







water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

Sunvest Development Corporation

720 Erbsville Rd., Waterloo, ON Stormwater Management Report

March 14, 2025

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WE 23014

Mr. Peter de Groot
Sunvest Group of Companies
901 Victoria St N Unit 1
Kitchener, Ontario
N2B 3C3

Dear Mr. de Groot:

Re: Sunvest Development Corporation
720 Erbsville Rd., Waterloo, ON
Stormwater Management Report

1.0 INTRODUCTION

Water's Edge has been authorized by Sunvest Development Corporation to conduct functional servicing and stormwater management (SWM) modelling for the proposed development at 720 Erbsville Rd, Waterloo. The study area comprises a property of about 9.3 hectares, of which a portion (3.1 hectares) has been designated for development. The development area is bound by residential neighborhoods on the north and south sides. It is assumed for purposes of description in this report that Erbsville Road runs north to south. Erbsville Road runs along the west side of the study area, while Laurel Creek is to its east. The land located east of Laurel Creek has been slated for future development and is currently undergoing a zone change application. **Figure 1** shows the site location, including the development area.

The redevelopment plan proposes to construct stacked townhouse buildings and townhouse blocks. The development will also include an amenity space and on-site parking for residents.

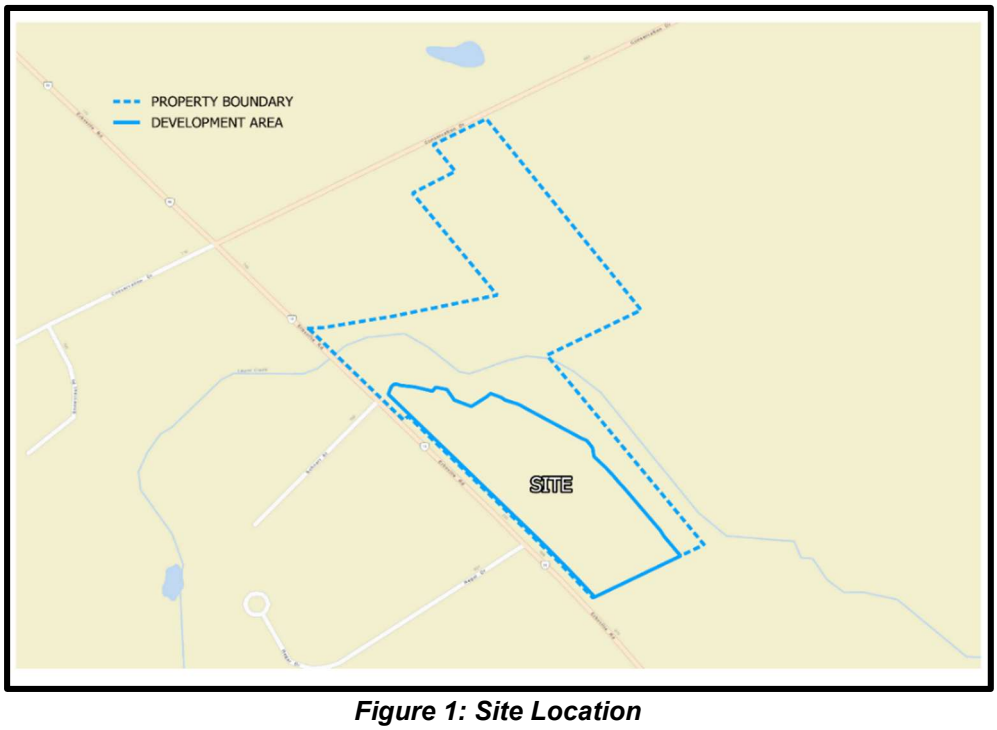


Figure 1: Site Location

2.0 EXISTING CONDITIONS

Currently, the study area consists of a single detached home, which will be demolished to accommodate the proposed development. Environmental buffer zones will be established to protect Laurel Creek, which runs through the property. **Figure 2** shows an aerial photograph of the site.

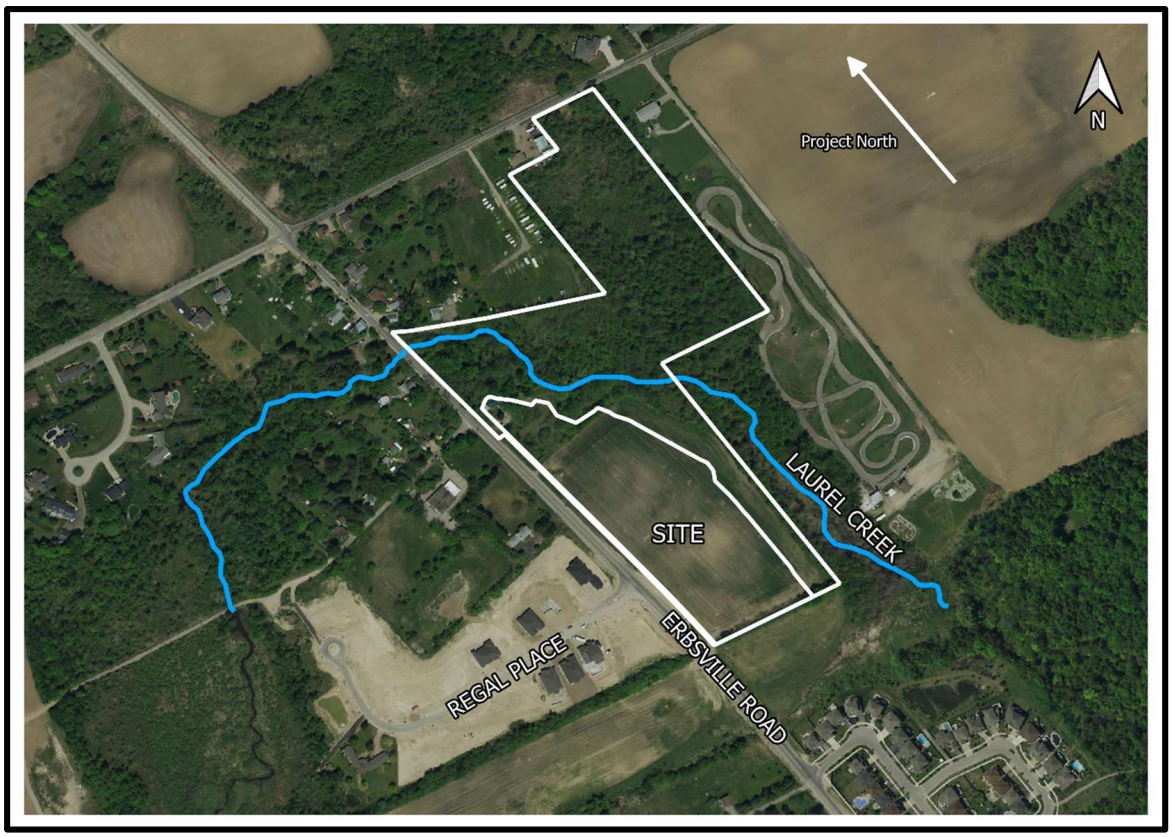


Figure 2: Site Location and Aerial Photo

3.0 EXISTING TOPOGRAPHY AND DRAINAGE

The development site is divided by two ridges, with all areas draining east towards Laurel Creek. The Site's pre-development catchment areas are delineated on the Pre-Development Storm Area Drainage Plan **Appendix A**.

4.0 STORMWATER MANAGEMENT

4.1 Stormwater Management Criteria

The criteria for managing stormwater in the proposed development site are based on previous studies, including the Laurel Creek Watershed Study (LCWS) (Dougan & Associates;, 2018), the Subwatershed Management Plan, Subwatershed Plans #313/309 (Planning Initiatives Ltd., April 1996), and guidelines from the Laurel Creek HEC -RAS model (which follow the GRCA and City of Waterloo requirements). The main criteria listed in the abovementioned sources are:

- The stormwater management must control the storm water quantity (peak flow) for storms with return periods of 2, 5, 25, and 100 years. The objective is to manage the proposed

flow conditions to the pre-development levels specified in Table B4.3 of the Subwatershed Report.
- Based on section D1.3.1 of the Subwatershed Study, active infiltration measures must be maintained on site to preserve the current annual infiltration rate of 195 mm.
- Grading and servicing design should not adversely impact groundwater or the neighbouring significant natural features.
- Extended detention control is necessary to prevent erosion for runoff rates up to the 100-year runoff, as specified in Table B 4.3 of the Subwatershed Management Plan. The extended detention must be released within 48 hours.
- All development-related work, except for minor encroachment to facilitate the construction of stormwater management facilities, must take place outside the established environmental buffers.

The intent of the current surfacewater monitoring for the development is to provide baseline water quality data that can be compared with the LCWS performance targets and postconstruction monitoring results. These targets are summarized below:

4.2 Storm Water Quality Criteria

In terms of water quality, various criteria were identified in the LCWS. With the exception of Total Suspended Solids (TSS), the criteria were established as instream targets, referring to the water quality in Laurel Creek and not the effluent from SWM facilities. Testing and measurement of the following parameters will be included in the Stage II and Stage III Monitoring Programs:

a) Temperature – maintain or reduce instream surfacewater temperatures in Laurel Creek to protect the cold-water fish species upstream of the reservoir (threshold of 22°C instream temperature from April 1 to October 31 and between 4°C and 14°C from November 1 to March 31).
b) Dissolved Oxygen (DO) – maintain an instream dissolved oxygen level of 6.0 mg/L or greater upstream of the Laurel Creek Reservoir.
c) Phosphorus (TP) – ninety percent (90%) of the phosphorus should be removed from the runoff from developments discharging to Laurel Creek. The target instream phosphorus concentration above the Laurel Creek Reservoir is 0.03 mg/L.
d) TSS – maintain concentration during rainfall events of less than 25 mg/L for the effluent from SWM facilities to Laurel Creek. No instream target was identified within the LCWS.
e) Bacteria (E.coli) – No E. Coli sampling was conducted by the City for their sampling Site at Erbsville Rd. It is noted that the LCWS target for E.coli is based on Provincial Water Quality Guidelines for bathing beaches. The instream target for E.coli is 100 CFU/100 mL for areas contributing to the Laurel Creek Reservoir. Measures to reduce E. Coli contributions are encouraged.

Table 1 summarizes the specific instream targets that apply to this site:

Table 1: Instream Water Quality Targets for Laurel Creek

Parameter	Target
TSS	No instream target (<25 mg/L for SWM facility effluent)
TP	≤0.03 mg/L
DO	≥6.0 mg/L
E.coli	<100 CFU/100 mL
Temperature	≤22°C (Apr-Oct), 4-14°C (Nov-Mar)

4.3 Stormwater Quantity Control

A stormwater management pond is required to control stormwater quantity for 2, 5, 25, and 100-year storm events. To ensure compliance, GAWSER hydrologic modelling was prepared for existing conditions in the Subwatershed Report. This modelling provided the target release rates

for the various storm events ranging from 2 to 100 - Year return periods. The peak flow targets for the development area and any external areas that contribute flow into the stormwater management pond are specified in **Table 2** (peak flow calculations derived from **Table B 4.3**, Page B-38 of the Subwatershed Report). See **Figure 3** for a map of catchment delineation which is based on **Figure B2J0** pg. **B-58**. (Planning Initiatives Ltd., 1996).

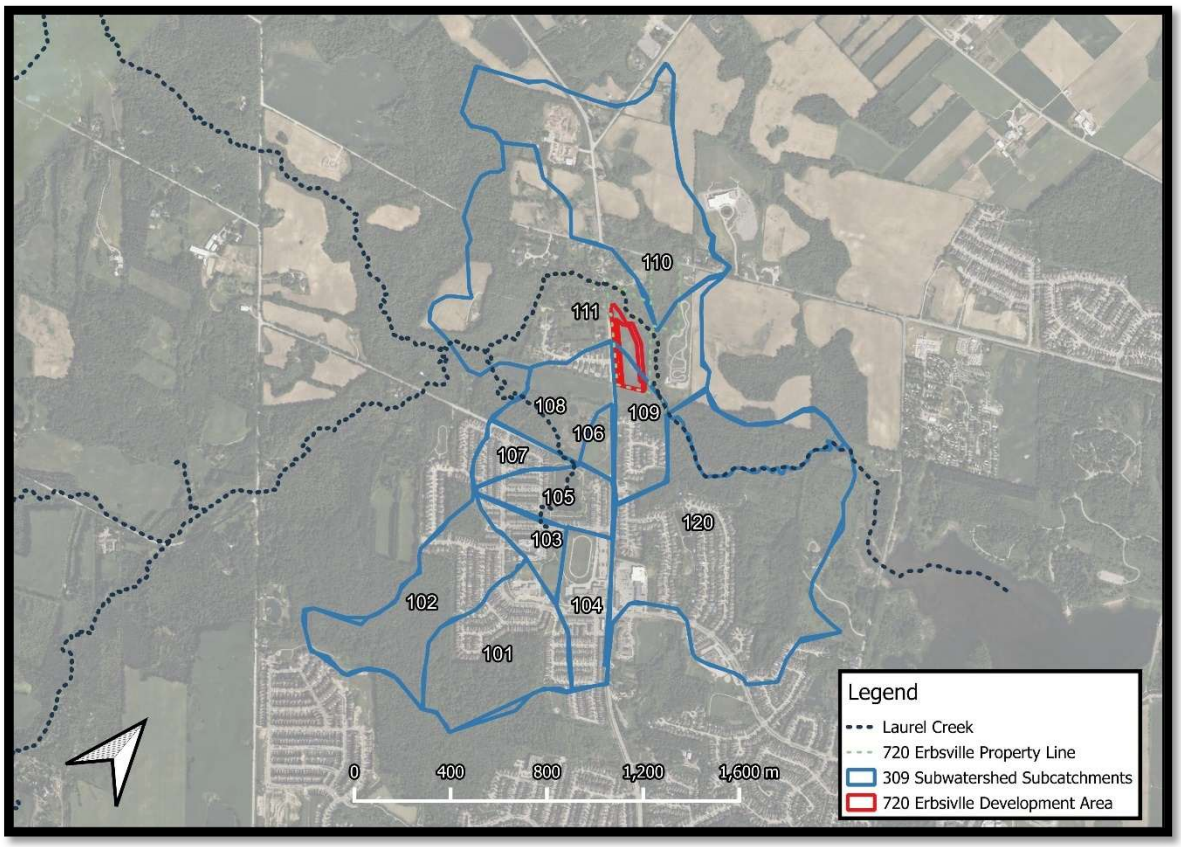


Figure 3: Subwatershed 309 Catchment Delineation (1996 Delineation)

Table 2: Peak Flow Targets

Sub-Catchment No. & Flow Targets	Area (ha)	Return Event			
		2 Year	5 Year	25 Year	100 Year
109	1.14	Southwest Flow			
Target ($m^3/s/ha$)		0.0036	0.0092	0.0290	0.0490
Flow (m^3/s)		0.004	0.010	0.033	0.056
111	1.94	Northwest Flow			
Target ($m^3/s/ha$)		0.0026	0.0045	0.0083	0.0124
Flow (m^3/s)		0.005	0.009	0.016	0.024
Total Area	**3.15**	-			
Peak Flow (m^3/s)	-	**0.009**	**0.019**	**0.049**	**0.080**

The peak discharges from the site during storm events must meet the specified targets in **Table 2**.

4.4 Catchment Delineation & Modelling Inputs

To ensure compliance, stormwater management controls are required. It is proposed to utilize one SWM pond and two infiltration swales to provide these controls. SWM modelling for the proposed development site was performed using the MIDUSS computer program, and the corresponding input and output files are presented in **Appendix B**. See **Appendix A** for the proposed SWM catchment delineation map.

For the modelling of the 2, 5, 25, and 100-year storm events, a 3-hour Chicago style storm based on the City of Waterloo intensity-duration-frequency (IDF) curve was used. **Table 3** summarizes the resulting rainfall depths for each storm event. **Figure 4** is a display of the rain intensity data for 5 min intervals.

Table 3: Rainfall Depths

Return Event	Depth (mm)
2 Year	32.4
5 Year	47.5
25 Year	69.1
100 Year	89.9

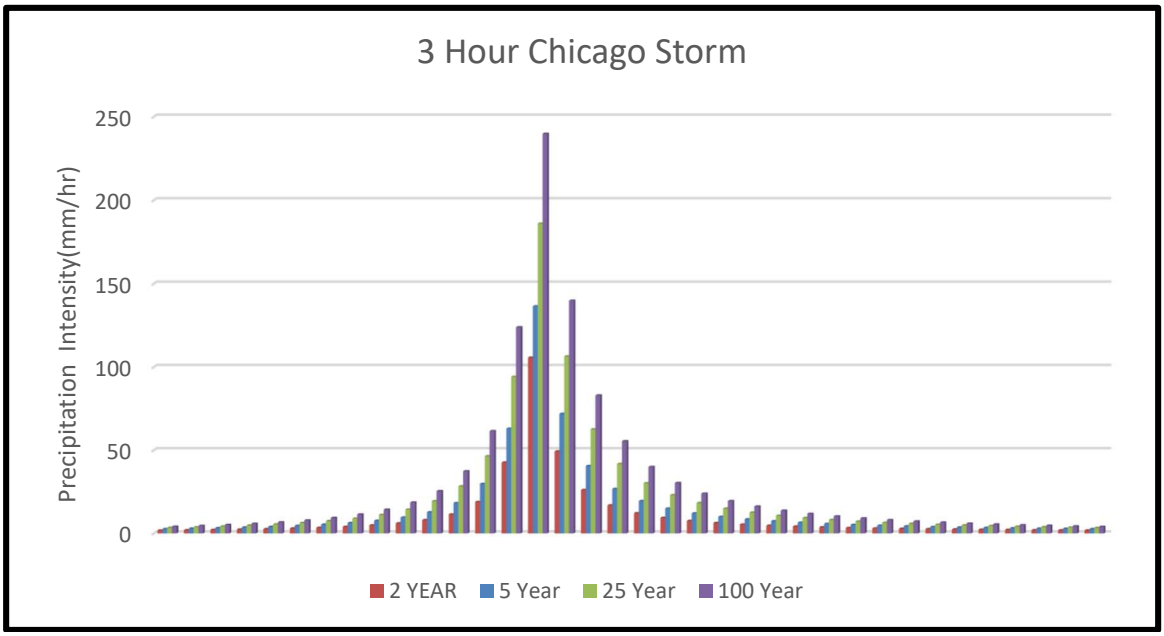


Figure 4: Chicago Storm Five Minute Intensities

Table 4 summarizes the modelling variables based on site-specific information. The following subsections describe each catchment from a SWM perspective:

Catchment A

Catchment A will be directed to a proposed SWM pond to be located in the southeast corner of the Site.

Catchment B
The rear yard areas and rear portions of the rooftops along the eastern development limit are low in elevation and cannot be routed to the SWM pond. As such, this catchment will be routed to an infiltration swale and is assumed to be 50% impervious.

Catchment C
This catchment will drain via catch basin to the SWM pond up to the 5-year storm. Anything greater than the 5-year storm will be directed to Erbsville Road. It is estimated to be 90% impervious.

Catchment D
This is park land that will drain to an infiltration swale along the north boundary. This catchment is assumed to be 25% impervious.

Table 4: MIDUSS Modelling Variables

Description	Area (Ha.)	Overland Slope	% Impervious	Perv. Manning's N	Pervious CN
Developing Lots Draining to Pond: Catchment A	2.38	2%	70	0.250	68
Rear portion of land draining to Infiltration Swale: Catchment B	0.50	2%	50	0.250	68
Catchment C	0.03	2%	90	0.250	68
Catchment D	0.26	2%	25	0.25	68
Total	**3.17**	-	-	-	-

4.5 Storm Water Design
The preliminary engineering drawings (**Appendix A**) provide grading details of the SWM pond and infiltration swales. The pond stage-storage-discharge calculations and MIDUSS modelling can be found in **Appendix B**.

4.5.1 Pond Design
The pond will have a volume of 1974 m^3 with a 75 mm orifice which is a minimum allowable MECP standard (MOE, 2003)) orifice with an invert of 347 m. The overflow weir has a width of 5 m with 3:1 end slopes and an invert of 349.85 m.

The stormwater management pond outlet will discharge runoff towards Laurel Creek via a 200 mm riverstone placed on the outlet bank extending 2 m downstream. The piped outlet will bypass the wetland and outlet directly to the creek. This will minimize the impact on the wetland.

Erosion control measures must be added at the outlet of the pipe by placing riverstone (D50= 200mm) at the outlet of the pipe on the bank of the creek. Minimum disturbance to the wetland is recommended, and caution must be taken.

4.5.2 Extended Detention Erosion Control

In accordance with the Subwatershed Report, the stormwater pond must be capable of retaining the volume of the 100-year storm and gradually discharge it over a period of 48 hours to prevent downstream flooding or erosion.

Given that the facility uses a minimum orifice size of 75 mm due to the size of the contributing sewershed and relatively small quantities of runoff, a full 48-hour detention time is not achieved. A release time of about 32 hrs for the pond is achieved via the 75 mm orifice. Erosion and increased flow peaks will be mitigated because flow targets are met and reduced from 5 through 100-year storm events. Additionally, the flow will not measurably be increased (See **Section 5.4**), so the only erosion protection required is at the outlet of the SWM Pond Pipe in the creek.

4.5.3 Infiltration Swale Design

The rear yard areas that drain east towards Laurel Creek (i.e., Catchment B) are too low to drain into the proposed stormwater management ponds. These areas will mainly consist of landscaped areas and rear portions of roofs (the front rooftops and asphalt areas will be channeled towards the proposed sewer system). It was determined that an infiltration swale of 460m^3 would be required. Additionally, a second smaller swale will be positioned in Catchment D on the edge of the park land (north). This second swale with a volume of 120m^3 will be sufficient (See **Appendix A**).

4.6 SWM Modelling Results

The pond volume and outlet control required to reduce the post-development flows and ensure compliance with the prescribed targets were determined using the MIDUSS software. Total discharges from the site are presented in **Table 5**, which indicates that the proposed peak discharges have been effectively controlled and remain below the target levels. **Table 6** shows the volume requirement of the stormwater management pond for all storm events. It Is noted that the 2-year discharge slightly exceeds the target by 2 L/s (0.002 m^3/s) this accounts for 1.5% of the average baseflow of Laurel Creek (based on GRCA gauge data). As a result, it is expected that this will not have any significant negative impact for the 2-year storm and allows for extended detention while having minimum orifice size.

Table 5: Peak Discharges

Return Event	Existing Conditions Targets (m^3/s)	Proposed Conditions Prior to Pond Routing and Swale (m^3/s)	Proposed Conditions After Pond Routing (m^3/s)
2 Year	0.009	0.056	0.011
5 Year	0.019	0.078	0.013
25 Year	0.049	0.115	0.015
100 Year	0.080	0.155	0.017

Table 6: Storage Characteristics of Stormwater Management Pond

Return Event	Pond Storage Volume (m^3)	Storage Water Level Elevation (m.a.s.l)
2 Year	373	348.579
5 Year	624	348.903
25 Year	1029	349.309
100 Year	1435	349.637

5.0 WATER BUDGET

The MOE 2003 guidelines state that developers are to mitigate the effects of decreased infiltration. A monthly water budget was calculated based on pre-development and post-development conditions.

A monthly water budget was created using weather data from Environment and Climate Change Canada weather station *Waterloo Wellington A (Automated)*. The inputted data was average temperature and precipitation from Canadian Climate Normals 1991-2020 data. Waterloo Fine Sandy Loam was determined to be the average soil type for the property using Ontario Soil Survey Complex and confirmed with CVD 2023 boreholes (CVD Eng. LTD., 2024) . Moderate rooted crops atop fine sandy loam (150mm water holding capacity) was considered the soil type for existing conditions (MOE, 2003, pp. 3-4). For post-development conditions, the same fine sandy loam (150 mm water holding capacity) was chosen as an approximate average to account for added topsoil (which would have higher holding capacity than existing conditions) and some compaction from development (which would have lower holding capacity than existing conditions). The assumption of the post-development soil maintaining the same water holding capacity is likely to have minimal affect on the catchment scale. It is inconsequential to make this assumption compared to selecting different soil conditions across the model (pre and post) given the simplistic state of the model (constant soil across catchments).

As such, existing flow patterns are to be mimicked while it is understood and expected that flow patterns from the site development are expected to change due to the urbanization of the catchments.

The following presents the site water budget, recognizing that the water budget consists of precipitation (as well as supporting parameters such as temperature) as input and infiltration, evapo-transpiration, and runoff as outputs. Runoff is further characterized as runoff to the existing adjacent wetlands and runoff that goes directly to the creek.

5.1.1 Input Parameters

Input parameters were based on standard procedures for Thornthwaite-Mather Monthly Water Balance and the MOE 2003 manual. Average monthly temperature and precipitation were obtained from the Waterloo Wellington Weather Station (See **Table 7**), which is located about 3.5 kilometres east of the site. This close proximity ensures values are representative of site conditions.

Table 7: Model Inputs

Parameter	Value Used
Topography	Rolling Land (0.2 MOE factor)
Soil	Open Sandy Loam (0.4 MOE factor)
Cover	Cultivated (0.1 MOE factor)
Infiltration factor (sum of topography, soil, & cover)	60% infiltration
Soil Moisture - Storage Capacity	150mm
Latitude	43º
Temperature	Climate Normal Monthly Avg.
Precipitation	Climate Normal Monthly Avg.

