PRELIMINARY STORMWATER MANAGEMENT REPORT

Porta

Belleville, ON

July 18, 2025

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Revision Summary

July 18, 2025

Initial submission for zoning bylaw amendment application.

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1 Introduction and Background

Harbour 25 LP is proposing to develop a vacant parcel of land in Belleville to create up to 213 residential units that are arranged as towns and stacked towns, and one commercial building with 7-units– south of Dundas Street West near the intersection of Dundas Street West and Bay Bridge Road. The development site has an area of approximately 2.94ha and is bounded by Dundas Street West to the north, Old Bay Bridge Road to the west, Crates Marina along the east perimeter and the Ramada Inn Hotel on the south side. The lands also directly abut the Bay of Quinte. The property boundary is roughly as shown in Figure 1-1.

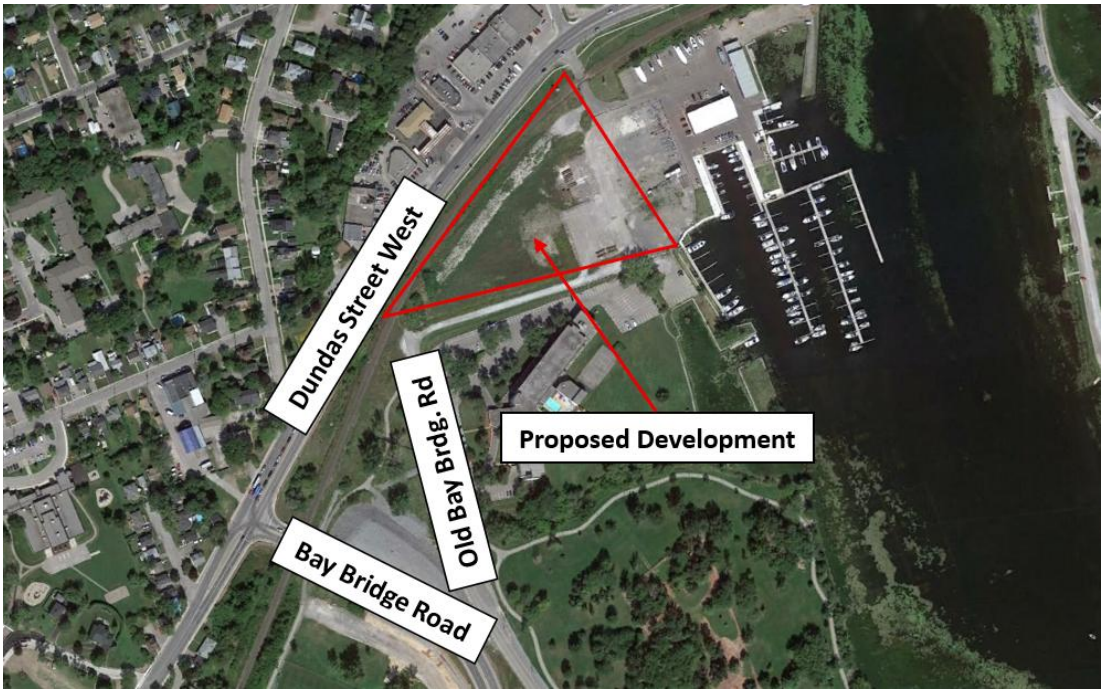


Figure 1-1: Development Site Location (Google, Maxar Tech 2018)

Access to the site is gained from Dundas Street West, which is shared with Crates Marina. Future access will be from Old Bay Bridge Road and only an emergency vehicle access and pedestrian access to Dundas Street West will be retained.

The lands were the subject of a recent plan of subdivision and site plan approval for a development concept that included over 300 condominium units arranged in three towers. The new concept is better suited to the current market conditions.

2 Existing Conditions

The site has sparse vegetation with bushes and few trees. Drainage at the site is poorly defined, but generally, surface drainage is collected in a ditch along the south limits and discharged into the Bay of Quinte. The lands have been historically filled with materials that are known to be contaminated. The extents and nature of the contamination has be extensively studied by BluMetric Environmental Inc within the framework of a Site-Specific Risk Assessment (SSRA). The SSRA has been accepted by the Ministry of the Environment (MOE) and has resulted issuance of two certificates of property use. Of interest to the future development of the lands is the recommendation that during the construction process, all workers may wear normal clothing but should ensure that they wash daily upon completion of work.

Contaminants within the soils exceed the ministry guidelines and recommendations to manage exposure are included within the certificates of property use (CPU). Contaminated soils may be left on site, but must be covered by 1m of clean fill or an asphalt surface. The structure of the asphalt cap is defined within the CPUs. Measures for building design must also be taken to prevent entry of landfill gases through service connections.

The investigations found that groundwater conditions are within acceptable limits and no specialized procedures are required with respect to working around or pumping of groundwater.

Bedrock elevations were taken into consideration in the design of servicing pipes (storm, sanitary, watermain). Bedrock contours were provided in BluMetric's *Risk Assessment Report* and reproduced in *Design Drawing 07*.

The property boundary is highlighted in Figure 2-1.

