89	0.021
182.90	0.40	124	0.028
183.00	0.50	160	0.030
183.10	0.60	195	0.033
183.20	0.70	230	0.035
183.30	0.80	265	0.038
183.40	0.90	301	0.040
183.50	1.00	336	0.042
183.60	1.10	371	0.043
183.70	1.20	406	0.045
183.80	1.30	442	0.047
183.90	1.40	477	0.428
184.00	1.50	512	1.122
184.10	1.60	548	2.022

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COMBINED SWMF DETAILS

SWMF Outlet Invert	182.35 m
Overflow Sill	183.80 m
Top of SWMF	184.10 m

SWMF STAGE-STORAGE-DISCHARGE TABLE

Stage (m)	Depth (m)	Active Storage (m^3)	Total Pond Discharge (m^3/s)
182.50	0.00	0	0.000
182.60	0.10	37	0.008
182.70	0.20	107	0.023
182.80	0.30	177	0.043
182.90	0.40	247	0.052
183.00	0.50	317	0.057
183.10	0.60	386	0.061
183.20	0.70	456	0.066
183.30	0.80	526	0.070
183.40	0.90	596	0.074
183.50	1.00	666	0.077
183.60	1.10	736	0.081
183.70	1.20	806	0.084
183.80	1.30	876	0.087
183.90	1.40	946	0.849
184.00	1.50	1016	2.238
184.10	1.60	1086	4.036

Appendix D: OGS Sizing Reports

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/04/2022

Province:	Ontario
City:	Collingwood
Nearest Rainfall Station:	BARRIE-ORO
Climate Station Id:	6117700
Years of Rainfall Data:	14
Site Name:	Drainage Area - 201
Drainage Area (ha):	0.92
Runoff Coefficient 'c':	0.75
Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	
Estimated Water Quality Flow Rate (L/s):	22.49
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	140 Mountain Road
Project Number:	121036
Designer Name:	Matt Ray
Designer Company:	Tatham Engineering
Designer Email:	mray@tathameng.com
Designer Phone:	705-444-2665
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	78
EFO6	88
EFO8	94
EFO10	96
EFO12	98

Recommended Stormceptor EFO Model:	**EFO6**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**88**
Water Quality Runoff Volume Capture (%):	**> 90**

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

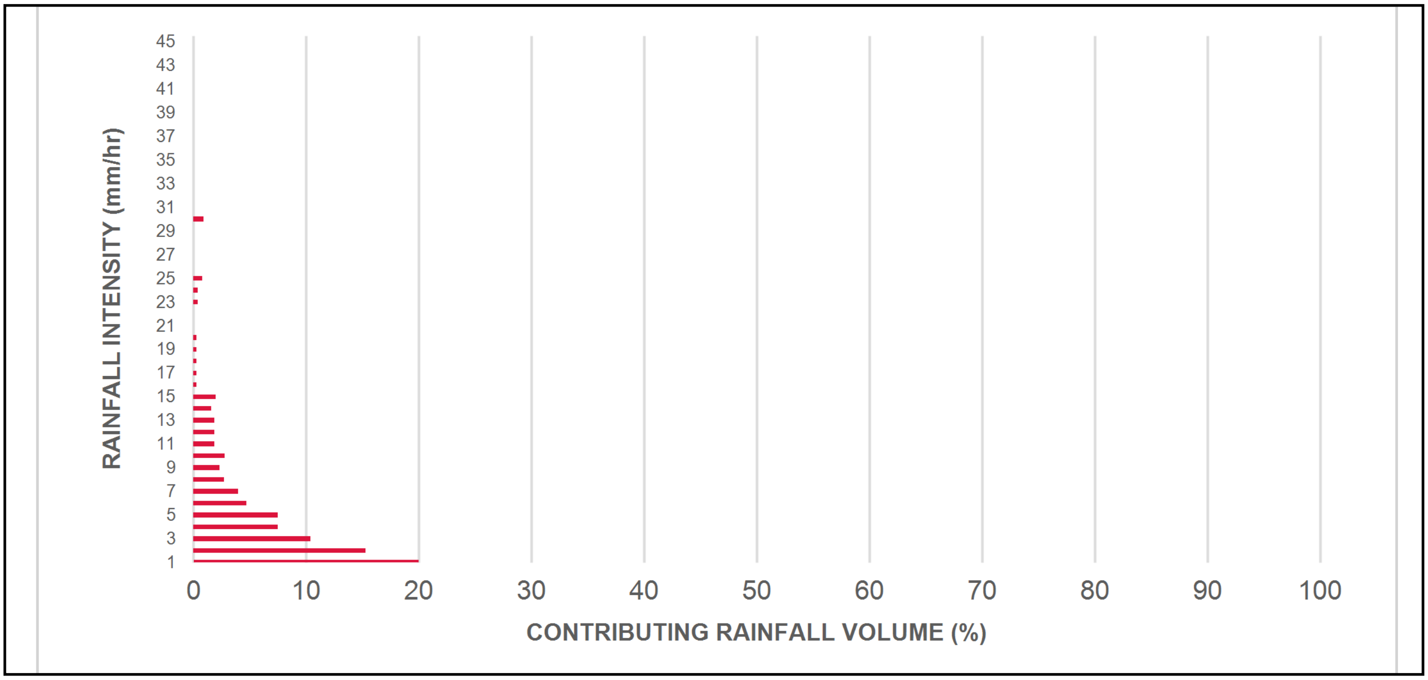
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