5.1.2 Model Assumptions

It is assumed that 10% of impervious runoff is evaporated. Additionally, it is assumed that there is no infiltration in winter months. The snow storage is accumulated throughout the winter and then begins to be released when temperatures are above 0ºC. Initially 10% of snow is released in the first warm month and 50% of remaining snow each month after. It is assumed that the soil is saturated in January and again in December according to standard Thornthwaite-Mather Modelling.

5.2 Mitigation of Reduced Infiltration

It is important to maintain infiltration rates. So, an infiltration swale is proposed along the east side of the property (catchment B) (see **Appendix B**). This swale is sized at 460 m^3. All water in the catchment will runoff into the infiltration swale (including the roofs in this catchment area). Another infiltration swale is proposed along the north side of the park land (catchment D) This swale is sized at 120 m^3.

Additionally, 95% of the runoff from the rooftops will be diverted to infiltration galleries. For SWM calculations, infiltration galleries are ignored. But, for water balance; the infiltration gallery sizing of 95% accounts for approximately 25 mm of all rainfall (TRCA Rainfall Depth vs Rainfall Amounts in **Figure 5**). There is 5,713 m^2 of roof top area contributing to the infiltration galleries. The infiltration galleries should be sized to a minimum of 143 m^3 to accommodate rainfall depths up to 25 mm.

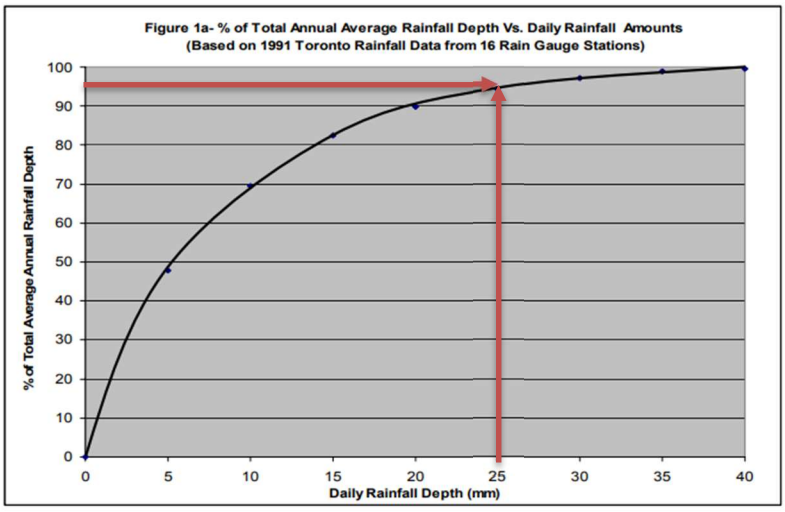


Figure 5: TRCA Annual Average Rainfall Depth vs. Daily Rainfall Amounts

5.3 Model Results

Table 8 details the annual water balance volumes (m^3) and depths [mm] based on the Thornthwaite-Mather monthly water balance calculation.

For existing conditions, site runoff flows overland through a small strip of wetland into the creek. Based, on site visits, known grading of the farm field and the model, it can be concluded that there is minimal runoff for existing conditions. The primary source of surface water to the wetland is from Laurel Creek during overbank flow conditions where the stream will inundate the wetland as well as ground water inputs.

Under proposed conditions, and to meet SWM targets, surficial catchment runoff is directed to the SWM Pond which ultimately outlets to the creek. As a result, there will be minimal overland runoff to the wetland. The wetland will still receive some overland flow from limited pervious rear yard areas and direct precipitation over the wetland catchment as well as indirect contributions due to infiltration from the proposed adjacent swales and site infiltration. Therefore, the wetlands will receive minimal runoff from the site under proposed conditions and the primary source of water will continue to be Laurel Creek itself.

The impact of development on the wetland is therefore negligible. It has been shown that there is minimal runoff under existing conditions and runoff will bypass the wetland and flow directly to Laurel Creek under proposed conditions. We can conclude that post-development flow patterns remain similar to that of existing conditions, including any runoff to the existing wetland. We note that Table 8 summarizes runoff characteristics, and any runoff noted in this table is actually 'runoff to the creek' and not the wetland. See Section 5.4.1 for a further discussion of water budget impacts in light of watershed-level contributions.

Post mitigation, there will be an increase of infiltration from existing conditions by 38%. This will impact the groundwater levels in minimal way. Some impacts from the need for mitigation include increased development costs of including infiltration galleries and reduced utilizable footprint of backyards due to infiltration swales.

Table 8: Model Results **AET= Precipitation - Runoff - Infiltration*

Parameter	Pre-Development	Post Development (no mitigation)	Post Development (with mitigation)
Precipitation [mm]	916	916	916
Precipitation (m^3)	29,015	29,015	29,015
Recharge to Creek			
Volume (m^3)	7,144	3,326	9,952
Depth [mm]	226	105	314
Change From Existing (m^3)	0	-3,818	2,808
Change From Existing (mm)	0	-121	89
% Difference	0	-53%	39%
Actual ET from the site			
Volume (m^3)	17,108	8,567	9,580
Depth (mm)	540	270	302
Change From Existing (m^3)	0	8,540	7,528
Change From Existing (mm)	0	270	238
% Difference	0	50%	44%

Runoff to Creek			
Volume (m^3)	4763	17,121	9,483
Depth (mm)	150	541	299
Change From Existing (m^3)	0	12,358	4,720
Change From Existing (mm)	0	390	149
% Difference	0	259%	99%
Summation of Recharge and Runoff to Creek			
Volume (m^3)	11,907	20,448	19,435
Depth (mm)	376	646	614
Change From Existing (m^3)	0	15,685	7,528
Change From Existing (mm)	0	495	238
% Difference	0	329%	63%

For a detailed summary of modelling results, please refer to **Appendix D**.

5.4 Water Quantity

5.4.1 Laurel Creek Impact

The upstream Laurel Creek catchment area is 1,841 ha, whereas the development area is only 3.16 ha. The development site accounts for 0.17% of the Laurel Creek catchment area. See **Figure 6** (Catchment Developed in HEC-HMS 2024). Therefore, if the development site sees a 63% increase of combined runoff and recharge, then it is estimated to account for less than 0.06% increase in discharge of Laurel Creek. It is estimated the post construction, there will be an increase of 0.0008 m^3/s of flow based on (2014-2024) gauge data.

This value is insignificant since using the typical Acoustic Doppler Velocimeter to measure streamflow would report a value to 3 decimal places, less than would be required to identify this difference. Water Survey Canada has a standard tolerance of +/-5% for streamflow discharge measurements (Water Survey of Canada, 2016). The average recorded GRCA flow in the creek is 0.49m^3/s and the minimum is 0.074 m^3/s. The 5% tolerance of these values are 0.024 and 0.003m^3/s respectively. Therefore, an additional 0.0008m^3/s of flow within the creek does not even represent the acceptable data noise in the creek meaning flow measurements upstream and downstream of the site on average throughout the year would show no difference.

As a result, if the post development is not changing the flow to Laurel Creek, it will not increase the water level of the creek. If the creek water level is not increased, then the surrounding groundwater level will not be influenced. If the groundwater level does not change, then we can conclude that the adjacent wetland will not be affected in terms of level or flow patterns.

See **Appendix D** for estimated monthly discharge rates to Laurel Creek.

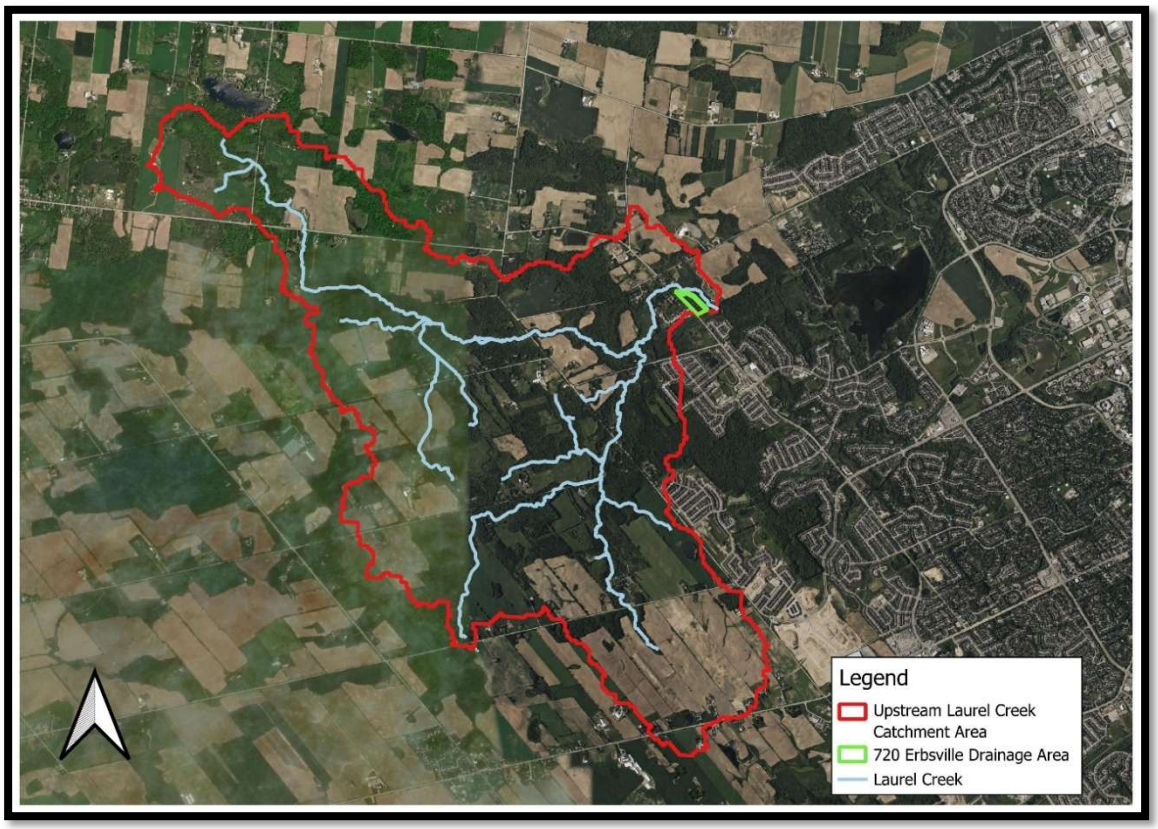


Figure 6: Upstream Catchment Area, Laurel Creek (HEC-HMS Delineation 2024)

6.0 STORMWATER QUALITY CONTROL

6.1 LCWS Water Quality Parameters

6.1.1 Total Suspended Solids (TSS):

Concentrations of TSS collected in Laurel Creek by the City of Waterloo in 2021 ranged from 3 mg/L to 54 mg/L with only the March 11, 2021 and June 26, 2021 samples marginally above the LCWS target. As well, pre-development monitoring for the site conducted from 2014-2022, and in 2024, has shown that TSS concentrations at the City's Station 20 site have been consistently low, as from 2006 to 2020 only 5.2% of TSS samples exceeded the 25 mg/L target. As such, recent TSS results are consistent with historic data and can be representative of future patterns if development adheres to the stated criteria.

The Subwatershed Report requires that a water quality facility be provided to control the first 25 mm of runoff if it is not infiltrated. Based on an Enhanced Protection Level for the downstream receiver, stormwater quality control must be provided to achieve 80 percent Total Suspended Solids (TSS) removal efficiency for 90 percent of annual flows (MOE, 2003). Given the small area of the development (3.1 ha), Oil Grit Separators (OGS) are proposed to provide treatment of the runoff. Additionally, sedimentation in the pond resulting from extended detention will provide the required Enhanced Protection Level.

The units should be inspected and cleaned regularly (typically once every 6 to 12 months) as per the manufacturer's specifications. OGS units are typically credited for a 50 percent TSS removal, therefore the remaining 30 percent TSS removal will be provided by the extended detention of the stormwater management pond. Based on the MOE 2003 guidelines, dry ponds with extended

detention can provide a TSS removal of 60 percent. Therefore, the total TSS removal for the site treatment-train is 50 percent for the OGS, and (0.50 X 60% = 30%) for the pond for a total of 80 percent. It is recommended to have two *Stormceptor EFO4* OGS units in parallel for the inlet of the pond. Each unit provides estimated 44% TSS removal. As a result, this will be a conservative design providing adequate water quality control.

Given the low detention time and limited outlet capacity there are concerns as to the effectiveness of the SWM pond on controlling TSS and Chloride loading during spring melt events. As a result, it is recommended to implement a salt management plan for 720 Erbsville.

6.1.2 Dissolved Oxygen (DO):

The site's pre-construction monitoring found DO concentrations ranged between 2.73 mg/L and 13.58 mg/L. Four of the eleven samples taken in 2021 were below the minimum target of 6.0 mg/L. Since approximately 28% of samples have historically not met the LCWS target, future monitoring will likely also have results where targets are not met. The occurrence and frequency of such shortcomings will be examined through future monitoring and compared to these historical observations.

6.1.3 Total Phosphorus (TP):

TP results historically fail to meet the target and only a single 2021 sample met the LCWS target of 0.03 mg/L. The TP concentrations ranged from 0.014 mg/L to 0.094 mg/L with an average concentration of 0.037 mg/L. The highest TP concentrations are in the spring, concurrent with spring melt. Stantec has suggested that exceedances may be a result of upstream agricultural practices.

From a practical perspective, Phosphorus is largely linked to sediment and the reduction of sediment in the SWM runoff will limit TP delivery to the creek. Urban land practices are also likely to reduce TP loadings.

6.1.4 E. Coli:

The City does not measure samples for *E.coli* concentrations. The proposed design will minimize the direct transmission of contaminated runoff to Laurel Creek but no future E. Coli monitoring will be conducted.

6.2 Mitigation of Water Temperature Increase

Surfacewater temperature monitoring results, as conducted by the City of Waterloo and reported by Stantec, show that the temperature ranges from 1 to 21.3°C during the year with no exceedances of the LCWS targets noted. Higher temperatures are noted in the summer months and the data is consistent with historical data trends reported by the City of Waterloo. As such, it is important to maintain these conditions.

Water temperature is assumed to increase because of development (MOE 2003). The subwatershed plan provides water temperature targets for Laurel Creek as follows:

- <22ºC from April 1 to October 31; and
- 4ºC to 14ºC From November 1 to March 31

A mass balance surface temperature-volume calculation was used to estimate the approximate change in surfacewater temperature.

Based on Stantec's sampled water temperature from 2021, and Environment and Climate Change's Kitchener/Waterloo weather station, a relationship of air temperature to water temperature of Laurel Creek was derived (See **Table 9**).

Table 9: Relationship of Air Temperature to Water Temperature of Laurel Creek

Date	Recorded Surface Temp of Laurel Creek* (ºC)	ECCC Kitchener/Waterloo Temperature (ºC)	Difference Between Mean (Daily) Air Temp and Water Sampled Instantaneous) Temp (ºC)	Absolute Value Difference Between Mean (Daily) Air Temp and Water Sampled Instantaneous) Temp ºC)	Precipitation (mm)
2021-03-11	1.0	0.8	-0.2	0.2	0.0
2021-05-05	5.0	5.8	0.8	0.8	0.0
2021-05-19	18.5	16.7	-1.8	1.8	0.0
2021-05-28	8.7	5.2	-3.5	3.5	17.8
2021-06-03	15.9	19.2	3.3	3.3	1.2
2021-06-21	18.7	17.8	-0.9	0.9	0.0
2021-06-26	18.1	22.7	4.6	4.6	0.0
2021-07-07	20.6	19.6	-1.0	1.0	3.3
2021-07-26	21.3	20.7	-0.6	0.6	0.0
2021-08-04	17.7	18.4	0.7	0.7	0.0
2021-08-17	18.6	21.7	3.1	3.1	0.0
Average	**14.92**	**15.33**	**0.41**	***1.86***	**2.03**

*Based on Stantec Monitoring Data

It was concluded that Laurel Creek water temperature is generally within +/- 1.86ºC of the air temperature. A range of +/-1.86ºC is used in the relationship between air temperature and water temperature as it is not usually an independently related relationship (dependent on upstream inputs, solar radiation, and precipitation). It is estimated pre-development water temperature of Laurel Creek would be below the targets. Throughout the report water temperature estimates of Laurel Creek will be referred to as Laurel Creek Water Temperature (+1.86ºC)/ Laurel Creek Water Temperature (-1.86ºC). During winter months when the average air temperature was below 0ºC Laurel Creek was estimated to be 0ºC.

From **Table 10** it is noted that June, July, and August are the most susceptible to breaching the targets, being within 2.54ºC of the target. To estimate the temperature effect of development, Water's Edge considered the All-Weather Ground Surface Temperature Model (Herb, 2006)and shifted the surface temperatures linearly based on the difference in each month's air temperature from the Department of Natural Resources, MN to Waterloo Average temperatures. This adjustment yielded the surface temperature estimates in **Table 11**. The model considered months from April to September which are the ones most affecting runoff. Based on the monthly air temperature in months October to March, the surface temperature of Laurel Creek would be below the targets and therefore will not be modelled.

From **Table 11** a weighted temperature volume balance could be calculated based on monthly flows from the monthly water balance. **Figure 7** identifies the influence of runoff on meeting the targets for surfacewater temperature. It is assumed that the runoff will be at the same temperature as the surficial material that receives precipitation.

Table 10: Surface Temperature Estimates and Targets

	Parameter	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A	Climate normal Air Temp (ºC)	-6.5	-5.5	-1	6.2	12.5	17.6	20	18.9	14.5	8.2	2.5	-3.3
B	Laurel Creek Max Temp Target (ºC)	14	14	14	22	22	22	22	22	22	22	14	14
C	Estimated Laurel Creek water temp (+ 1.8ºC from air temp)	0	0	0.9	8.1	14.4	19.5	21.9	20.8	16.4	10.1	4.4	0
D	Exceedance from Target (C-B)	-14	-14	-13.1	-13.9	-7.6	-2.5	-0.1	-1.2	-5.6	-11.9	-9.6	-14
E	Estimated Laurel Creek Surface temp (Water temp - 1.8ºC from air temp)	0	0	0	4.3	10.6	15.7	18.1	17.0	12.6	6.3	0.6	0
F	Exceedance from Target (E-B)	-14	-14	-14	-17.7	-11.4	-6.3	-3.9	-5.0	-9.4	-15.7	-13.4	-14

Table 11: Estimate of Surface Temperatures

All Temps in (ºC)	Apr.	May	Jun.	July	Aug.	Sep.
Waterloo Climate Normal Temp	6.2	12.5	17.6	20	18.9	14.5
Adjustments From St. Paul MN to Waterloo, ON	-3.7	-1.2	-1.0	-2.3	-0.2	-5.2
Asphalt	13.9	20.5	27.8	30.3	27.1	20.5
Res. Roof	8.8	15.5	22.6	24.8	21.6	15.1
Pond	7.5	13.9	20.2	22.9	21.2	13.7
Sod	5.3	12.1	17.1	19.2	19.0	11.1
Corn	6.5	13.3	18.0	18.9	18.0	11.5

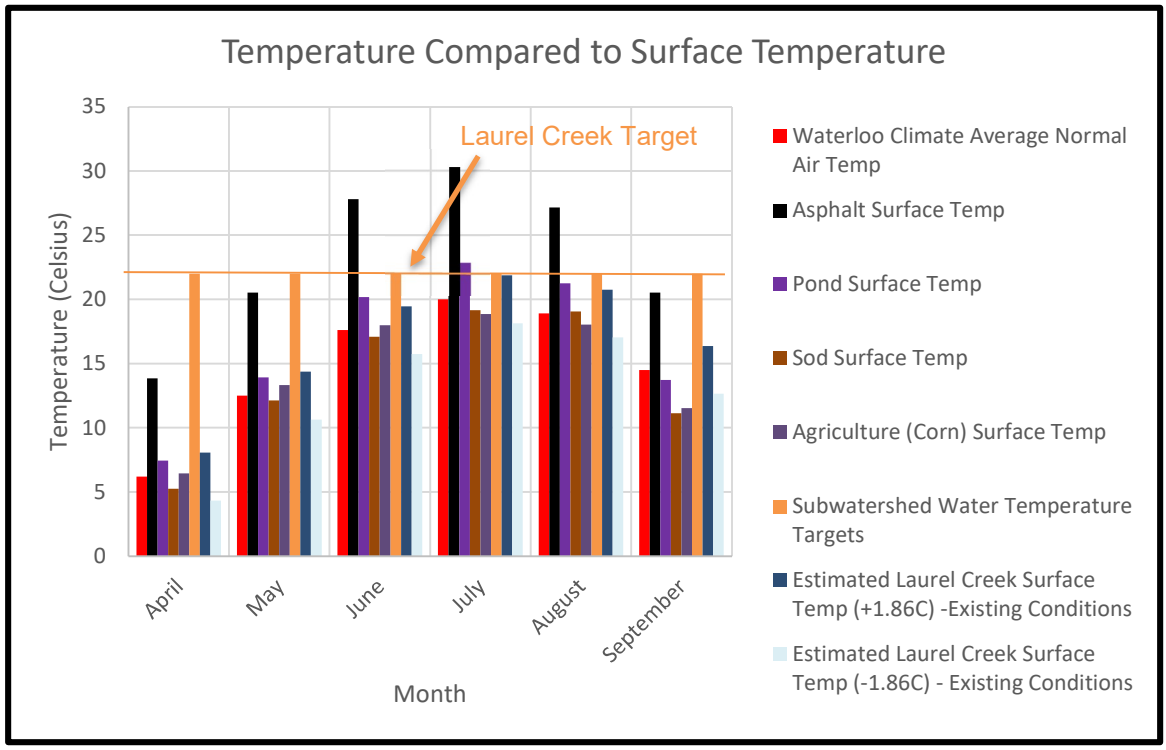


Figure 7: Air Temperature Compared to Surface Temperature Targets and Estimates

A summary of **Figure 7** is discussed as follows:

Non-Growing Season Months (October - March): Surface temperatures were not studied; however, the estimated water temperature difference was the greatest from the targets in these months and the flows are lower.

April: Every surface temperature is below the target in April. This represents the largest gap between target and creek temperature. Asphalt runoff will increase temperature compared to creek temperatures. All other surface temperatures are within the range of the estimated predevelopment Laurel Creek temperature.

May: Asphalt runoff will increase temperature compared to creek temperatures. Asphalt surface temperature is close to subwatershed target. All other surface temperatures are within the range of the estimated predevelopment Laurel Creek temperature.

June: Asphalt runoff is higher than subwatershed targets. All other ones are close to targets. Estimated Laurel Creek still has a few degrees buffer in temperature compared to target. All other surface temperatures are within the range of the estimated pre-development Laurel Creek temperature.

July: This month's estimated Laurel Creek temperature is close to the target. Asphalt and Ponds are higher than the target. All other surface temperatures are within the range of the estimated pre-development Laurel Creek temperature.

August: This month's estimated Laurel Creek temperature has cooled and is further from the target. Asphalt temperatures are higher than the target. All other surface temperatures are within the range of the estimated pre-development Laurel Creek temperature.

September: Every land cover surface temperature is below the targets. The estimated Laurel Creek temperature is far below the target.

June, July, and August are most likely to raise the temperature of Laurel Creek as surface temperatures during these months are sufficiently higher. According to **Figure 5,** this accounts for 95% of the flow. It is assumed that the temperature of this flow will be cooled to 8ºC by the utility pipes and the pipe outletting to the creek. This value approximates the ambient ground temperature (surrounding the pipes). It is assumed that the remaining 5% will be at the estimated temperature of the surficial material (**Table 11**).

The weighted temperature balance was derived from volumes of runoff from the monthly water balance model. It is assumed that recharge will not warm the creek because it is mixed with groundwater. From this assumption of cooling, April, August, and September will have higher temperatures and flows than pre-development.

6.3 Temperature Mitigation

The following additional strategies will be used to mitigate the impacts of development on water temperature:

- Utilizing pipes to convey storm water through the development to the SWM pond, as well as a pipe to convey the pond's discharge to the creek, will cool the storm water.
- Utilizing infiltration swales at the rear property to promote surfacewater to mix with groundwater and cool runoff (not accounted for in runoff balance).

It can be concluded that in the months of October - March, the target will not be breached because the creek temperature is far below 14ºC. June, July, and August in the summer months are the most sensitive months and closest to the targets. It is estimated that the pond outlet will only be warmer than Laurel Creek during April, August, and September, however the flow will be minimal and not have an impact on temperature given the aforementioned mitigation measures.

6.4 Temperature Summary

Using the weighted temperature (T) – volume (V) balance it is possible to estimate the temperature of the creek using the following equation:

$$\bar{T}_{Laurel\ Creek\ Post\ Development} = \frac{\left[V_{Laurel\ Creek\ Pre\ Development} \times \bar{T}_{Laurel\ Creek}\right] + \left[V_{Post\ Development\ Runnoff} \times T_{Temperature\ of\ 720\ Erbsville\ Runoff}\right]}{V_{Laurel\ Creek\ Pre\ Development} + V_{Post\ Development\ Runnoff}}$$

Estimated temperatures of Laurel Creek are shown in **Table 12** and shows that development will have negligible on the creek temperatures with or without cooling assumptions.

Table 12: Laurel Creek Water Temperatures (in degrees Celsius)

	April	May	June	July	August	September
Pre-Development (Max water temp +1.86°C)	8.1	14.4	19.5	21.9	20.8	16.4
Post Development Without Cooling (Max water Temp of Laurel Creek)	8.1	14.4	19.5	21.9	20.8	16.4
Post Development with Cooling (Max water Temp of Laurel Creek)	8.1	14.4	19.4	21.8	20.7	16.4
Pre-Development (Min water temp - 1.86°C)	4.3	10.6	15.7	18.1	17	12.6
Post Development Without Cooling (Min Water Temp of Laurel Creek)	4.3	10.6	15.7	18.1	17.0	12.6
Post Development with Cooling (Min Water Temp of Laurel Creek)	4.3	10.6	15.6	18.0	16.9	12.6

Note: Unshaded is maximum Laurel Creek Temperature and shaded is minimum Laurel Creek Temperature.

