Functional Servicing and Stormwater Management Report

Circle K

Type of Document:
Site Plan Approval Application - City of Ottawa File No.: PC2018-0342

Project Name:
Circle K Nepean
1545 Woodroffe Avenue, City of Ottawa

Project Number:
BRM-00606364-B0

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Date Submitted:
2021-04-22 Issued for Client Review
2021-04-27 Issued for Site Plan Application

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1. Introduction

EXP has been retained by Circle K to complete the Civil Engineering design for the development of a gas station and convenience store site in the City of Ottawa, at 1545 Woodroffe Avenue. This report will review the requirements for site servicing, grading and stormwater management for the proposed development. The location and aerial view of the site is shown in Figures 1 and 2.

1.1. Existing Site Information

The existing site is located at the at the northeast corner of Woodroffe Avenue and Medhurst Drive intersection in the City of Ottawa. Currently, the site is occupied by an existing ESSO gas station, car wash and convenience store, as well as an abandoned Tim Hortons location. The site is generally flat with sloping towards the existing catchbasins on the site. Externally, the site frontage slopes down slightly along Woodroffe Avenue towards the north. The site is abutted by residential areas to the north and east.

Figure 1 - Existing Site

Figure 2 - Existing Aerial

1.2. Proposed Development

The proposed Circle K site is approximately 0.82 Ha (8,210 m^2) in area and will be comprised of a Convenience Store/Retail Building, a Car Wash Building, and Fueling Area, as well as parking and landscaped areas. The proposed development is indicated in Figure 3 and details are summarized in Table 1.

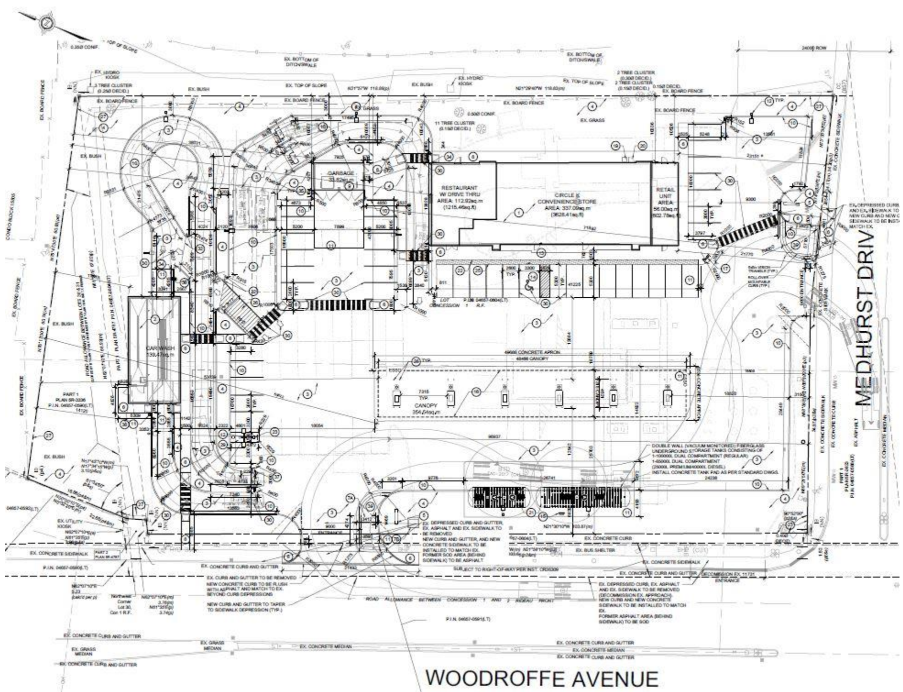

Figure 3 – Proposed Development

Table 1 - Proposed Site Information

Location	Building	Site Area (m2)
A	C-Store, Car Wash (Building Areas)	646
B	Fueling Canopy	354
C	Landscape Open Space	1820
Remaining Site	Parking, Drive Aisles, Pedestrian Walkways and Loading Areas	5390
Total Site Area		**8210**

2. Sanitary Servicing

2.1. Sanitary Sewer System

Sanitary sewage outflow from the site is calculated using the current Engineering Design Criteria for the City of Ottawa. Sewage flows will be calculated based on use as a commercial site with an average design flow of 50,000 L/ha/day plus allowances for infiltration. Based on the site area of 0.82 hectares, the average estimated daily flow equates to 41,000 L/day or **0.47 l/s**.

In accordance with City Design Criteria, applying a peaking factor of 1.5, the peak sanitary discharge for the Circle-K site will be 1.5*0.47 l/s **= 0.71 l/s.** An infiltration allowance of 0.28 L/s/hectare will be required to be incorporated into the sanitary sewer discharge rate.

> *Therefore, the sanitary discharge rate = 0.71 litres/second + I/I (Site area) = (0.71 l/s) + (0.28 l/s/ha * 0.82 ha) = 0.94 litres/second.*

Estimated Car Wash Demand

A carwash is included in the proposed development which will discharge to the proposed sanitary sewer system on site. The sanitary discharge for the car wash is as follows:

- Carwash cycle water usage: Basic - 130 L, Full - 175 L, Premium - 290 L
- Average usage of 175 L / wash cycle
- Carwash cycle time: 2 minutes washing plus 2 minutes dry time = 4 minutes total

Therefore, peak carwash flow rate = 175 L per 4 minutes = 43.75 L/min or 0.73 litres/second

Peak Sanitary Demand

The total peak sanitary discharge is therefore 0.94 l/s + 0.73 l/s = **1.67 l/s**.

The sanitary sewage flow from the proposed Circle K site will discharge to the existing 300mm diameter PVC sanitary sewer main located within the Medhurst Drive ROW.

2.2. Sanitary Service Connection

Sewage flows from the building and the car wash facility will be collected in a series of 200mm diameter sewers and flow through the site, ultimately discharging by gravity to a proposed sampling sanitary manhole at the south frontage of Medhurst Drive. Due to the nature of the sewage, an oil and grease interceptor will be included prior to discharging flows from the restaurant portion of the building. The car wash facility also includes a water re-claim and treatment structure prior to discharging into the proposed sanitary system. The existing sanitary sewers, as well as the proposed sanitary sewer arrangement for the Circle K Development are shown on Drawing C-02 – Site Servicing Plan (see Appendix A).

2.3. Recommendations

The proposed sanitary sewage flows within the development will be conveyed via a series of 200mm diameter sewers, connecting to a proposed manhole located within the Medhurst Drive ROW immediately outside of the site. The proposed site is being reconstructed with similar facilities and functions as the existing site. Therefore, sanitary flows are expected to remain similar to the existing discharge from the site into the existing municipal sanitary sewer system. It is anticipated that the existing sanitary sewer will have adequate capacity to receive flows from the proposed development.

3. Water Distribution

3.1. Proposed Water Servicing System

Construction record drawings for the Medhurst Drive and Woodroffe Avenue area indicate that there is an existing 305 mm diameter watermain located along the frontage of the Medhurst Drive. There is also a 406 mm and a 1220 mm backbone watermain within the Woodroffe Avenue ROW. It is proposed that the site will be serviced via a new 100mm diameter water service for domestic flow, connected into the existing 305 mm diameter watermain on Medhurst Drive.

Car wash water consumption rate was calculated above as an average of 0.73 l/s. Water demands for the remainder of the proposed development were determined from the City of Ottawa Design Criteria, which recommends a water consumption for commercial uses as 28m^3/ha/day.

Maximum daily demand and peak hour water demand estimates are based on the City's peaking factors of 1.5 and 1.8 respectively, for commercial use.