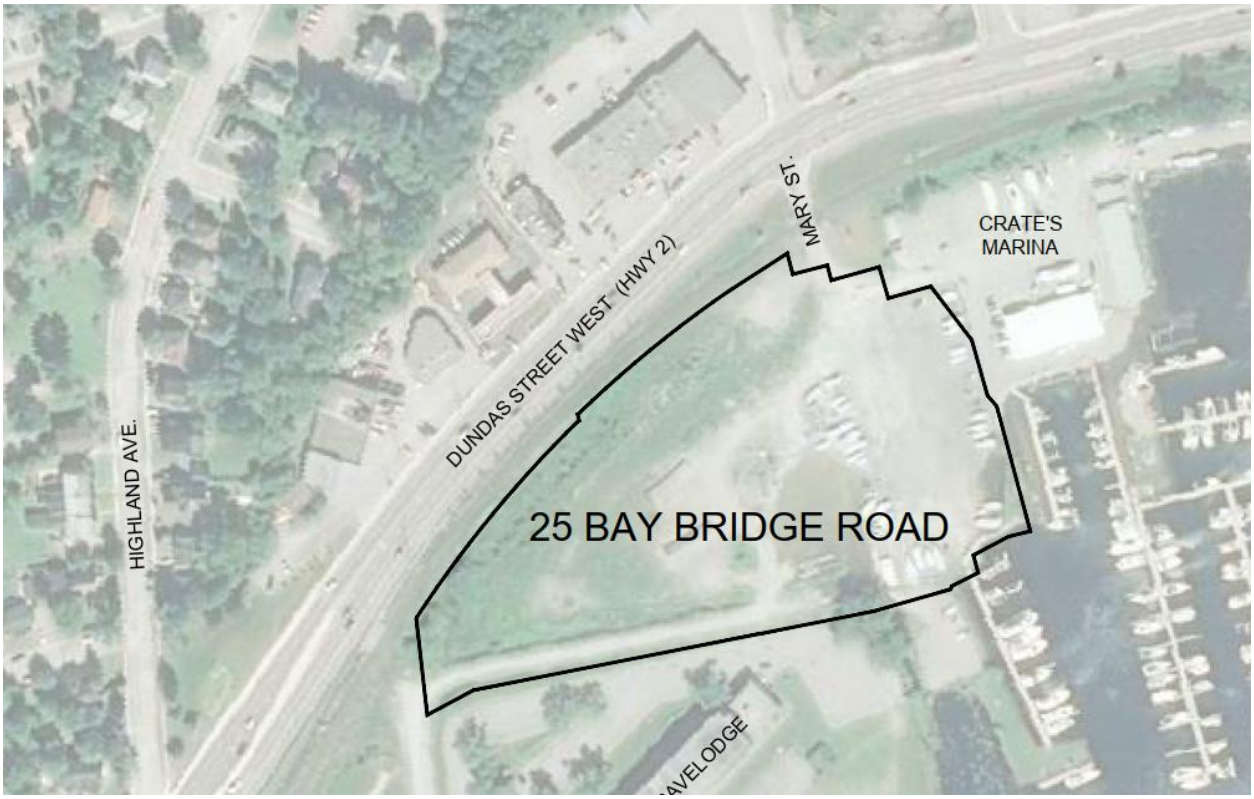


Figure 2-1: Property Limits (Google, Maxar Tech 2018)

2.1 SWM Targets

The stormwater management plan focuses on three environmental objectives when considering the treatment and conveyance of stormwater runoff. The objectives are to mitigate flooding, quality and erosion impacts to the receiving system. SWM targets were prepared in consultations with Quinte Conservation Authority and the City of Belleville. Relevant guidance documents include:

- Bay of Quinte Remedial Action Plan, Stormwater Management Guidelines, March 2006,
- City of Belleville Engineering Standards,
- Quinte Conservation Stormwater Management Submission Guidelines, May 2012, and
- Ministry of Environmental Stormwater Planning and Design Manual (2003).

Other guiding documents that provide help with design options or direction include the 2024 PPS, MTO Drainage Manual (1997), and LID Guidelines (2010).

Based on the guidance above, Jewell proposed a SWM methodology to achieve the following targets:

Quality Control

- Treat stormwater discharge to achieve **Enhanced** quality control objectives

Erosion and Sediment Control

- Minimize the potential for erosion of soils
- Mitigate the release of sediment offsite

Quantity Treatment is not necessary as storm water will be discharged into the Bay of Quinte.

3 Proposed Conditions

3.1 Drainage Scheme

Jewell's SWM solution includes a storm sewer network sized to receive and convey runoff from the 100-yr storm event to the Bay of Quinte. The JF8-8-2 Jellyfish Filter is proposed to be located at the downstream end of the pipe network to provide quality treatment of runoff prior reaching the outlet to the Bay of Quinte.

As mentioned in Section 1, the existing site has generally poor drainage. All site drainage occurs at the surface through poorly defined swales that discharge to the Bay of Quinte. Proposed drainage will occur through underground storm sewers. The SWM solution accounts for external catchments, increases in surface hardening, and the objective to achieve safe runoff conveyance for all return period events.

3.2 External Catchments

There is an external catchment contributing to the storm sewer network that includes grassed area between the northern boundary of the site and Dundas St. W. (see Appendix B). Runoff from this catchment drains in a southwest direction towards two concrete pipes that convey runoff under the CP tracks. This drainage is then received by a ditch inlet that directs stormwater to the proposed storm sewer network.

A small portion of the municipal road allowance near the proposed extension of Old Bay Bridge Road, near the southwest corner of the site boundary, also enters the proposed storm network. Storm sewers are planned to accommodate these external catchments.