As discussed in **Section 5.4.1**, the development will contribute to an average of 0.06% more runoff to Laurel Creek. Thus, it can be concluded that there will be no noticeable temperature increase caused by development.

7.0 MONITORING

A monitoring program is to be designed and implemented by the developer. The plan will serve to ensure that the mitigation measures proposed within the development are incorporated and performing at an acceptable level and will also help to communicate performance and understand potential impacts.

Based on the framework provided in the LCWS, the City of Waterloo has implemented the following monitoring strategy:

1) ***System (watershed wide) Monitoring*** – undertaken by the City

2) ***Development / During Construction Monitoring*** – The developer is responsible for monitoring during the development process and includes 3 stages;

   a) Pre-Construction Monitoring

   b) During-Construction Monitoring

   c) Post-Construction Monitoring

3) ***Post Development Monitoring*** – the City is responsible for monitoring facilities following municipal assumption.

7.1 Pre-Construction Monitoring Program

With reference to the North Waterloo Scoped Subwatershed Study (2013), the pre-construction monitoring program consists of stream temperature monitoring, water quality sampling (surface), groundwater level monitoring, and streamflow rate monitoring (via GRCA Laurel Creek gauge). This stage of the monitoring program has been completed by Stantec with annual monitoring reports prepared for 2014 to 2022. Water's Edge has since assumed monitoring for 2024 ongoing.

1) **Groundwater** – monitoring currently includes levels.

2) **Streamflow Monitoring -** Water's Edge is monitoring streamflow upstream of the site via GRCA Laurel Creek gauge to ensure there is no significant changes to the flows that would affect the assumptions used in the design.

3) **Water Quality Monitoring** As of 2023, Water's Edge has expanded on Stantec's surfacewater quality monitoring location on Laurel Creek downstream of the proposed SWM outlet. At this location in-situ water quality measurements for temperature, pH, and DO are sampled. Additionally, there is one water quality gauge upstream of Erbsville Road. There are five temperature loggers (u/s and d/s) in the monitoring program that will be able to detect spatial variations in the stream network. TDS and phosphorus are currently being sampled.

7.2 During-Construction Monitoring Program

This stage will begin at the commencement of area grading of the subdivision and will continue until 90% stabilization of the SWM Facility contributing catchment area is achieved (buildings are constructed, lots are sodded). Monitoring will include:

4) **Stormwater Management Facility** - Standard inspection of vegetation, structures, and general operation of hydraulic controls (observations of drawdown) within the Stormwater Management Facility. These inspections are to occur seasonally and typically after a significant rainfall event. Pressure transducers will be installed in each facility to monitor water levels and drawdown.

5) **Erosion and Sediment Control** – per ESC Plans.

6) **Groundwater** – monitoring will include ground water levels.

7) **Streamflow Monitoring** – See section 5.4.1 Completing streamflow measurements u/s and d/s, during construction would not pick up any changes as the runoff from the SWM Pond would be too small to measure. Water's Edge is monitoring streamflow upstream of the site via GRCA Laurel Creek gauge to ensure there is no significant changes to the flows that would affect the assumptions used in the design.

8) **Water Quality Monitoring** Water's Edge will continue with the pre-construction water quality monitoring with the addition of water quality monitoring u/s and d/s the pond outlet.

7.3 Post-Construction Monitoring Program

This period of the monitoring will begin following full build-out of the subdivision (i.e. houses are constructed, lots are sodded, open spaces are stabilized) for a duration of 2 years. The purpose of this stage of the monitoring is to ensure that the SWM Facility continues to operate as designed and that the groundwater elevations within the site are within acceptable levels of what was predicted. Monitoring during this stage will include:

1) **Stormwater Management Facility** - Standard inspection of vegetation, structures, and general operation of hydraulic controls (observations of drawdown) within the Stormwater Management Facility. These inspections are to occur seasonally and typically after a significant rainfall event. Pressure transducers will be installed in each facility to monitor water levels and drawdown.

2) **Groundwater** – monitoring will include ground water levels.

3) **Streamflow Monitoring** – See section 5.4.1 Completing streamflow measurements u/s and d/s, post construction would not pick up any changes as the runoff from the SWM Pond would be too small to measure. Water's Edge is monitoring streamflow upstream the site

via GRCA Laurel Creek gauge to ensure there is no significant changes to the flows that would affect the assumptions used in the design.

9) **Water Quality Monitoring** Water's Edge will continue with the pre-construction water quality monitoring plan post construction with the addition of continued water quality monitoring u/s and d/s the pond outlet.

8.0 SUMMARY

Based on design and modelling, the following is concluded:

1. One proposed stormwater management pond and and two infiltration swales will provide stormwater quantity and erosion control for the developing area.

2. OGS units at the inlet of the stormwater management pond in conjunction with the stormwater management pond itself will provide a treatment-train for stormwater quality control to provide 80 percent TSS removal.

3. Water temperature, erosion crontrol, and infiltration have all all been considered when analysing the effects of development on stormwater and the proposed development's design has implemented measures to manage the effects.

4. Infiltration galleries directing 95% of roof runoff (up to 25 mm per event) will be installed to mitigate impacts of increased imperviousness.
5. The development of 720 Erbsville will require thorough monitoring of a site specific watershed. This will allow stakeholders to make informed decisions in the future and track the impacts of climate change on Laurel Creek. This will help protect any negative consequences as there is a benchmark of existing water quality/quanitiy and any major changes will be noted.

6. Based on the watershed characteristics and local hydrology, and the proposed storm water controls to be implemented, it is our professional opinion that the development site will have negligible impact on the watershed wide water balance; **hence a watershed wide water balance is not warranted**.

7. Based on site observations and our water budget analyses, the existing runoff conditions to the wetland will closely match the proposed runoff conditions to the wetland and we conclude that there will be no negative impact on the wetland.

8. Infiltration to ground water will increase post development by 39%.which will impact the water table in a minimal way.

Respectfully submitted,





Ed Gazendam, Ph.D., P.Eng.,
President, Sr.Water Resources Engineer

Tim Antonio, B.A.Sc., P.Eng.
Water Resources Engineer

Water's Edge Environmental Solutions Team Ltd.

Attachments:

Appendix A: Catchment Area Drawings
Appendix B: Modelling Outputs
Appendix C: OGS Sizing Report and Specifications.
Appendix D: Water Balance Summary

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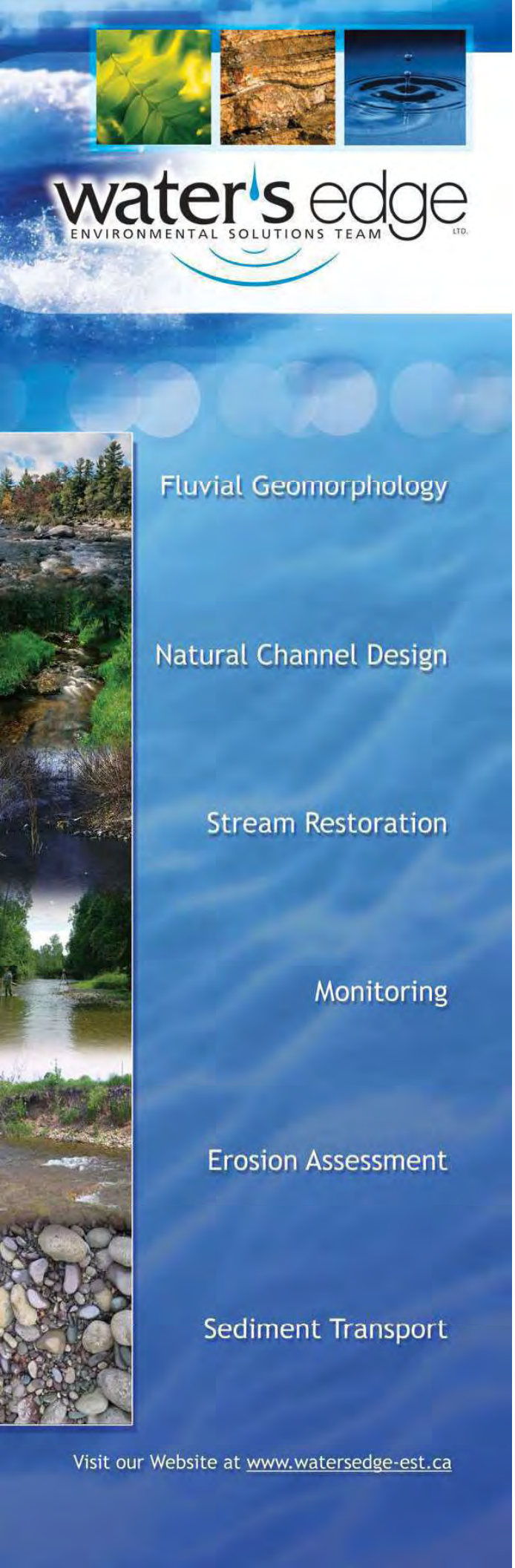
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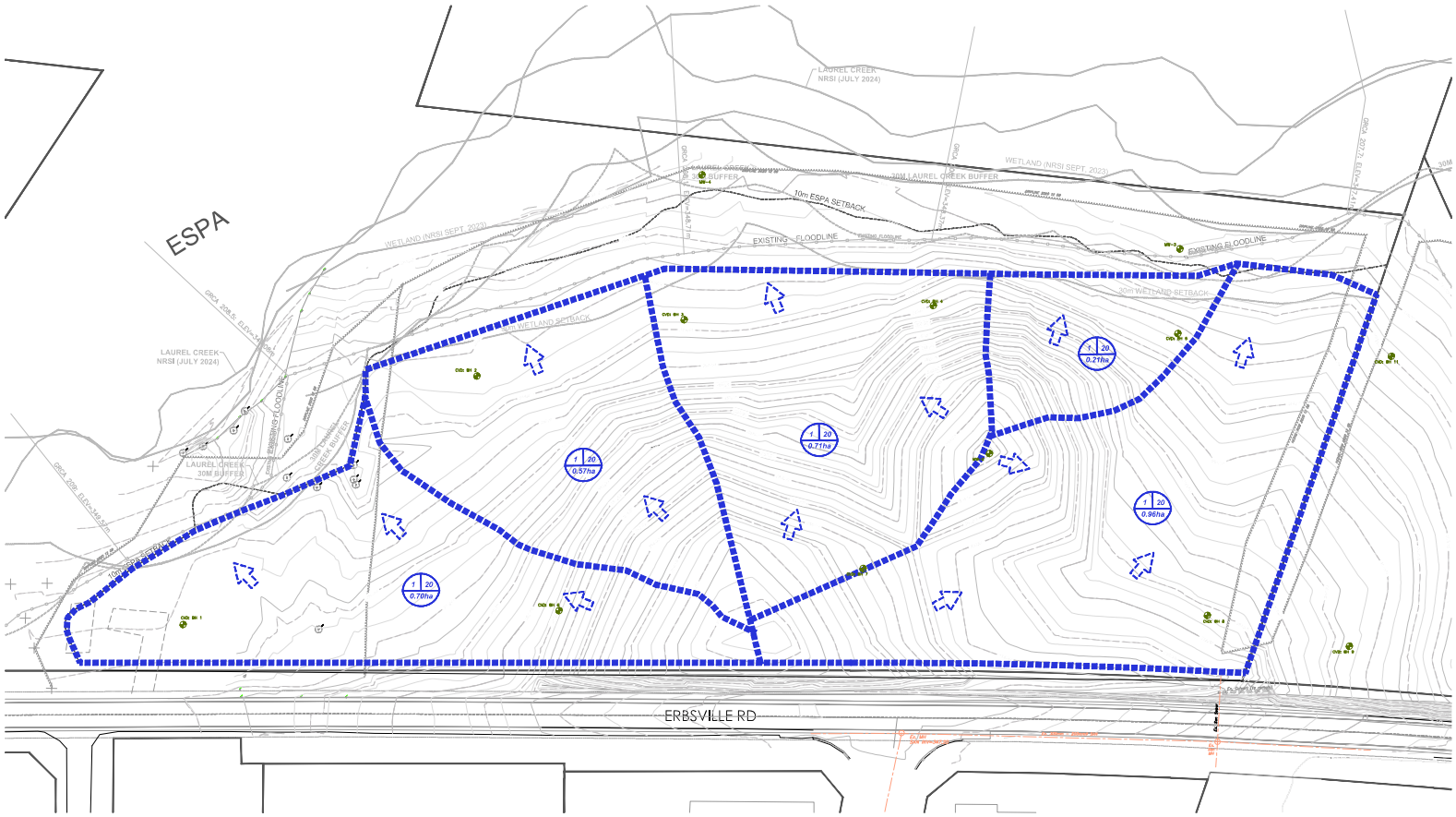
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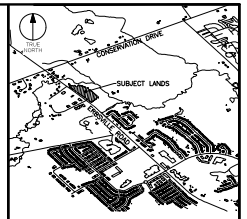
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APPENDIX A:

Catchment Area Drawings





KEY PLAN N.T.S.

GENERAL NOTES & DISCLAIMER:

1. UNTIL APPROVED BY THE MUNICIPALITY, THIS PLAN IS NOT FOR CONSTRUCTION.
2. THIS IS NOT A LEGAL PLAN OF SURVEY.
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4. JPE SHOULD BE SHALL BE NOTIFIED IMMEDIATELY OF ANY VARIATIONS OF EXISTING CONDITIONS SHOWN ON THIS PLAN.
5. WRITTEN DIMENSIONS SHALL HAVE PRECEDENCE OVER SCALED DIMENSIONS.
6. DISTANCES HEREON ARE IN METRES, TO CONVERT TO FEET DIVIDE BY 3.048.
7. THE POSITION OF EXISTING BUILDINGS, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERHEAD UTILITIES AND STRUCTURES IS NOT NECESSARILY COMPLETE OR ACCURATE AND THEIR EXISTENCE IS NOT GUARANTEED. THE INFORMATION IS NOT GUARANTEED AND ARE STARTING WORK. THE CONTRACTOR SHALL OBTAIN LOCATES AND UNDERTAKE THEIR OWN INVESTIGATION OF THE EXACT LOCATION OF ALL UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR ANY CONFLICTS OR DAMAGE TO THEM.

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FINAL DESIGN TO IDENTIFY PIPE SIZES, INVERTS, SERVICE LOCATIONS, CONSTRUCTION DETAILS, NOTES ETC.

TOPO SURVEY AND EXISTING SERVICING LOCATIONS WERE DERIVED FROM DRAWINGS PREPARED BY IBI GROUP.

REV#	BY:	DESCRIPTION:	DATE
1	JPE	2ND SUBMISSION (NORTH SWM POND REMOVED)	2025.02.25

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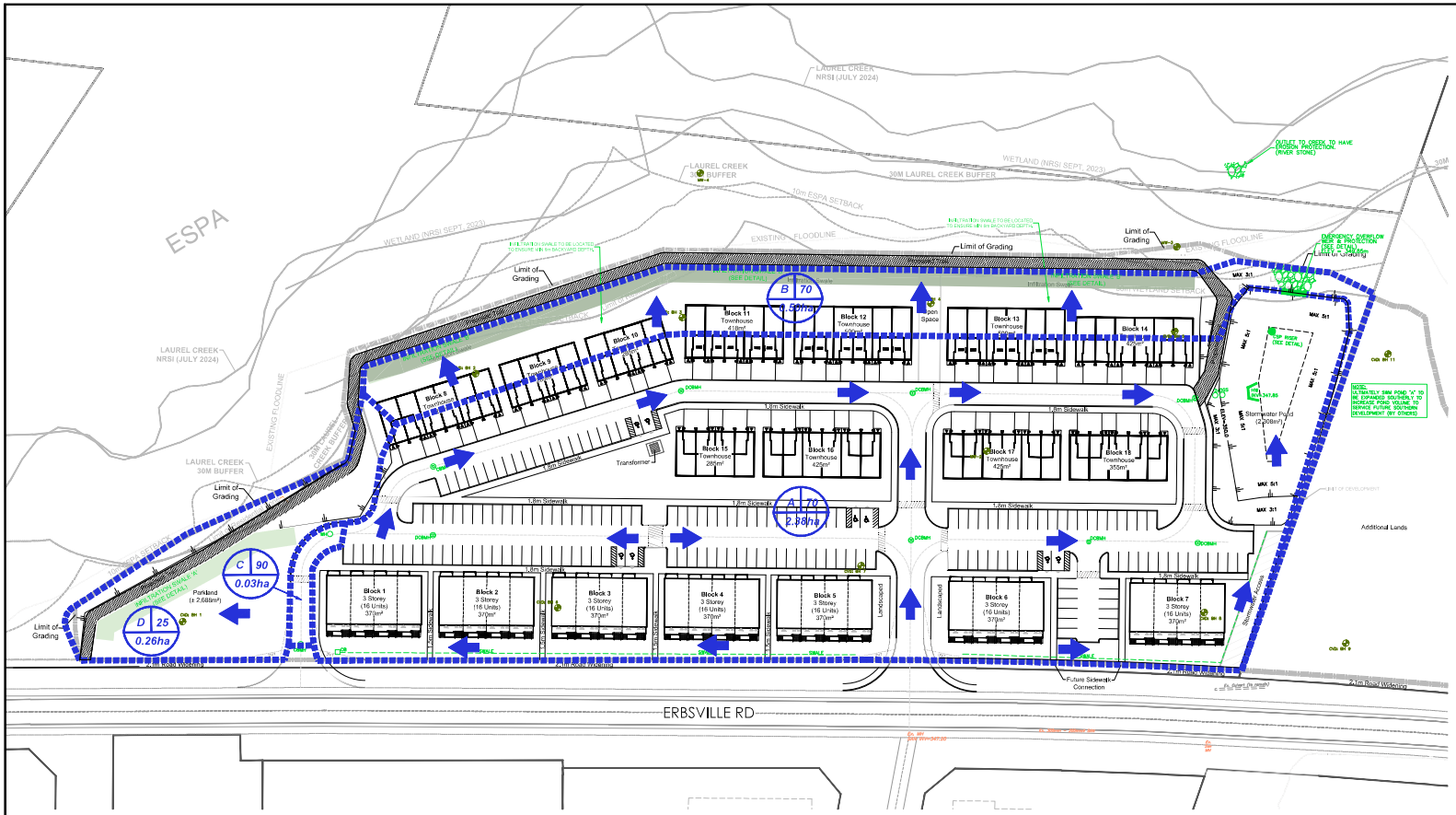
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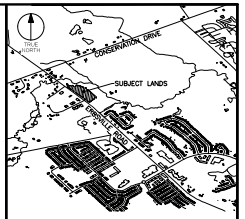
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Drawn By: MES	Checked By: JP
Project #: JPE-1027	Dwg #: FE - 3
	Rev #: 1

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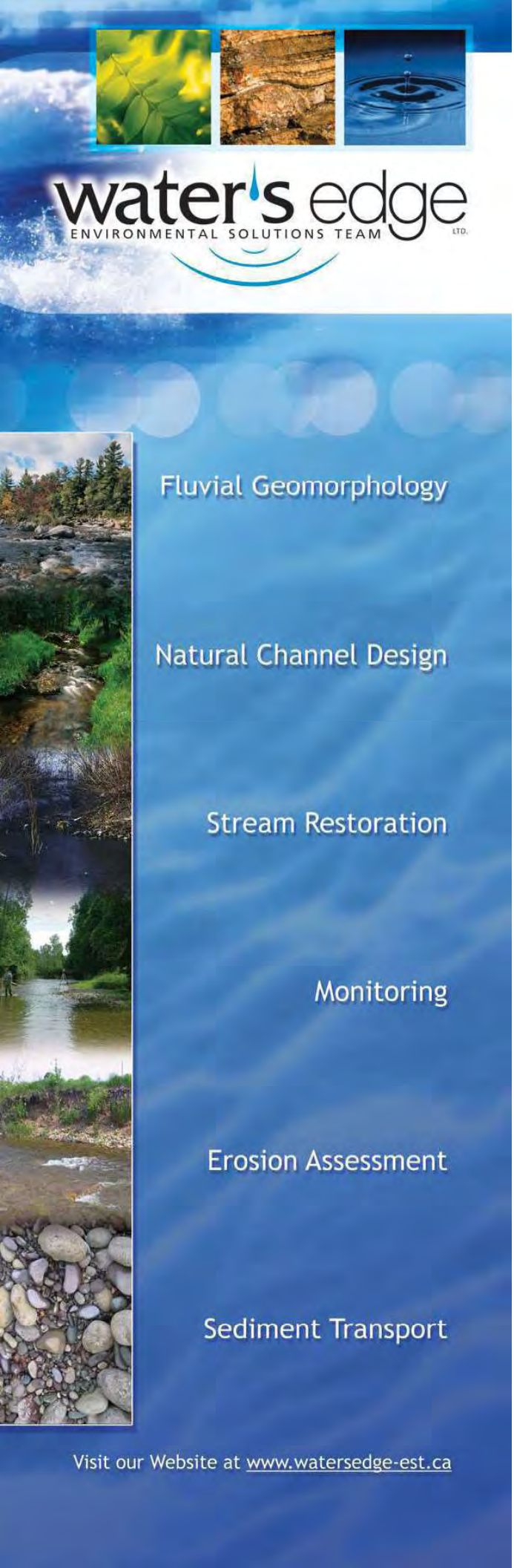
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Rev #:	1		

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APPENDIX B:

MIDUSS MODELLING Output

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"             348.100  0.00729  106.820"
"             348.150  0.00780  129.250"
"             348.200  0.00827  152.890"
"             348.250  0.00872  177.770"
"             348.300  0.00914  203.900"
"             348.350  0.00955  231.300"
"             348.400  0.00994  259.990"
"             348.450  0.01031  289.990"
"             348.500  0.01068  321.320"
"             348.550  0.01103  354.000"
"             348.600  0.01137  388.040"
"             348.650  0.01170  423.480"
"             348.700  0.01202  460.320"
"             348.750  0.01233  498.580"
"             348.800  0.01263  538.290"
"             348.850  0.01293  579.460"
"             348.900  0.01322  622.120"
"             348.950  0.01351  666.280"
"             349.000  0.01378  711.960"
"             349.050  0.01406  759.180"
"             349.100  0.01432  807.980"
"             349.150  0.01459  858.330"
```

```
"             349.200   0.01485   910.290"
"             349.250   0.01510   963.870"
"             349.300   0.01535  1019.090"
"             349.350   0.01559  1075.960"
"             349.400   0.01584  1134.520"
"             349.450   0.01607  1194.760"
"             349.500   0.01631  1256.720"
"             349.550   0.01654  1320.420"
"             349.600   0.01677  1385.860"
"             349.650   0.01699  1453.080"
"             349.700   0.01722  1522.100"
"             349.750   0.01743  1592.920"
"             349.800   0.01765  1665.570"
"             349.850   0.01787  1740.070"
"             349.900    0.1739  1816.450"
"             349.950    0.4689  1894.710"
"             350.000    0.8638  1974.870"
"         1.  WEIRS"
"              Crest     Weir     Crest     Left     Right"
"           elevation coefficie   breadth sideslope sideslope"
"             349.850     1.600     5.000     3.000     3.000"
"         1.  ORIFICES"
"            Orifice   Orifice   Orifice Number of"
"             invert coefficie  diameter  orifices"
"             347.700     0.630    0.0750     1.000"
"           Peak outflow                 0.015    c.m/sec"
"           Maximum level                349.309    metre"
"           Maximum storage             1029.395    c.m"
"           Centroidal lag              13.551   hours"
"              0.569     0.569     0.015     0.000 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"               0.569     0.015     0.015     0.000"
" 51       PIPE DESIGN"
"      0.015   Current peak flow    c.m/sec"
"      0.013   Manning 'n'"
"      0.300   Diameter    metre"
"      0.600   Gradient   %"
"           Depth of flow                0.092    metre"
"           Velocity                    0.834    m/sec"
"           Pipe capacity                0.075    c.m/sec"
"           Critical depth               0.094    metre"
" 53       ROUTE    Pipe Route 38"
"     37.50      Pipe Route 38 Reach length   ( metre)"
"      0.389   X-factor <= 0.5"
"     33.733   K-lag   ( seconds)"
"      0.000   Default(0) or user spec.(1) values used"
"      0.500   X-factor <= 0.5"
"     30.000   K-lag   ( seconds)"
"      0.500   Beta weighting factor"
"     37.500   Routing time step   ( seconds)"
"         1   No. of sub-reaches"
"           Peak outflow                 0.015    c.m/sec"
"              0.569     0.015     0.015     0.000 c.m/sec"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
```