*Average daily water demand = (28 m^3/ha/day) * 0.82ha / 86400 *1000 = 0.27 litres/second*

Total Water Demand = 0.73 l/s (Car Wash) + 0.27 l/s (Domestic) = 1.0 l/s

*Maximum daily demand = (1.0 l/s) * (1.5) = 1.5 litres/second*

*Peak hour water demand = (1.5 l/s) * (1.8) = **2.7 litres/second***

A detailed Fire Flow calculation has been prepared using the recommendation for the Fire Underwriters Survey. The fire flow calculation indicates that the recommended fire flow for this proposed development will be **9,000 l/min (150 litres/sec).** Calculations for the required domestic and fire flow demand are provided in Appendix B.

The total water demand for the site is estimated as the maximum day water demand plus fire, resulting in a total demand of approximately (1.5 l/s + 150 l/s) **= 151.50 l/s** or (9,090 litres/min). A 100mm diameter water service would be enough to supply up to 9,090 litres/minute assuming a water velocity of 5 m/s and an average pressure range of 60 psi at the street line.

Currently, there is an existing fire hydrant located on the north side of Woodroffe Avenue adjacent the site for fire fighting purposes. A fire hydrant flow test will be conducted to confirm there is adequate pressure in the system for firefighting purposes.

Refer to the Site Servicing Plan in Appendix A showing the extent of proposed water servicing to be installed.

3.2. Recommendations

It is anticipated that the existing municipal watermain located within the Medhurst Drive ROW has enough capacity to support the proposed development for both domestic and fire flow purposes. There is adequate coverage from the existing fire hydrant and modifications or upgrades to the existing watermains located within the Medhurst and Woodroffe ROWs will not be required in order to support the proposed development.

4. Stormwater Management Analysis

Stormwater management design for this development was carried out in accordance with all applicable design standards including but not limited to:

- Ontario Ministry of the Environment - Stormwater Management Planning and Design Manual, March 2003
- Rideau Valley Conservation Authority (RVCA) Development Policies
- Pinecrest Creek/Westboro Area Subwatershed Study Area
- City of Ottawa Engineering Design Criteria, latest version

To design the facilities to meet these requirements, it is essential to select the appropriate modelling methodology for the storm system design. Since this is a small site, (~1 ha), and since it is not necessary to match the timing of the peak release rate to the pre-development conditions, complex modelling techniques are not necessary and are typically inaccurate for a site of this size. The Modified Rational Method is adequate to conform the required storm volumes to control post development runoff conditions.

A portion of the north and northwest perimeter of the site will remain undisturbed, flowing uncontrolled to the west. The existing (0.043 ha) wooded area will remain, thus, will be omitted from the stormwater management analysis.

5.1. Allowable Release Rate

The existing 1050mm diameter storm sewer on Medhurst Drive has been designed to accommodate the stormwater flow from the subject site at a run-off co-efficient of 0.70. This value has been used to determine the allowable release rate for the site. The municipal storm sewer connects to an 1800mm diameter storm sewer a short distance away, which crosses Woodroffe avenue where it then connects to a 2400mm diameter storm sewer that flows north eventually discharging to Pinecrest Creek.

Contributing Drainage Area = 0.778 ha

Runoff coefficient C = 0.70

Table 2: Allowable Release Rate

Storm Event (yr.)	Rainfall Intensity (mm/hr)	Allowable Release Rate (L/s)
2	76.81	116.19
5	104.19	157.62
10	122.14	184.77
25	144.69	218.89
50	161.47	244.27
100	178.56	270.12

For detailed calculations see Appendix C.

5.2. Stormwater Quantity Management

As the development will change the site imperviousness, it is important to quantify this to determine the proposed storm runoff rates. Based on the post development surface conditions, the weighted runoff coefficient of the site is 0.80. Refer to Calculation Sheet 2 in Appendix C for detailed breakdown of the post-development run-off coefficient.

The development of this site would otherwise increase the rate of stormwater runoff, in excess of the allowable design flows as determined above. On-site quantity controls are required to protect the integrity of the surrounding areas. Storm water quantity will be controlled through an orifice tube located within the downstream end of the system to ensure that post development flows from the site will be controlled to the allowable release rate for storm events up to and including the 100-year storm event.

There are multiple scenarios that must be considered for this site based on the information provided in the pre-consultation meeting with the City of Ottawa. The first is to limit the peak discharge to the more stringent of: (1a) the peak discharge from a 5-year storm considering a runoff coefficient of C=0.5 as per the City of Ottawa Design Guidelines, or (1b) 33.5L/s/ha as per the SWM Guidelines for the Pinecrest Creek / Westboro Area. The second scenario is to limit the peak discharge during the 25mm design storm such that the peak outflow does not exceed 5.8 L/s/ha as per the SWM Guidelines for the Pinecrest Creek / Westboro Area. This amounts to a peak discharge rate of 4.76 L/s during the 25mm design storm. Therefore, on-site stormwater detention is required to enable a controlled maximum discharge rate under the two scenarios.

Scenario #1

The allowable peak 5-year storm considering a runoff coefficient of C=0.5 is calculated using the IDF coefficients for a 5-year storm event. The peak development flow is controlled to a runoff coefficient of 0.5 at a time of concentration of 10 minutes, the allowable flow is therefore:

$Q_A = 0.5 \times 104.19$ mm/hr $\times$ 7780 m^2 / 3600

$Q_A = 112.58$ L/s

33.5 L/s/ha x 0.778 ha = **26.06 L/s**

Thus, the Pinecrest Creek / Westboro Area maximum discharge rate is the more stringent criteria and will be used to calculate maximum allowable site discharge rates.

Scenario #2

Based on the size of the site, the allowable storm discharge rate corresponds to a runoff of 5.8 L/s/ha x 0.778 ha = 4.51 L/s

Stormwater Detention

Storage will be provided via underground pipe and manhole storage, as well as additional underground storage chambers to meet the volumes required per the findings of the quantity control analysis.

A total volume of 297.80 m^3 storage is required to meet post-development flows to allowable release rates (see Appendix C). The total volume available in the storm system including pipe and structures is approximately 72.8 m^3. Therefore, additional storage will be required elsewhere in the storm system. Table 6.3 below summarizes the available storage for this development. Detailed calculations are provided in Calculation Sheet 3 in Appendix C.

Table 3: Available Stormwater Storage without Additional storage measures

Pipe (m^3)	Catchbasin / Manholes (m^3)	Surface (m^3)	Total Storage (m^3)
52.30	20.5	-	**72.80**

As seen above, storage provided via roof control, parking lot surface storage and pipe storage was deemed to be insufficient to meet the storage volumes required per the findings of the quantity control analysis. Further, it is not recommended to provide surface storage due to site uses, and potential for stormwater contamination from fuel spills. Therefore, an underground storage system will be necessary to provide quantity control storage volume. Two options were explored including the use of oversized pipes and storage chambers. It was determined that the use of sub-surface storage chambers was more cost effective than the oversized pipe option, thus the use of sub-storage chambers was selected as the preferred underground storage option.

A subsurface stormwater storage system (i.e. Stormtech underground storage chambers) has been specified to provide overall site stormwater quantity control volume. The proposed Stormtech stormwater storage systems will provide a total storage volume of 225 m^3. Refer to Appendix C for Stormtech Storage Calculations. The layout of Stormtech subsurface stormwater detention facility is shown on the Site Servicing Plan, Drawing C02.