An external catchment that is not diverted to the proposed storm sewer network is the runoff that travels north from the Ramada (formerly Travelodge) property to a poorly defined swale located along the dividing line between the south boundary of the proposed development and the north boundary of the Travelodge property. With the proposed development, this flow path will be retained along the toe of the proposed 3.0 wide multi-purpose trail. Near the southeast corner of the property, where the swale begins to bend southward, it is proposed to relocate the swale slightly outside the development boundary. At the outlet to the Bay of Quinte, the existing 450mm culvert will be replaced with an HDPE culvert of the same size to pass the runoff from this swale under a sidewalk to the Bay of Quinte.

3.2.1 Storm Sewer Network

Jewell conceptually sized a storm sewer network that is planned to convey runoff for the 5-yr storm event. Peak flows were determined using the Rational Method and intensity-duration-

frequency (IDF) curves for Belleville. Five-year peak flows are estimated to be 0.39m^3/s. This includes all internal and external contributions. A 675mm storm sewer at 0.25% has a capacity of 0.42m^3/s and would represent the minimum size and slope required to convey the expected 5-yr event.

Storm sewer sizing calculations are provided in Appendix C. A headwall is proposed at the storm sewer outlet and Jewell has ensured the pipes are sufficiently submerged to avoid any adverse impacts due to freezing. It is estimated that pipes should be below 74.8m to allow full conveyance at all times of the year.

Jewell will adjust sewer sizes during detailed design to take into account the backwater effects of the Bay of Quinte. As a precaution, the road network has a saw-tooth profile that permits shallow ponding over each catchbasin before spilling overland to the next in sequence.

In storm events that exceed 5-yr storm, the proposed grading provides overland flow routes along the roadway that direct runoff towards the Bay of Quinte.

The proposed SWM solution provides no negative flooding impacts.

3.2.2 Major Flows

Major flows will follow the road network and will be discharged overland to the Bay of Quinte.

3.3 Site Hydrology

Jewell used the Rational Method to estimate peak flows and for sizing of conveyance features. The Rational Method equation is shown below. It relies on an estimation of runoff coefficient, flow intensity, and drainage area.

Equation 1: Rational Method

$$Q = \frac{CiA}{360}$$

Where:

Q = Peak Flow in m^3/s
C = Runoff Coefficient
i = Rainfall Intensity in mm/hr
A = Area in hectares

The intensity of the 25mm event is calculated using the following formula:

Equation 2: Peak Intensity, 25mm Event

$$i = 43C + 5.9$$

3.4 Climate Resiliency

Climate Change projections typically increase rainfall intensity values by 10% compared to base-year events. The proposed development's conveyance features will be designed with surplus capacity (volume-to-capacity ratio < 90%) to ensure that runoff is adequately conveyed during events larger than the design event. Therefore, climate resiliency is provided.

4 Stormwater Management Controls

Runoff will be conveyed through storm sewers, which will collect runoff and convey it to stormwater treatment technologies, before discharging to the Bay of Quinte.

4.1 Quality Treatment

Since the lands have known contamination that will remain on site but below a protective cap, it is not advisable to employ any stormwater management technologies that rely on infiltration. Instead, Jewell considered treatment techniques that would remain separated from groundwater. A preferred technology is an oil grit separator (OGS unit). Given the recent direction from MECP that sizing calculations must be completed on an assumed particle size distribution (PSD) that is heavily weighted to fines, most end of pipe OGS units are unable to demonstrate successful treatment of the ETV particle size distribution. However, the Jellyfish style of unit containing filters can achieve the required treatment level. These are more expensive to install and to maintain that a traditional OGS unit based on dynamic separation.

A JF8-8-2 Jellyfish filter will be used to provide *Enhanced* (80%) TSS removal of the ETV PSD. The units are also capable of removing total phosphorus (TP) with an expected removal efficiency of 77%. The TP removal will be an added benefit to the Bay of Quinte that is an Area in Recovery from the historic effects of phosphorus loading.

The JF8 unit should be implemented in the 3-MH Offline Configuration. Jellyfish Filters are ETV verified technologies and have access ports to facilitate maintenance operations. The design calculations will be confirmed in detailed design.

Jewell used the sizing tool provided by Imbrium Systems and contacted a representative from Rinker Materials to determine Jellyfish Filter sizing given the information provided in Table 4-1.

Table 4-1: Inputs for Sizing

Treatment Area (ha)	Percent Impervious	Quality Flow (L/s)	Runoff Coefficient
2.9 ha	60%	41.7 L/s	0.65

4.1.1 Jellyfish Treatment

The Jellyfish Filter is used to treat the development's surface runoff. The Jellyfish Filter will capture pollutants in stormwater run-off before entering the Bay of Quinte by removing floatables, litter, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate bound pollutants.

A JF8-8-2 unit would be placed in an offline configuration such that flows exceeding the treatment design flow rate may be bypassed. This arrangement is typically implemented using a flow diversion in an upstream manhole that ensures a minimum of 18" (450mm) head can be developed before flows would begin to divert. A collection manhole is situated downstream of the unit where the outflow pipe and the diversion pipe join in order to provide a single outlet.