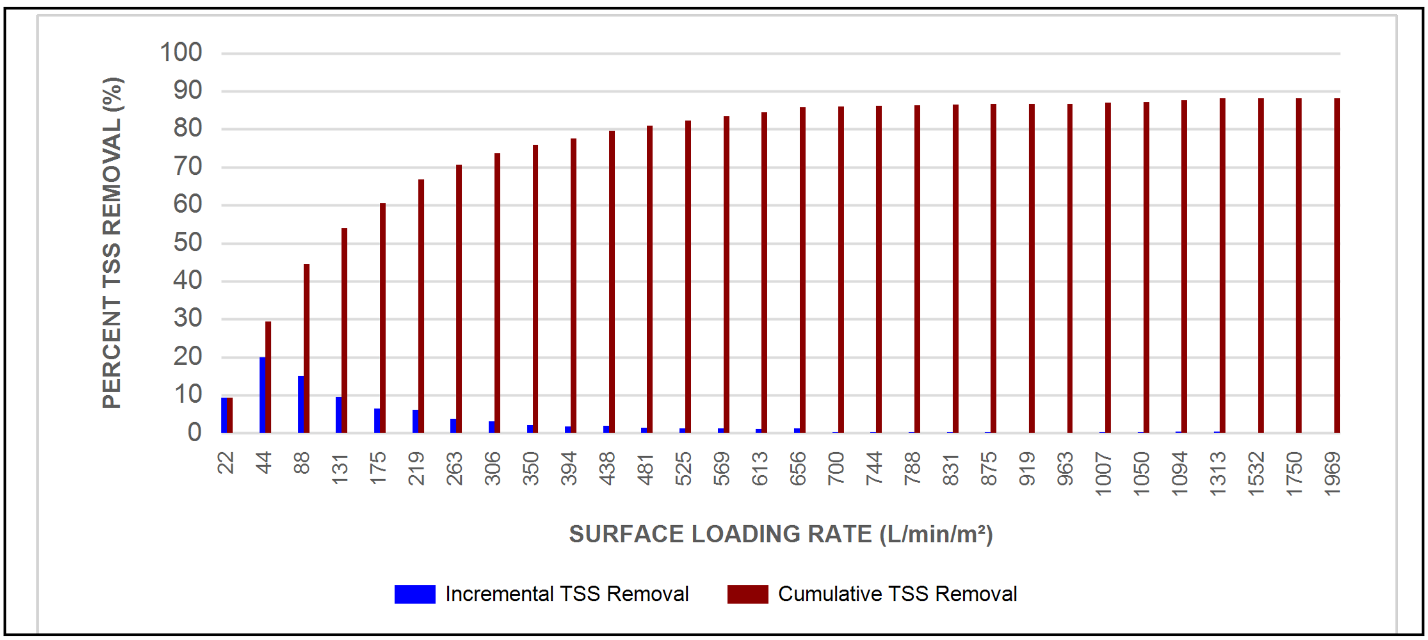
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	9.4	9.4	0.96	58.0	22.0	100	9.4	9.4
1	20.0	29.4	1.92	115.0	44.0	100	20.0	29.4
2	15.3	44.7	3.84	230.0	88.0	98	15.1	44.5
3	10.4	55.1	5.75	345.0	131.0	92	9.5	54.0
4	7.5	62.6	7.67	460.0	175.0	87	6.5	60.6
5	7.5	70.1	9.59	575.0	219.0	83	6.2	66.8
6	4.7	74.9	11.51	691.0	263.0	80	3.8	70.6
7	4.0	78.8	13.43	806.0	306.0	78	3.1	73.7
8	2.7	81.6	15.35	921.0	350.0	76	2.1	75.8
9	2.3	83.9	17.26	1036.0	394.0	74	1.7	77.5
10	2.8	86.6	19.18	1151.0	438.0	72	2.0	79.5
11	1.9	88.6	21.10	1266.0	481.0	70	1.4	80.9
12	1.9	90.5	23.02	1381.0	525.0	68	1.3	82.2
13	1.9	92.4	24.94	1496.0	569.0	66	1.3	83.5
14	1.6	94.0	26.85	1611.0	613.0	65	1.0	84.5
15	2.0	96.0	28.77	1726.0	656.0	64	1.3	85.8
16	0.3	96.3	30.69	1841.0	700.0	64	0.2	85.9
17	0.3	96.6	32.61	1957.0	744.0	64	0.2	86.1
18	0.3	96.9	34.53	2072.0	788.0	63	0.2	86.3
19	0.3	97.2	36.45	2187.0	831.0	63	0.2	86.5
20	0.3	97.5	38.36	2302.0	875.0	63	0.2	86.7
21	0.0	97.5	40.28	2417.0	919.0	62	0.0	86.7
22	0.0	97.5	42.20	2532.0	963.0	62	0.0	86.7
23	0.4	97.9	44.12	2647.0	1007.0	62	0.2	86.9
24	0.4	98.3	46.04	2762.0	1050.0	60	0.2	87.2
25	0.8	99.1	47.96	2877.0	1094.0	59	0.5	87.7
30	0.9	100.0	57.55	3453.0	1313.0	54	0.5	88.2
35	0.0	100.0	67.14	4028.0	1532.0	48	0.0	88.2
40	0.0	100.0	76.73	4604.0	1750.0	42	0.0	88.2
45	0.0	100.0	86.32	5179.0	1969.0	37	0.0	88.2
Estimated Net Annual Sediment (TSS) Load Reduction =								**88 %**

Climate Station ID: 6117700 *Years of Rainfall Data*: 14

RAINFALL DATA FROM BARRIE-ORO RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

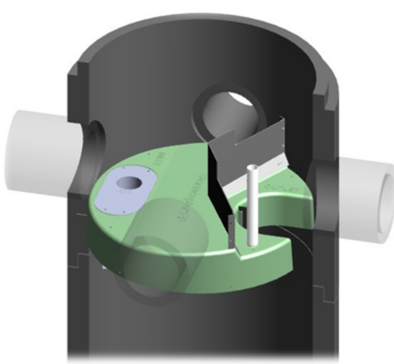
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

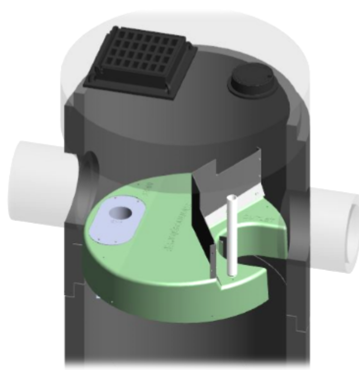
DESIGN FLEXIBILITY

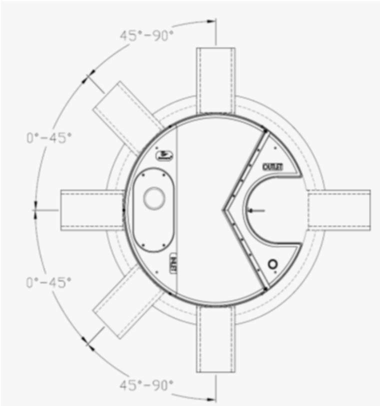
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR
"OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

11/04/2022

Province:	Ontario
City:	Collingwood
Nearest Rainfall Station:	BARRIE-ORO
Climate Station Id:	6117700
Years of Rainfall Data:	14
Site Name:	Drainage Area - 202
Drainage Area (ha):	1.03
Runoff Coefficient 'c':	0.75
Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	
Estimated Water Quality Flow Rate (L/s):	25.18
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	140 Mountain Road
Project Number:	121036
Designer Name:	Matt Ray
Designer Company:	Tatham Engineering
Designer Email:	mray@tathameng.com
Designer Phone:	705-444-2665
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	76
EFO6	87
EFO8	93
EFO10	96
EFO12	98

Recommended Stormceptor EFO Model:	**EFO6**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**87**
Water Quality Runoff Volume Capture (%):	**> 90**

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

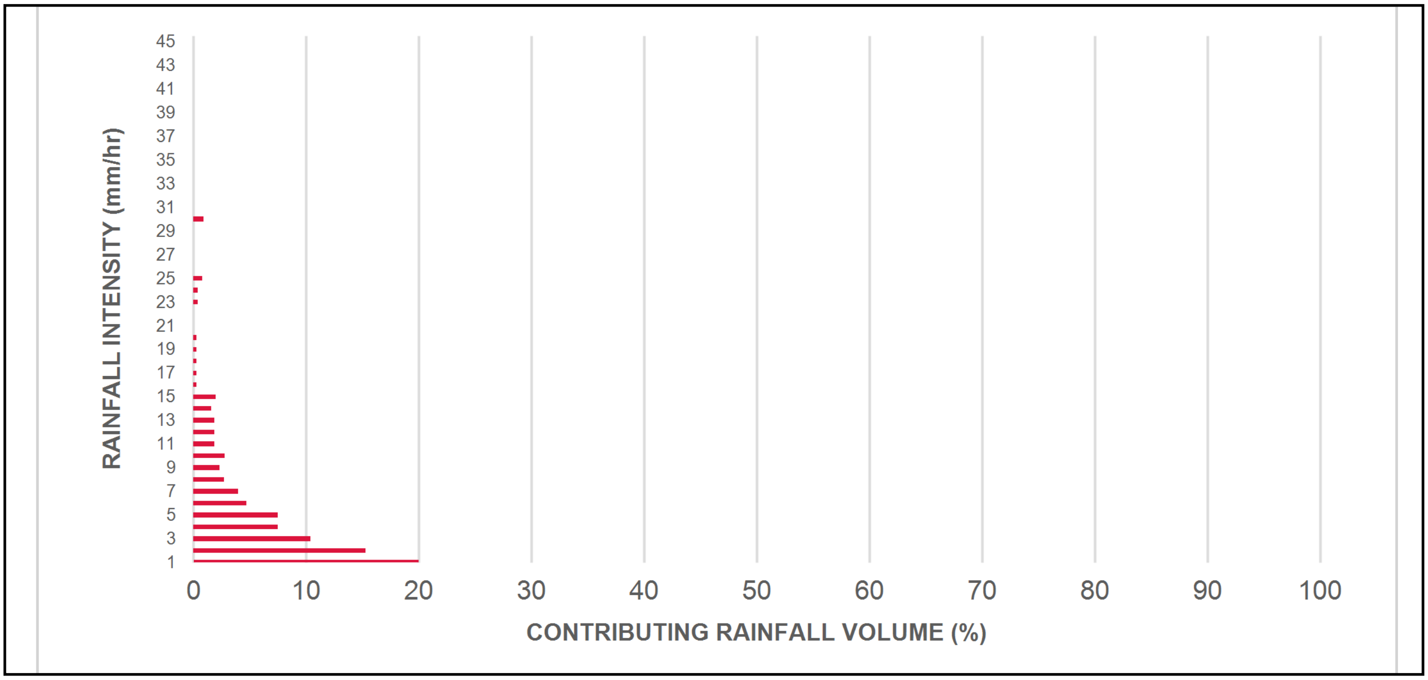
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Stormceptor® EF Sizing Report