Outlet Control

The preferred method for restricting the stormwater discharge from the site into the storm system is through the installation of an orifice tube. This orifice is designed to release the specified flow of stormwater under the hydraulic head conditions present, based upon the formula:

$$A = Q / [c \sqrt{(2 g h)}]$$

Where:
A = Orifice Area (m^2)
Q = Allowable discharge (m^3)
c = 0.82 (orifice tube coefficient)
g = Gravitational Constant = 9.81 m/s^2
h = Height of water over the center of orifice (m)

The post-development flows will be restricted by the orifice tube and released to the allowable discharge rates for all storm events. The controlled flow restriction will affect the required ponding of stormwater for on-site detention. Refer to Table 4 for required storage, as well as demonstration that post-development flows will be restricted to the allowable rate for all storm events up to the 100-year event. The orifice is proposed to be located upstream of MH2, as shown on Site Servicing Plan, drawing C-02 (Appendix A).

Table 4: Post-Development Controlled Peak Flow and Storage

Storm Event (yr.)	Allowable Release Rate (L/s)	Controlled Peak Flow (L/s)	Storage Required (m^3)	Storage Available (m^3)
2	122.61	7.36	110.82	297.80
5	166.33	10.86	143.81	
10	194.99	14.97	158.65	
25	230.99	20.89	200.62	
50	257.77	23.30	231.39	
100	285.05	25.89	274.79	

For detailed calculations see Appendix C.

5.3. Stormwater Quality Management

The stormwater quality control for the development will adhere to the Rideau Valley Conservation Authority stormwater management criteria. This target is achieved through the proposed stormwater management system.

The design of the onsite storm sewer drainage system will incorporate a stormwater quality treatment unit. Sizing calculations confirms that a model Stormceptor EF06 will provide 61% long-term TSS removal efficiency with 90% of the average annual runoff treated. The Stormceptor sizing is based on a 0.778 ha drainage area with runoff coefficient 0.80. The Stormceptor will be installed at the location shown on the Site Servicing Plan, drawing C-02, downstream of manhole MH2.

Refer to Appendix C for sizing calculation of the Stormceptor oil/grit separator model EF06.

Additionally, the Low Impact Development (L.I.D) feature in the form of "Enhanced Grass Swales" in the landscape areas will be included in the system to maximize the natural infiltration and retention of rainwater through site development and further enhance stormwater quality. Further LID features, such as infiltration trenches, permeable pavers or rainwater harvesting have been considered, however due to the site use would not be appropriate in this case given the potential for groundwater contamination.

5.4. Storm Conveyance

The subject site currently drains to existing 1050 diameter concrete storm sewer on Medhurst Drive. All outflow from the site will be directed via perimeter swales, catchbasins and roof drains and outlet south of the site utilizing the same receiving municipal sewer. There will be small areas around the perimeter of the site to drain uncontrolled to the municipal ROW in order to accommodate the proposed development.

The proposed grading will maintain the existing drainage patterns as much as possible to avoid drainage diversion. As shown in the site grading and site servicing drawings (Appendix A) this site has been designed to integrate both minor and major storm systems. The overall site grading ensures that the existing drainage pattern on adjacent properties have not been altered and stormwater runoff from the subject development has been self-contained.

Minor System: Storm Sewer

The site has been graded to contain the stormwater from the site, and to direct it through a series of catchbasins located throughout the site and roof water leaders on the building. These catchbasins and roof drains flow into an underground storm sewer system (minor system). The underground storm sewer has been designed to accommodate the 10-year peak storm event based on City of Ottawa Intensity Duration Frequency (IDF) curve with Time of Concentration of (Tc) 10 minutes, using Rational Method. Storm sewer sizing and gradients will maintain a minimum velocity of 0.9 m/sec and maximum 4.0 m/sec. The detailed design of the minor system is provided in Storm Design Sheet in Appendix C.

Major System: Overland Flow

In the event of a major storm, defined as storms larger than the 2-year event and up to the 100-year event, the outlet control provided in the system in the form of an orifice tube will utilize the available storm sewer infrastructure by allowing the system to back up, thus providing the required storage. Outlet controls in the sewer system are designed to restrict the post-development flows exiting from the system to an allowable release rate and also effectively restrict the flows by detaining the water in the system to release it at an allowable release rate and will not have any impact on downstream overland flow capacity.

The controlled release rates of stormwater are directed to a Stormceptor to ensure that runoff from the site is treated to RVCA water quality requirements before it is released from the site.

In events larger than the 100-year return storm, the site has been graded to include an overland flow route. This route allows the stormwater to overtop the local highpoints and flow overland and off-site to Woodroffe Avenue, consistent with the existing overland flow route.

The major overland flow routes are shown on the Site Grading Plan, drawing C-01, in Appendix A.

5.5. Erosion Control

As this development requires site grading and excavation, there will be a potential for soil erosion and off-site release of sediment during the construction phase. Sediment Control in accordance with the City and CA standards are to be implemented during construction to ensure the quality of stormwater runoff during construction. It is essential that effective environmental and sedimentation controls be in place and maintained throughout the site during all construction activities. It is recommended that the following be implemented on a temporary basis to assist in achieving acceptable runoff quality during construction. Refer to Appendix A for Erosion and Sediment Control Plan Drawing C03.

- Installation and maintenance of silt fences around the entire perimeter of the site for the duration of the construction period;
- Provision of a mud mat construction entrance to control the tracking of sediment and debris onto adjacent streets;
- Installation and maintenance of catchbasin sediment barriers throughout the site and during all construction activities in order to reduce and trap sediment on site. Constant attention will be paid to maintaining them silt free. All catchbasin grates shall be covered with geo-textile filter fabric during the period of construction of the proposed works;
- Reduce stormwater drainage velocities where possible;
- All topsoil stockpiles to be surrounded with sediment control fencing.

To ensure the functionality of the erosion and sediment control measures, inspection and maintenance of the systems shall be performed on a weekly basis and after every rainfall event during construction. The sediment and erosion control measures shall not be removed until final asphalt paving and/or sodding are complete.

5.6. Water Balance

The water balance target for the development is to retain the first 10mm runoff through infiltration, evapotranspiration and rainwater reuse as per RVCA's requirements. Various Low Impact Development (LID) measures were considered. The required water balance volume for the development area is 82.0 m^3. Due to the nature of the site, it is not recommended to provide any infiltration or other similar LID measures. However, landscape areas will provide some additional water balance benefit. Although the post-development water balance target has not been achieved across the entire site, the water balance will not significantly change from the pre-development conditions.

5. Utilities

The proposed development is located within a serviced area of the City of Ottawa with Gas, Hydro and Bell infrastructure existing within the adjacent municipal road allowances. During the detailed engineering design stage, consultation with each of the utilities will be necessary to provide the utilities with specific load requirements for the development and proposed service entry locations. This will allow each utility to assess if any upgrading of their distribution system in the area is required.

6. Conclusions

Grading, Drainage and Stormwater Management

The site will be graded in accordance with the appropriate design criteria and all surface runoff from the site will be directed to the underground stormwater management system. Provisions for an emergency overland flow route will be incorporated into the design and allow stormwater runoff to safely and appropriately discharge from the site.

Water Servicing

The provision of domestic and fire protection to the proposed development can be accomplished satisfactorily. It is proposed that the development be serviced off the existing 305mm diameter watermain located within the Medhurst Drive ROW. A 100mm water service connection will be tapped off the existing 305mm diameter watermain. The water service connection would enter the meter room of the C-store building.

Sanitary Servicing

Sanitary Servicing for the proposed development can be accomplished satisfactorily. The proposed sanitary sewage flows within the development will be conveyed via a series of 200mm diameter sewers connecting to a new manhole within the Medhurst Drive ROW immediately south of the site. Sanitary discharge will flow by gravity into the municipal sewer.