4.1.2 Hydro International Downstream Defender (alternative)

The Downstream Defender is an alternative option. The unit provides treatment before entering the Bay of Quinte by removing suspended solids, pollutants, oils, and floatables. These units are not considered capable of providing the full level of treatment to achieve the 80% TSS removal objective based on ETV PSD. A DD10 unit could be considered for Porta if the Fine PSD is used. The ministry practice is to require the ETV PSD, but this presumes an Ontario-wide assumption of the characterization of influent. It is suspected that the primary source of sediment from Porta site will be from winter maintenance. Winter sands for road maintenance must comply with OPSS 1004 Table 12 for Winter Sand (see Figure 4-1).

The OPSS requires that winter sands be within the purple and green lines, but the ETV PSD is much finer shown as the blue line. It is expected that the FINE distribution better represents the expected PSD from the Porta site (see Figure 4-2).

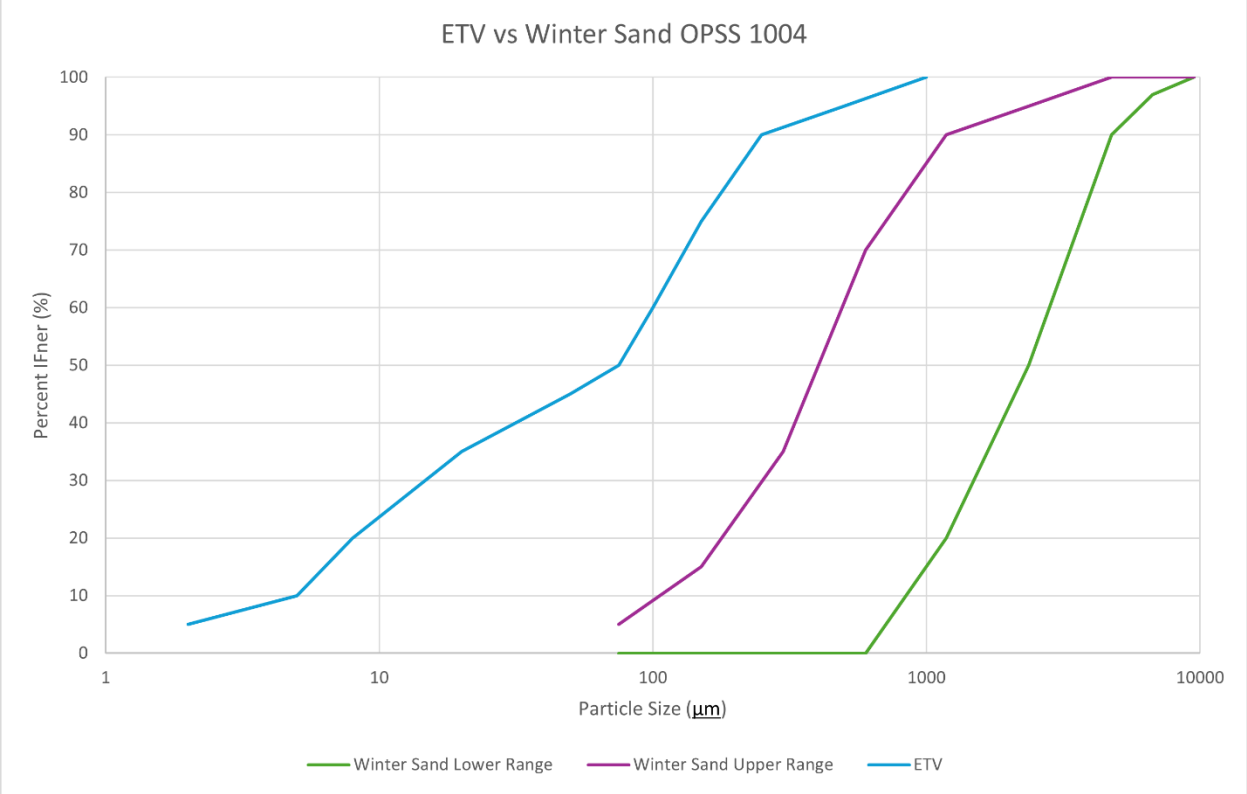


Figure 4-1: OPSS PSD compared with ETV PSD

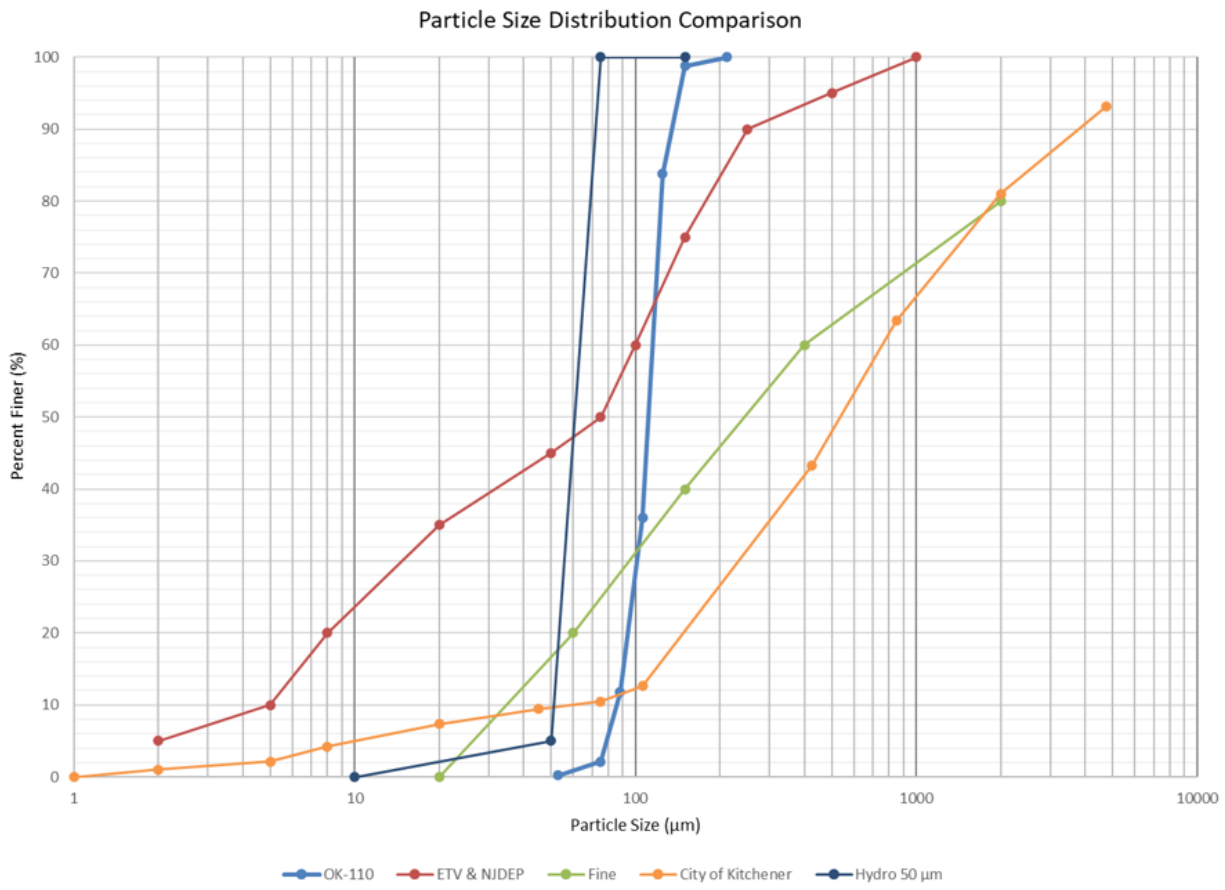


Figure 4-2: FINE PSD compared with NJDEP, OK110 and City of Kitchener

Accordingly, the quality treatment objective is achieved for the site.

5 Low-Impact Development

Low Impact Development is a requirement of the 2020 Provincial Policy Statement. This requires that all developments consider LID strategies to reduce the impact of development on the hydrologic regime.

The Low Impact Development Guidelines (Toronto and Region Conservation Authority, 2010) states that "increases in the quantity, rate, and frequency of runoff can be linked to two root causes:

- the conversion of undeveloped or agricultural land cover to urban uses, and
- the application of storm sewer systems."

The goal of LID site design strategies is to minimize these two sources of hydrologic impacts (Toronto and Region Conservation Authority, 2010, p. 3.3). Large urban areas are negatively impacted by flash flooding associated with extensive hardening. The LID design techniques seek to mitigate flooding and erosion associated with urbanization. While water quality improvements are associated with the recommended techniques, quantity control remains the focus of LID.

The guidelines provide some site design strategies for reducing the hydrologic impact postulating 4 major groupings or "themes":

1) Preserving important hydrologic features and functions;