```
"         1   Node #"
"           Total Property Outflow"
"           Maximum flow                 0.015    c.m/sec"
"           Hydrograph volume          1193.565    c.m"
"               0.569     0.015     0.015     0.015"
" 40       HYDROGRAPH Start - New Tributary"
"         2   Start - New Tributary"
"               0.569     0.000     0.015     0.015"
" 33       CATCHMENT 102"
"         1   Triangular SCS"
"         2   Proportional to %"
"         1   SCS method"
"       102   Catchment C "
"      5.000   % Impervious"
"      0.260   Total Area"
"     38.000   Flow length"
"      2.000   Overland Slope"
"      0.247   Pervious Area"
"     38.000   Pervious length"
"      2.000   Pervious slope"
"      0.013   Impervious Area"
"      2.000   Impervious length"
"      2.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     68.000   Pervious SCS Curve No."
"      0.267   Pervious Runoff coefficient"
"      0.100   Pervious Ia/S coefficient"
"     11.953   Pervious Initial abstraction"
"      0.015   Impervious Manning 'n'"
"     98.000   Impervious SCS Curve No."
"      0.802   Impervious Runoff coefficient"
"      0.100   Impervious Ia/S coefficient"
"      0.518   Impervious Initial abstraction"
"               0.017     0.000     0.015     0.015 c.m/sec"
"           Catchment 102          Pervious   Impervious Total Area "
"           Surface Area          0.247      0.013      0.260      hectare"
"           Time of concentration  19.286     0.344      16.704     minutes"
"           Time to Centroid       120.035    85.355     115.307    minutes"
"           Rainfall depth         69.174     69.174     69.174     mm"
"           Rainfall volume        170.86     8.99       179.85     c.m"
"           Rainfall losses        50.679     13.705     48.831     mm"
"           Runoff depth           18.494     55.469     20.343     mm"
"           Runoff volume          45.68      7.21       52.89      c.m"
"           Runoff coefficient     0.267      0.802      0.294      "
"           Maximum flow           0.016      0.006      0.017      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"         4   Add Runoff "
"               0.017     0.017     0.015     0.015"
" 57       TRENCH Design d/s of 102"
"      0.017   Peak inflow"
"     52.892   Hydrograph volume"
"     14.000   Ground elevation"
"     13.000   Downstream trench invert"
"      1.000   Trench height"
"     12.000   Water table elevation"
"      3.000   Trench top width"
```

```
"      1.800   Trench bottom width"
"     50.000   Voids ratio (%)"
"     50.000   Hydraulic conductivity"
"      0.000   Trench gradient (%)"
"     50.000   Trench length"
"      1.000   Include base width"
"       21.   Number of stages"
"             Level Discharge    Volume"
"            13.000     0.000      0.0"
"            13.050     0.000      2.3"
"            13.100     0.000      4.7"
"            13.150     0.000      7.1"
"            13.200     0.000      9.6"
"            13.250     0.000     12.2"
"            13.300     0.000     14.9"
"            13.350     0.000     17.6"
"            13.400     0.000     20.4"
"            13.450     0.000     23.3"
"            13.500     0.000     26.3"
"            13.550     0.000     29.3"
"            13.600     0.000     32.4"
"            13.650     0.000     35.6"
"            13.700     0.000     38.8"
"            13.750     0.000     42.2"
"            13.800     0.000     45.6"
"            13.850     0.000     49.1"
"            13.900     0.000     52.7"
"            13.950     0.000     56.3"
"            14.000     0.000     60.0"
"         1.  MANHOLE"
"             Access"
"           diameter"
"              1.200"
"          Peak outflow              0.000    c.m/sec"
"          Outflow volume            0.002    c.m"
"          Peak exfiltration         0.003    c.m/sec"
"          Exfiltration volume      52.913    c.m"
"          Maximum level            13.605    metre"
"          Maximum storage          32.740    c.m"
"          Centroidal lag            4.553    hours"
"          Infiltration area 2 sides  70.593   sq.metre"
"          Infiltration Base area     90.000   sq.metre"
"              0.017    0.017    0.000    0.003 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"              0.017    0.000    0.000    0.003"
" 40       HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"              0.017    0.000    0.000    0.003"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"           Total Property Outflow"
"          Maximum flow              0.015    c.m/sec"
"          Hydrograph volume      1193.567    c.m"
"              0.017    0.000    0.000    0.015"
```



```
" 40       HYDROGRAPH Start - New Tributary"
"         2   Start - New Tributary"
"              0.017    0.000    0.000    0.015"
" 33       CATCHMENT 2"
"         1   Triangular SCS"
"         2   Proportional to %"
"         1   SCS method"
"         2   Catchment C draining to back of lots"
"     50.000   % Impervious"
"      0.500   Total Area"
"     16.000   Flow length"
"      2.000   Overland Slope"
"      0.250   Pervious Area"
"     16.000   Pervious length"
"      2.000   Pervious slope"
"      0.250   Impervious Area"
"     16.000   Impervious length"
"      2.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     68.000   Pervious SCS Curve No."
"      0.267   Pervious Runoff coefficient"
"      0.100   Pervious Ia/S coefficient"
"     11.953   Pervious Initial abstraction"
"      0.015   Impervious Manning 'n'"
"     98.000   Impervious SCS Curve No."
"      0.903   Impervious Runoff coefficient"
"      0.100   Impervious Ia/S coefficient"
"      0.518   Impervious Initial abstraction"
"              0.115    0.000    0.000    0.015 c.m/sec"
"          Catchment 2          Pervious   Impervious Total Area "
"          Surface Area          0.250      0.250      0.500      hectare"
"          Time of concentration 11.477     1.199      3.546      minutes"
"          Time to Centroid      110.724    86.392     91.948     minutes"
"          Rainfall depth        69.174     69.174     69.174     mm"
"          Rainfall volume       172.93     172.93     345.87     c.m"
"          Rainfall losses       50.686     6.692      28.689     mm"
"          Runoff depth          18.487     62.482     40.485     mm"
"          Runoff volume         46.22      156.20     202.42     c.m"
"          Runoff coefficient    0.267      0.903      0.585      "
"          Maximum flow          0.020      0.111      0.115      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"         4   Add Runoff "
"              0.115    0.115    0.000    0.015"
" 57       TRENCH Design d/s of 2"
"      0.115   Peak inflow"
"    202.423   Hydrograph volume"
"     14.000   Ground elevation"
"     13.000   Downstream trench invert"
"      1.000   Trench height"
"     12.000   Water table elevation"
"      3.000   Trench top width"
"      1.800   Trench bottom width"
"     50.000   Voids ratio (%)"
"     50.000   Hydraulic conductivity"
"      0.000   Trench gradient (%)"
"    230.000   Trench length"
```

```
"      1.000   Include base width"
"       21.   Number of stages"
"             Level Discharge   Volume"
"            13.000    0.000     0.0"
"            13.050    0.000    10.5"
"            13.100    0.000    21.4"
"            13.150    0.000    32.6"
"            13.200    0.000    44.2"
"            13.250    0.000    56.1"
"            13.300    0.000    68.3"
"            13.350    0.000    80.9"
"            13.400    0.000    93.8"
"            13.450    0.000   107.1"
"            13.500    0.000   120.8"
"            13.550    0.000   134.7"
"            13.600    0.000   149.0"
"            13.650    0.000   163.7"
"            13.700    0.000   178.7"
"            13.750    0.000   194.1"
"            13.800    0.000   209.8"
"            13.850    0.000   225.8"
"            13.900    0.000   242.2"
"            13.950    0.000   258.9"
"            14.000    0.000   276.0"
"         1.   MANHOLE"
"              Access"
"             diameter"
"               1.200"
"          Peak outflow              0.000    c.m/sec"
"          Outflow volume            0.002    c.m"
"          Peak exfiltration         0.013    c.m/sec"
"          Exfiltration volume       202.421    c.m"
"          Maximum level             13.549    metre"
"          Maximum storage           134.471    c.m"
"          Centroidal lag            3.923   hours"
"          Infiltration area 2 sides   294.562   sq.metre"
"          Infiltration Base area    414.000   sq.metre"
"              0.115    0.115    0.000    0.013 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"              0.115    0.000    0.000    0.013"
" 40       HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"              0.115    0.000    0.000    0.013"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"             Total Property Outflow"
"          Maximum flow              0.015    c.m/sec"
"          Hydrograph volume         1193.569    c.m"
"              0.115    0.000    0.000    0.015"
" 40       HYDROGRAPH   Confluence    1"
"         7   Confluence "
"         1   Node #"
"             Total Property Outflow"
"          Maximum flow              0.015    c.m/sec"
```



```
"          Hydrograph volume         1193.569    c.m"
"              0.115    0.015    0.000    0.000"
" 38       START/RE-START TOTALS 1"
"         3   Runoff Totals on EXIT"
"          Total Catchment area              3.140    hectare"
"          Total Impervious area             1.929    hectare"
"          Total % impervious               61.433"
" 19       EXIT"
```

```
"             MIDUSS Output ------------------------------------------------>"
"             MIDUSS version                    Version 2.25  rev. 473"
"             MIDUSS created                    February 7, 2010"
"         10  Units used:                       ie METRIC"
"             Job folder:              C:\Users\TimAntonio\Water's Edge\"
"            Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\2024
Revised Plan\October 17"
"             Output filename:         23014_25YR24HRSCS_20241017_1357.out"
"             Licensee name:                    Water's Edge"
"             Company                           Water's Edge"
"             Date & Time last used:            2024-10-17 at 1:57:42 PM"
" 31        TIME PARAMETERS"
"      5.000  Time Step"
"    180.000  Max. Storm length"
"   5760.000  Max. Hydrograph"
" 81        ADD COMMENT================================================="
"        1  Lines of comment"
"          25YR 24HR SCS"
" 32        STORM Chicago storm"
"          1  Chicago storm"
"   3261.000  Coefficient A"
"     16.190  Constant B"
"      0.938  Exponent C"
"      0.400  Fraction R"
"    180.000  Duration"
"      1.000  Time step multiplier"
"           Maximum intensity          185.969    mm/hr"
"           Total depth                69.174    mm"
"          6  025hyd  Hydrograph extension used in this file"
" 33        CATCHMENT 101"
"          1  Triangular SCS"
"          2  Proportional to %"
"          1  SCS method"
"        101  Catchment A"
"     70.000  % Impervious"
"      2.380  Total Area"
"    274.000  Flow length"
"      2.000  Overland Slope"
"      0.714  Pervious Area"
"    274.000  Pervious length"
"      2.000  Pervious slope"
"      1.666  Impervious Area"
"    639.333  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.268  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.921  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.569    0.000    0.000    0.000 c.m/sec"
"          Catchment 101         Pervious   Impervious Total Area "
```



```
"          Surface Area          0.714     1.666     2.380     hectare"
"          Time of concentration  63.099    10.959    16.735    minutes"
"          Time to Centroid       172.143   99.904    107.907   minutes"
"          Rainfall depth         69.174    69.174    69.174    mm"
"          Rainfall volume        493.90    1152.43   1646.33   c.m"
"          Rainfall losses        50.654    5.467     19.023    mm"
"          Runoff depth           18.520    63.706    50.150    mm"
"          Runoff volume          132.23    1061.35   1193.58   c.m"
"          Runoff coefficient     0.268     0.921     0.725     "
"          Maximum flow           0.020     0.565     0.569     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.569    0.569    0.000    0.000"
" 81        ADD COMMENT================================================="
"        1  Lines of comment"
"          SWM POND"
" 54        POND DESIGN"
"     0.569  Current peak flow    c.m/sec"
"     0.080  Target outflow    c.m/sec"
"    1193.6  Hydrograph volume    c.m"
"        47.  Number of stages"
"   347.700  Minimum water level    metre"
"   350.000  Maximum water level    metre"
"   347.700  Starting water level    metre"
"         0  Keep Design Data: 1 = True; 0 = False"
"              Level Discharge   Volume"
"            347.700    0.000    0.000"
"            347.750  0.00070   0.7400"
"            347.800  0.00276    5.110"
"            347.850  0.00390   15.030"
"            347.900  0.00477   29.500"
"            347.950  0.00551   46.690"
"            348.000  0.00616   65.520"
"            348.050  0.00675   85.580"
"            348.100  0.00729  106.820"
"            348.150  0.00780  129.250"
"            348.200  0.00827  152.890"
"            348.250  0.00872  177.770"
"            348.300  0.00914  203.900"
"            348.350  0.00955  231.300"
"            348.400  0.00994  259.990"
"            348.450  0.01031  289.990"
"            348.500  0.01068  321.320"
"            348.550  0.01103  354.000"
"            348.600  0.01137  388.040"
"            348.650  0.01170  423.480"
"            348.700  0.01202  460.320"
"            348.750  0.01233  498.580"
"            348.800  0.01263  538.290"
"            348.850  0.01293  579.460"
"            348.900  0.01322  622.120"
"            348.950  0.01351  666.280"
"            349.000  0.01378  711.960"
"            349.050  0.01406  759.180"
"            349.100  0.01432  807.980"
"            349.150  0.01459  858.330"
```

```
"              349.200   0.01485   910.290"
"              349.250   0.01510   963.870"
"              349.300   0.01535  1019.090"
"              349.350   0.01559  1075.960"
"              349.400   0.01584  1134.520"
"              349.450   0.01607  1194.760"
"              349.500   0.01631  1256.720"
"              349.550   0.01654  1320.420"
"              349.600   0.01677  1385.860"
"              349.650   0.01699  1453.080"
"              349.700   0.01722  1522.100"
"              349.750   0.01743  1592.920"
"              349.800   0.01765  1665.570"
"              349.850   0.01787  1740.070"
"              349.900    0.1739  1816.450"
"              349.950    0.4689  1894.710"
"              350.000    0.8638  1974.870"
"          1.  WEIRS"
"               Crest      Weir     Crest      Left     Right"
"           elevation coefficie   breadth sideslope sideslope"
"             349.850     1.600     5.000     3.000     3.000"
"          1.  ORIFICES"
"             Orifice   Orifice   Orifice Number of"
"              invert coefficie  diameter  orifices"
"             347.700     0.630    0.0750     1.000"
"           Peak outflow                 0.015    c.m/sec"
"           Maximum level                349.309    metre"
"           Maximum storage             1029.395    c.m"
"           Centroidal lag              13.551   hours"
"              0.569     0.569     0.015     0.000 c.m/sec"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"               0.569     0.015     0.015     0.000"
" 51        PIPE DESIGN"
"       0.015   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.300   Diameter    metre"
"       0.600   Gradient   %"
"           Depth of flow                0.092    metre"
"           Velocity                    0.834    m/sec"
"           Pipe capacity                0.075    c.m/sec"
"           Critical depth               0.094    metre"
" 53        ROUTE    Pipe Route 38"
"      37.50      Pipe Route 38 Reach length   ( metre)"
"       0.389   X-factor <= 0.5"
"      33.733   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.500   X-factor <= 0.5"
"      30.000   K-lag   ( seconds)"
"       0.500   Beta weighting factor"
"      37.500   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
"           Peak outflow                 0.015    c.m/sec"
"               0.569     0.015     0.015     0.000 c.m/sec"
" 40        HYDROGRAPH   Combine    1"
"          6   Combine "
```



```
"          1   Node #"
"            Total Property Outflow"
"           Maximum flow                 0.015    c.m/sec"
"           Hydrograph volume          1193.565    c.m"
"                0.569     0.015     0.015     0.015"
" 40        HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.569     0.000     0.015     0.015"
" 33        CATCHMENT 102"
"          1   Triangular SCS"
"          2   Proportional to %"
"          1   SCS method"
"        102   Catchment C "
"       5.000   % Impervious"
"       0.260   Total Area"
"      38.000   Flow length"
"       2.000   Overland Slope"
"       0.247   Pervious Area"
"      38.000   Pervious length"
"       2.000   Pervious slope"
"       0.013   Impervious Area"
"       2.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      68.000   Pervious SCS Curve No."
"       0.267   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      11.953   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.802   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.017     0.000     0.015     0.015 c.m/sec"
"           Catchment 102          Pervious   Impervious Total Area "
"           Surface Area          0.247      0.013      0.260      hectare"
"           Time of concentration  19.286     0.344      16.704     minutes"
"           Time to Centroid       120.035    85.355     115.307    minutes"
"           Rainfall depth         69.174     69.174     69.174     mm"
"           Rainfall volume        170.86     8.99       179.85     c.m"
"           Rainfall losses        50.679     13.705     48.831     mm"
"           Runoff depth           18.494     55.469     20.343     mm"
"           Runoff volume          45.68      7.21       52.89      c.m"
"           Runoff coefficient     0.267      0.802      0.294      "
"           Maximum flow           0.016      0.006      0.017      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.017     0.017     0.015     0.015"
" 57        TRENCH Design d/s of 102"
"       0.017   Peak inflow"
"      52.892   Hydrograph volume"
"      14.000   Ground elevation"
"      13.000   Downstream trench invert"
"       1.000   Trench height"
"      12.000   Water table elevation"
"       3.000   Trench top width"
```

```
"      1.800   Trench bottom width"
"     50.000   Voids ratio (%)"
"     50.000   Hydraulic conductivity"
"      0.000   Trench gradient (%)"
"     50.000   Trench length"
"      1.000   Include base width"
"       21.   Number of stages"
"             Level Discharge    Volume"
"            13.000     0.000      0.0"
"            13.050     0.000      2.3"
"            13.100     0.000      4.7"
"            13.150     0.000      7.1"
"            13.200     0.000      9.6"
"            13.250     0.000     12.2"
"            13.300     0.000     14.9"
"            13.350     0.000     17.6"
"            13.400     0.000     20.4"
"            13.450     0.000     23.3"
"            13.500     0.000     26.3"
"            13.550     0.000     29.3"
"            13.600     0.000     32.4"
"            13.650     0.000     35.6"
"            13.700     0.000     38.8"
"            13.750     0.000     42.2"
"            13.800     0.000     45.6"
"            13.850     0.000     49.1"
"            13.900     0.000     52.7"
"            13.950     0.000     56.3"
"            14.000     0.000     60.0"
"         1.  MANHOLE"
"             Access"
"           diameter"
"              1.200"
"          Peak outflow              0.000    c.m/sec"
"          Outflow volume            0.002    c.m"
"          Peak exfiltration         0.003    c.m/sec"
"          Exfiltration volume      52.913    c.m"
"          Maximum level            13.605    metre"
"          Maximum storage          32.740    c.m"
"          Centroidal lag            4.553    hours"
"          Infiltration area 2 sides  70.593   sq.metre"
"          Infiltration Base area     90.000   sq.metre"
"              0.017    0.017    0.000    0.003 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"              0.017    0.000    0.000    0.003"
" 40       HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"              0.017    0.000    0.000    0.003"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"           Total Property Outflow"
"          Maximum flow              0.015    c.m/sec"
"          Hydrograph volume      1193.567    c.m"
"              0.017    0.000    0.000    0.015"
```



```
" 40       HYDROGRAPH Start - New Tributary"
"         2   Start - New Tributary"
"              0.017    0.000    0.000    0.015"
" 33       CATCHMENT 2"
"         1   Triangular SCS"
"         2   Proportional to %"
"         1   SCS method"
"         2   Catchment C draining to back of lots"
"     50.000   % Impervious"
"      0.500   Total Area"
"     16.000   Flow length"
"      2.000   Overland Slope"
"      0.250   Pervious Area"
"     16.000   Pervious length"
"      2.000   Pervious slope"
"      0.250   Impervious Area"
"     16.000   Impervious length"
"      2.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     68.000   Pervious SCS Curve No."
"      0.267   Pervious Runoff coefficient"
"      0.100   Pervious Ia/S coefficient"
"     11.953   Pervious Initial abstraction"
"      0.015   Impervious Manning 'n'"
"     98.000   Impervious SCS Curve No."
"      0.903   Impervious Runoff coefficient"
"      0.100   Impervious Ia/S coefficient"
"      0.518   Impervious Initial abstraction"
"              0.115    0.000    0.000    0.015 c.m/sec"
"          Catchment 2          Pervious   Impervious Total Area "
"          Surface Area          0.250      0.250      0.500      hectare"
"          Time of concentration 11.477     1.199      3.546      minutes"
"          Time to Centroid      110.724    86.392     91.948     minutes"
"          Rainfall depth        69.174     69.174     69.174     mm"
"          Rainfall volume       172.93     172.93     345.87     c.m"
"          Rainfall losses       50.686     6.692      28.689     mm"
"          Runoff depth          18.487     62.482     40.485     mm"
"          Runoff volume         46.22      156.20     202.42     c.m"
"          Runoff coefficient    0.267      0.903      0.585      "
"          Maximum flow          0.020      0.111      0.115      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"         4   Add Runoff "
"              0.115    0.115    0.000    0.015"
" 57       TRENCH Design d/s of 2"
"      0.115   Peak inflow"
"    202.423   Hydrograph volume"
"     14.000   Ground elevation"
"     13.000   Downstream trench invert"
"      1.000   Trench height"
"     12.000   Water table elevation"
"      3.000   Trench top width"
"      1.800   Trench bottom width"
"     50.000   Voids ratio (%)"
"     50.000   Hydraulic conductivity"
"      0.000   Trench gradient (%)"
"    230.000   Trench length"
```

```
"      1.000   Include base width"
"       21.   Number of stages"
"             Level Discharge   Volume"
"            13.000    0.000     0.0"
"            13.050    0.000    10.5"
"            13.100    0.000    21.4"
"            13.150    0.000    32.6"
"            13.200    0.000    44.2"
"            13.250    0.000    56.1"
"            13.300    0.000    68.3"
"            13.350    0.000    80.9"
"            13.400    0.000    93.8"
"            13.450    0.000   107.1"
"            13.500    0.000   120.8"
"            13.550    0.000   134.7"
"            13.600    0.000   149.0"
"            13.650    0.000   163.7"
"            13.700    0.000   178.7"
"            13.750    0.000   194.1"
"            13.800    0.000   209.8"
"            13.850    0.000   225.8"
"            13.900    0.000   242.2"
"            13.950    0.000   258.9"
"            14.000    0.000   276.0"
"         1.   MANHOLE"
"              Access"
"             diameter"
"               1.200"
"          Peak outflow              0.000    c.m/sec"
"          Outflow volume            0.002    c.m"
"          Peak exfiltration         0.013    c.m/sec"
"          Exfiltration volume     202.421    c.m"
"          Maximum level            13.549    metre"
"          Maximum storage         134.471    c.m"
"          Centroidal lag            3.923   hours"
"          Infiltration area 2 sides  294.562  sq.metre"
"          Infiltration Base area    414.000  sq.metre"
"              0.115    0.115    0.000    0.013 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"              0.115    0.000    0.000    0.013"
" 40       HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"              0.115    0.000    0.000    0.013"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"             Total Property Outflow"
"          Maximum flow              0.015    c.m/sec"
"          Hydrograph volume      1193.569    c.m"
"              0.115    0.000    0.000    0.015"
" 40       HYDROGRAPH   Confluence    1"
"         7   Confluence "
"         1   Node #"
"             Total Property Outflow"
"          Maximum flow              0.015    c.m/sec"
```



```
"          Hydrograph volume      1193.569    c.m"
"              0.115    0.015    0.000    0.000"
" 38       START/RE-START TOTALS 1"
"         3   Runoff Totals on EXIT"
"          Total Catchment area          3.140    hectare"
"          Total Impervious area         1.929    hectare"
"          Total % impervious           61.433"
" 19       EXIT"
```

```
"             MIDUSS Output ------------------------------------------------>"
"             MIDUSS version                    Version 2.25  rev. 473"
"             MIDUSS created                    February 7, 2010"
"         10  Units used:                       ie METRIC"
"             Job folder:              C:\Users\TimAntonio\Water's Edge\"
"             Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\2024
Revised Plan\October 17"
"             Output filename:         23014_5YR24HRSCS_20241017_1408.out"
"             Licensee name:                    Water's Edge"
"             Company                           Water's Edge"
"             Date & Time last used:            2024-10-17 at 2:04:15 PM"
" 31        TIME PARAMETERS"
"      5.000  Time Step"
"    180.000  Max. Storm length"
"   5760.000  Max. Hydrograph"
" 81        ADD COMMENT================================================="
"        1  Lines of comment"
"          5YR 24HR SCS"
" 32        STORM Chicago storm"
"          1  Chicago storm"
"   1755.000  Coefficient A"
"     12.347  Constant B"
"      0.895  Exponent C"
"      0.400  Fraction R"
"    180.000  Duration"
"      1.000  Time step multiplier"
"          Maximum intensity         136.512    mm/hr"
"          Total depth               47.549    mm"
"          6  005hyd  Hydrograph extension used in this file"
" 33        CATCHMENT 101"
"          1  Triangular SCS"
"          2  Proportional to %"
"          1  SCS method"
"        101  Catchment A"
"     70.000  % Impervious"
"      2.380  Total Area"
"    274.000  Flow length"
"      2.000  Overland Slope"
"      0.714  Pervious Area"
"    274.000  Pervious length"
"      2.000  Pervious slope"
"      1.666  Impervious Area"
"    639.333  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.172  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.888  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.359     0.000     0.000     0.000 c.m/sec"
"          Catchment 101         Pervious   Impervious Total Area "
```