Utilities

Utilities can be provided satisfactorily. Hydro, communications and gas infrastructure will be available adjacent to the property for connection from the municipal road right of way. Consultation with each of the utilities is underway to provide the utilities with specific load requirements for the development and proposed service connection points. This will allow each utility to assess if any upgrading of their distribution system in the area is required.

Sincerely,
EXP Services Inc

Jordan Stern, P.Eng.
Project Engineer

Crystal Frazao
Project Manager

Appendix A – C-01, Site Grading Plan

C-02, Site Servicing Plan

C-03, Erosion and Sediment Control Plan

Appendix B – Firefighting Water Design Calculations

Project Number: 606364-B0
Date: April 22, 2021
Preapared By: Jordan Stern, P.Eng.
Reviewed By: William Grandy, P.Eng

Circle-K Nepean
1545 Woodroffe Avenue, City of Ottawa

FIRE UNDERWRITERS SURVEY FIRE FLOW CALCULATIONS

$$F = 220C\sqrt{A}$$

F = the required fire flow in litres per minute
C = Coefficient related to the type of construction

A = the total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered

C Values
1.5 = wood frame construction (structure essentially all combustible)
1.0 = ordinary construction (brick or other masonry walls, combustible floor and interior)
0.8 = non-combustible construction (unprotected metal structural components, masonry or metal walls)
0.6 = fire resistive construction (fully protected frame, floors, roof)

Area ID	A (sq.m)	C	F (L/min)*	Occupancy Adjustment	F (adjusted)	Automatic Sprinkler Adjustment (%)	Exposure Increase (%)	F (final) (L/min)*
Proposed Building (Car Wash)	140.00	1.0	3000	25%	3750	0%	15%	4000
Proposed Building (C-Store)	640.00	1.0	6000	25%	7500	0%	15%	9000

Maximum Fire Flow Rate Req'd =	9000

*rounded to the nearest 1,000 L/min per the Fire Underwriters Survey procedure guidelines

Appendix C – Stormwater Management Design Calculations

PROJECT NO. : BRM-00606364-B0
PROJECT NAME. : Circle K - Nepean
Date: April 22, 2021

CALCULATION Sheet :1

Allowable Release Rate

Drainage Area	0.778	ha
Runoff Coefficent, C	0.70	

Run off Calculation (using Modified Rational Method):

$Q = C_i * C * i * A / 360$ cms

C = Runoff Coefficient
i = Rainfall intensity (mm/hr) [City of Ottawa IDF]
A = Watershed area (ha)

Time of Concentration, T_c	10	min

IDF Eqn : $i = A / (B + T)^{C}$

A, B & C Parameter for IDF Curve

Year	A =	B =	C =
2	732.951	6.199	0.810
5	998.071	6.053	0.814
10	1174.184	6.014	0.816
25	1402.884	6.018	0.819
50	1569.58	6.014	0.820
100	1735.688	6.014	0.820

Pre Development Peak Flows:

YEAR	Rainfall	Intensity Peaking	Flows	
	mm/hr	Factor, C_i	m3/sec	L/Sec
2	76.81	1.00	0.1162	116.19
5	104.19	1.00	0.1576	157.62
10	122.14	1.00	0.1848	184.77
25	144.69	1.00	0.2189	218.89
50	161.47	1.00	0.2443	244.27
100	178.56	1.25	0.3377	337.65

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CALCULATION Sheet :2

Post-Development Run off Coefficient and Peak Flow

See : Drawing C04 For Catchment ID

Catchment ID	Land Type	Area, A (ha)	C	Total Area (ha)	A x C	Weighted C
201	Impervious	0.0140	0.95	0.014	0.0133	0.95
	Pervious	0.0000	0.20		0.0000	
202	Impervious	0.0000	0.90	0.043	0.0000	0.20
	Pervious	0.0430	0.20		0.0086	
203	Impervious	0.0450	0.90	0.050	0.0405	0.83
	Pervious	0.0050	0.20		0.0010	
204	Impervious	0.1600	0.90	0.175	0.1440	0.84
	Pervious	0.0150	0.20		0.0030	
205	Impervious	0.0690	0.90	0.069	0.0621	0.90
	Pervious	0.0000	0.20		0.0000	
206	Impervious	0.1170	0.90	0.119	0.1053	0.89
	Pervious	0.0020	0.20		0.0004	
207	Impervious	0.0800	0.90	0.094	0.0720	0.80
	Pervious	0.0140	0.20		0.0028	
208	Impervious	0.0420	0.95	0.042	0.0399	0.95
	Pervious	0.0000	0.20		0.0000	
209	Impervious	0.0060	0.90	0.036	0.0054	0.32
	Pervious	0.0300	0.20		0.0060	
210	Impervious	0.0510	0.95	0.051	0.0485	0.95
	Pervious	0.0000	0.20		0.0000	

Total Drainage Area	0.693	ha
Weighted Runoff Coefficent Total Site, C	0.80	

Run off Calculation (using Modified Rational Method):

Q = C_i * C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall intensity (mm/hr) [City of Ottawa IDF]

A = Watershed area (ha)

Time of concentration, T_c		10	min

IDF Eqn : i = A / (B + T)^ C

A, B & C parameter for IDF Curve

Year	A =	B =	C =
2	732.951	6.20	0.81
5	998.071	6.05	0.814
10	1174.184	6.01	0.816
25	1402.884	6.02	0.819
50	1569.58	6.01	0.82
100	1735.688	6.01	0.82

Post Development Uncontrolled Flows:

YEAR	Rainfall	Intensity Peaking	Flows	
	mm/hr	Factor, C_i	m3/sec	L/Sec
2	76.81	1.00	0.1179	117.93
5	104.19	1.00	0.1600	159.98
10	122.14	1.00	0.1875	187.54
25	144.69	1.00	0.2222	222.16
50	161.47	1.00	0.2479	247.92
100	178.56	1.25	0.3265	326.54

PROJECT NO. : BRM-00606364-B0
PROJECT NAME. : Circle K - Nepean
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CALCULATION Sheet : 3

Available Storage

Water Level	AVAILABLE STORAGE					
	Pipe	Catch Basins	CBMH	Surface	Cultec	Total
(m)	(m3)	(m3)	(m3)		(m3)	(m3)
84.43	0.00	0.00	0.00		0.00	0.00
84.58	3.74	0.00	0.17		14.06	17.97
84.73	7.47	0.00	0.34		28.13	35.94
84.88	11.21	0.00	0.51		42.19	53.90
85.03	14.94	0.00	0.71		56.25	71.91
85.18	18.68	0.00	1.21		70.31	90.20
85.33	22.41	0.00	1.72		84.38	108.51
85.48	26.15	0.00	2.23		98.44	126.82
85.63	29.89	0.03	2.74		112.50	145.15
85.78	33.62	0.08	3.25		126.56	163.51
85.93	37.36	0.13	3.75		140.63	181.87
86.08	41.09	0.19	4.37		154.69	200.33
86.23	44.83	0.24	5.11		168.75	218.93
86.38	48.56	0.30	5.96		182.81	237.64
86.53	52.30	0.49	6.81		196.88	256.48
86.68	52.30	0.76	7.66		210.94	271.66
86.83	52.30	1.03	8.50		225.00	286.84
86.98	52.30	1.30	9.35		225.00	287.96
87.13	52.30	1.57	10.20		225.00	289.07
87.28	52.30	1.84	11.05		225.00	290.19
87.43	52.30	2.11	11.90		225.00	291.31
87.58	52.30	2.38	12.75		225.00	292.43
87.73	52.30	2.65	13.59		225.00	293.55
87.88	52.30	2.92	14.44		225.00	294.67
87.98	52.30	3.10	15.01		225.00	295.41
88.10	52.30	3.32	15.69		225.00	296.31
88.13	52.30	3.37	15.86		225.00	296.53
88.18	52.30	3.46	16.14		225.00	296.90
88.22	52.30	3.54	16.37		225.00	297.20
88.30	52.30	3.68	16.82	0.00	225.00	297.80