2) siting and layout of development;
3) reducing impervious area; and
4) using natural drainage systems.

Discussion of the LID design used in the stormwater management design is provided below.

Due to the underlying contamination, no infiltration measures are encouraged and therefore some of the LID techniques will not be applicable to the Porta site.

5.1 Theme 1 – Preserving Important Hydrologic Features

This theme focuses on preservation. Site design is adjusted to preserve natural features that benefit hydrology.

- Preserve stream buffers, including along intermittent and ephemeral channels
- Preserve areas of undisturbed soil and vegetation cover
- Avoid development on permeable soils
- Preserve existing trees and, where possible, tree clusters

Important hydrologic features include:

- Highly permeable soils

- Pocket wetlands
- Significant small (headwater) drainage features
- Riparian buffers
- Floodplains
- Undisturbed natural vegetation
- Tree clusters

There are no natural features on the site and there is no need for protection of any soils.

5.2 Theme 2 – Application of Siting and Layout Techniques

Siting and layout techniques aim to reduce the environmental impacts of the development by fitting the development within the framework of the natural heritage features.

- Fit the design to the terrain
- Use open space or clustered development
- Use innovative street network designs
- Reduce roadway setbacks and lot frontages

There are no natural heritage features on site.

5.3 Theme 3 – Reducing the Impervious Area

Imperviousness can be reduced by minimizing unnecessary surface hardening. Some strategies include:

- Reducing street width
- Reducing building footprints
- Reducing parking footprints
- Considering alternatives to cul-de-sacs
- Eliminating unnecessary sidewalks and driveways

A reduced roadway width is used for the private roads. This helps to reduce unnecessary impervious cover.

5.4 Theme 4 – Using Natural Drainage Systems

These strategies focus on the use of existing natural drainage systems where available “to take advantage of undisturbed vegetated areas and natural drainage patterns.”

- “Disconnect” impervious areas
- Preserve or create micro-topography
- Extend drainage flow paths

Where possible, flows are encouraged to drain across pervious grassed surfaces prior to collection in the storm sewers. Pervious grassed surfaces will encourage infiltration into the soils.