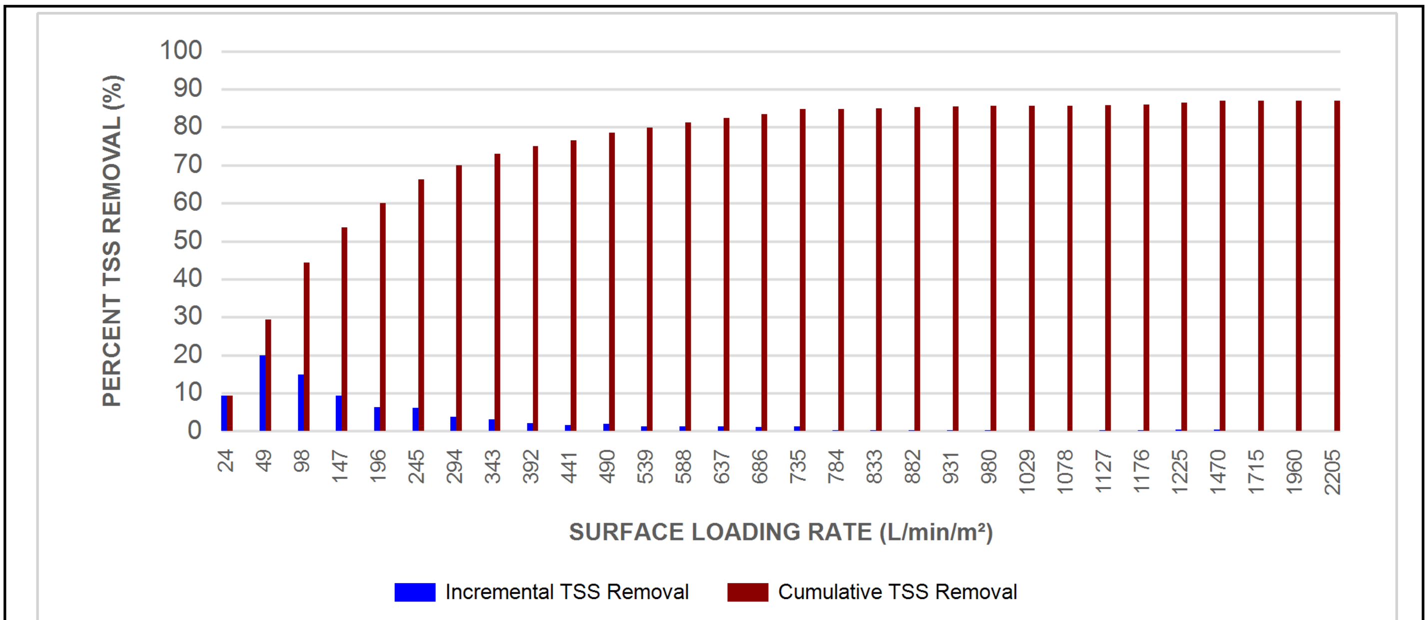
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	9.4	9.4	1.07	64.0	24.0	100	9.4	9.4
1	20.0	29.4	2.15	129.0	49.0	100	20.0	29.4
2	15.3	44.7	4.30	258.0	98.0	97	14.9	44.3
3	10.4	55.1	6.44	387.0	147.0	91	9.4	53.7
4	7.5	62.6	8.59	515.0	196.0	84	6.3	60.1
5	7.5	70.1	10.74	644.0	245.0	81	6.1	66.2
6	4.7	74.9	12.89	773.0	294.0	79	3.7	69.9
7	4.0	78.8	15.03	902.0	343.0	77	3.1	72.9
8	2.7	81.6	17.18	1031.0	392.0	74	2.0	75.0
9	2.3	83.9	19.33	1160.0	441.0	72	1.7	76.6
10	2.8	86.6	21.48	1289.0	490.0	70	1.9	78.6
11	1.9	88.6	23.62	1417.0	539.0	68	1.3	79.9
12	1.9	90.5	25.77	1546.0	588.0	66	1.3	81.2
13	1.9	92.4	27.92	1675.0	637.0	64	1.2	82.4
14	1.6	94.0	30.07	1804.0	686.0	64	1.0	83.4
15	2.0	96.0	32.21	1933.0	735.0	64	1.3	84.7
16	0.3	96.3	34.36	2062.0	784.0	63	0.2	84.8
17	0.3	96.6	36.51	2191.0	833.0	63	0.2	85.0
18	0.3	96.9	38.66	2319.0	882.0	62	0.2	85.2
19	0.3	97.2	40.80	2448.0	931.0	62	0.2	85.4
20	0.3	97.5	42.95	2577.0	980.0	62	0.2	85.6
21	0.0	97.5	45.10	2706.0	1029.0	61	0.0	85.6
22	0.0	97.5	47.25	2835.0	1078.0	60	0.0	85.6
23	0.4	97.9	49.39	2964.0	1127.0	59	0.2	85.8
24	0.4	98.3	51.54	3092.0	1176.0	58	0.2	86.0
25	0.8	99.1	53.69	3221.0	1225.0	56	0.5	86.5
30	0.9	100.0	64.43	3866.0	1470.0	50	0.5	87.0
35	0.0	100.0	75.16	4510.0	1715.0	43	0.0	87.0
40	0.0	100.0	85.90	5154.0	1960.0	37	0.0	87.0
45	0.0	100.0	96.64	5798.0	2205.0	33	0.0	87.0
Estimated Net Annual Sediment (TSS) Load Reduction =								**87 %**

Climate Station ID: 6117700 *Years of Rainfall Data*: 14

RAINFALL DATA FROM BARRIE-ORO RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

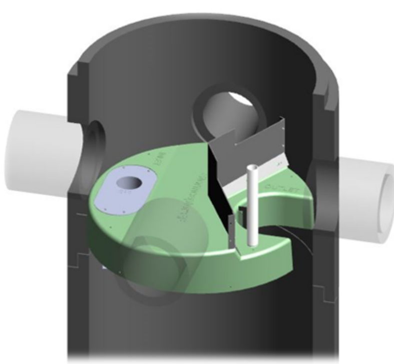
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

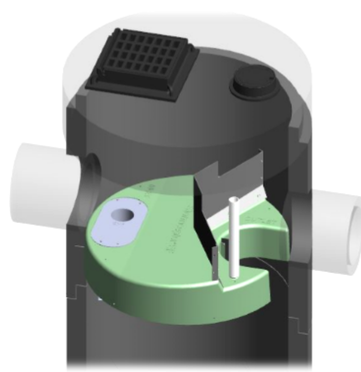
DESIGN FLEXIBILITY

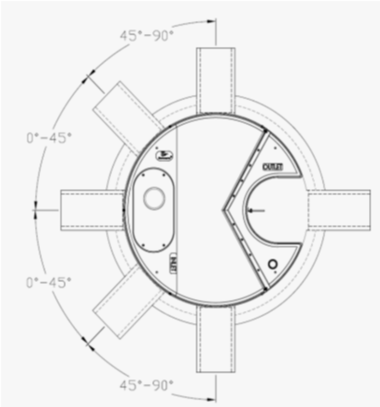
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Stormceptor® EF4 and EFO4 Oil-Grit Separators

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

In accordance with

ISO 14034:2016

**Environmental management —
Environmental technology verification (ETV)**

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

November 10, 2017
Vancouver, BC, Canada

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

Technology description and application

The Stormceptor® EF4 and EFO4 are treatment devices designed to remove oil, sediment, trash, debris, and pollutants attached to particulates from Stormwater and snowmelt runoff. The device takes the place of a conventional manhole within a storm drain system and offers design flexibility that works with various site constraints. The EFO4 is designed with a shorter bypass weir height, which accepts lower surface loading rate into the sump, thereby reducing re-entrainment of captured free floating light liquids.