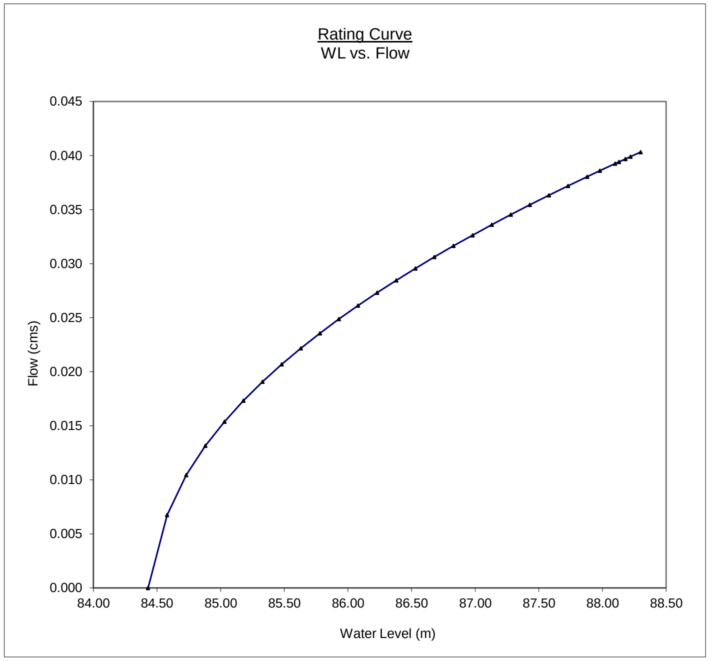
PROJECT NO. : BRM-00606364-B0
PROJECT NAME. : Circle K - Nepean
Date: April 22, 2021

CALCULATION Sheet : 4

Orifice Coefficient =	0.82	
Invert =	84.43	m
Orifice Tube =	85	mm

Water	AVAILABLE STORAGE					
Level	Pipe	Catch Basins	CBMH	Surface	Cultec	Total
(m)	(m3)	(m3)	(m3)	(m3)	(m3)	(m3)
84.43	0.00	0.00	0.00	0.00	0.00	0.00
84.58	3.74	0.00	0.17	0.00	14.06	17.97
84.73	7.47	0.00	0.34	0.00	28.13	35.94
84.88	11.21	0.00	0.51	0.00	42.19	53.90
85.03	14.94	0.00	0.71	0.00	56.25	71.91
85.18	18.68	0.00	1.21	0.00	70.31	90.20
85.33	22.41	0.00	1.72	0.00	84.38	108.51
85.48	26.15	0.00	2.23	0.00	98.44	126.82
85.63	29.89	0.03	2.74	0.00	112.50	145.15
85.78	33.62	0.08	3.25	0.00	126.56	163.51
85.93	37.36	0.13	3.75	0.00	140.63	181.87
86.08	41.09	0.19	4.37	0.00	154.69	200.33
86.23	44.83	0.24	5.11	0.00	168.75	218.93
86.38	48.56	0.30	5.96	0.00	182.81	237.64
86.53	52.30	0.49	6.81	0.00	196.88	256.48
86.68	52.30	0.76	7.66	0.00	210.94	271.66
86.83	52.30	1.03	8.50	0.00	225.00	286.84
86.98	52.30	1.30	9.35	0.00	225.00	287.96
87.13	52.30	1.57	10.20	0.00	225.00	289.07
87.28	52.30	1.84	11.05	0.00	225.00	290.19
87.43	52.30	2.11	11.90	0.00	225.00	291.31
87.58	52.30	2.38	12.75	0.00	225.00	292.43
87.73	52.30	2.65	13.59	0.00	225.00	293.55
87.88	52.30	2.92	14.44	0.00	225.00	294.67
87.98	52.30	3.10	15.01	0.00	225.00	295.41
88.10	52.30	3.32	15.69	0.00	225.00	296.31
88.13	52.30	3.37	15.86	0.00	225.00	296.53
88.18	52.30	3.46	16.14	0.00	225.00	296.90
88.22	52.30	3.54	16.37	0.00	225.00	297.20
88.30	52.30	3.68	16.82	0.00	225.00	297.80

Water	Flow Through
Level	Orifice
(m)	(cms)
84.43	0.000
84.58	0.007
84.73	0.010
84.88	0.013
85.03	0.015
85.18	0.017
85.33	0.019
85.48	0.021
85.63	0.022
85.78	0.024
85.93	0.025
86.08	0.026
86.23	0.027
86.38	0.028
86.53	0.030
86.68	0.031
86.83	0.032
86.98	0.033
87.13	0.034
87.28	0.035
87.43	0.035
87.58	0.036
87.73	0.037
87.88	0.038
87.98	0.039
88.10	0.039
88.13	0.039
88.18	0.040
88.22	0.040
88.30	0.040



PROJECT NO. : BRM-00606364-B0
PROJECT NAME. : Circle K - Nepean
Date: April 22, 2021

CALCULATION Sheet :5

STORAGE CALCULATION - 2 Yr Storm Event

Orfice Location - D/S MH2 ; Orifice Tube - 85 mm

Duration of Storm =	2	Year
Area =	0.693	ha
Weighted Runoff C =	0.798	
Factored Runoff coefficent, Cf =	0.798	
Release Rate Q =	7.36	l/s

I D F Coefficents (For 2 yr)
[City of Ottawa IDF]

A =	732.95
B =	6.20
C =	0.81

Orifice Coefficient	0.82	
Ponding Depth	0.00	
Lowest Surface Elev.	88.3	m
Orifice Invert	84.43	m
Elevation of Ponding	84.60	m
Head of Water	0.1275	m
Orifice Diameter	85	mm
Orifice Flow	0.0074	cms

Storm Duration (min)	Rainfall Intensity (mm / hr)	Storm Runoff Rate (m^3/s)	Storm Runoff Volume (m^3)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
0	0.00	0.000	0	0	0.00
15	61.77	0.095	85	7	78.73
20	52.03	0.080	96	9	87.04
25	45.17	0.069	104	11	92.99
30	40.04	0.061	111	13	97.42
35	36.06	0.055	116	15	100.81
40	32.86	0.050	121	18	103.44
50	28.04	0.043	129	22	107.09
60	24.56	0.038	136	26	109.25
70	21.91	0.034	141	31	110.40
80	19.83	0.030	146	35	110.82
90	18.14	0.028	150	40	110.69
100	16.75	0.026	154	44	110.12
120	14.56	0.022	161	53	107.99
360	6.14	0.009	204	159	44.81
720	3.53	0.005	234	234	0.00
1440	2.02	0.003	268	268	0.00

Maximum Required Storage = 110.82 m^3

PROJECT NO. : BRM-00606364-B0
PROJECT NAME. : Circle K - Nepean
Date: April 22, 2021

CALCULATION Sheet :6

STORAGE CALCULATION - 5 Yr Storm Event

Orfice Location - D/S MH2 ; Orifice Tube - 85 mm

Duration of Storm =	5	Year
Area =	0.693	ha
Weighted Runoff C =	0.798	
Factored Runoff coefficent, Cf =	0.80	
Release Rate Q =	10.86	l/s