```
"          Surface Area          0.714      1.666      2.380      hectare"
"          Time of concentration  92.484     12.512     18.633     minutes"
"          Time to Centroid       205.875    103.595    111.424    minutes"
"          Rainfall depth         47.549     47.549     47.549     mm"
"          Rainfall volume        339.50     792.17     1131.67    c.m"
"          Rainfall losses        39.381     5.317      15.536     mm"
"          Runoff depth           8.168      42.232     32.013     mm"
"          Runoff volume          58.32      703.59     761.90     c.m"
"          Runoff coefficient     0.172      0.888      0.673      "
"          Maximum flow           0.007      0.358      0.359      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.359     0.359     0.000     0.000"
" 81        ADD COMMENT================================================="
"        1  Lines of comment"
"          SWM POND"
" 54        POND DESIGN"
"      0.359  Current peak flow    c.m/sec"
"      0.080  Target outflow    c.m/sec"
"      761.9  Hydrograph volume    c.m"
"         47.  Number of stages"
"    347.700  Minimum water level    metre"
"    350.000  Maximum water level    metre"
"    347.700  Starting water level    metre"
"          0  Keep Design Data: 1 = True; 0 = False"
"               Level Discharge   Volume"
"             347.700    0.000    0.000"
"             347.750  0.00070   0.7400"
"             347.800  0.00276    5.110"
"             347.850  0.00390   15.030"
"             347.900  0.00477   29.500"
"             347.950  0.00551   46.690"
"             348.000  0.00616   65.520"
"             348.050  0.00675   85.580"
"             348.100  0.00729  106.820"
"             348.150  0.00780  129.250"
"             348.200  0.00827  152.890"
"             348.250  0.00872  177.770"
"             348.300  0.00914  203.900"
"             348.350  0.00955  231.300"
"             348.400  0.00994  259.990"
"             348.450  0.01031  289.990"
"             348.500  0.01068  321.320"
"             348.550  0.01103  354.000"
"             348.600  0.01137  388.040"
"             348.650  0.01170  423.480"
"             348.700  0.01202  460.320"
"             348.750  0.01233  498.580"
"             348.800  0.01263  538.290"
"             348.850  0.01293  579.460"
"             348.900  0.01322  622.120"
"             348.950  0.01351  666.280"
"             349.000  0.01378  711.960"
"             349.050  0.01406  759.180"
"             349.100  0.01432  807.980"
"             349.150  0.01459  858.330"
```

```
"              349.200   0.01485   910.290"
"              349.250   0.01510   963.870"
"              349.300   0.01535  1019.090"
"              349.350   0.01559  1075.960"
"              349.400   0.01584  1134.520"
"              349.450   0.01607  1194.760"
"              349.500   0.01631  1256.720"
"              349.550   0.01654  1320.420"
"              349.600   0.01677  1385.860"
"              349.650   0.01699  1453.080"
"              349.700   0.01722  1522.100"
"              349.750   0.01743  1592.920"
"              349.800   0.01765  1665.570"
"              349.850   0.01787  1740.070"
"              349.900    0.1739  1816.450"
"              349.950    0.4689  1894.710"
"              350.000    0.8638  1974.870"
"          1.  WEIRS"
"               Crest     Weir     Crest     Left     Right"
"           elevation coefficie   breadth sideslope sideslope"
"             349.850     1.600     5.000     3.000     3.000"
"          1.  ORIFICES"
"             Orifice   Orifice   Orifice Number of"
"              invert coefficie  diameter  orifices"
"             347.700     0.630    0.0750     1.000"
"           Peak outflow                 0.013    c.m/sec"
"           Maximum level                348.903    metre"
"           Maximum storage              624.444    c.m"
"           Centroidal lag               10.391   hours"
"              0.359     0.359     0.013     0.000 c.m/sec"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"               0.359     0.013     0.013     0.000"
" 51        PIPE DESIGN"
"       0.013   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.300   Diameter    metre"
"       0.600   Gradient   %"
"           Depth of flow                0.085    metre"
"           Velocity                     0.799    m/sec"
"           Pipe capacity                0.075    c.m/sec"
"           Critical depth               0.087    metre"
" 53        ROUTE    Pipe Route 38"
"      37.50      Pipe Route 38 Reach length   ( metre)"
"       0.399   X-factor <= 0.5"
"      35.210   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.500   X-factor <= 0.5"
"      30.000   K-lag   ( seconds)"
"       0.500   Beta weighting factor"
"      37.500   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
"           Peak outflow                 0.013    c.m/sec"
"               0.359     0.013     0.013     0.000 c.m/sec"
" 40        HYDROGRAPH   Combine    1"
"          6   Combine "
```



```
"          1   Node #"
"            Total Property Outflow"
"           Maximum flow                 0.013    c.m/sec"
"           Hydrograph volume          761.926    c.m"
"                0.359     0.013     0.013     0.013"
" 40        HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.359     0.000     0.013     0.013"
" 33        CATCHMENT 102"
"          1   Triangular SCS"
"          2   Proportional to %"
"          1   SCS method"
"        102   Catchment C "
"       5.000   % Impervious"
"       0.260   Total Area"
"      38.000   Flow length"
"       2.000   Overland Slope"
"       0.247   Pervious Area"
"      38.000   Pervious length"
"       2.000   Pervious slope"
"       0.013   Impervious Area"
"       2.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      68.000   Pervious SCS Curve No."
"       0.172   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      11.953   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.782   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.006     0.000     0.013     0.013 c.m/sec"
"           Catchment 102          Pervious   Impervious Total Area "
"           Surface Area          0.247      0.013      0.260      hectare"
"           Time of concentration  28.267     0.393      22.873     minutes"
"           Time to Centroid       132.885    86.775     123.962    minutes"
"           Rainfall depth         47.549     47.549     47.549     mm"
"           Rainfall volume        117.45     6.18       123.63     c.m"
"           Rainfall losses        39.389     10.345     37.937     mm"
"           Runoff depth           8.160      37.204     9.612      mm"
"           Runoff volume          20.16      4.84       24.99      c.m"
"           Runoff coefficient     0.172      0.782      0.202      "
"           Maximum flow           0.005      0.004      0.006      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.006     0.006     0.013     0.013"
" 57        TRENCH Design d/s of 102"
"       0.006   Peak inflow"
"      24.992   Hydrograph volume"
"      14.000   Ground elevation"
"      13.000   Downstream trench invert"
"       1.000   Trench height"
"      12.000   Water table elevation"
"       3.000   Trench top width"
```

```
"      1.800   Trench bottom width"
"     50.000   Voids ratio (%)"
"     50.000   Hydraulic conductivity"
"      0.000   Trench gradient (%)"
"     50.000   Trench length"
"      1.000   Include base width"
"       21.   Number of stages"
"             Level Discharge    Volume"
"            13.000     0.000      0.0"
"            13.050     0.000      2.3"
"            13.100     0.000      4.7"
"            13.150     0.000      7.1"
"            13.200     0.000      9.6"
"            13.250     0.000     12.2"
"            13.300     0.000     14.9"
"            13.350     0.000     17.6"
"            13.400     0.000     20.4"
"            13.450     0.000     23.3"
"            13.500     0.000     26.3"
"            13.550     0.000     29.3"
"            13.600     0.000     32.4"
"            13.650     0.000     35.6"
"            13.700     0.000     38.8"
"            13.750     0.000     42.2"
"            13.800     0.000     45.6"
"            13.850     0.000     49.1"
"            13.900     0.000     52.7"
"            13.950     0.000     56.3"
"            14.000     0.000     60.0"
"         1.  MANHOLE"
"             Access"
"           diameter"
"              1.200"
"          Peak outflow              0.000    c.m/sec"
"          Outflow volume             0.002    c.m"
"          Peak exfiltration          0.002    c.m/sec"
"          Exfiltration volume       24.990    c.m"
"          Maximum level             13.238    metre"
"          Maximum storage           11.548    c.m"
"          Centroidal lag             3.363   hours"
"          Infiltration area 2 sides  27.714   sq.metre"
"          Infiltration Base area     90.000   sq.metre"
"             0.006     0.006     0.000     0.002 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"             0.006     0.000     0.000     0.002"
" 40       HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"             0.006     0.000     0.000     0.002"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"           Total Property Outflow"
"          Maximum flow              0.013    c.m/sec"
"          Hydrograph volume         761.928    c.m"
"             0.006     0.000     0.000     0.013"
```



```
" 40       HYDROGRAPH Start - New Tributary"
"         2   Start - New Tributary"
"             0.006     0.000     0.000     0.013"
" 33       CATCHMENT 2"
"         1   Triangular SCS"
"         2   Proportional to %"
"         1   SCS method"
"         2   Catchment C draining to back of lots"
"     50.000   % Impervious"
"      0.500   Total Area"
"     16.000   Flow length"
"      2.000   Overland Slope"
"      0.250   Pervious Area"
"     16.000   Pervious length"
"      2.000   Pervious slope"
"      0.250   Impervious Area"
"     16.000   Impervious length"
"      2.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     68.000   Pervious SCS Curve No."
"      0.171   Pervious Runoff coefficient"
"      0.100   Pervious Ia/S coefficient"
"     11.953   Pervious Initial abstraction"
"      0.015   Impervious Manning 'n'"
"     98.000   Impervious SCS Curve No."
"      0.876   Impervious Runoff coefficient"
"      0.100   Impervious Ia/S coefficient"
"      0.518   Impervious Initial abstraction"
"             0.078     0.000     0.000     0.013 c.m/sec"
"          Catchment 2          Pervious   Impervious Total Area "
"          Surface Area          0.250      0.250      0.500      hectare"
"          Time of concentration 16.822     1.369      3.897      minutes"
"          Time to Centroid      119.869    87.721     92.981     minutes"
"          Rainfall depth        47.549     47.549     47.549     mm"
"          Rainfall volume       118.87     118.87     237.75     c.m"
"          Rainfall losses       39.399     5.887      22.643     mm"
"          Runoff depth          8.150      41.662     24.906     mm"
"          Runoff volume         20.37      104.15     124.53     c.m"
"          Runoff coefficient    0.171      0.876      0.524      "
"          Maximum flow          0.007      0.078      0.078      c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"         4   Add Runoff "
"             0.078     0.078     0.000     0.013"
" 57       TRENCH Design d/s of 2"
"      0.078   Peak inflow"
"    124.529   Hydrograph volume"
"     14.000   Ground elevation"
"     13.000   Downstream trench invert"
"      1.000   Trench height"
"     12.000   Water table elevation"
"      3.000   Trench top width"
"      1.800   Trench bottom width"
"     50.000   Voids ratio (%)"
"     50.000   Hydraulic conductivity"
"      0.000   Trench gradient (%)"
"    230.000   Trench length"
```

```
"      1.000   Include base width"
"       21.   Number of stages"
"             Level Discharge   Volume"
"            13.000    0.000     0.0"
"            13.050    0.000    10.5"
"            13.100    0.000    21.4"
"            13.150    0.000    32.6"
"            13.200    0.000    44.2"
"            13.250    0.000    56.1"
"            13.300    0.000    68.3"
"            13.350    0.000    80.9"
"            13.400    0.000    93.8"
"            13.450    0.000   107.1"
"            13.500    0.000   120.8"
"            13.550    0.000   134.7"
"            13.600    0.000   149.0"
"            13.650    0.000   163.7"
"            13.700    0.000   178.7"
"            13.750    0.000   194.1"
"            13.800    0.000   209.8"
"            13.850    0.000   225.8"
"            13.900    0.000   242.2"
"            13.950    0.000   258.9"
"            14.000    0.000   276.0"
"         1.   MANHOLE"
"             Access"
"            diameter"
"              1.200"
"          Peak outflow              0.000   c.m/sec"
"          Outflow volume            0.002   c.m"
"          Peak exfiltration         0.010   c.m/sec"
"          Exfiltration volume     124.530   c.m"
"          Maximum level            13.328   metre"
"          Maximum storage          75.242   c.m"
"          Centroidal lag            3.195   hours"
"          Infiltration area 2 sides  175.700  sq.metre"
"          Infiltration Base area    414.000  sq.metre"
"              0.078    0.078    0.000    0.010 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"              0.078    0.000    0.000    0.010"
" 40       HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"              0.078    0.000    0.000    0.010"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"             Total Property Outflow"
"          Maximum flow              0.013   c.m/sec"
"          Hydrograph volume       761.929   c.m"
"              0.078    0.000    0.000    0.013"
" 40       HYDROGRAPH   Confluence    1"
"         7   Confluence "
"         1   Node #"
"             Total Property Outflow"
"          Maximum flow              0.013   c.m/sec"
```



```
"          Hydrograph volume       761.929   c.m"
"              0.078    0.013    0.000    0.000"
" 38       START/RE-START TOTALS 1"
"         3   Runoff Totals on EXIT"
"          Total Catchment area              3.140   hectare"
"          Total Impervious area             1.929   hectare"
"          Total % impervious               61.433"
" 19       EXIT"
```

```
"             MIDUSS Output ------------------------------------------------>"
"             MIDUSS version                    Version 2.25  rev. 473"
"             MIDUSS created                    February 7, 2010"
"         10  Units used:                       ie METRIC"
"             Job folder:              C:\Users\TimAntonio\Water's Edge\"
"            Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\2024
Revised Plan\October 17"
"             Output filename:         23014_2YR24HRSCS_20241017_1416.out"
"             Licensee name:                    Water's Edge"
"             Company                           Water's Edge"
"             Date & Time last used:            2024-10-17 at 2:16:09 PM"
" 31        TIME PARAMETERS"
"      5.000  Time Step"
"    180.000  Max. Storm length"
"   5760.000  Max. Hydrograph"
" 81        ADD COMMENT================================================="
"        1  Lines of comment"
"          2YR 24HR SCS"
" 32        STORM Chicago storm"
"          1  Chicago storm"
"   1101.000  Coefficient A"
"      9.258  Constant B"
"      0.882  Exponent C"
"      0.400  Fraction R"
"    180.000  Duration"
"      1.000  Time step multiplier"
"           Maximum intensity          105.659    mm/hr"
"           Total depth                32.400    mm"
"          6  002hyd  Hydrograph extension used in this file"
" 33        CATCHMENT 101"
"          1  Triangular SCS"
"          2  Proportional to %"
"          1  SCS method"
"        101  Catchment A"
"     70.000  % Impervious"
"      2.410  Total Area"
"    274.000  Flow length"
"      2.000  Overland Slope"
"      0.723  Pervious Area"
"    274.000  Pervious length"
"      2.000  Pervious slope"
"      1.687  Impervious Area"
"    639.333  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.092  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.845  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.236     0.000     0.000     0.000 c.m/sec"
"          Catchment 101         Pervious   Impervious Total Area "
```



```
"          Surface Area          0.723     1.687     2.410     hectare"
"          Time of concentration  137.530    14.084    19.595    minutes"
"          Time to Centroid       263.507   106.890   113.882   minutes"
"          Rainfall depth        32.400    32.400    32.400    mm"
"          Rainfall volume        234.25    546.59    780.84    c.m"
"          Rainfall losses       29.413    5.009     12.331    mm"
"          Runoff depth          2.987     27.391    20.069    mm"
"          Runoff volume          21.59     462.08    483.67    c.m"
"          Runoff coefficient    0.092     0.845     0.619     "
"          Maximum flow          0.002     0.236     0.236     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.236     0.236     0.000     0.000"
" 81        ADD COMMENT================================================="
"        1  Lines of comment"
"          SWM POND"
" 54        POND DESIGN"
"     0.236  Current peak flow    c.m/sec"
"     0.080  Target outflow    c.m/sec"
"     483.7  Hydrograph volume    c.m"
"        47.  Number of stages"
"   347.700  Minimum water level    metre"
"   350.000  Maximum water level    metre"
"   347.700  Starting water level    metre"
"          0  Keep Design Data: 1 = True; 0 = False"
"               Level Discharge   Volume"
"             347.700    0.000    0.000"
"             347.750  0.00070   0.7400"
"             347.800  0.00276    5.110"
"             347.850  0.00390   15.030"
"             347.900  0.00477   29.500"
"             347.950  0.00551   46.690"
"             348.000  0.00616   65.520"
"             348.050  0.00675   85.580"
"             348.100  0.00729  106.820"
"             348.150  0.00780  129.250"
"             348.200  0.00827  152.890"
"             348.250  0.00872  177.770"
"             348.300  0.00914  203.900"
"             348.350  0.00955  231.300"
"             348.400  0.00994  259.990"
"             348.450  0.01031  289.990"
"             348.500  0.01068  321.320"
"             348.550  0.01103  354.000"
"             348.600  0.01137  388.040"
"             348.650  0.01170  423.480"
"             348.700  0.01202  460.320"
"             348.750  0.01233  498.580"
"             348.800  0.01263  538.290"
"             348.850  0.01293  579.460"
"             348.900  0.01322  622.120"
"             348.950  0.01351  666.280"
"             349.000  0.01378  711.960"
"             349.050  0.01406  759.180"
"             349.100  0.01432  807.980"
"             349.150  0.01459  858.330"
```

```
"              349.200   0.01485   910.290"
"              349.250   0.01510   963.870"
"              349.300   0.01535  1019.090"
"              349.350   0.01559  1075.960"
"              349.400   0.01584  1134.520"
"              349.450   0.01607  1194.760"
"              349.500   0.01631  1256.720"
"              349.550   0.01654  1320.420"
"              349.600   0.01677  1385.860"
"              349.650   0.01699  1453.080"
"              349.700   0.01722  1522.100"
"              349.750   0.01743  1592.920"
"              349.800   0.01765  1665.570"
"              349.850   0.01787  1740.070"
"              349.900    0.1739  1816.450"
"              349.950    0.4689  1894.710"
"              350.000    0.8638  1974.870"
"          1.  WEIRS"
"               Crest     Weir     Crest     Left     Right"
"           elevation coefficie   breadth sideslope sideslope"
"             349.850     1.600     5.000     3.000     3.000"
"          1.  ORIFICES"
"             Orifice   Orifice   Orifice Number of"
"              invert coefficie  diameter  orifices"
"             347.700     0.630    0.0750     1.000"
"           Peak outflow                 0.011    c.m/sec"
"           Maximum level              348.579    metre"
"           Maximum storage              373.498    c.m"
"           Centroidal lag               8.100    hours"
"              0.236     0.236     0.011     0.000 c.m/sec"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"               0.236     0.011     0.011     0.000"
" 51        PIPE DESIGN"
"       0.011   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       0.300   Diameter    metre"
"       0.600   Gradient   %"
"           Depth of flow                0.078    metre"
"           Velocity                   0.762    m/sec"
"           Pipe capacity                0.075    c.m/sec"
"           Critical depth               0.080    metre"
" 53        ROUTE    Pipe Route 38"
"      37.50      Pipe Route 38 Reach length   ( metre)"
"       0.409   X-factor <= 0.5"
"      36.915   K-lag   ( seconds)"
"       0.000   Default(0) or user spec.(1) values used"
"       0.500   X-factor <= 0.5"
"      30.000   K-lag   ( seconds)"
"       0.500   Beta weighting factor"
"      42.857   Routing time step   ( seconds)"
"           1   No. of sub-reaches"
"           Peak outflow                 0.011    c.m/sec"
"               0.236     0.011     0.011     0.000 c.m/sec"
" 40        HYDROGRAPH   Combine    1"
"          6   Combine "
```



```
"          1   Node #"
"            Total Property Outflow"
"           Maximum flow                 0.011    c.m/sec"
"           Hydrograph volume          483.683    c.m"
"                0.236     0.011     0.011     0.011"
" 40        HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                0.236     0.000     0.011     0.011"
" 33        CATCHMENT 102"
"          1   Triangular SCS"
"          2   Proportional to %"
"          1   SCS method"
"        102   Catchment C "
"       5.000   % Impervious"
"       0.260   Total Area"
"      38.000   Flow length"
"       2.000   Overland Slope"
"       0.247   Pervious Area"
"      38.000   Pervious length"
"       2.000   Pervious slope"
"       0.013   Impervious Area"
"       2.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      68.000   Pervious SCS Curve No."
"       0.092   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      11.953   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.753   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                0.003     0.000     0.011     0.011 c.m/sec"
"           Catchment 102          Pervious   Impervious Total Area "
"           Surface Area          0.247      0.013      0.260      hectare"
"           Time of concentration  42.035     0.442      29.523     minutes"
"           Time to Centroid       152.976    87.586     133.305    minutes"
"           Rainfall depth         32.400     32.400     32.400     mm"
"           Rainfall volume        80.03      4.21       84.24      c.m"
"           Rainfall losses        29.414     7.988      28.343     mm"
"           Runoff depth           2.986      24.412     4.057      mm"
"           Runoff volume          7.38       3.17       10.55      c.m"
"           Runoff coefficient     0.092      0.753      0.125      "
"           Maximum flow           0.001      0.003      0.003      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                0.003     0.003     0.011     0.011"
" 57        TRENCH Design d/s of 102"
"       0.003   Peak inflow"
"      10.549   Hydrograph volume"
"      14.000   Ground elevation"
"      13.000   Downstream trench invert"
"       1.000   Trench height"
"      12.000   Water table elevation"
"       3.000   Trench top width"
```

```
"      1.800   Trench bottom width"
"     50.000   Voids ratio (%)"
"     50.000   Hydraulic conductivity"
"      0.000   Trench gradient (%)"
"     50.000   Trench length"
"      1.000   Include base width"
"       21.   Number of stages"
"             Level Discharge    Volume"
"            13.000     0.000      0.0"
"            13.050     0.000      2.3"
"            13.100     0.000      4.7"
"            13.150     0.000      7.1"
"            13.200     0.000      9.6"
"            13.250     0.000     12.2"
"            13.300     0.000     14.9"
"            13.350     0.000     17.6"
"            13.400     0.000     20.4"
"            13.450     0.000     23.3"
"            13.500     0.000     26.3"
"            13.550     0.000     29.3"
"            13.600     0.000     32.4"
"            13.650     0.000     35.6"
"            13.700     0.000     38.8"
"            13.750     0.000     42.2"
"            13.800     0.000     45.6"
"            13.850     0.000     49.1"
"            13.900     0.000     52.7"
"            13.950     0.000     56.3"
"            14.000     0.000     60.0"
"         1.  MANHOLE"
"             Access"
"           diameter"
"              1.200"
"          Peak outflow              0.000    c.m/sec"
"          Outflow volume            0.001    c.m"
"          Peak exfiltration         0.001    c.m/sec"
"          Exfiltration volume      10.549    c.m"
"          Maximum level            13.049    metre"
"          Maximum storage           2.264    c.m"
"          Centroidal lag           2.688    hours"
"          Infiltration area 2 sides  5.770   sq.metre"
"          Infiltration Base area    90.000   sq.metre"
"             0.003     0.003     0.000     0.001 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"             0.003     0.000     0.000     0.001"
" 40       HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"             0.003     0.000     0.000     0.001"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"           Total Property Outflow"
"          Maximum flow              0.011    c.m/sec"
"          Hydrograph volume       483.683    c.m"
"             0.003     0.000     0.000     0.011"
```



```
" 40       HYDROGRAPH Start - New Tributary"
"         2   Start - New Tributary"
"             0.003     0.000     0.000     0.011"
" 33       CATCHMENT 2"
"         1   Triangular SCS"
"         2   Proportional to %"
"         1   SCS method"
"         2   Catchment C draining to back of lots"
"     50.000   % Impervious"
"      0.500   Total Area"
"     16.000   Flow length"
"      2.000   Overland Slope"
"      0.250   Pervious Area"
"     16.000   Pervious length"
"      2.000   Pervious slope"
"      0.250   Impervious Area"
"     16.000   Impervious length"
"      2.000   Impervious slope"
"      0.250   Pervious Manning 'n'"
"     68.000   Pervious SCS Curve No."
"      0.092   Pervious Runoff coefficient"
"      0.100   Pervious Ia/S coefficient"
"     11.953   Pervious Initial abstraction"
"      0.015   Impervious Manning 'n'"
"     98.000   Impervious SCS Curve No."
"      0.834   Impervious Runoff coefficient"
"      0.100   Impervious Ia/S coefficient"
"      0.518   Impervious Initial abstraction"
"             0.056     0.000     0.000     0.011 c.m/sec"
"          Catchment 2          Pervious   Impervious Total Area "
"          Surface Area          0.250     0.250     0.500     hectare"
"          Time of concentration  25.016     1.541     3.875     minutes"
"          Time to Centroid       133.276    88.562    93.008    minutes"
"          Rainfall depth        32.400    32.400    32.400    mm"
"          Rainfall volume        81.00     81.00     162.00    c.m"
"          Rainfall losses       29.416    5.376     17.396    mm"
"          Runoff depth          2.984     27.025    15.004    mm"
"          Runoff volume          7.46      67.56     75.02     c.m"
"          Runoff coefficient     0.092     0.834     0.463     "
"          Maximum flow           0.002     0.056     0.056     c.m/sec"
" 40       HYDROGRAPH Add Runoff "
"         4   Add Runoff "
"             0.056     0.056     0.000     0.011"
" 57       TRENCH Design d/s of 2"
"      0.056   Peak inflow"
"     75.021   Hydrograph volume"
"     14.000   Ground elevation"
"     13.000   Downstream trench invert"
"      1.000   Trench height"
"     12.000   Water table elevation"
"      3.000   Trench top width"
"      1.800   Trench bottom width"
"     50.000   Voids ratio (%)"
"     50.000   Hydraulic conductivity"
"      0.000   Trench gradient (%)"
"    230.000   Trench length"
```