6 Maintenance

The stormwater management features included in this plan include a JF8-8-2 Jellyfish Filter and private storm sewer system.

During detailed design stages, the necessary operation and maintenance manuals will be finalized and transferred to the owners. The infrastructure will remain privately owned and operated.

For further detail and guidance, Section 3.2 of the Jellyfish Filter Owner's Manual outlines maintenance activities for various SWM technologies.

7 Erosion and Sediment Control

Erosion and sediment control is one of the three targets identified in Section 2.3. The following measures are proposed to prevent the negative erosion and sediment impacts of development.

Typical site development requires removal of some vegetated cover. While it is the intention to reduce vegetation removal, exposed soils from the work will be at risk of eroding into the receiving drainage system. Measures will need to be put in place to reduce erosion during construction, and for a period of up to one year after construction is completed. Typical erosion and sediment control measures include:

- Siltation fencing.
- Strawbale check dams.

Controls are to be placed downstream of all active work areas and upstream of protected receivers. Controls should also be placed around stockpiles of topsoil and fill materials.

Typical OPSDs provide good instruction on the correct placement and construction of the controls. The controls provide some protection if they are properly maintained, but they should be considered last-resort measures. The most effective means of control are those which prevent or reduce erosion at the source. This would include diligent stabilization of exposed areas immediately after grading is completed.

The site developer and contractor should actively maintain the new drainage works to remove accumulations of sediment within catch basin sumps.

A silt fence should be located along the upland perimeter of all sensitive features during the construction process, which should be maintained until the lands have stabilized or as directed by the municipality. There would be benefit in maintaining this silt fence for up to 2 growing seasons.

8 Conclusions

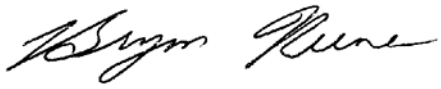
Harbour 25 LP is proposing to develop a 2.94ha parcel of vacant land in Belleville to create 213 residential units – most of these are within townhouse style units, and seven residential units will be associated with the commercial building. The subject lands are south of Dundas Street West and east of Bay Bridge Road.

Stormwater quality controls are required to achieve the *Enhanced* treatment objectives.

Due to the location abutting the Bay of Quinte, no quantity controls are required.

Runoff will be collected with storm sewers and will discharge through an underground storm treatment unit that is proposed to be a J8-8-2 Jellyfish Filter, where quality flows will receive *Enhanced* treatment. Major flows will be directed through the site roadways system to the Bay of Quinte.

Prepared by,



Bryon Keene, P.Eng.

Jewell Engineering Inc.

APPENDIX A

Belleville IDF Curves

Environment Canada/Environnement Canada

Short Duration Rainfall Intensity-Duration-Frequency Data
Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2014/12/21

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BELLEVILLE ON 6150689
(composite)
Latitude: 44 9'N Longitude: 77 23'W Elevation/Altitude: 76 m

Years/Années : 1960 - 2006 # Years/Années : 37

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Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

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Year / Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1960	6.3	9.1	12.4	23.4	25.4	35.1	53.8	55.1	55.9
1961	6.1	7.9	8.9	12.2	18.0	18.8	23.9	34.0	36.3
1963	12.4	19.0	23.1	28.4	30.7	31.0	31.0	31.7	44.4
1964	4.3	5.6	7.4	12.2	12.4	20.6	45.2	45.7	45.7
1966	6.3	8.9	10.4	11.9	13.2	16.0	32.8	37.8	38.1
1967	7.4	9.9	10.4	10.4	11.9	13.2	26.4	42.4	58.7
1968	7.9	11.9	13.7	18.5	21.8	27.2	43.9	57.1	57.1
1969	5.8	9.7	13.0	17.5	24.4	31.0	37.8	43.2	62.2
1971	7.4	11.4	13.0	23.9	25.1	25.4	25.7	25.7	32.5
1972	9.4	10.7	11.7	12.4	14.7	20.6	28.2	33.5	50.5
1973	7.4	10.7	11.9	18.0	21.3	21.8	37.3	45.5	48.0
1974	10.9	15.2	17.8	25.4	25.4	25.4	34.3	42.7	42.7
1977	4.8	8.1	9.9	14.7	25.1	30.2	60.5	66.0	66.0
1980	13.2	16.9	19.0	20.5	20.5	34.6	46.9	47.6	59.6
1981	-99.9	-99.9	13.3	25.5	29.4	34.6	46.2	49.2	57.4
1982	4.6	8.5	10.1	14.2	18.3	24.7	39.8	45.0	45.0
1983	6.5	8.9	10.5	18.4	22.2	30.7	39.6	39.6	50.3
1984	5.1	8.1	10.1	11.3	19.7	23.7	33.4	51.4	55.1
1985	10.5	16.2	20.0	27.0	27.4	42.3	42.3	44.5	44.5
1986	9.1	14.4	16.4	23.2	25.2	35.0	59.2	68.8	78.9
1987	4.3	6.6	9.3	14.2	24.7	37.1	39.2	39.2	39.2
1988	3.7	6.2	7.4	8.6	9.2	10.6	20.8	22.2	28.2