I D F Coefficents (For 5 yr)
[City of Ottawa IDF]

A =	998.07
B =	6.05
C =	0.814

Orifice Coefficient	0.82	
Ponding Depth	0.00	
Lowest Surface Elev.	88.3	m
Orifice Invert	84.43	m
Elevation of Ponding	84.75	m
Head of Water	0.2775	m
Orifice Diameter	85	mm
Orifice Flow	0.0109	cms

Storm Duration (min)	Rainfall Intensity (mm / hr)	Storm Runoff Rate (m^3/s)	Storm Runoff Volume (m^3)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
0	0.00	0.000	0	0	0.00
15	83.56	0.128	115	10	105.69
20	70.25	0.108	129	13	116.41
25	60.90	0.094	140	16	123.97
30	53.93	0.083	149	20	129.50
35	48.52	0.074	156	23	133.64
40	44.18	0.068	163	26	136.76
50	37.65	0.058	173	33	140.87
60	32.94	0.051	182	39	143.01
70	29.37	0.045	189	46	143.81
80	26.56	0.041	196	52	143.65
90	24.29	0.037	201	59	142.75
100	22.41	0.034	206	65	141.28
120	19.47	0.030	215	78	137.04
360	8.17	0.013	271	235	36.57
720	4.68	0.007	310	310	0.00
1440	2.67	0.004	354	354	0.00

Maximum Required Storage = 143.81 ***m^3***

PROJECT NO. : BRM-00606364-B0
PROJECT NAME. : Circle K - Nepean
Date: April 22, 2021

CALCULATION Sheet : 7

STORAGE CALCULATION - 10 Yr Storm Event

Orfice Location - D/S MH2 ; Orifice Tube - 85 mm

Duration of Storm = 10 Year

Area = 0.693 ha
Weighted Runoff C = 0.798
Factored Runoff coefficent, Cf = 0.798

Release Rate Q = 14.97 l/s

I D F Coefficents (For 10 yr)
[City of Ottawa IDF]
A = 1174.18
B = 6.01
C = 0.816

Orifice Coefficient	0.82	
Ponding Depth	0.00	
Lowest Surface Elev.	88.3	m
Orifice Invert	84.43	m
Elevation of Ponding	85.00	m
Head of Water	0.5275	m
Orifice Diameter	85	mm
Orifice Flow	0.0150	cms

Storm Duration (min)	Rainfall Intensity (mm / hr)	Storm Runoff Rate (m^3/s)	Storm Runoff Volume (m^3)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
0	0.00	0.000	0	0	0.00
15	97.85	0.150	135	13	121.75
20	82.21	0.126	151	18	133.51
25	71.22	0.109	164	22	141.58
30	63.05	0.097	174	27	147.30
35	56.70	0.087	183	31	151.39
40	51.62	0.079	190	36	154.29
50	43.97	0.068	203	45	157.61
60	38.45	0.059	213	54	158.65
70	34.27	0.053	221	63	158.13
80	30.98	0.048	228	72	156.49
90	28.32	0.043	235	81	154.01
100	26.12	0.040	241	90	150.85
120	22.69	0.035	251	108	143.04
360	9.50	0.015	315	315	0.00
720	5.44	0.008	361	361	0.00
1440	3.10	0.005	411	411	0.00

Maximum Required Storage = 158.65 ***m^3***

CALCULATION Sheet :8

STORAGE CALCULATION - 25 Yr Storm Event

Orfice Location - D/S MH2 ; Orifice Tube - 85 mm

Duration of Storm =	25	Year	Orifice Coefficient	0.82
Area =	0.693	ha	Ponding Depth	0.00
Weighted Runoff C =	0.798		Lowest Surface Elev.	88.3 m
Factored Runoff coefficent, Cf =	0.88		Orifice Invert	84.43 m
			Elevation of Ponding	85.50 m
			Head of Water	1.0275 m
			Orifice Diameter	85 mm
Release Rate Q =	20.89	l/s	Orifice Flow	0.0209 cms

I D F Coefficents (For 25 yr)
[City of Ottawa IDF]

A =	1402.88
B =	6.02
C =	0.819

Storm Duration (min)	Rainfall Intensity (mm / hr)	Storm Runoff Rate (m^3/s)	Storm Runoff Volume (m^3)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
0	0.00	0.000	0	0	0.00
15	115.83	0.196	176	19	157.27
20	97.26	0.164	197	25	172.04
25	84.22	0.142	213	31	182.02
30	74.51	0.126	227	38	188.92
35	66.99	0.113	238	44	193.72
40	60.97	0.103	247	50	196.98
50	51.90	0.088	263	63	200.28
60	45.36	0.077	276	75	200.62
70	40.42	0.068	287	88	198.95
80	36.53	0.062	296	100	195.83
90	33.38	0.056	304	113	191.61
100	30.78	0.052	312	125	186.54
120	26.72	0.045	325	150	174.45
360	11.16	0.019	407	407	0.00
720	6.37	0.011	465	465	0.00
1440	3.62	0.006	528	528	0.00

Maximum Required Storage = 200.62 ***m^3***

PROJECT NO. : BRM-00606364-B0
PROJECT NAME. : Circle K - Nepean
Date: April 22, 2021

CALCULATION Sheet : 9

STORAGE CALCULATION - 50 Yr Storm Event

Orfice Location - D/S MH2 ; Orifice Tube - 85 mm

Duration of Storm =	50	Year
Area =	0.693	ha
Weighted Runoff C =	0.798	
Factored Runoff coefficent, Cf =	0.90	
Release Rate Q =	23.30	l/s

I D F Coefficents (For 50 yr)
[City of Ottawa IDF]

A =	1569.58
B =	6.01
C =	0.82

Orifice Coefficient	0.82	
Ponding Depth	0.00	
Lowest Surface Elev.	88.3	m
Orifice Invert	84.43	m
Elevation of Ponding	85.75	m
Head of Water	1.2775	m
Orifice Diameter	85	mm
Orifice Flow	0.0233	cms

Storm Duration (min)	Rainfall Intensity (mm / hr)	Storm Runoff Rate (m^3/s)	Storm Runoff Volume (m^3)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
0	0.00	0.000	0	0	0.00
15	129.22	0.224	201	21	180.52
20	108.47	0.188	226	28	197.56
25	93.91	0.163	244	35	209.10
30	83.08	0.144	259	42	217.14
35	74.68	0.129	272	49	222.77
40	67.95	0.118	283	56	226.64
50	57.83	0.100	301	70	230.70
60	50.55	0.088	315	84	231.39
70	45.02	0.078	328	98	229.78
80	40.69	0.070	338	112	226.52
90	37.18	0.064	348	126	222.01
100	34.28	0.059	356	140	216.52
120	29.75	0.052	371	168	203.33
360	12.41	0.021	464	464	0.00
720	7.08	0.012	530	530	0.00
1440	4.02	0.007	602	602	0.00

Maximum Required Storage = 231.39 ***m^3***

PROJECT NO. : BRM-00606364-B0
PROJECT NAME. : Circle K - Nepean
Date: April 22, 2021

CALCULATION Sheet :10

STORAGE CALCULATION - 100 Yr Storm Event

Orfice Location - D/S MH2 ; Orifice Tube - 85 mm

Duration of Storm = 100 Year

Area = 0.693 ha
Weighted Runoff C = 0.798
Factored Runoff coefficent, Cf = 0.950

Release Rate Q = 25.89 l/s

I D F Coefficents (For 100 yr)	
[City of Ottawa IDF]	
A =	1735.688
B =	6.014
C =	0.820