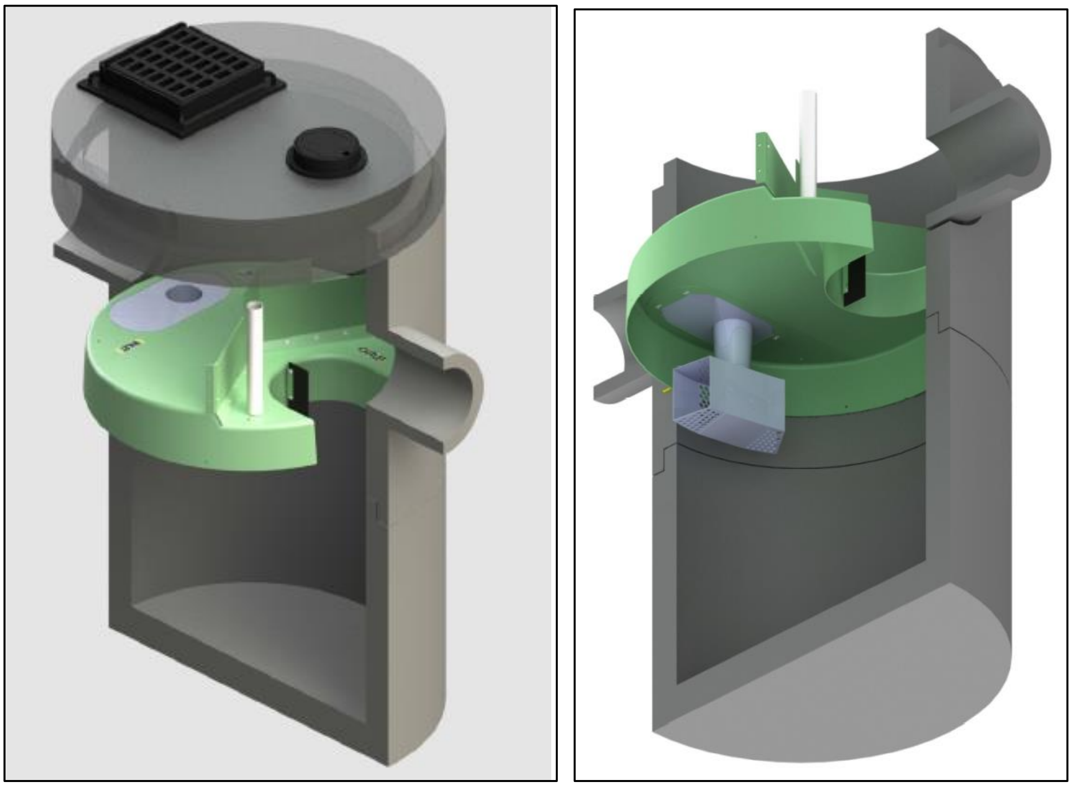


Figure 1. Graphic of typical inline Stormceptor® unit and core components.

Stormwater and snowmelt runoff enters the Stormceptor® EF/EFO's upper chamber through the inlet pipe(s) or a surface inlet grate. An insert divides the unit into lower and upper chambers and incorporates a weir to reduce influent velocity and separate influent (untreated) from effluent (treated) flows. Influent water ponds upstream of the insert's weir providing driving head for the water flowing downwards into the drop pipe where a vortex pulls the water into the lower chamber. The water diffuses at lower velocities in multiple directions through the drop pipe outlet openings. Oil and other floatables rise up and are trapped beneath the insert, while sediments undergo gravitational settling to the sump's bottom. Water from the sump can exit by flowing upward to the outlet riser onto the top side of the insert and downstream of the weir, where it discharges through the outlet pipe.

Maximum flow rate into the lower chamber is a function of weir height and drop pipe orifice diameter. The Stormceptor® EF and EFO are designed to allow a surface loading rate of 1135 L/min/m^2 (27.9 gal/min/ft^2) and 535 L/min/m^2 (13.1 gal/min/ft^2) into the lower chamber, respectively. When prescribed surface loading rates are exceeded, ponding water can overtop the weir height and bypass the lower treatment chamber, exiting directly through the outlet pipe. Hydraulic testing and scour testing demonstrate that the internal bypass effectively prevents scour at all bypass flow rates. Increasing the bypass flow rate does not increase the orifice-controlled flow rate into the lower treatment chamber where sediment is stored. This internal bypass feature allows for in-line installation, avoiding the cost of additional bypass structures. During bypass, treatment continues in the lower chamber at the maximum flow rate. The Stormceptor® EFO's lower design surface loading rate is favorable for minimizing re-entrainment and washout of captured light liquids. Inspection of Stormceptor® EF and EFO devices is performed from grade by inserting a sediment probe through the outlet riser and an oil dipstick through the oil inspection pipe. The unit can be maintained by using a vacuum hose through the outlet riser.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Imbrium Systems Inc.'s Stormceptor® OGS device, 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 Environment Canada's Environmental Technology Verification (ETV) Program. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test [a]:

During the capture test, the Stormceptor® EF OGS device, 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 70, 64, 54, 48, 46, 44, and 49 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Stormceptor® EFO, 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 70, 64, 54, 48, 42, 40, and 34 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 [a]:

During the scour test, the Stormceptor® EF and Stormceptor® EFO OGS devices, with 10.2 cm (4 inches) of test sediment pre-loaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment storage depth, generate corrected effluent concentrations of 4.6, 0.7, 0, 0.2, and 0.4 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[a]:

During the light liquid re-entrainment test, the Stormceptor® EFO OGS device with surrogate low-density polyethylene beads preloaded within the lower chamber oil collection zone, representing a floating light liquid volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.5, 99.8, 99.8, and 99.9 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.

[a] 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)

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 2 indicates that the test sediment used for the capture and scour tests met this condition.