```
"      1.000   Include base width"
"       21.   Number of stages"
"             Level Discharge   Volume"
"            13.000    0.000     0.0"
"            13.050    0.000    10.5"
"            13.100    0.000    21.4"
"            13.150    0.000    32.6"
"            13.200    0.000    44.2"
"            13.250    0.000    56.1"
"            13.300    0.000    68.3"
"            13.350    0.000    80.9"
"            13.400    0.000    93.8"
"            13.450    0.000   107.1"
"            13.500    0.000   120.8"
"            13.550    0.000   134.7"
"            13.600    0.000   149.0"
"            13.650    0.000   163.7"
"            13.700    0.000   178.7"
"            13.750    0.000   194.1"
"            13.800    0.000   209.8"
"            13.850    0.000   225.8"
"            13.900    0.000   242.2"
"            13.950    0.000   258.9"
"            14.000    0.000   276.0"
"         1.   MANHOLE"
"              Access"
"             diameter"
"               1.200"
"          Peak outflow              0.000   c.m/sec"
"          Outflow volume            0.001   c.m"
"          Peak exfiltration         0.008   c.m/sec"
"          Exfiltration volume      74.973   c.m"
"          Maximum level            13.187   metre"
"          Maximum storage          41.231   c.m"
"          Centroidal lag            2.619   hours"
"          Infiltration area 2 sides  100.492  sq.metre"
"          Infiltration Base area    414.000  sq.metre"
"              0.056    0.056    0.000    0.008 c.m/sec"
" 40       HYDROGRAPH Next link "
"         5   Next link "
"              0.056    0.000    0.000    0.008"
" 40       HYDROGRAPH Copy to Outflow"
"         8   Copy to Outflow"
"              0.056    0.000    0.000    0.008"
" 40       HYDROGRAPH   Combine    1"
"         6   Combine "
"         1   Node #"
"             Total Property Outflow"
"          Maximum flow              0.011   c.m/sec"
"          Hydrograph volume       483.684   c.m"
"              0.056    0.000    0.000    0.011"
" 40       HYDROGRAPH   Confluence    1"
"         7   Confluence "
"         1   Node #"
"             Total Property Outflow"
"          Maximum flow              0.011   c.m/sec"
```



```
"          Hydrograph volume       483.684   c.m"
"              0.056    0.011    0.000    0.000"
" 38       START/RE-START TOTALS 1"
"         3   Runoff Totals on EXIT"
"          Total Catchment area        3.170   hectare"
"          Total Impervious area       1.950   hectare"
"          Total % impervious         61.514"
" 19       EXIT"
```

```
"             MIDUSS Output ------------------------------------------------>"
"             MIDUSS version                    Version 2.25  rev. 473"
"             MIDUSS created                    February 7, 2010"
"         10  Units used:                       ie METRIC"
"             Job folder:              C:\Users\TimAntonio\Water's Edge\"
"           Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\2024
Revised Plan\October 17\No routing or swale"
"             Output filename:       23014_100YR24HRSCS_20241021_0737NR.out"
"             Licensee name:                    Water's Edge"
"             Company                           Water's Edge"
"             Date & Time last used:            2024-10-21 at 7:36:45 AM"
" 31        TIME PARAMETERS"
"       5.000   Time Step"
"     180.000   Max. Storm length"
"    5760.000   Max. Hydrograph"
" 81        ADD COMMENT================================================="
"         1  Lines of comment"
"           100YR 24HR SCS"
" 32        STORM Chicago storm"
"           1   Chicago storm"
"    4692.000   Coefficient A"
"      17.437   Constant B"
"       0.956   Exponent C"
"       0.400   Fraction R"
"     180.000   Duration"
"       1.000   Time step multiplier"
"           Maximum intensity          239.793    mm/hr"
"           Total depth                89.960    mm"
"         6   100hyd   Hydrograph extension used in this file"
" 33        CATCHMENT 101"
"           1   Triangular SCS"
"           2   Proportional to %"
"           1   SCS method"
"         101   Catchment A"
"      70.000   % Impervious"
"       2.380   Total Area"
"     274.000   Flow length"
"       2.000   Overland Slope"
"       0.714   Pervious Area"
"     274.000   Pervious length"
"       2.000   Pervious slope"
"       1.666   Impervious Area"
"     639.333   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      68.000   Pervious SCS Curve No."
"       0.342   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      11.953   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.933   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                 0.776     0.000     0.000     0.000 c.m/sec"
"           Catchment 101          Pervious   Impervious Total Area "
```



```
"           Surface Area          0.714      1.666      2.380      hectare"
"           Time of concentration  50.140      9.863     15.334     minutes"
"           Time to Centroid       156.008    97.678    105.602    minutes"
"           Rainfall depth         89.960     89.960     89.960     mm"
"           Rainfall volume        642.31     1498.73    2141.05    c.m"
"           Rainfall losses        59.164     6.000      21.949     mm"
"           Runoff depth           30.796     83.961     68.011     mm"
"           Runoff volume          219.88     1398.78    1618.67    c.m"
"           Runoff coefficient     0.342      0.933      0.756      "
"           Maximum flow           0.041      0.771      0.776      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.776     0.776     0.000     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                 0.776     0.000     0.000     0.000"
" 33          CATCHMENT 102"
"           1   Triangular SCS"
"           2   Proportional to %"
"           1   SCS method"
"         102   Catchment C "
"       5.000   % Impervious"
"       0.260   Total Area"
"      38.000   Flow length"
"       2.000   Overland Slope"
"       0.247   Pervious Area"
"      38.000   Pervious length"
"       2.000   Pervious slope"
"       0.013   Impervious Area"
"       2.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      68.000   Pervious SCS Curve No."
"       0.342   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      11.953   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.813   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                 0.034     0.000     0.000     0.000 c.m/sec"
"           Catchment 102          Pervious   Impervious Total Area "
"           Surface Area          0.247      0.013      0.260      hectare"
"           Time of concentration  15.325      0.310     13.654     minutes"
"           Time to Centroid       113.674    84.488    110.426    minutes"
"           Rainfall depth         89.960     89.960     89.960     mm"
"           Rainfall volume        222.20     11.69      233.90     c.m"
"           Rainfall losses        59.235     16.854     57.116     mm"
"           Runoff depth           30.725     73.107     32.844     mm"
"           Runoff volume          75.89      9.50       85.40      c.m"
"           Runoff coefficient     0.342      0.813      0.365      "
"           Maximum flow           0.032      0.007      0.034      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.034     0.034     0.000     0.000"
```

```
" 40        HYDROGRAPH Next link "
"          5  Next link "
"               0.034    0.000    0.000    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"               0.034    0.000    0.000    0.000"
" 40        HYDROGRAPH   Combine    1"
"          6  Combine "
"          1  Node #"
"             Total Property Outflow"
"           Maximum flow              0.000    c.m/sec"
"           Hydrograph volume         0.000    c.m"
"               0.034    0.000    0.000    0.000"
" 40        HYDROGRAPH Start - New Tributary"
"          2  Start - New Tributary"
"               0.034    0.000    0.000    0.000"
" 33        CATCHMENT 2"
"          1  Triangular SCS"
"          2  Proportional to %"
"          1  SCS method"
"          2  Catchment C draining overland to Laurel Creek"
"      50.000  % Impervious"
"       0.500  Total Area"
"      16.000  Flow length"
"       2.000  Overland Slope"
"       0.250  Pervious Area"
"      16.000  Pervious length"
"       2.000  Pervious slope"
"       0.250  Impervious Area"
"      16.000  Impervious length"
"       2.000  Impervious slope"
"       0.250  Pervious Manning 'n'"
"      68.000  Pervious SCS Curve No."
"       0.340  Pervious Runoff coefficient"
"       0.100  Pervious Ia/S coefficient"
"      11.953  Pervious Initial abstraction"
"       0.015  Impervious Manning 'n'"
"      98.000  Impervious SCS Curve No."
"       0.914  Impervious Runoff coefficient"
"       0.100  Impervious Ia/S coefficient"
"       0.518  Impervious Initial abstraction"
"               0.155    0.000    0.000    0.000 c.m/sec"
"          Catchment 2          Pervious   Impervious Total Area "
"          Surface Area         0.250      0.250      0.500      hectare"
"          Time of concentration  9.120      1.079      3.260      minutes"
"          Time to Centroid      106.116    85.578     91.149     minutes"
"          Rainfall depth        89.960     89.960     89.960     mm"
"          Rainfall volume       224.90     224.90     449.80     c.m"
"          Rainfall losses       59.347     7.711      33.529     mm"
"          Runoff depth          30.613     82.249     56.431     mm"
"          Runoff volume         76.53      205.62     282.16     c.m"
"          Runoff coefficient    0.340      0.914      0.627      "
"          Maximum flow          0.040      0.145      0.155      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"          4  Add Runoff "
"               0.155    0.155    0.000    0.000"
```



```
" 40        HYDROGRAPH Next link "
"          5  Next link "
"               0.155    0.000    0.000    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8  Copy to Outflow"
"               0.155    0.000    0.000    0.000"
" 40        HYDROGRAPH   Combine    1"
"          6  Combine "
"          1  Node #"
"             Total Property Outflow"
"           Maximum flow              0.000    c.m/sec"
"           Hydrograph volume         0.000    c.m"
"               0.155    0.000    0.000    0.000"
" 40        HYDROGRAPH   Confluence    1"
"          7  Confluence "
"          1  Node #"
"             Total Property Outflow"
"           Maximum flow              0.000    c.m/sec"
"           Hydrograph volume         0.000    c.m"
"               0.155    0.000    0.000    0.000"
" 38        START/RE-START TOTALS 1"
"          3  Runoff Totals on EXIT"
"           Total Catchment area              3.140    hectare"
"           Total Impervious area             1.929    hectare"
"           Total % impervious               61.433"
" 19        EXIT"
```

```
"             MIDUSS Output ------------------------------------------------>"
"             MIDUSS version                    Version 2.25  rev. 473"
"             MIDUSS created                    February 7, 2010"
"         10  Units used:                       ie METRIC"
"             Job folder:              C:\Users\TimAntonio\Water's Edge\"
"            Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\2024
Revised Plan\October 17\No routing or swale"
"             Output filename:       23014_25YR24HRSCS_20241017_1357NR.out"
"             Licensee name:                    Water's Edge"
"             Company                           Water's Edge"
"             Date & Time last used:            2024-10-21 at 8:01:40 AM"
" 31        TIME PARAMETERS"
"      5.000  Time Step"
"    180.000  Max. Storm length"
"   5760.000  Max. Hydrograph"
" 81        ADD COMMENT================================================="
"         1  Lines of comment"
"          25YR 24HR SCS"
" 32        STORM Chicago storm"
"          1  Chicago storm"
"   3261.000  Coefficient A"
"     16.190  Constant B"
"      0.938  Exponent C"
"      0.400  Fraction R"
"    180.000  Duration"
"      1.000  Time step multiplier"
"          Maximum intensity         185.969    mm/hr"
"          Total depth               69.174    mm"
"          6  025hyd  Hydrograph extension used in this file"
" 33        CATCHMENT 101"
"          1  Triangular SCS"
"          2  Proportional to %"
"          1  SCS method"
"        101  Catchment A"
"     70.000  % Impervious"
"      2.380  Total Area"
"    274.000  Flow length"
"      2.000  Overland Slope"
"      0.714  Pervious Area"
"    274.000  Pervious length"
"      2.000  Pervious slope"
"      1.666  Impervious Area"
"    639.333  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.268  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.921  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.569    0.000    0.000    0.000 c.m/sec"
"          Catchment 101         Pervious   Impervious Total Area "
```



```
"         Surface Area         0.714     1.666     2.380     hectare"
"         Time of concentration  63.099     10.959     16.735     minutes"
"         Time to Centroid      172.143    99.904    107.907    minutes"
"         Rainfall depth        69.174    69.174    69.174    mm"
"         Rainfall volume       493.90    1152.43   1646.33   c.m"
"         Rainfall losses       50.654    5.467     19.023    mm"
"         Runoff depth          18.520    63.706    50.150    mm"
"         Runoff volume         132.23    1061.35   1193.58   c.m"
"         Runoff coefficient    0.268     0.921     0.725     "
"         Maximum flow          0.020     0.565     0.569     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"         4  Add Runoff "
"              0.569    0.569    0.000    0.000"
" 40        HYDROGRAPH Start - New Tributary"
"         2  Start - New Tributary"
"              0.569    0.000    0.000    0.000"
" 33        CATCHMENT 102"
"         1  Triangular SCS"
"         2  Proportional to %"
"         1  SCS method"
"       102  Catchment C "
"      5.000  % Impervious"
"      0.260  Total Area"
"     38.000  Flow length"
"      2.000  Overland Slope"
"      0.247  Pervious Area"
"     38.000  Pervious length"
"      2.000  Pervious slope"
"      0.013  Impervious Area"
"      2.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.267  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.802  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.017    0.000    0.000    0.000 c.m/sec"
"          Catchment 102         Pervious   Impervious Total Area "
"         Surface Area         0.247     0.013     0.260     hectare"
"         Time of concentration  19.286     0.344     16.704     minutes"
"         Time to Centroid      120.035    85.355    115.307    minutes"
"         Rainfall depth        69.174    69.174    69.174    mm"
"         Rainfall volume       170.86    8.99      179.85    c.m"
"         Rainfall losses       50.679    13.705    48.831    mm"
"         Runoff depth          18.494    55.469    20.343    mm"
"         Runoff volume         45.68     7.21      52.89     c.m"
"         Runoff coefficient    0.267     0.802     0.294     "
"         Maximum flow          0.016     0.006     0.017     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"         4  Add Runoff "
"              0.017    0.017    0.000    0.000"
```

```
" 40        HYDROGRAPH Next link "
"           5  Next link "
"                0.017    0.000    0.000    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"           8  Copy to Outflow"
"                0.017    0.000    0.000    0.000"
" 40        HYDROGRAPH   Combine    1"
"           6  Combine "
"           1  Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                0.017    0.000    0.000    0.000"
" 40        HYDROGRAPH Start - New Tributary"
"           2  Start - New Tributary"
"                0.017    0.000    0.000    0.000"
" 33        CATCHMENT 2"
"           1  Triangular SCS"
"           2  Proportional to %"
"           1  SCS method"
"           2  Catchment C draining to back of lots"
"       50.000  % Impervious"
"        0.500  Total Area"
"       16.000  Flow length"
"        2.000  Overland Slope"
"        0.250  Pervious Area"
"       16.000  Pervious length"
"        2.000  Pervious slope"
"        0.250  Impervious Area"
"       16.000  Impervious length"
"        2.000  Impervious slope"
"        0.250  Pervious Manning 'n'"
"       68.000  Pervious SCS Curve No."
"        0.267  Pervious Runoff coefficient"
"        0.100  Pervious Ia/S coefficient"
"       11.953  Pervious Initial abstraction"
"        0.015  Impervious Manning 'n'"
"       98.000  Impervious SCS Curve No."
"        0.903  Impervious Runoff coefficient"
"        0.100  Impervious Ia/S coefficient"
"        0.518  Impervious Initial abstraction"
"                0.115    0.000    0.000    0.000 c.m/sec"
"           Catchment 2          Pervious   Impervious Total Area "
"           Surface Area         0.250      0.250      0.500      hectare"
"           Time of concentration  11.477     1.199      3.546      minutes"
"           Time to Centroid       110.724    86.392     91.948     minutes"
"           Rainfall depth         69.174     69.174     69.174     mm"
"           Rainfall volume        172.93     172.93     345.87     c.m"
"           Rainfall losses        50.686     6.692      28.689     mm"
"           Runoff depth           18.487     62.482     40.485     mm"
"           Runoff volume          46.22      156.20     202.42     c.m"
"           Runoff coefficient     0.267      0.903      0.585      "
"           Maximum flow           0.020      0.111      0.115      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"           4  Add Runoff "
"                0.115    0.115    0.000    0.000"
```



```
" 40        HYDROGRAPH Next link "
"           5  Next link "
"                0.115    0.000    0.000    0.000"
" 40        HYDROGRAPH Copy to Outflow"
"           8  Copy to Outflow"
"                0.115    0.000    0.000    0.000"
" 40        HYDROGRAPH   Combine    1"
"           6  Combine "
"           1  Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                0.115    0.000    0.000    0.000"
" 40        HYDROGRAPH   Confluence    1"
"           7  Confluence "
"           1  Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                0.115    0.000    0.000    0.000"
" 38        START/RE-START TOTALS 1"
"           3  Runoff Totals on EXIT"
"           Total Catchment area                3.140    hectare"
"           Total Impervious area               1.929    hectare"
"           Total % impervious                  61.433"
" 19        EXIT"
```

```
"             MIDUSS Output ------------------------------------------------>"
"             MIDUSS version                    Version 2.25  rev. 473"
"             MIDUSS created                    February 7, 2010"
"         10  Units used:                       ie METRIC"
"             Job folder:              C:\Users\TimAntonio\Water's Edge\"
"             Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\2024
Revised Plan\October 17\No routing or swale"
"             Output filename:         23014_5YR24HRSCS_20241021_0809NR.out"
"             Licensee name:                    Water's Edge"
"             Company                           Water's Edge"
"             Date & Time last used:            2024-10-21 at 8:07:58 AM"
" 31        TIME PARAMETERS"
"      5.000  Time Step"
"    180.000  Max. Storm length"
"   5760.000  Max. Hydrograph"
" 81        ADD COMMENT================================================="
"        1  Lines of comment"
"          5YR 24HR SCS"
" 32        STORM Chicago storm"
"          1  Chicago storm"
"   1755.000  Coefficient A"
"     12.347  Constant B"
"      0.895  Exponent C"
"      0.400  Fraction R"
"    180.000  Duration"
"      1.000  Time step multiplier"
"          Maximum intensity         136.512    mm/hr"
"          Total depth               47.549    mm"
"          6  005hyd  Hydrograph extension used in this file"
" 33        CATCHMENT 101"
"          1  Triangular SCS"
"          2  Proportional to %"
"          1  SCS method"
"        101  Catchment A"
"     70.000  % Impervious"
"      2.380  Total Area"
"    274.000  Flow length"
"      2.000  Overland Slope"
"      0.714  Pervious Area"
"    274.000  Pervious length"
"      2.000  Pervious slope"
"      1.666  Impervious Area"
"    639.333  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.172  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.888  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.359     0.000     0.000     0.000 c.m/sec"
"          Catchment 101         Pervious   Impervious Total Area "
```



```
"         Surface Area          0.714      1.666      2.380      hectare"
"         Time of concentration  92.484     12.512     18.633     minutes"
"         Time to Centroid       205.875    103.595    111.424    minutes"
"         Rainfall depth         47.549     47.549     47.549     mm"
"         Rainfall volume        339.50     792.17     1131.67    c.m"
"         Rainfall losses        39.381     5.317      15.536     mm"
"         Runoff depth           8.168      42.232     32.013     mm"
"         Runoff volume          58.32      703.59     761.90     c.m"
"         Runoff coefficient     0.172      0.888      0.673      "
"         Maximum flow           0.007      0.358      0.359      c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"         4  Add Runoff "
"              0.359     0.359     0.000     0.000"
" 40        HYDROGRAPH Next link "
"         5  Next link "
"              0.359     0.000     0.000     0.000"
" 40        HYDROGRAPH Start - New Tributary"
"         2  Start - New Tributary"
"              0.359     0.000     0.000     0.000"
" 33        CATCHMENT 102"
"          1  Triangular SCS"
"          2  Proportional to %"
"          1  SCS method"
"        102  Catchment C "
"      5.000  % Impervious"
"      0.260  Total Area"
"     38.000  Flow length"
"      2.000  Overland Slope"
"      0.247  Pervious Area"
"     38.000  Pervious length"
"      2.000  Pervious slope"
"      0.013  Impervious Area"
"      2.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.172  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.782  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.006     0.000     0.000     0.000 c.m/sec"
"          Catchment 102         Pervious   Impervious Total Area "
"          Surface Area          0.247      0.013      0.260      hectare"
"          Time of concentration  28.267     0.393      22.873     minutes"
"          Time to Centroid       132.885    86.775     123.962    minutes"
"          Rainfall depth         47.549     47.549     47.549     mm"
"          Rainfall volume        117.45     6.18       123.63     c.m"
"          Rainfall losses        39.389     10.345     37.937     mm"
"          Runoff depth           8.160      37.204     9.612      mm"
"          Runoff volume          20.16      4.84       24.99      c.m"
"          Runoff coefficient     0.172      0.782      0.202      "
"          Maximum flow           0.005      0.004      0.006      c.m/sec"
```

```
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.006     0.006     0.000     0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                 0.006     0.000     0.000     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                 0.006     0.000     0.000     0.000"
" 40        HYDROGRAPH   Combine    1"
"          6   Combine "
"          1   Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                 0.006     0.000     0.000     0.000"
" 40        HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                 0.006     0.000     0.000     0.000"
" 33        CATCHMENT 2"
"          1   Triangular SCS"
"          2   Proportional to %"
"          1   SCS method"
"          2   Catchment C draining to back of lots"
"       50.000   % Impervious"
"        0.500   Total Area"
"       16.000   Flow length"
"        2.000   Overland Slope"
"        0.250   Pervious Area"
"       16.000   Pervious length"
"        2.000   Pervious slope"
"        0.250   Impervious Area"
"       16.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       68.000   Pervious SCS Curve No."
"        0.171   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       11.953   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.876   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                  0.078     0.000     0.000     0.000 c.m/sec"
"             Catchment 2           Pervious   Impervious Total Area "
"             Surface Area          0.250      0.250      0.500      hectare"
"             Time of concentration 16.822     1.369      3.897      minutes"
"             Time to Centroid      119.869    87.721     92.981     minutes"
"             Rainfall depth        47.549     47.549     47.549     mm"
"             Rainfall volume       118.87     118.87     237.75     c.m"
"             Rainfall losses       39.399     5.887      22.643     mm"
"             Runoff depth          8.150      41.662     24.906     mm"
"             Runoff volume         20.37      104.15     124.53     c.m"
"             Runoff coefficient    0.171      0.876      0.524      "
"             Maximum flow          0.007      0.078      0.078      c.m/sec"
```



```
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.078     0.078     0.000     0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                 0.078     0.000     0.000     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                 0.078     0.000     0.000     0.000"
" 40        HYDROGRAPH   Combine    1"
"          6   Combine "
"          1   Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                 0.078     0.000     0.000     0.000"
" 40        HYDROGRAPH   Confluence    1"
"          7   Confluence "
"          1   Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                 0.078     0.000     0.000     0.000"
```

```
"             MIDUSS Output ------------------------------------------------>"
"             MIDUSS version                    Version 2.25  rev. 473"
"             MIDUSS created                    February 7, 2010"
"         10  Units used:                       ie METRIC"
"             Job folder:              C:\Users\TimAntonio\Water's Edge\"
"             Water's Edge Team Site - Documents\2023 Projects\23014 - 720 Erbsville Rd\10 Modelling\2024
Revised Plan\October 17\No routing or swale"
"             Output filename:         23014_2YR24HRSCS_20241017_1416NR.out"
"             Licensee name:                    Water's Edge"
"             Company                           Water's Edge"
"             Date & Time last used:            2024-10-21 at 8:15:50 AM"
" 31        TIME PARAMETERS"
"      5.000  Time Step"
"    180.000  Max. Storm length"
"   5760.000  Max. Hydrograph"
" 81        ADD COMMENT================================================="
"        1  Lines of comment"
"          2YR 24HR SCS"
" 32        STORM Chicago storm"
"         1  Chicago storm"
"   1101.000  Coefficient A"
"      9.258  Constant B"
"      0.882  Exponent C"
"      0.400  Fraction R"
"    180.000  Duration"
"      1.000  Time step multiplier"
"          Maximum intensity        105.659    mm/hr"
"          Total depth              32.400    mm"
"         6  002hyd  Hydrograph extension used in this file"
" 33        CATCHMENT 101"
"         1  Triangular SCS"
"         2  Proportional to %"
"         1  SCS method"
"       101  Catchment A"
"     70.000  % Impervious"
"      2.410  Total Area"
"    274.000  Flow length"
"      2.000  Overland Slope"
"      0.723  Pervious Area"
"    274.000  Pervious length"
"      2.000  Pervious slope"
"      1.687  Impervious Area"
"    639.333  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.092  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.845  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.236    0.000    0.000    0.000 c.m/sec"
"          Catchment 101         Pervious   Impervious Total Area "
```



```
"         Surface Area         0.723     1.687     2.410     hectare"
"         Time of concentration  137.530    14.084    19.595    minutes"
"         Time to Centroid      263.507   106.890   113.882   minutes"
"         Rainfall depth       32.400    32.400    32.400    mm"
"         Rainfall volume       234.25    546.59    780.84    c.m"
"         Rainfall losses      29.413    5.009     12.331    mm"
"         Runoff depth         2.987     27.391    20.069    mm"
"         Runoff volume         21.59     462.08    483.67    c.m"
"         Runoff coefficient    0.092     0.845     0.619     "
"         Maximum flow          0.002     0.236     0.236     c.m/sec"
" 40        HYDROGRAPH Add Runoff "
"         4  Add Runoff "
"              0.236    0.236    0.000    0.000"
" 40        HYDROGRAPH Next link "
"         5  Next link "
"              0.236    0.000    0.000    0.000"
" 40        HYDROGRAPH Start - New Tributary"
"         2  Start - New Tributary"
"              0.236    0.000    0.000    0.000"
" 33        CATCHMENT 102"
"         1  Triangular SCS"
"         2  Proportional to %"
"         1  SCS method"
"       102  Catchment C "
"      5.000  % Impervious"
"      0.260  Total Area"
"     38.000  Flow length"
"      2.000  Overland Slope"
"      0.247  Pervious Area"
"     38.000  Pervious length"
"      2.000  Pervious slope"
"      0.013  Impervious Area"
"      2.000  Impervious length"
"      2.000  Impervious slope"
"      0.250  Pervious Manning 'n'"
"     68.000  Pervious SCS Curve No."
"      0.092  Pervious Runoff coefficient"
"      0.100  Pervious Ia/S coefficient"
"     11.953  Pervious Initial abstraction"
"      0.015  Impervious Manning 'n'"
"     98.000  Impervious SCS Curve No."
"      0.753  Impervious Runoff coefficient"
"      0.100  Impervious Ia/S coefficient"
"      0.518  Impervious Initial abstraction"
"               0.003    0.000    0.000    0.000 c.m/sec"
"         Catchment 102         Pervious   Impervious Total Area "
"         Surface Area         0.247     0.013     0.260     hectare"
"         Time of concentration  42.035     0.442     29.523    minutes"
"         Time to Centroid      152.976   87.586    133.305   minutes"
"         Rainfall depth       32.400    32.400    32.400    mm"
"         Rainfall volume       80.03     4.21      84.24     c.m"
"         Rainfall losses      29.414    7.988     28.343    mm"
"         Runoff depth         2.986     24.412    4.057     mm"
"         Runoff volume         7.38      3.17      10.55     c.m"
"         Runoff coefficient    0.092     0.753     0.125     "
"         Maximum flow          0.001     0.003     0.003     c.m/sec"
```