Orifice Coefficient	0.82	
Ponding Depth	0.00	
Lowest Surface Elev.	88.3	m
Orifice Invert	84.43	m
Elevation of Ponding	86.05	m
Head of Water	1.5775	m
Orifice Diameter	85	mm
Orifice Flow	0.0259	cms

Storm Duration (min)	Rainfall Intensity (mm / hr)	Storm Runoff Rate (m^3/s)	Storm Runoff Volume (m^3)	Release Flow Volume (m^3)	Required Storage Volume (m^3)
0	0.00	0.000	0	0	0.00
10	178.56	0.327	196	16	180.39
15	142.89	0.261	235	23	211.89
20	119.95	0.219	263	31	232.17
25	103.85	0.190	285	39	246.04
30	91.87	0.168	302	47	255.81
40	75.15	0.137	330	62	267.68
50	63.95	0.117	351	78	273.21
60	55.89	0.102	368	93	274.79
70	49.79	0.091	382	109	273.70
80	44.99	0.082	395	124	270.67
90	41.11	0.075	406	140	266.19
100	37.90	0.069	416	155	260.57
120	32.89	0.060	433	186	246.74
360	13.72	0.025	542	542	0.00
720	7.83	0.014	618	618	0.00
1440	4.45	0.008	703	703	0.00

Maximum Required Storage = 274.79 ***m^3***

Project Number: BRM-006060364-B0

Circle K Nepean - 1545 Woodroffe Avenue, Ottawa, ON

STORM SEWER DESIGN

CALCULATION Sheet :11

Date April 27, 2021

Q=0.0028*C*I*A (cms)
C : RUNOFF COEFFICIENT
i : RAINFALL INTENSITY
IDF Eqn : i = A / (B +T) ^C
A : AREA (ha)

Town of Bradford	
IDF Parameter	10 yr
A =	1174.184
B =	6.014
C =	0.816

See DWG C04 for Drainage Areas	MAINTENANCE HOLE FROM	MAINTENANCE HOLE TO	LENGTH (m)	Total Area, A_T	Com. C C_c	$C_c A_T$	TOTAL $C_c A_T$	FLOW TIME (min) TO	FLOW TIME (min) IN	$I\ 10_{yr}$ (mm/h)	TOTAL Q (cms)	S (%)	D (mm)	Q FULL (cms)	V FULL (m/s)	Sec. Time (sec)	Accum. Time (sec)
Area 201	CAR WASH	CBMH6	16.63	0.014	0.95	0.013	0.013	10.00	0.30	122.14	0.005	2.00	100	0.007	0.93	0.30	10.30
Area 202	CB9	CBMH6	29.0	0.043	0.20	0.009	0.009	10.00	0.40	122.14	0.003	1.00	250	0.059	1.21	0.40	10.40
Area 203	CB7	CBMH6	15.2	0.050	0.83	0.042	0.042	10.00	0.21	122.14	0.014	1.00	250	0.059	1.21	0.21	10.21
Area 204	CBMH6	CBMH5	28.7	0.175	0.90	0.158	0.221	10.40	0.35	119.71	0.074	1.00	300	0.097	1.37	0.35	10.75
Area 205	CBMH5	CBMH3	48.1	0.044	0.90	0.040	0.040	10.00	0.43	122.14	0.014	1.82	300	0.130	1.85	0.43	10.43
Area 207, Area 208	CB4	CBMH3	20.2	0.136	0.85	0.116	0.116	10.00	0.20	122.14	0.040	2.00	250	0.084	1.71	0.20	10.20
Area 206	CBMH3	MH2	25.8	0.116	0.90	0.104	0.260	10.43	0.19	119.50	0.087	2.00	375	0.248	2.25	0.19	10.63
Area 210	STORE	CBMH8	23.6	0.051	0.95	0.048	0.048	10.00	0.32	122.14	0.017	2.00	150	0.022	1.22	0.32	10.32
Area 209	CBMH8	MH2	17.7	0.036	0.32	0.012	0.060	10.32	0.20	120.17	0.020	1.43	250	0.071	1.45	0.20	10.53
-	MH2	STC EFO6	3.3			0.000	0.320	10.63	0.02	118.38	0.106	2.00	375	0.248	2.25	0.02	10.65
							Controlled Flow (See Calculation Sheet 10) =				0.026	2.00	375	0.248	2.25	0.02	10.65
-	STC EFO6	MH1	3.3					10.65	0.02	118.24	0.026	2.00	375	0.248	2.25	0.02	10.67
-	MH1	EX STM MH	15.5					10.67	0.07	118.10	0.026	5.00	375	0.392	3.55	0.07	10.75

Stormceptor® EF Sizing Report

STORMCEPTOR®

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION 04/27/2021

Province:	Ontario
City:	Nepean
Nearest Rainfall Station:	OTTAWA MACDONALD-CARTIER INT'L AP
NCDC Rainfall Station Id:	6000
Years of Rainfall Data:	37
Site Name:	
Drainage Area (ha):	0.82
Runoff Coefficient 'c':	0.75
Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Project Name:	CK-Nepean
Project Number:	45153
Designer Name:	Leanna Badke
Designer Company:	EXP Services Inc.
Designer Email:	leanna.badke@exp.com
Designer Phone:	416-807-4187
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	22.23
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	26.06
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	75
EFO6	83
EFO8	87
EFO10	90
EFO12	92

Recommended Stormceptor EFO Model: EFO6

Estimated Net Annual Sediment (TSS) Load Reduction (%): 83

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 waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