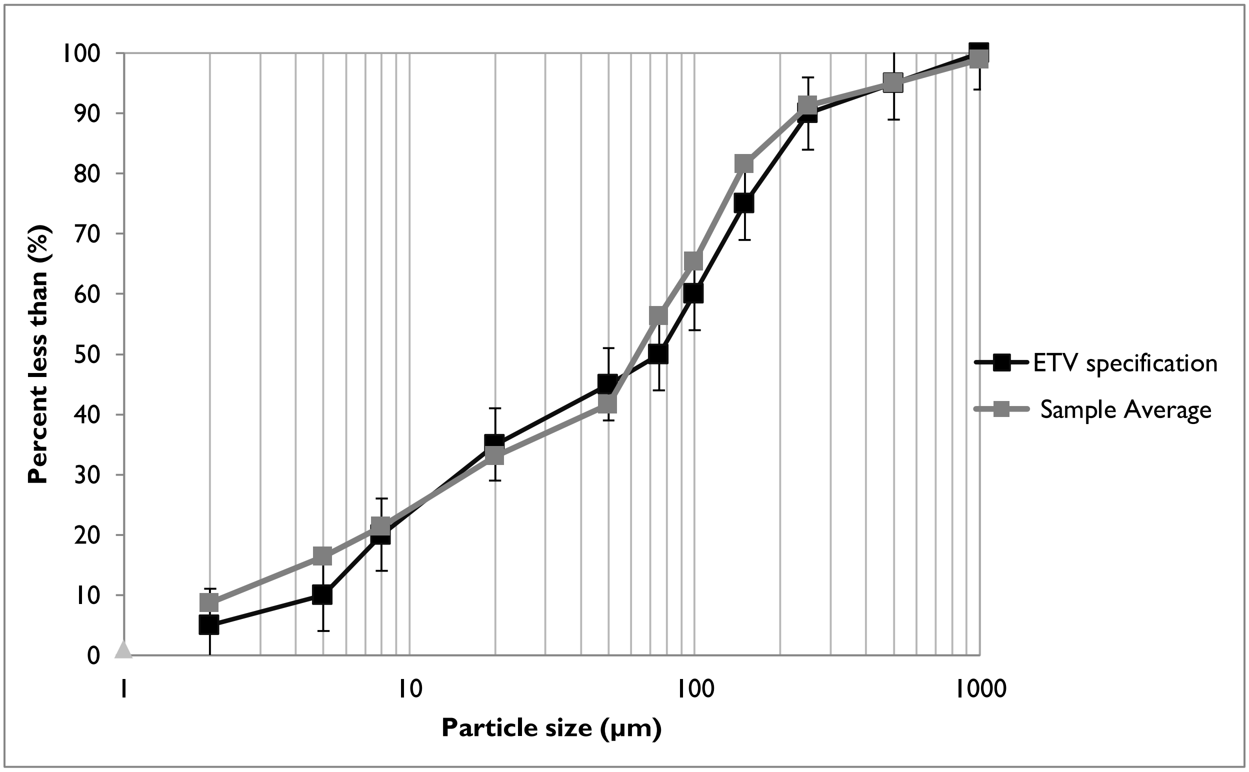


Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

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 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). Since the EF and EFO models are identical except for the weir height, which bypasses flows from the EFO model at a surface loading rate of 535 L/min/m^2 (13.1 gpm/ft^2), sediment capture tests at surface loading rates from 40 to 400 L/min/m^2 were only performed on the EF unit. Surface loading rates of 600, 1000, and 1400 L/min/m^2 were tested on both units separately. Results for the EFO model at these higher flow rates are presented in Table 2.

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 EF4 at specified surface loading rates

Particle size fraction (µm)	**Surface loading rate (L/min/m^2)**						
	40	80	200	400	600	1000	1400
>500	90	58	58	100*	86	72	100*
250 - 500	100*	100*	100	100*	100*	100*	100*
150 - 250	90	82	26	100*	100*	67	90
105 - 150	100*	100*	100*	100*	100*	100*	100
75 - 105	100*	92	74	82	77	68	76
53 - 75	Undefined [a]	56	100*	72	69	50	80
20 - 53	54	100*	54	33	36	40	31
8 - 20	67	52	25	21	17	20	20
5 – 8	33	29	11	12	9	7	19
<5	13	0	0	0	0	0	4
All particle sizes by mass balance	**70.4**	**63.8**	**53.9**	**47.5**	**46.0**	**43.7**	**49.0**

[a] An outlier in the feed sample sieve data resulted in a negative removal efficiency for this size fraction.
* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 171% (average 128%). See text and Bulletin # CETV 2016-11-0001 for more information.

Table 2. Removal efficiencies (%) of the EFO4 at surface loading rates above the bypass rate of 535 L/min/m^2

Particle size fraction (µm)	**Surface loading rate (L/min/m^2)**		
	600	1000	1400
>500	89	83	100*
250 - 500	90	100*	92
150 - 250	90	67	100*
105 - 150	85	92	77
75 - 105	80	71	65
53 - 75	60	31	36
20 - 53	33	43	23
8 - 20	17	23	15
5 – 8	10	3	3
<5	0	0	0
All particle sizes by mass balance	**41.7**	**39.7**	**34.2**

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 103 and 111% (average 107%). 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 EF4 at each of the tested surface loading rates. Figure 4 shows the same graph for the EFO4 unit at surface loading rates above the bypass rate of 535 L/min/m^2.

As expected, the capture efficiency for fine particles in both units was generally found to decrease as surface loading rates increased.

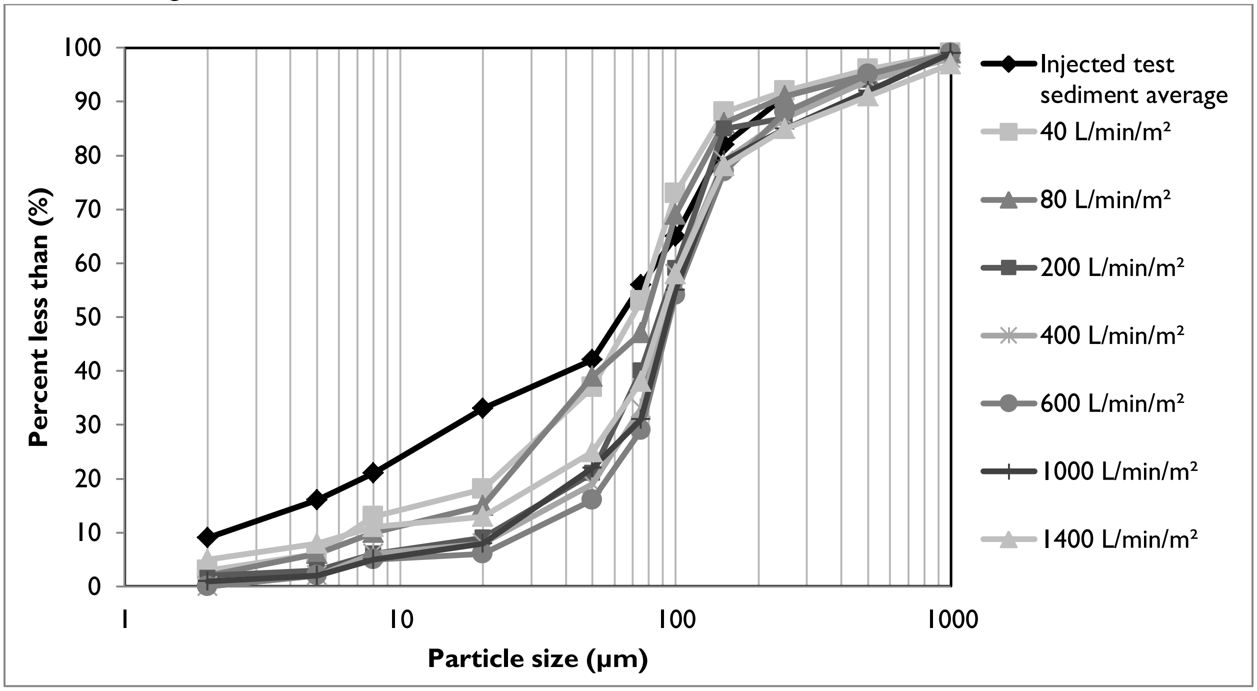


Figure 3. Particle size distribution of sediment retained in the EF4 in relation to the injected test sediment average.