```
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.003     0.003     0.000     0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                 0.003     0.000     0.000     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                 0.003     0.000     0.000     0.000"
" 40        HYDROGRAPH   Combine    1"
"          6   Combine "
"          1   Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                 0.003     0.000     0.000     0.000"
" 40        HYDROGRAPH Start - New Tributary"
"          2   Start - New Tributary"
"                 0.003     0.000     0.000     0.000"
" 33        CATCHMENT 2"
"          1   Triangular SCS"
"          2   Proportional to %"
"          1   SCS method"
"          2   Catchment C draining to back of lots"
"       50.000   % Impervious"
"        0.500   Total Area"
"       16.000   Flow length"
"        2.000   Overland Slope"
"        0.250   Pervious Area"
"       16.000   Pervious length"
"        2.000   Pervious slope"
"        0.250   Impervious Area"
"       16.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       68.000   Pervious SCS Curve No."
"        0.092   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       11.953   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.834   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                 0.056     0.000     0.000     0.000 c.m/sec"
"              Catchment 2           Pervious   Impervious Total Area "
"              Surface Area          0.250      0.250      0.500      hectare"
"              Time of concentration 25.016     1.541      3.875      minutes"
"              Time to Centroid      133.276    88.562     93.008     minutes"
"              Rainfall depth        32.400     32.400     32.400     mm"
"              Rainfall volume       81.00      81.00      162.00     c.m"
"              Rainfall losses       29.416     5.376      17.396     mm"
"              Runoff depth          2.984      27.025     15.004     mm"
"              Runoff volume         7.46       67.56      75.02      c.m"
"              Runoff coefficient    0.092      0.834      0.463      "
"              Maximum flow          0.002      0.056      0.056      c.m/sec"
```

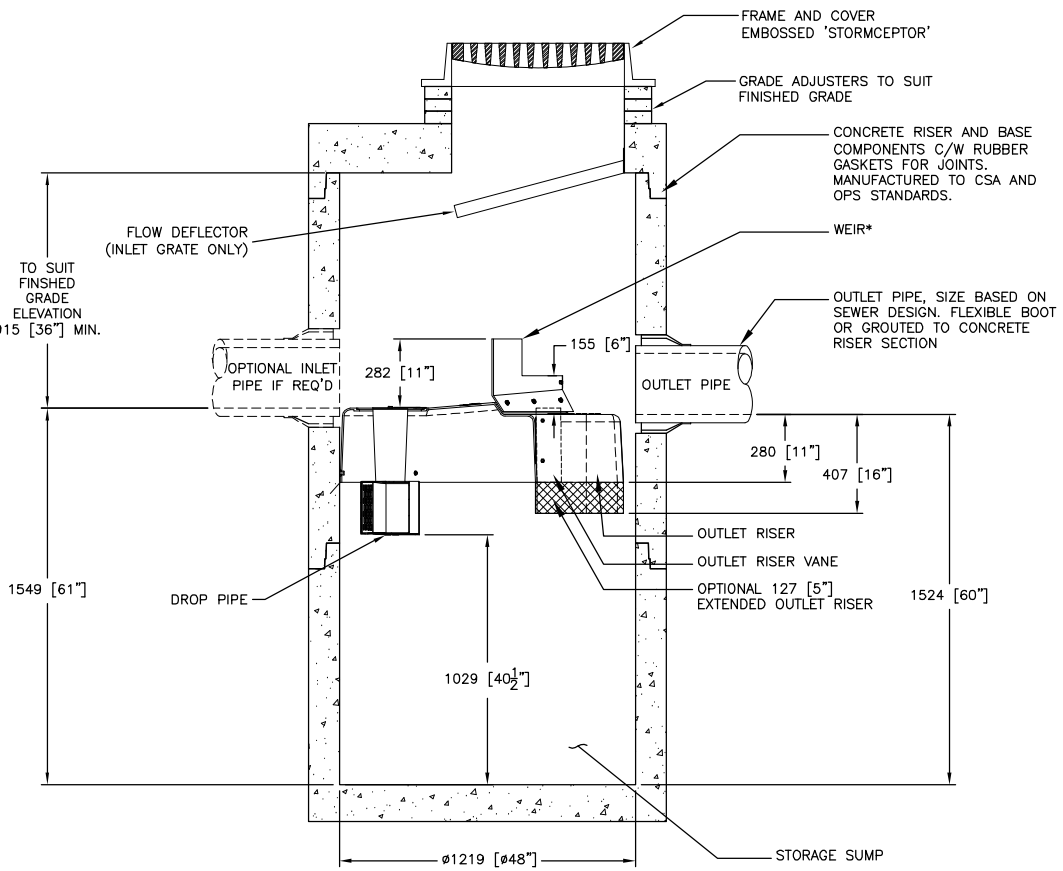