1989	14.5	16.7	17.9	18.4	24.2	24.2	27.7	27.7	37.7
1990	6.9	8.3	10.0	12.3	13.6	20.8	29.7	34.8	38.7
1991	8.5	13.8	18.5	18.8	32.0	32.4	32.4	32.4	32.7
1992	6.3	7.6	8.4	13.2	18.8	21.9	38.2	48.3	50.1
1993	8.2	15.8	23.6	28.3	28.3	28.3	-99.9	-99.9	69.6
1994	8.8	10.2	14.5	18.3	23.6	25.5	38.2	49.2	52.8
1995	8.0	12.9	14.9	19.3	27.5	31.5	48.5	58.5	67.3
1996	6.9	10.4	13.4	19.2	25.1	41.3	41.5	53.8	53.8
1997	10.3	16.8	20.9	25.5	42.8	50.0	56.0	56.0	56.0
1998	9.5	12.1	15.1	22.1	25.0	32.6	38.6	38.6	50.2
1999	9.6	13.1	17.9	23.2	29.4	36.9	42.8	72.7	72.7
2000	10.4	13.4	14.7	16.8	29.0	39.8	52.0	52.4	53.0
2001	7.4	10.1	11.0	11.8	16.7	17.4	21.2	31.6	39.8
2002	7.1	9.4	14.0	21.0	22.4	26.0	39.4	44.2	49.8
2003	7.6	13.5	20.1	26.2	27.0	27.0	31.1	-99.9	56.2
2004	14.4	22.1	28.8	33.3	33.3	49.0	89.9	114.4	124.5
2006	9.0	14.7	18.8	19.5	19.5	19.5	37.3	42.7	59.8
# Yrs. Années	38	38	39	39	39	39	38	37	39
Mean Moyenne	8.1	11.7	14.4	18.9	23.2	28.6	39.8	46.6	52.8
Std. Dev. Écart-type	2.7	3.8	4.9	6.0	6.7	9.0	13.0	16.3	16.4
Skew. Dissymétrie	0.69	0.66	0.83	0.29	0.20	0.37	1.60	2.08	2.19
Kurtosis	3.44	3.23	3.63	2.58	4.05	3.21	7.90	10.48	11.56

*-99.9 Indicates Missing Data/Données manquantes

Warning: annual maximum amount greater than 100-yr return period amount
Avertissement : la quantité maximale annuelle excède la quantité pour une période de retour de 100 ans

Year/Année	Duration/Durée	Data/Données	100-yr/ans
2004	6 h	89.9	80.5
2004	12 h	114.4	97.6
2004	24 h	124.5	104.4

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Table 2a : Return Period Rainfall Amounts (mm)
Quantité de pluie (mm) par période de retour

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	7.6	10.0	11.6	13.5	15.0	16.5	38
10 min	11.1	14.4	16.7	19.5	21.6	23.6	38
15 min	13.6	18.0	20.8	24.5	27.2	29.9	39
30 min	18.0	23.2	26.7	31.1	34.4	37.6	39
1 h	22.1	28.0	31.9	36.8	40.5	44.1	39
2 h	27.1	35.1	40.4	47.0	52.0	56.9	39
6 h	37.7	49.1	56.7	66.3	73.4	80.5	38
12 h	44.0	58.3	67.8	79.9	88.8	97.6	37
24 h	50.1	64.7	74.3	86.5	95.5	104.4	39

Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits
Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	91.6	120.0	138.8	162.6	180.2	197.7	38
	+/- 9.4	+/- 15.8	+/- 21.3	+/- 28.8	+/- 34.4	+/- 40.1	38
10 min	66.5	86.6	100.0	116.9	129.4	141.8	38
	+/- 6.7	+/- 11.2	+/- 15.1	+/- 20.4	+/- 24.4	+/- 28.5	38
15 min	54.4	71.8	83.4	97.9	108.7	119.5	39
	+/- 5.7	+/- 9.6	+/- 12.9	+/- 17.4	+/- 20.8	+/- 24.3	39
30 min	35.9	46.5	53.4	62.2	68.8	75.3	39
	+/- 3.4	+/- 5.8	+/- 7.8	+/- 10.5	+/- 12.6	+/- 14.7	39
1 h	22.1	28.0	31.9	36.8	40.5	44.1	39
	+/- 1.9	+/- 3.2	+/- 4.4	+/- 5.9	+/- 7.1	+/- 8.2	39
2 h	13.5	17.5	20.2	23.5	26.0	28.5	39
	+/- 1.3	+/- 2.2	+/- 3.0	+/- 4.0	+/- 4.8	+/- 5.6	39
6 h	6.3	8.2	9.5	11.1	12.2	13.4	38
	+/- 0.6	+/- 1.1	+/- 1.4	+/- 1.9	+/- 2.3	+/- 2.7	38
12 h	3.7	4.9	5.7	6.7	7.4	8.1	37
	+/- 0.4	+/- 0.7	+/- 0.9	+/- 1.2	+/- 1.5	+/- 1.7	37
24 h	2.1	2.7	3.1	3.6	4.0	4.4	39
	+/- 0.2	+/- 0.3	+/- 0.4	+/- 0.6	+/- 0.7	+/- 0.8	39

Table 3 : Interpolation Equation / Équation d'interpolation: R = A*T^B

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)
RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
T = Rainfall duration (h) / Durée de la pluie (h)