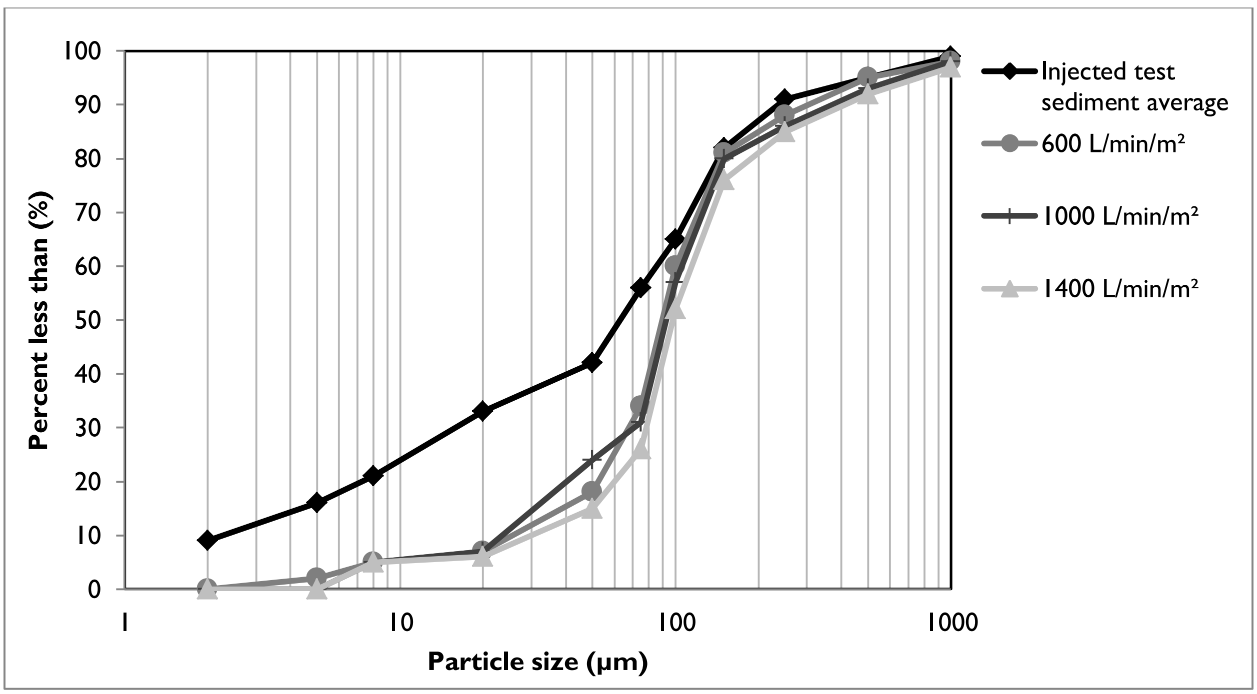


Figure 4. Particle size distribution of sediment retained in the EFO4 in relation to the injected test sediment average at surface loading rates above the bypass rate of 535 L/min/m²

Table 4 shows the results of the sediment scour and re-suspension test for the EF4 unit. The EFO4 was not tested as it was reasonably assumed that scour rates would be lower given that flow bypass occurs at a lower surface loading rate. The scour test involved preloading 10.2 cm of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Clean water was run through the device at five surface loading rates over a 30 minute period. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water. Typically, the smallest 5% of particles captured during the 40 L/min/m² sediment capture test is also used to adjust the concentration, as per the method described in Bulletin # CETV 2016-09-0001. However, since the composites of effluent concentrations were below the Reporting Detection Limit of the Laser Diffraction PSD methodology, this adjustment was not made. Results showed average adjusted effluent sediment concentrations below 5 mg/L at all tested surface loading rates.

It should be noted that the EF4 starts to internally bypass water at 1135 L/min/m², potentially resulting in the dilution of effluent concentrations, which would not normally occur under typical field conditions because the field influent concentration would contain a much higher sediment concentration than during the lab test. Recalculation of effluent concentrations to account for dilution at surface loading rates above the bypass rate showed sediment effluent concentrations to be below 1.6 mg/L.

Table 4. Scour test adjusted effluent sediment concentration.

Run	Surface loading rate (L/min/m²)	Run time (min)	Background sample concentration (mg/L)	Adjusted effluent suspended sediment concentration (mg/L) [a]	Average (mg/L)
1	200	1:00	<RDL	11.9	4.6
		2:00		7.0	
		3:00		4.4	
		4:00		2.2	
		5:00		1.0	
		6:00		1.2	
2	800	7:00	<RDL	1.1	0.7
		8:00		0.9	
		9:00		0.6	
		10:00		1.4	
		11:00		0.1	
		12:00		0	
3	1400	13:00	<RDL	0	0
		14:00		0.1	
		15:00		0	
		16:00		0	
		17:00		0	
		18:00		0	
4	2000	19:00	1.2	0.2	0.2
		20:00		0	
		21:00		0	
		22:00		0.7	
		23:00		0	

		24:00		0.4	
5	2600	25:00	1.6	0.3	0.4
		26:00		0.4	
		27:00		0.7	
		28:00		0.4	
		29:00		0.2	
		30:00		0.4	

[a] 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.

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 5. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m²) of surrogate low-density polyethylene beads within the oil collection skirt and running clean water through the device continuously at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m²). Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates. The effluent flow was screened to capture all re-entrained pellets throughout the test.

Table 5. Light liquid re-entrainment test results for the EFO4.

Surface Loading Rate (L/min/m2)	Time Stamp	Amount of Beads Re-entrained			
		Mass (g)	Volume (L)[a]	% of Pre-loaded Mass Re-entrained	% of Pre-loaded Mass Retained
200	62	0	0	0.00	100
800	247	168.45	0.3	0.52	99.48
1400	432	51.88	0.09	0.16	99.83
2000	617	55.54	0.1	0.17	99.84
2600	802	19.73	0.035	0.06	99.94
Total Re-entrained		295.60	0.525	0.91	--
Total Retained		32403	57.78	--	99.09
Total Loaded		32699	58.3	--	--

[a] Determined from bead bulk density of 0.56074 g/cm³

Variances from testing Procedure

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

1. During the capture test, the 40 L/min/m² and 80 L/min/m² surface loading rates were evaluated over 3 and 2 days respectively due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit at these lower flow rates. Pumps were shut down at the end of each intermediate day, and turned on again the following morning. The target flow rate was re-established within 30 seconds of switching on the pump. This procedure may have allowed sediments to be captured that otherwise may have exited the unit if the test was

continuous. On the basis of practical considerations, this variance was approved by the verifier prior to testing.

2. During the scour test, the coefficient of variation (COV) for the lowest flow rate tested (200 L/min/m^2) was 0.07, which exceeded the specified limit of 0.04 target specified in the OGS Procedure. A pump capable of attaining the highest flow rate of 3036 L/min had difficulty maintaining the lowest flow of 234 L/min but still remained within +/- 10% of the target flow and is viewed as having very little impact on the observed results. Similarly, for the light liquid re-entrainment test the COV for the flow rate of the 200 L/min/m^2 run was 0.049, exceeding the limit of 0.04, but is believed to introduce negligible bias.

3. Due to pressure build up in the filters, the runs at 1000 L/min/m^2 for the Stormceptor® EF4 and 1000 and 1400 L/min/m^2 for the Stormceptor® EFO4 were slightly shorter than the target. The run times were 54, 59 and 43 minutes respectively, versus targets of 60 and 50 minutes. The final feed samples were timed to coincide with the end of the run. Since >25 lbs of sediment was fed, the shortened time did not invalidate the runs.

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 Imbrium Systems Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories, and dated September 8, 2017; the 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 Stormceptor® EF4 and EFO4 please contact:

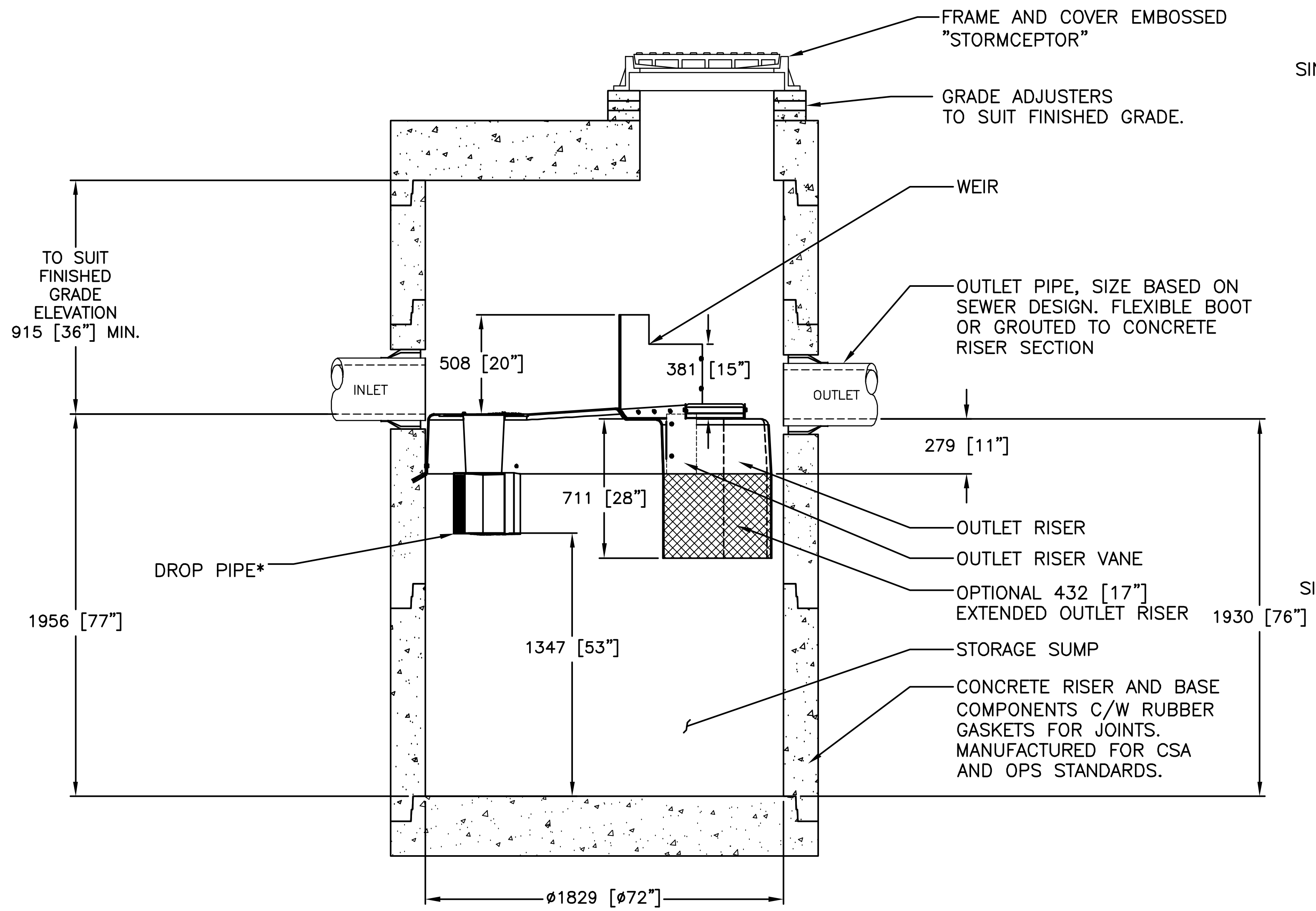
Imbrium Systems, Inc.
407 Fairview Drive
Whitby, ON
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

For more information on ISO 14034:2016 / ETV please contact:

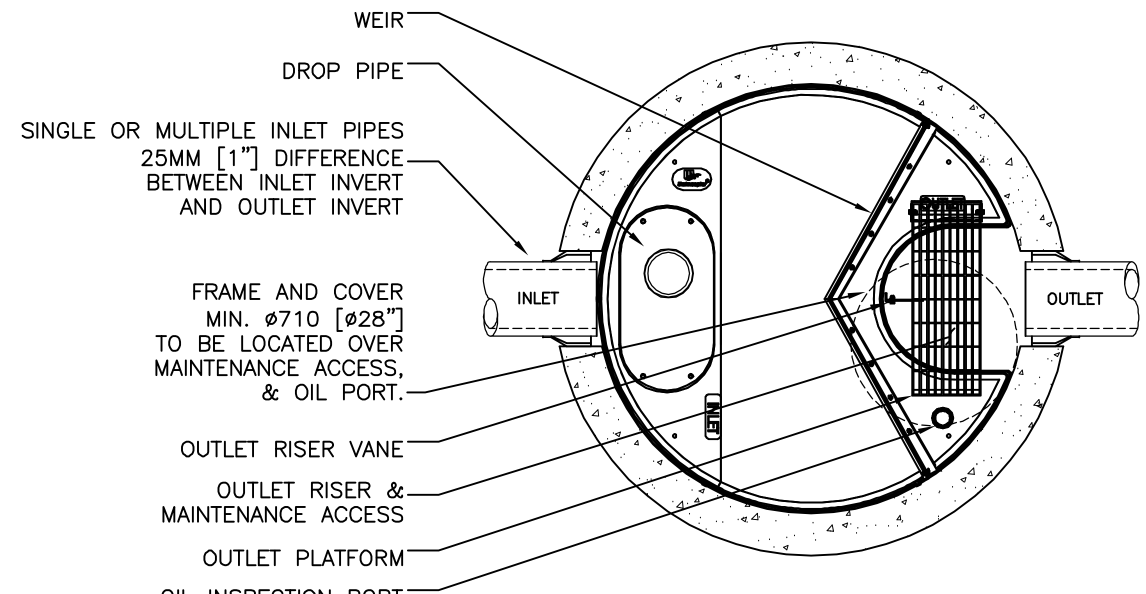
GLOBE Performance Solutions
World Trade Centre
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com

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.

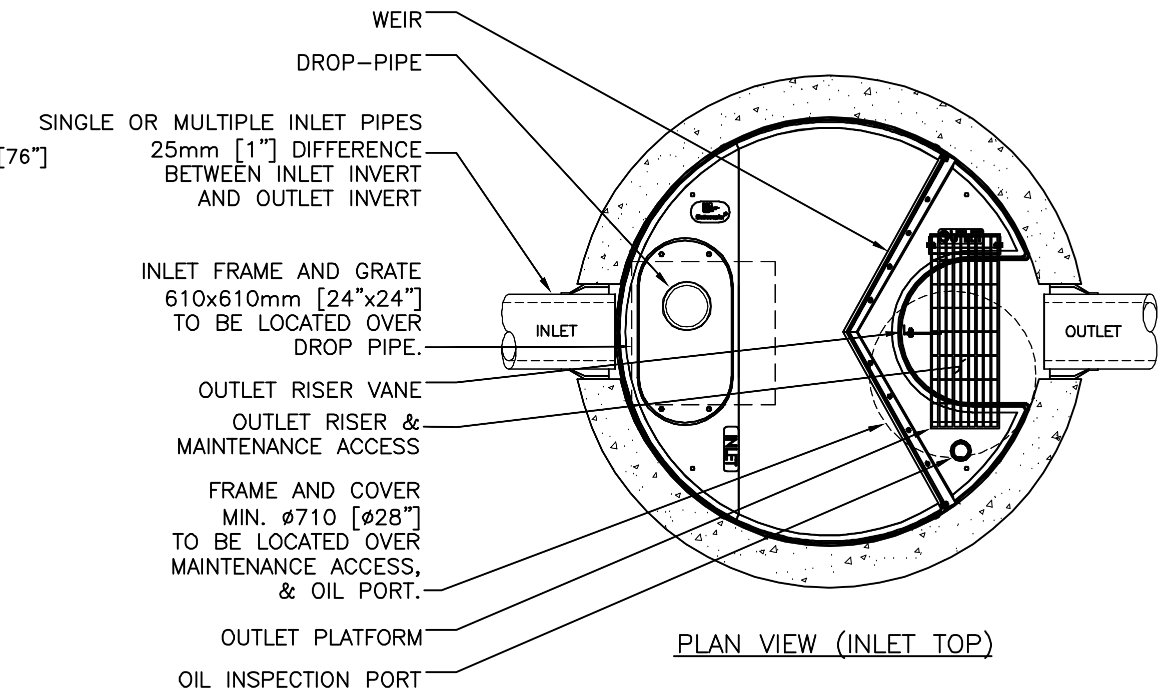
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF6 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO6 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO6				
STRUCTURE ID	*				
HYDROCARBON STORAGE REQ'D (L)	*				
WATER QUALITY FLOW RATE (L/s)	*				
PEAK FLOW RATE (L/s)	*				
RETURN PERIOD OF PEAK FLOW (yrs)	*				
DRAINAGE AREA (HA)	*				
DRAINAGE AREA IMPERVIOUSNESS (%)	*				
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
####	####	####	####
####	####	####	####
####	####	####	####
1	6/8/18	OUTLET PLATFORM	JSK
0	05/26/17	INITIAL RELEASE	JSK