```
" 40        HYDROGRAPH Add Runoff "
"          4   Add Runoff "
"                 0.056     0.056     0.000     0.000"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"                 0.056     0.000     0.000     0.000"
" 40        HYDROGRAPH Copy to Outflow"
"          8   Copy to Outflow"
"                 0.056     0.000     0.000     0.000"
" 40        HYDROGRAPH   Combine    1"
"          6   Combine "
"          1   Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                 0.056     0.000     0.000     0.000"
" 40        HYDROGRAPH   Confluence    1"
"          7   Confluence "
"          1   Node #"
"              Total Property Outflow"
"           Maximum flow                0.000    c.m/sec"
"           Hydrograph volume           0.000    c.m"
"                 0.056     0.000     0.000     0.000"
" 38        START/RE-START TOTALS 1"
"          3   Runoff Totals on EXIT"
"           Total Catchment area                3.170    hectare"
"           Total Impervious area               1.950    hectare"
"           Total % impervious                  61.514"
" 19        EXIT"
```

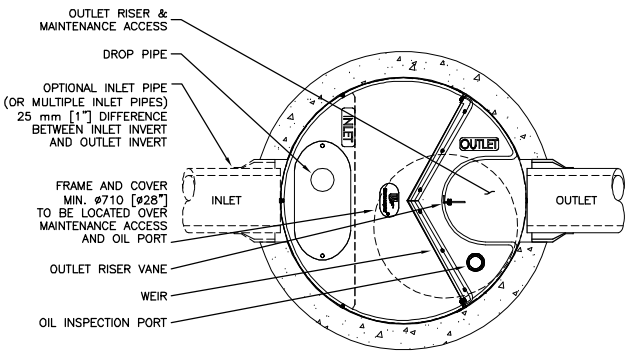


APPENDIX C:

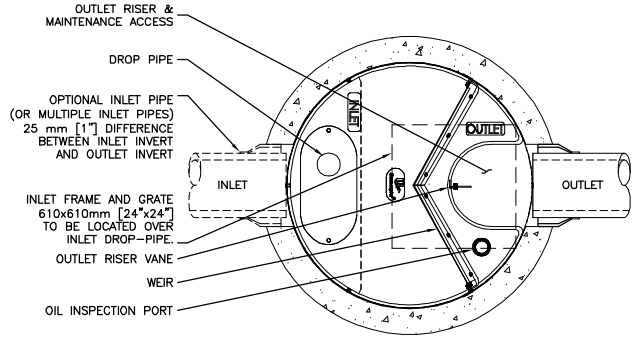
OGS Sizing Report and Specifications



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

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).

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 EF4 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EF04 (OIL CAPTURE CONFIGURATION). WEIR HEIGHT IS 150 mm (6 INCH) FOR EF04.

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.

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	EFO4				
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	6/6/18	UPDATES	JSK
0	5/29/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium
401 Parkview Drive, Bowmanville, ON L1C 5A6
TF 866-868-4661 CA +1-905-623-6600 INT. +1-416-868-6666

DATE: 10/13/2017
DESIGNED: JSK | DRAWN: JSK
CHECKED: BSF | APPROVED: SP
PROJECT No.: EFO4 | SEQUENCE No.: *
SHEET: 1 OF 1

Stormceptor®

Rinker MATERIALS

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

09/13/2023

Province:	Ontario
City:	Waterloo, ON
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
Climate Station Id:	6149387
Years of Rainfall Data:	34

Site Name:	Pond A

Drainage Area (ha):	1.04
% Imperviousness:	70.00

Runoff Coefficient 'c': 0.72

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	71.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	28.37
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	80.54
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	0
Estimated Average Annual Sediment Volume (L/yr):	0

Project Name:	720 Erbsville Rd Pond A
Project Number:	23014
Designer Name:	Tim Antonio
Designer Company:	Waters Edge
Designer Email:	tim@watersedge-est.ca
Designer Phone:	519-651-2390
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	49
EFO6	57
EFO8	62
EFO10	65
EFO12	67

Recommended Stormceptor EF Model: Parallel Models

Estimated Net Annual Sediment (TSS) Load Reduction (%): Parallel Models

Water Quality Runoff Volume Capture (%): > 90

imbrium

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 waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

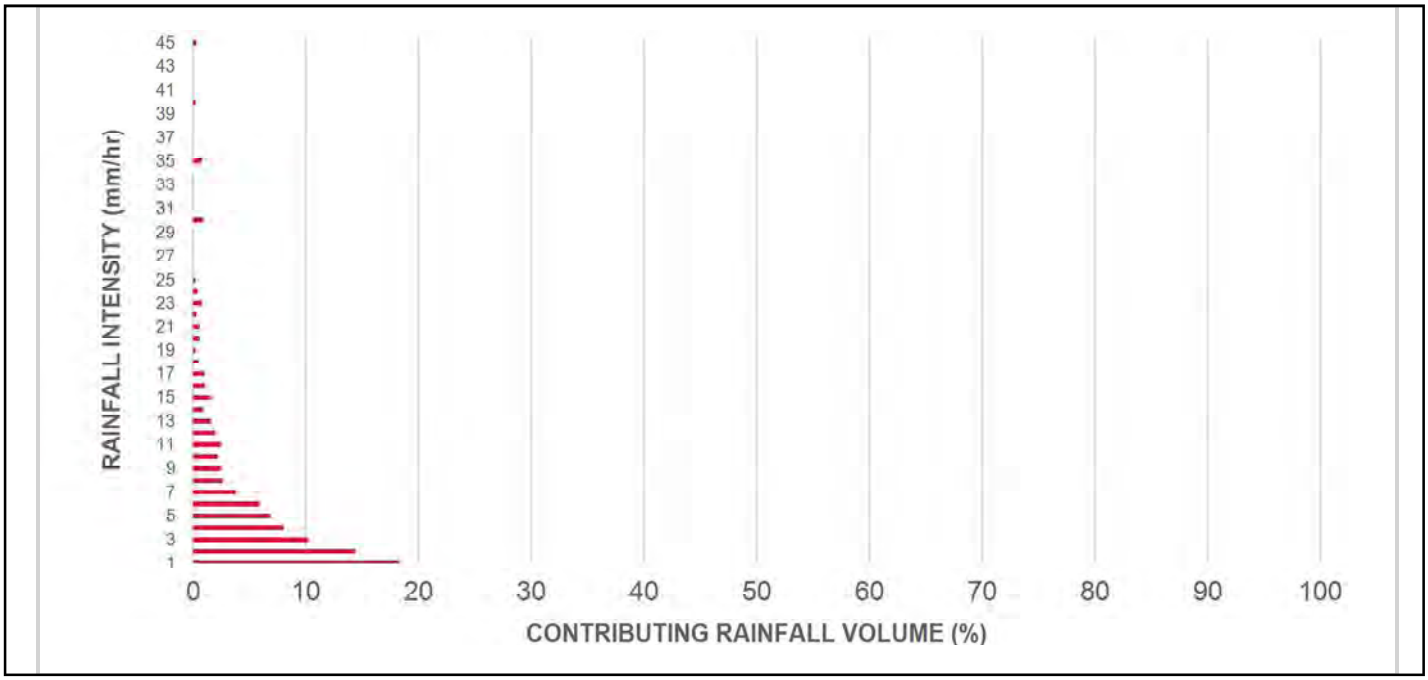
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a 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

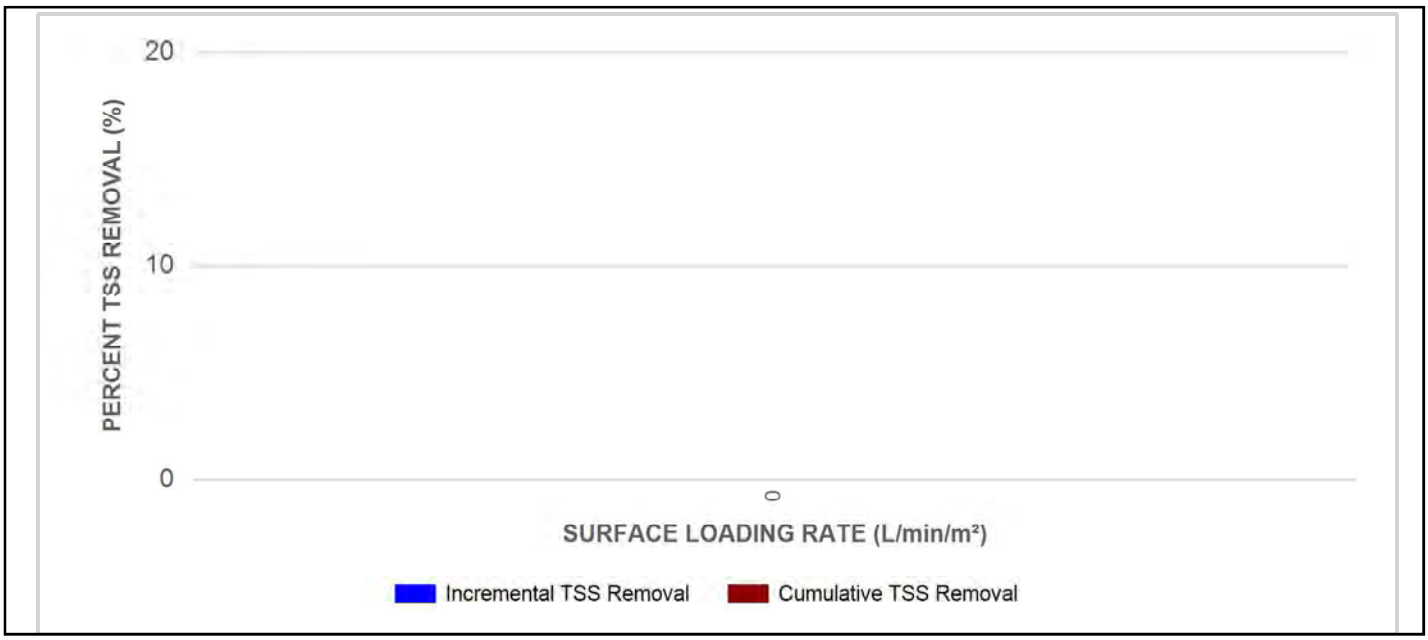
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.5	8.5	1.04	62.0	N/A	N/A	N/A	N/A
1.00	18.3	26.8	2.08	125.0	N/A	N/A	N/A	N/A
2.00	14.4	41.3	4.16	250.0	N/A	N/A	N/A	N/A
3.00	10.2	51.5	6.24	375.0	N/A	N/A	N/A	N/A
4.00	8.0	59.5	8.33	500.0	N/A	N/A	N/A	N/A
5.00	6.9	66.4	10.41	624.0	N/A	N/A	N/A	N/A
6.00	5.9	72.3	12.49	749.0	N/A	N/A	N/A	N/A
7.00	3.8	76.1	14.57	874.0	N/A	N/A	N/A	N/A
8.00	2.6	78.7	16.65	999.0	N/A	N/A	N/A	N/A
9.00	2.5	81.1	18.73	1124.0	N/A	N/A	N/A	N/A
10.00	2.2	83.3	20.82	1249.0	N/A	N/A	N/A	N/A
11.00	2.5	85.8	22.90	1374.0	N/A	N/A	N/A	N/A
12.00	2.0	87.8	24.98	1499.0	N/A	N/A	N/A	N/A
13.00	1.6	89.4	27.06	1624.0	N/A	N/A	N/A	N/A
14.00	0.9	90.4	29.14	1749.0	N/A	N/A	N/A	N/A
15.00	1.6	91.9	31.22	1873.0	N/A	N/A	N/A	N/A
16.00	1.1	93.0	33.31	1998.0	N/A	N/A	N/A	N/A
17.00	1.0	94.0	35.39	2123.0	N/A	N/A	N/A	N/A
18.00	0.5	94.6	37.47	2248.0	N/A	N/A	N/A	N/A
19.00	0.2	94.8	39.55	2373.0	N/A	N/A	N/A	N/A
20.00	0.6	95.4	41.63	2498.0	N/A	N/A	N/A	N/A
21.00	0.6	96.1	43.71	2623.0	N/A	N/A	N/A	N/A
22.00	0.3	96.4	45.80	2748.0	N/A	N/A	N/A	N/A
23.00	0.8	97.2	47.88	2873.0	N/A	N/A	N/A	N/A
24.00	0.4	97.6	49.96	2998.0	N/A	N/A	N/A	N/A
25.00	0.2	97.8	52.04	3122.0	N/A	N/A	N/A	N/A
30.00	0.9	98.7	62.45	3747.0	N/A	N/A	N/A	N/A
35.00	0.8	99.5	72.86	4371.0	N/A	N/A	N/A	N/A
40.00	0.2	99.7	83.27	4996.0	N/A	N/A	N/A	N/A
45.00	0.3	100.0	93.67	5620.0	N/A	N/A	N/A	N/A
Estimated Net Annual Sediment (TSS) Load Reduction =								**0 %**

Climate Station ID: 6149387 *Years of Rainfall Data*: 34

RAINFALL DATA FROM WATERLOO WELLINGTON AP 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

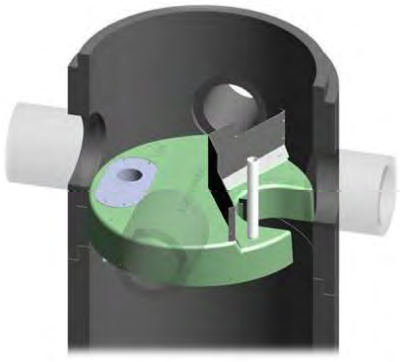
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test 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

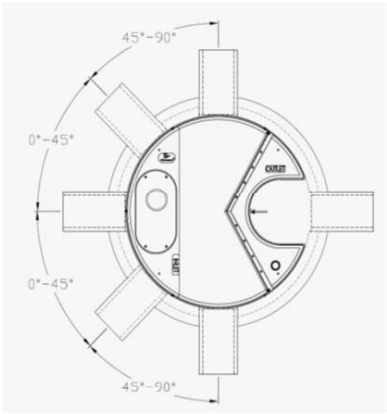
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend 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)	(ft^3)	(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/ft^3)

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

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Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EF

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

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® Rinker MATERIALS

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

09/13/2023

Province:	Ontario
City:	Waterloo, ON
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
Climate Station Id:	6149387
Years of Rainfall Data:	34

Site Name:	

Drainage Area (ha):	1.55
% Imperviousness:	70.00

Runoff Coefficient 'c': 0.72

Particle Size Distribution:	CA ETV
Target TSS Removal (%):	71.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	42.28
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	0
Estimated Average Annual Sediment Volume (L/yr):	0

Project Name:	720 Erbsville Rd Pond B
Project Number:	23014
Designer Name:	Tim Antonio
Designer Company:	Waters Edge
Designer Email:	tim@watersedge-est.ca
Designer Phone:	519-651-2390
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	44
EFO6	53
EFO8	59
EFO10	62
EFO12	64

Recommended Stormceptor EF Model: Parallel Models

Estimated Net Annual Sediment (TSS) Load Reduction (%): Parallel Models

Water Quality Runoff Volume Capture (%): > 90

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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 waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

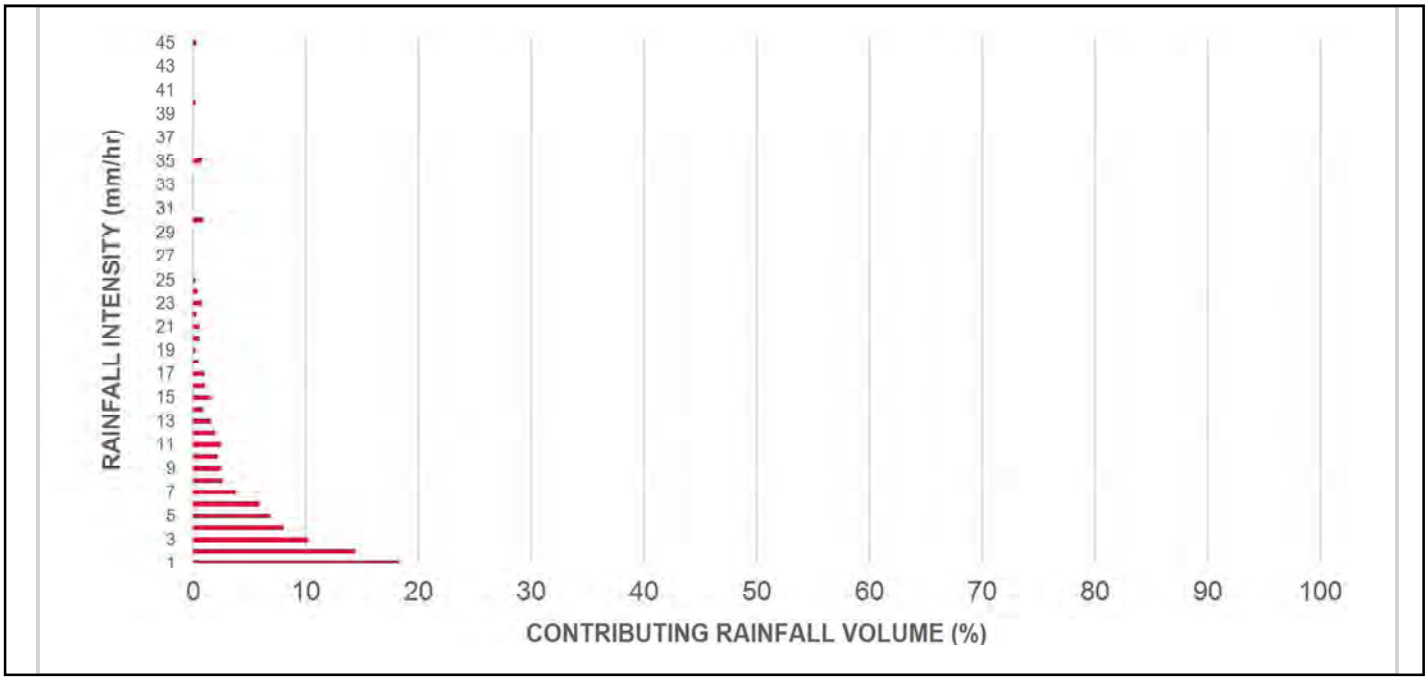
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a 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

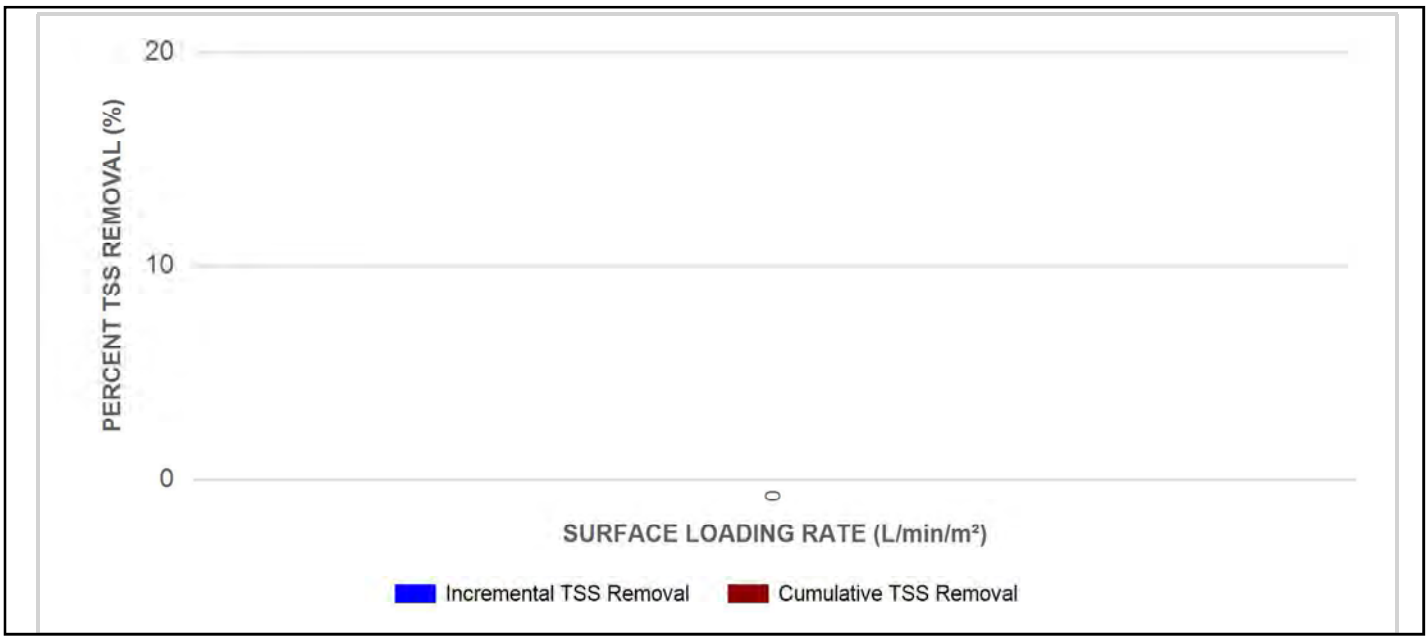
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.5	8.5	1.55	93.0	N/A	N/A	N/A	N/A
1.00	18.3	26.8	3.10	186.0	N/A	N/A	N/A	N/A
2.00	14.4	41.3	6.20	372.0	N/A	N/A	N/A	N/A
3.00	10.2	51.5	9.31	558.0	N/A	N/A	N/A	N/A
4.00	8.0	59.5	12.41	745.0	N/A	N/A	N/A	N/A
5.00	6.9	66.4	15.51	931.0	N/A	N/A	N/A	N/A
6.00	5.9	72.3	18.61	1117.0	N/A	N/A	N/A	N/A
7.00	3.8	76.1	21.72	1303.0	N/A	N/A	N/A	N/A
8.00	2.6	78.7	24.82	1489.0	N/A	N/A	N/A	N/A
9.00	2.5	81.1	27.92	1675.0	N/A	N/A	N/A	N/A
10.00	2.2	83.3	31.02	1861.0	N/A	N/A	N/A	N/A
11.00	2.5	85.8	34.13	2048.0	N/A	N/A	N/A	N/A
12.00	2.0	87.8	37.23	2234.0	N/A	N/A	N/A	N/A
13.00	1.6	89.4	40.33	2420.0	N/A	N/A	N/A	N/A
14.00	0.9	90.4	43.43	2606.0	N/A	N/A	N/A	N/A
15.00	1.6	91.9	46.54	2792.0	N/A	N/A	N/A	N/A
16.00	1.1	93.0	49.64	2978.0	N/A	N/A	N/A	N/A
17.00	1.0	94.0	52.74	3165.0	N/A	N/A	N/A	N/A
18.00	0.5	94.6	55.84	3351.0	N/A	N/A	N/A	N/A
19.00	0.2	94.8	58.95	3537.0	N/A	N/A	N/A	N/A
20.00	0.6	95.4	62.05	3723.0	N/A	N/A	N/A	N/A
21.00	0.6	96.1	65.15	3909.0	N/A	N/A	N/A	N/A
22.00	0.3	96.4	68.25	4095.0	N/A	N/A	N/A	N/A
23.00	0.8	97.2	71.36	4281.0	N/A	N/A	N/A	N/A
24.00	0.4	97.6	74.46	4468.0	N/A	N/A	N/A	N/A
25.00	0.2	97.8	77.56	4654.0	N/A	N/A	N/A	N/A
30.00	0.9	98.7	93.07	5584.0	N/A	N/A	N/A	N/A
35.00	0.8	99.5	108.59	6515.0	N/A	N/A	N/A	N/A
40.00	0.2	99.7	124.10	7446.0	N/A	N/A	N/A	N/A
45.00	0.3	100.0	139.61	8377.0	N/A	N/A	N/A	N/A
Estimated Net Annual Sediment (TSS) Load Reduction =								**0 %**

Climate Station ID: 6149387 *Years of Rainfall Data*: 34

RAINFALL DATA FROM WATERLOO WELLINGTON AP 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

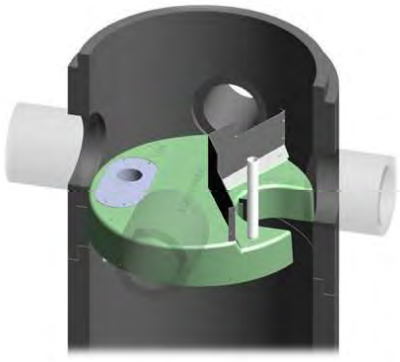
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test 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

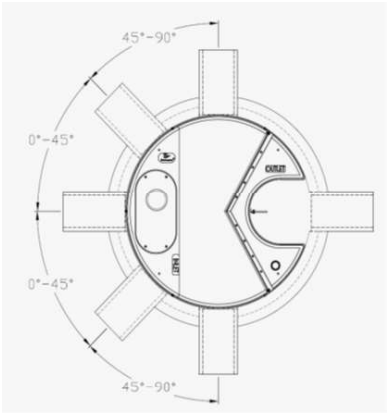
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend 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)	(ft^3)	(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/ft^3)

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

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Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EF

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26

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.



APPENDIX D:

Water Balance Summary

720 Erbsville Rd, WATERLOO, ON

Water Budget Summary

21-Nov-24

Without Infiltration Mitigation

Description	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Recharge (m3)													
Pre-Development	7144.4	183	93	45	908	2447	1224	612	306	153	78	731	365
Post-Development	3326.1	85	43	21	423	1139	570	285	142	71	36	340	170
Difference	**-3818.3**	-98	-50	-24	-485	-1308	-654	-327	-163	-82	-42	-391	-195
% change	-53%	-53%	-53%	-53%	-53%	-53%	-53%	-53%	-53%	-53%	-54%	-53%	-53%
Runoff (m3)													
Pre-Development	122.0	122	62	30	605	1631	816	408	204	102	52	487	243
Post-Development	17121	37	18	9	5779	1898	1656	1811	1498	1535	1170	1638	73
Difference	12358.5	-86	-43	-21	5174	267	840	1403	1294	1433	1118	1151	-171
% change	10127%	-70%	-70%	-70%	855%	16%	103%	344%	635%	1405%	2152%	236%	-70%

With Infiltration Mitigation

Description	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Recharge (m3)													
Pre-Development	7144.4	183	93	45	908	2447	1224	612	306	153	78	731	365
Post-Development with Mitigation	9952.0	98	49	24	2675	1857	1205	987	726	670	493	974	195
Difference	**2807.6**	-86	-43	-21	1767	-590	-19	375	420	517	415	243	-170
% change	39%	-47%	-47%	-47%	195%	-24%	-2%	61%	137%	338%	532%	33%	-47%
Runoff (m3)													
Pre-Development	4763	122	62	30	605	1631	816	408	204	102	52	487	243
Post-Development withn mitigation	9483	24	12	6	3169	1086	928	1000	823	840	639	908	47
Difference	4720.1	-98	-50	-24	2564	-545	113	592	619	738	587	421	-196
% change	99%	-81%	-81%	-81%	424%	-33%	14%	145%	304%	723%	1131%	86%	-81%
Sumation of Runoff and Rechage		60	31	15	8948	2984	2584	2811	2321	2374	1809	2546	120
Sumation of Runoff and Rechage (m3/s)		2.3E-05	1.3E-05	5.6E-06	3.5E-03	1.1E-03	1.0E-03	1.0E-03	8.7E-04	9.2E-04	6.8E-04	9.8E-04	4.5E-05

720 Erbsville Rd, WATERLOO, ON

Pre-Development Water Budget Calculations

November 20, 2024

Water Balance Method (Thornthwaite & Mather, 1957)

Precipitation: Waterloo-Wellington Normals (1966-1990), Vegetation: Moderately Rooted Crops, Soil: Silty Sand Loam

Description	Units	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temperature	deg C	**7.01**	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.5	8.2	2.5	-3.3
Heat Index (i)	-	**35.23**	0.00	0.00	0.00	1.38	4.00	6.72	8.16	7.49	5.01	2.11	0.35	0.00
UPET (unadjusted PET)	mm/day	**1.040**	0.00	0.00	0.00	0.94	1.96	2.80	3.19	3.01	2.29	1.26	0.37	0.00
Latitude correction for 43.5 deg (r)	-		24.3	24.4	30.6	33.6	38	38.6	38.9	36	31.2	28.5	24.1	22.9
PET (Potential ET)	mm	**563.0**	0.0	0.0	0.0	31.7	74.4	107.9	124.3	108.4	71.3	36.0	8.8	0.0
Precipitation	mm	**916.3**	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2
P - PET	mm		65.2	54.9	61.0	42.8	7.9	-25.5	-25.7	-24.5	16.5	31.4	78.3	71.2
Accum. Water Loss	mm						0.0	-25.5	-51.2	-75.7				
Soil Moisture Retention (Storage)	mm		150.0	150.0	150.0	150.0	150.0	127.0	100.0	91.0	109.8	144.6	150.0	150.0
Storage Change	mm		0.0	0.0	0.0	0.0	0.0	-23.0	-27.0	-9.0	18.8	34.8	5.4	0.0
AET (Actual ET)	mm	**546.1**	0.0	0.0	0.0	31.7	74.4	105.4	125.6	92.9	71.3	36.0	8.8	0.0
Water Balance as Surplus/Deficit	mm	**370.2**	65.2	54.9	61.0	42.8	7.9	-23.0	-27.0	-9.0	16.5	31.4	78.3	71.2
Determination of Water Balance as 'Combined-Runoff' (Recharge + Direct Runoff) - (using WBM Assumptions)														
Soil Moisture Surplus (SMS)	mm	**117.9**	0.0	0.0	0.0	42.8	7.9	0.0	0.0	0.0	-2.3	-3.4	72.9	0.0
Water Balance from SMS (Assumption 1)	mm	**123.5**	9.2	4.6	2.3	22.5	15.2	7.6	3.8	1.9	1.0	0.5	36.7	18.3
Accumulated Snow Availability (Assumption 2)	mm	**252.3**	0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Balance from Snow (Assumption 3)	mm	**252.3**	0.5	0.3	0.1	25.2	113.5	56.8	28.4	14.2	7.1	3.5	1.8	0.9
Water Balance as 'Combined-Runoff'	mm	**375.9**	9.7	4.9	2.4	47.8	128.8	64.4	32.2	16.1	8.0	4.1	38.5	19.2

Assumptions for Monthly 'Combined-Runoff' Estimations (from WBM):

1 - Combined 'Runoff' from the Soil Moisture Surplus is assumed to be 50% in the first month and then 50% of the remaining soil surplus each following month.

2 - All Snow is Accumulated and Stored throughout Winter Sub-Zero Months (i.e. No melt until first above-zero month)

3 - Combined 'Runoff' from Snowmelt is assumed to be 10% of the Accumulated Snow in the first month and then 50% of the remaining snowmelt in each following month.

MECP Infiltration Factors						
Topography		Soil		Cover		Sum of Factors
Rolling Land	0.20	Open Sandy Loam	0.40	Cultivated	0.10	**60%**

Assumptions for Evapotranspiration/Recharge/Runoff Proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE SWM P&DM 2003 - Table 3.1)

RECHARGE: Pre-Development to Wetland

Catchment	Area (m^2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Recharge (Based on MECP Inf. Factors)		**225.5**	5.8	2.9	1.4	28.7	77.3	38.6	19.3	9.7	4.8	2.5	23.1	11.5	mm
101 - Pervious	31676	**7144.4**	183.5	92.7	45.4	907.9	2447.1	1223.5	611.8	305.9	152.9	77.9	730.8	365.1	m^3
TOTAL	31676	**7144.4**	183.5	92.7	45.4	907.9	2447.1	1223.5	611.8	305.9	152.9	77.9	730.8	365.1	m^3

RUNOFF: Pre-Development to Wetland

Catchment	Area (m^2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Runoff (Based on MECP Inf. Factors)		**150.4**	3.9	2.0	1.0	19.1	51.5	25.8	12.9	6.4	3.2	1.6	15.4	7.7	mm
101 - Pervious	31676	**4763.0**	122.3	61.8	30.3	605.3	1631.4	815.7	407.8	203.9	102.0	51.9	487.2	243.4	m^3
TOTAL	31676	**4763.0**	122.3	61.8	30.3	605.3	1631.4	815.7	407.8	203.9	102.0	51.9	487.2	243.4	m^3

Assumptions for Recharge/Runoff Proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE 1995, 2003)

2 - Impervious Areas - Assume 10% lost to Evapotranspiration

water's edge
ENVIRONMENTAL SOLUTIONS TEAM

720 Erbsville Rd, WATERLOO, ON

Post-Development Water Budget Calculations

November 20, 2024

Determination of Evapotranspiration and Water Balance Components - by Water Balance Method (Thornthwaite & Mather, 1957)

Precipitation: Waterloo-Wellington Normals (1966-1990), Vegetation: Mature Grasses with Trees/Shubs, Soil: Silty Sand Loam

Vegetation/Soil: Mature Grasses with Trees & Shubs / Silty Sand Loam

Pervious Areas: Hilly lawns and grassed pasture with Trees and Shubs

Description	Units	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temperature	deg C	**7.01**	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.5	8.2	2.5	-3.3
Heat Index (i)	-	**35.23**	0.00	0.00	0.00	1.38	4.00	6.72	8.16	7.49	5.01	2.11	0.35	0.00
UPET (unadjusted PET)	mm/day	**1.040**	0.00	0.00	0.00	0.94	1.96	2.80	3.19	3.01	2.29	1.26	0.37	0.00
Latitude correction for 43.5 deg (r)	-		24.3	24.4	30.6	33.6	38	38.6	38.9	36	31.2	28.5	24.1	22.9
PET (Potential ET)	mm	**563.0**	0.0	0.0	0.0	31.7	74.4	107.9	124.3	108.4	71.3	36.0	8.8	0.0
Precipitation	mm	**916.3**	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2
P - PET	mm		65.2	54.9	61.0	42.8	7.9	-25.5	-25.7	-24.5	16.5	31.4	78.3	71.2
Accum. Water Loss	mm						0.0	-25.5	-51.2	-75.7				
Soil Moisture Retention (Storage)	mm		150.0	150.0	150.0	150.0	150.0	127.0	100.0	91.0	109.8	144.6	150.0	150.0
Storage Change	mm		0.0	0.0	0.0	0.0	0.0	-23.0	-27.0	-9.0	18.8	34.8	5.4	0.0
AET (Actual ET)	mm	**546.1**	0.0	0.0	0.0	31.7	74.4	105.4	125.6	92.9	71.3	36.0	8.8	0.0
Water Balance as Surplus/Deficit	mm	**370.2**	65.2	54.9	61.0	42.8	7.9	-23.0	-27.0	-9.0	16.5	31.4	78.3	71.2
Determination of Water Balance as 'Combined-Runoff' (Recharge + Direct Runoff) - (using WBM Assumptions)														
Soil Moisture Surplus (SMS)	mm	**117.9**	0.0	0.0	0.0	42.8	7.9	0.0	0.0	0.0	-2.3	-3.4	72.9	0.0
Water Balance from SMS (Assumption 1)	mm	**123.5**	9.2	4.6	2.3	22.5	15.2	7.6	3.8	1.9	1.0	0.5	36.7	18.3
							3.95	1.98	0.99	0.49	0.25	0.12	0.06	
			0.04	0.02	0.01	21.40	10.70	5.35	2.68	1.34	0.67	0.33	0.17	0.08
			9.11	4.56	2.28	1.14	0.57	0.28	0.14	0.07	0.04	0.02	36.45	18.23
Accumulated Snow (Assumption 2)	mm	**252.3**	0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Balance from Snow (Assumption 3)	mm	**252.3**	0.5	0.3	0.1	25.2	113.5	56.8	28.4	14.2	7.1	3.5	1.8	0.9
Water Balance as 'Combined-Runoff'	mm	**375.8**	9.7	4.9	2.4	47.8	128.8	64.4	32.2	16.1	8.0	4.0	38.5	19.2

Assumptions for Monthly 'Combined-Runoff' Estimations (from WBM):

1 - Combined 'Runoff' from the Soil Moisture Surplus is assumed to be 50% in the first month and then 50% of the remaining soil surplus each following month.

2 - All Snow is Accumulated and Stored throughout Winter Sub-Zero Months (i.e. No melt until first above-zero month)

3 - Combined 'Runoff' from Snowmelt is assumed to be 10% of the Accumulated Snow in the first month and then 50% of the remaining snowmelt in each following month.

MECP Infiltration Factors						
Topography		Soil		Cover		Sum of Factors
Rolling Land	0.20	Open Sandy Loam	0.40	Cultivated	0.10	**70%**

Assumptions for Evapotranspiration/Recharge/Runoff Proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE SWM P&DM 2003 - Table 3.1)

RECHARGE: Post-Development to Wetland

Catchment	Area (m2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Recharge (Based on MECP Inf. Factors)		**263**	6.8	3.4	1.7	33.4	90.1	45.1	22.5	11.3	5.6	2.8	26.9	13.4
Snow melt (impervious areas)			0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pervious Areas	12643	**3326**	85.4	43.2	21.1	422.8	1139.5	569.7	284.9	142.4	71.2	35.6	340.3	170.0
Impervious Areas (Roofs, Driveways, Ponds)	19033	**0**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL	31676	**3326**	85.4	43.2	21.1	422.8	1139.5	569.7	284.9	142.4	71.2	35.6	340.3	170.0

RUNOFF: Post-Development to Wetland

Catchment	Area (m2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Runoff (Based on MECP Inf. Factors)		**113**	2.9	1.5	0.7	14.3	38.6	19.3	9.7	4.8	2.4	1.2	11.5	5.8
Snow melt (impervious areas)			0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
201A - Pervious	12643	**1425**	36.6	18.5	9.1	181.2	488.3	244.2	122.1	61.0	30.5	15.3	145.8	72.9
Impervious Areas	19033	**15696**	0.0	0.0	0.0	5598.0	1409.8	1411.5	1689.0	1437.2	1504.0	1154.5	1492.0	0.0
TOTAL	31676	**17121**	36.6	18.5	9.1	5779.2	1898.1	1655.7	1811.1	1498.2	1534.5	1169.8	1637.8	72.9

720 Erbsville Rd, WATERLOO, ON

Post-Development (with mitigation) Water Budget Calculations

21-Nov-24

Determination of Evapotranspiration and Water Balance Components - by Water Balance Method (Thornthwaite & Mather, 1957)

Precipitation: Waterloo-Wellington Normals (1966-1990), Vegetation: Mature Grasses with Trees/Shubs, Soil: Silty Sand Loam
Vegetation/Soil: Mature Grasses with Trees & Shubs / Silty Sand Loam
Pervious Areas: Hilly lawns and grassed pasture with Trees and Shubs

Description	Units	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temperature	deg C	**7.01**	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.5	8.2	2.5	-3.3
Heat Index (i)	-	**35.23**	0.00	0.00	0.00	1.38	4.00	6.72	8.16	7.49	5.01	2.11	0.35	0.00
UPET (unadjusted PET)	mm/day	**1.040**	0.00	0.00	0.00	0.94	1.96	2.80	3.19	3.01	2.29	1.26	0.37	0.00
Latitude correction for 43.5 deg (r)	-		24.3	24.4	30.6	33.6	38	38.6	38.9	36	31.2	28.5	24.1	22.9
PET (Potential ET)	mm	**563.0**	0.0	0.0	0.0	31.7	74.4	107.9	124.3	108.4	71.3	36.0	8.8	0.0
Precipitation	mm	**916.3**	65.2	54.9	61	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.1	71.2
P - PET	mm		65.2	54.9	61.0	42.8	7.9	-25.5	-25.7	-24.5	16.5	31.4	78.3	71.2
Accum. Water Loss	mm						0.0	-25.5	-51.2	-75.7				
Soil Moisture Retention (Storage)	mm		150.0	150.0	150.0	150.0	150.0	127.0	100.0	91.0	109.8	144.6	150.0	150.0
Storage Change	mm		0.0	0.0	0.0	0.0	0.0	-23.0	-27.0	-9.0	18.8	34.8	5.4	0.0
AET (Actual ET)	mm	**546.1**	0.0	0.0	0.0	31.7	74.4	105.4	125.6	92.9	71.3	36.0	8.8	0.0
Water Balance as Surplus/Deficit	mm	**370.2**	65.2	54.9	61.0	42.8	7.9	-23.0	-27.0	-9.0	16.5	31.4	78.3	71.2
Determination of Water Balance as 'Combined-Runoff' (Recharge + Direct Runoff) - (using WBM Assumptions)														
Soil Moisture Surplus (SMS)	mm	**117.9**	0.0	0.0	0.0	42.8	7.9	0.0	0.0	0.0	-2.3	-3.4	72.9	0.0
Water Balance from SMS (Assumption 1)	mm	**123.5**	9.2	4.6	2.3	22.5	15.2	7.6	3.8	1.9	1.0	0.5	36.7	18.3
Accumulated Snow (Assumption 2)	mm	**252.3**	0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Balance from Snow (Assumption 3)	mm	**252.3**	0.5	0.3	0.1	25.2	113.5	56.8	28.4	14.2	7.1	3.5	1.8	0.9
Water Balance as 'Combined-Runoff'	mm	**375.8**	9.7	4.9	2.4	47.8	128.8	64.4	32.2	16.1	8.0	4.0	38.5	19.2

Assumptions for Monthly 'Combined-Runoff' Estimations (from WBM):

1 - Combined 'Runoff' from the Soil Moisture Surplus is assumed to be 50% in the first month and then 50% of the remaining soil surplus each following month.
2 - All Snow is Accumulated and Stored throughout Winter Sub-Zero Months (i.e. No melt until first above-zero month)
3 - Combined 'Runoff' from Snowmelt is assumed to be 10% of the Accumulated Snow in the first month and then 50% of the remaining snowmelt in each following month.

MECP Infiltration Factors						
Topography		Soil		Cover		Sum of Factors
Rolling Land	0.20	Open Sandy Loam	0.40	Cultivated	0.10	**70%**

Assumptions for Evapotranspiration/Recharge/Runoff Proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE SWM P&DM 2003 - Table 3.1)

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RECHARGE: Post-Development to Wetland

Catchment	Area (m2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Recharge (Based on MECP Inf. Factors)		**263.1**	6.8	3.4	1.7	33.4	90.1	45.1	22.5	11.3	5.6	2.8	26.9	13.4	
Snow melt (impervious areas)			0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Pervious Areas for Total Property	14482	**3810**	97.9	49.4	24.2	484.3	1305.2	652.6	326.3	163.2	81.6	40.8	389.8	194.7	
Catchment B Roof tops directed to infiltration swale	1417	**1169**	0.0	0.0	0.0	416.9	105.0	105.1	125.8	107.0	112.0	86.0	111.1	0.0	100%
Rooftops directed to infiltration gallery	5713	**4973**	0.0	0.0	0.0	1773.7	446.7	447.2	535.1	455.4	476.5	365.8	472.7	0.0	95%
Impervious area - no infiltration	10057	**0.0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
TOTAL	31669	**9952**	97.9	49.4	24.2	2674.8	1856.9	1204.9	987.2	725.5	670.1	492.6	973.6	194.7	100%

RUNOFF: Post-Development to Wetland

8227 4894

Catchment	Area (m2)	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Runoff (Based on MECP Inf. Factors)		**112.8**	2.9	1.5	0.7	14.3	38.6	19.3	9.7	4.8	2.4	1.2	11.5	5.8	
Snow melt (impervious areas)			0.0	0.0	0.0	252.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Laurel Creek Streamflow avg (GRCA data) (2021-2023) (CMS)						0.3	0.1	0.1	0.1	0.1	0.1				
Average Monthly Quantity of Laurel Creek Stream flow (m^3)						698945	386643	230477	243537	204490	322676				
Catchment A&C	**23997.0**	**9483.0**	23.8	12.0	5.9	3169.2	1086.2	928.3	1000.1	823.1	839.6	639.2	908.2	47.4	
% of average volume flow for Laurel Creek	**n/a**					0.45%	0.28%	0.40%	0.41%	0.40%	0.26%				
Pervious Area	**8227.0**	**927.6**	23.8	12.0	5.9	117.9	317.8	158.9	79.4	39.7	19.9	9.9	94.9	47.4	
	0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
Impervious Area	**15770.0**	**8555.4**	0.0	0.0	0.0	3051.3	768.4	769.4	920.6	783.4	819.8	629.3	813.2	0.0	
Rooftops draining to infiltration Galleries	**5713.0**	**261.7**	0.0	0.0	0.0	93.4	23.5	23.5	28.2	24.0	25.1	19.3	24.9	0.0	5%
Remaining Impervious (Sidewalk/pavement)	**10057.0**	**8293.7**	0.0	0.0	0.0	2958.0	744.9	745.8	892.5	759.4	794.7	610.1	788.4	0.0	
Catchment D (directed to swale)	**2607.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
Park Land	**2607.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Catchment B (directed to swale)	**5000.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Rear Lots Roofs 4, 9, 13 directed to infiltration swale	**1417.0**	**0.0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Rear Lots pervious Area	**3583.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL (sum of blue)	31604	9483	24	12	6	3169	1086	928	1000	823	840	639	908	47	

Assumptions for Recharge/Runoff proportioning:

1 - Pervious Areas - by MOE Infiltration Factor Method (MOE 1995, 2003).
2 - Impervious Areas - Assume 10% lost to Evapotranspiration.
3 - Infiltration gallery (per Toronto Wet Weather Flow Management Guidelines):
4 - All rear draining roofs of east lots (catchment 4,9,13) drain into infiltration swale except 10% is assumed to evaporate
5- All rear draining roofs of east lots (catchment 4,9,13) drain into infiltration swale assume no runnoff to wetland
6 - 65% rain from remaining rooftop areas is infiltrated in infiltration galleries and remainder (35% goes to runnoff in wetland)