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

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

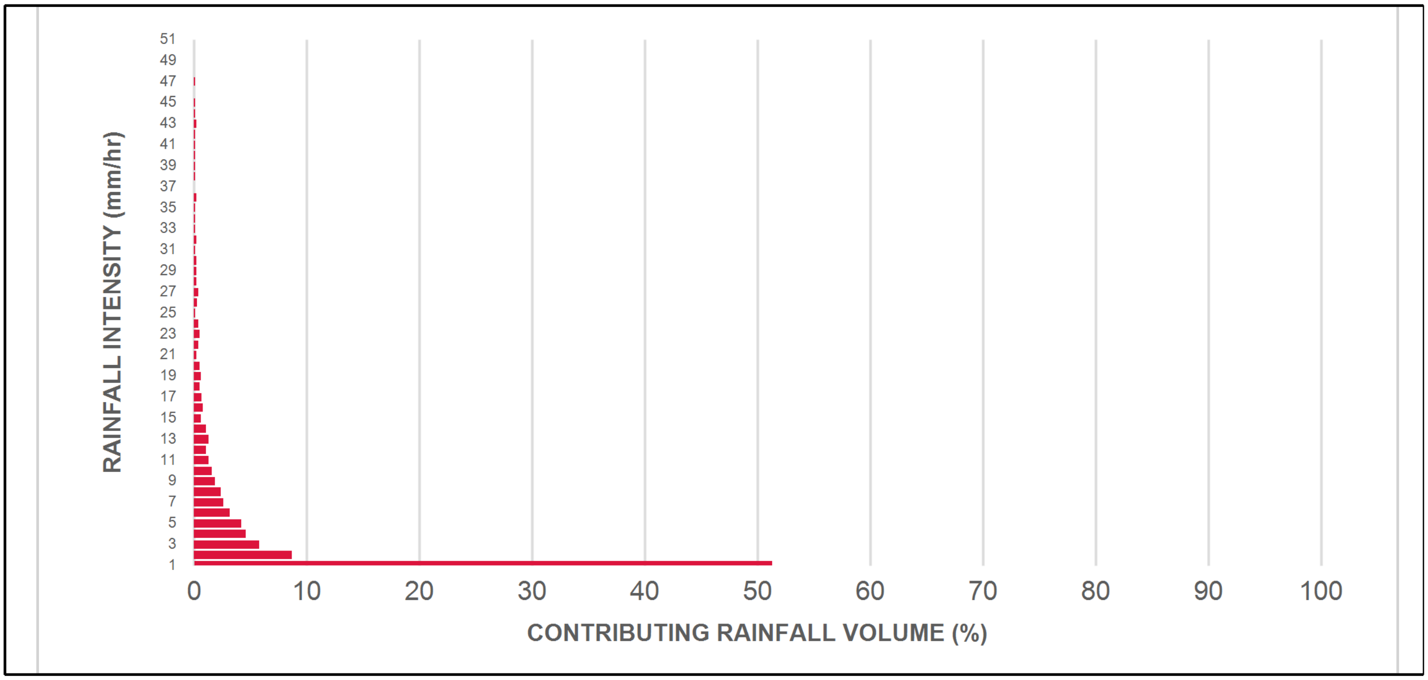
Upstream Flow Controlled Results

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 (%)
1	51.3	51.3	1.71	103.0	39.0	93	47.7	47.7
2	8.7	60.0	3.42	205.0	78.0	90	7.8	55.5
3	5.8	65.8	5.13	308.0	117.0	86	5.0	60.5
4	4.6	70.4	6.84	410.0	156.0	81	3.7	64.3
5	4.2	74.6	8.55	513.0	195.0	77	3.2	67.5
6	3.2	77.8	10.26	615.0	234.0	73	2.3	69.8
7	2.6	80.4	11.97	718.0	273.0	70	1.8	71.7
8	2.4	82.8	13.68	821.0	312.0	66	1.6	73.2
9	1.9	84.7	15.39	923.0	351.0	63	1.2	74.4
10	1.6	86.3	17.10	1026.0	390.0	59	0.9	75.4
11	1.3	87.6	18.81	1128.0	429.0	57	0.7	76.1
12	1.1	88.7	20.52	1231.0	468.0	56	0.6	76.7
13	1.3	90.0	22.23	1334.0	507.0	55	0.7	77.4
14	1.1	91.1	23.94	1436.0	546.0	54	0.6	78.0
15	8.9	100.0	25.65	1539.0	585.0	53	4.7	82.7
16	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
17	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
18	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
19	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
20	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
21	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
22	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
23	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
24	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
25	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7

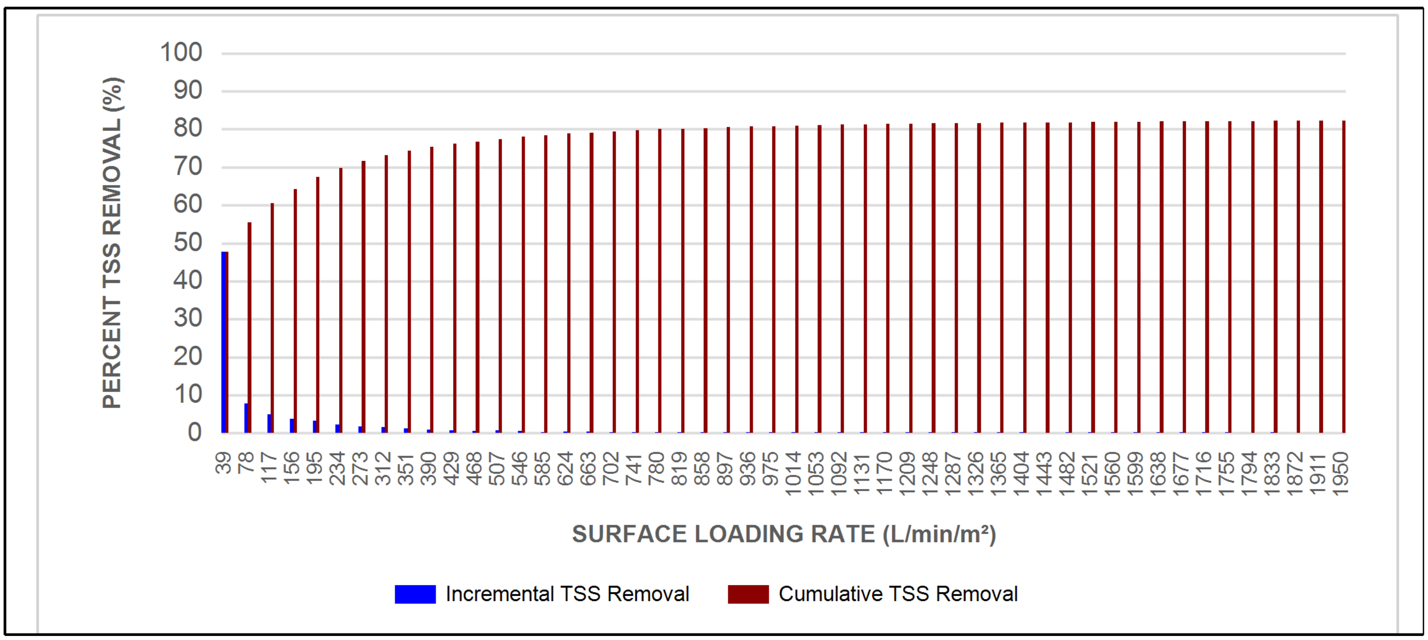
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
26	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
27	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
28	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
29	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
30	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
31	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
32	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
33	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
34	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
35	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
36	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
37	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
38	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
39	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
40	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
41	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
42	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
43	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
44	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
45	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
46	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
47	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
48	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
49	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
50	0.0	100.0	26.00	1560.0	593.0	52	0.0	82.7
							Estimated Net Annual Sediment (TSS) Load Reduction =	**83 %**

Stormceptor® EF Sizing Report

RAINFALL DATA FROM OTTAWA MACDONALD-CARTIER INT'L AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



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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

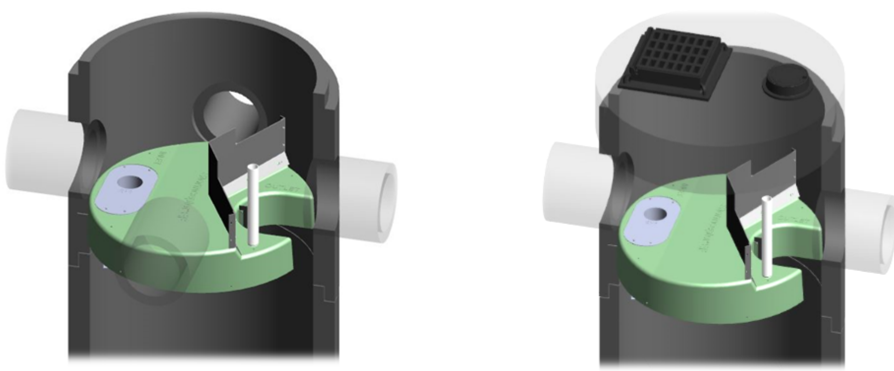
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test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

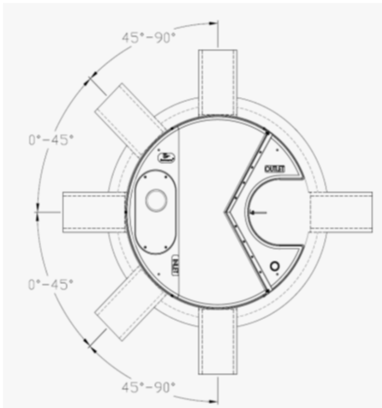
DESIGN FLEXIBILITY

►**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

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 shall be determined using historical rainfall data and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. 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/m2 to 2600 L/min/m2) 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.