Stormceptor® EF

imbrium

SCALE = NTS

DATE: 10/13/2017	
DESIGNED: JSK	DRAWN: JSK
CHECKED: BSF	APPROVED: SP
PROJECT No.: EFO6	SEQUENCE No.: *
SHEET: 1 OF 1	

I:\IMBRIUM\PRODUCTS\STORMCEPTOR EF\40 DRAWINGS & DETAILS\STANDARD DETAILS\EFO STANDARD DETAILS\EFO6-DETAIL.DWG 4/12/2019 11:05 AM

Appendix E: Phosphorus Loading, Water Budget

Development Export Summary

Development :121036 - 140 Mountain Rd

Pre-Development Phosphorus Export

DEVELOPMENT : 121036 - 140 Mountain Rd

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Natural Heritage				
Forest		2.02	0.06	0.12
	Natural Heritage Land use Class Total :	**2.02**		**0.12**
	Development Total :	**2.02**		**0.12**

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : 121036 - 140 Mountain Rd

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea :

Slope Area (ha)
Surface Slope Gradient (%)
Length of Slope (m)

Cropt Type Factor)
Tillage Type Factor

R (rainfall / runoff for Lake Simcoe)
K (soil errodability factor)
NN (determined by slope)

LS (slope length gradient factor)
C (crop management factor)
P (prevention + capture)
Soil Loss (kg/year)
Phosphorus export (kg/ha/yr)
Phosphorus load (kg/yr)

PRE Developed Area (ha) :
Phosphorus export (kg/ha/yr) :
Phosphorus load (kg/yr) :

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : 121036 - 140 Mountain Rd

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Natural Heritage				
Forest		0.08	0.06	.005
	Natural Heritage Land use Class Total :	**0.08**		
Urban				
Commercial		1.95	~~0.20~~ 1.05	~~2.74~~
	Urban Land use Class Total :	**1.95**		~~**2.74**~~ 2.048
	Development Total :	**2.03**		~~**2.74**~~ 2.053

12/6/2022 Page 1 of 1

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : 121036 - 140 Mountain Rd

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea :

Slope Area (ha)	R (rainfall / runoff for Lake Simcoe)
Surface Slope Gradient (%)	K (soil errodability factor)
Length of Slope (m)	NN (determined by slope)
Cropt Type Factor)	LS (slope length gradient factor)
Tillage Type Factor	C (crop management factor)
	P (prevention + capture)
	Soil Loss (kg/year)
	Phosphorus export (kg/ha/yr)
	Phosphorus load (kg/yr)

PRE Developed Area (ha) :

Phosphorus export (kg/ha/yr) :

Phosphorus load (kg/yr) :

12/6/2022 Page 1 of 1

Updated : Sept 2014

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Commercial					
1.95	100	0.20	68.5 %	0.27	Bottom of SWMFs to be vegetated, will perform similar to vegetated filter strips and detention storage will perform similar to Dry Pond.
User Entry					

Updated : Sept 2014

Development Area P and BMP Summary

Total PreDevelopment Area (ha):	2.02	
PreDevelopment Area excluding Wetlands (ha):	2.02	
Total PostDevelopment Area (ha):	2.03	
Total Area treated by BMP's (ha):	1.95	
Treated Area total:	1.95	
Total PreDevelopment Load (kg/yr):	0.12	
Total PostDevelopment Load (kg/yr):	~~2.74~~	2.055
Total P Load Reduction with BMP's (kg/yr):	~~0.27~~	1.401
Minimum P Load Reduction Required:	2.62	1.935
Total PostDevelopment Load with BMP's (kg/yr)	~~2.47~~	0.654

Conclusion : Net increase in P load, additional reduction is required.

Updated : Sept 2014

Post Dev Construction

Erosion Control Measures
Buffer/Riparian Zone Preservation

Sediment Control Measures - Perimeter Controls
Interceptor Swale/Dike
Vehicle Tracking Control/Mud Mat
Sediment/Silt Fence

Sediment Control Measures - Settling Controls
Sediment Traps

TATHAM ENGINEERING

Water Budget

Project Details

140 Mountain Road	121036

Prepared By

M.Ray	Nov 20/22

Water Balance Detials

Methodology	Thornthwaite Method
Climate Data & Source	Thornbury SLAMA Climate Normal Data for 1981 to 2010 (Environment Canada)
Thornthwaite Coefficient	1.056

Month	Temp (°C)	Precip (mm)	Heat Index	PET (mm)	Daylight Factor	Adjusted PET (mm)	AET (mm)	Surplus (mm)	Deficit (mm)
Jan.	-6.3	100.0	0.0	0.0	0.77	0.0	0.0	100.0	0.0
Feb.	-5.4	68.4	0.0	0.0	0.87	0.0	0.0	68.4	0.0
Mar.	-1.5	64.0	0.0	0.0	1.00	0.0	0.0	64.0	0.0
Apr.	5.5	65.3	1.2	28.9	1.12	32.5	32.5	32.8	0.0
May	11.5	82.7	3.5	71.4	1.23	88.0	82.7	0.0	5.3
Jun.	16.7	79.1	6.2	107.1	1.29	138.1	79.1	0.0	59.0
Jul.	19.8	72.1	8.0	129.6	1.26	163.5	72.1	0.0	91.4
Aug.	19.2	78.2	7.7	115.9	1.17	135.1	78.2	0.0	56.9
Sep.	15.5	95.9	5.5	80.0	1.04	83.4	83.4	12.5	0.0
Oct.	9.1	87.3	2.5	41.4	0.92	37.9	37.9	49.4	0.0
Nov.	3.1	99.6	0.5	11.3	0.80	9.0	9.0	90.6	0.0
Dec.	-2.7	99.4	0.0	0.0	0.74	0.0	0.0	99.4	0.0
Total	**-**	**992**	**35.1**	**585.4**	**-**	**687.5**	**474.9**	**517.1**	**212.6**

Additional Notes

PET = Potential Evapotranspiration; AET = Actual Evapotranspiration

Equations

$$PET = 16\left(\frac{L}{12}\right)\left(\frac{N}{30}\right)\left(\frac{10T_d}{I}\right)^{\alpha}$$ Where

PET is the estimated potential evapotranspiration (mm/month)

T_d is the average daily temperature (degrees Celsius; if this is negative, use 0) of the month being calculated

N is the number of days in the month being calculated

L is the average day length (hours) of the month being calculated

$$\alpha = (6.75 \times 10^{-7})I^3 - (7.71 \times 10^{-5})I^2 + (1.792 \times 10^{-2})I + 0.49239$$

$I = \sum_{i=1}^{12}\left(\frac{T_{m_i}}{5}\right)^{1.514}$ is a heat index which depends on the 12 monthly mean temperatures T_{m_i}.[1]

TATHAM ENGINEERING

Water Budget

Project Details

140 Mountain Road	121036

Prepared By

M.Ray	Nov 20/22

Pre-Development Catchment Details

Area (ha)	2.02
Pervious Area (ha)	2.02
Impervious Area (ha)	0.0

Post Development Catchment Details

Area (ha)	2.02
Pervious Area (ha)	0.53
Impervious Area (ha)	1.49

Infiltration Factor	Pre-Development			Post Development		
	Pervious	Impervious	Total	Pervious	Impervious	Total
Topography	0.150	0.0		0.300	0.0	
Soil	0.300	0.0		0.300	0.0	
Land Cover	0.200	0.0		0.104	0.0	
Infiltration Factor	0.650	0.0		0.704	0.0	

Water Budget	Pervious	Impervious	Total	Pervious	Impervious	Total
Water Surplus (m^3)	10,446	0	10,446	2,741	7,705	10,446
Infiltration (m^3)	6,790	0	6,790	1,929	0	1,929
Runoff (m^3)	3,656	0	3,656	812	7,705	8,517
Reduction in Infiltration Volume (m^3)						**4,861**