****

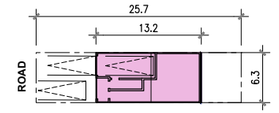
Statistics/Statistiques	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans
Mean of RR/Moyenne de RR	32.9	42.9	49.5	57.9	64.1	70.3
Std. Dev. /Écart-type (RR)	31.7	41.6	48.1	56.4	62.5	68.6
Std. Error/Erreur-type	6.8	8.7	9.9	11.4	12.6	13.7
Coefficient (A)	20.3	26.4	30.4	35.5	39.3	43.0
Exponent/Exposant (B)	-0.677	-0.677	-0.678	-0.678	-0.678	-0.678
Mean % Error/% erreur moyenne	7.8	7.4	7.2	7.2	7.2	7.2

APPENDIX B

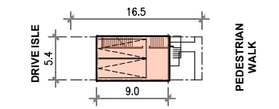
Storm Sewer Servicing Concept

Total 213 Residential Units

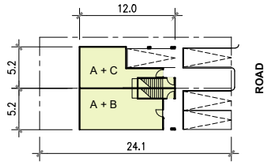
TYPE A
2 Units Stacked
Unit A: 2200sf
Unit B: 1430
Total Units = 22



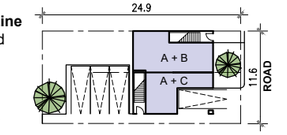
TYPE B
2 Units Stacked
Unit A: 1385sf
Unit B: 550sf
Total Units = 88



TYPE C
2 @ 2 Units Stkd
Unit A: 900sf
Unit B: 750sf
Unit C: 650sf
Total Units = 48



TYPE D - Rail Line
2 @ 2 Units Stkd
Unit A: 800sf
Unit B: 700sf
Unit C: 600sf
Total Units = 48



TYPE E
Condo
850sf
Total Units = 7

Catchment ID
Area (Ha) Runoff Coefficient
Catchment Boundary

Statistics to come:

Per Unit type (A,B,C,D E):
1. Bedrooms / w/c's (estimate)
2. max height
3. lot area
4. frontage
5. lot coverage percentage
6. min. landscaped area
7. min front, side, rear yard setbacks
8. parking spaces per unit

General:
1. site dimensions
2. parking count visitor
3. commercial area
4. amenity area (building)
5. other...

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RDArchitect.ca

169 Shoreline Drive,
Oro-Medonte, ON L0L 1T0

ROSALIE DAWSON ARCHITECT INC.

Porta - Townhome Study

25 Dundas Street West, Belleville Ontario

Client: MDM Developments

drawing: Low Rise Site Plan Sketch - V4,
Legal Boundaries Updated - 21M318

issued for: Consultant Coordination

scale:	1:750	plot date:	2025.06.06
job number:	21009		
drawn by:	RD		
dwg. ref. no:	N/A	drawing no:	1

APPENDIX C

Storm Sewer Design Sheet

STORM SEWER DESIGN SHEET

Peak Runoff Estimate by Rational Method

$$Q = \frac{1}{360}\, C\, i\, A$$

Where:

Q = Peak Flow in cms
C = Runoff Coefficient
i = Rainfall Intensity in mm/hr
A = Area in hectares

Intensity for: **Belleville** **Station:** 6150689

$$i = A * T_c^{\,B}$$

Where:

i = Rainfall Intensity in mm/hr
T_c = Time of Concentration in hours

5-Year Parameters

A 26.5
B -0.677

Manning's Coef

CSP 0.024
RCP/PVC 0.013

Pipe Capacity by Manning's Equation

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

Where:

A = area of pipe in m^2
R = Hydraulic radius = A / P
P = Wetted perimeter
S = Slope (m/m)
n = Manning's friction coef.

Check

$q \leq Q$
$V \leq 6\ m/s$

LOCATION			PEAK FLOW CALCULATION									PROPOSED SEWER									
STREET / CATCHMENT AREA ID	FROM	TO	CATCHMENT AREAS				R.C. x A	CUM. R.C x A	TIME OF CONCENTRATION	INTENSITY	PEAK FLOW	Pipe Size	Length	Type of Pipe	Grade *(use m/m)*	Capacity, n = 0.013	Full Flow Velocity	Time of Flow	Actual Velocity at Q_d	q/Q	Check Capacity
			RUNOFF COEFFICIENT																		
			0.3	0.45	0.65	0.9	ha	ha	min	mm/hr	m^3/s	(mm)	(m)		(%)	(m^3/s)	(m/s)	min	(m/s)		
Site		**Outlet**			2.94		1.91	1.91	15.0	67.7	0.36	675	20.0	RCP	0.25%	0.42	1.17	0.28	1.32	0.86	OK
Site with EXT 1		**Outlet**	0.5		2.94		2.06	2.06	15.0	67.7	0.39	675	20.0	RCP	0.25%	0.42	1.17	0.28	1.33	0.92	OK
									Quality Flow		**0.04**	300	20.0	PVC	0.50%	0.07	0.97	0.34	1.01	0.61	OK
Catchment 101																					
										MTO Chart 2.30 shows pipe capacity is 107% of Pipe Flowing Full Calculation											

JEWELL ENGINEERING

Jewell Engineering Inc
1-71 Millennium Parkway
Belleville, ON, K8N 4Z5
Ph. 613-969-1111
Fx. 613-969-8988
www.jewelleng.ca

Designed: Ella Siegner
Checked: Bryon Keene, P.Eng.
Date: July 9, 2025

Project:
Porta
Harbour 25 LP

APPENDIX D

Jellyfish Filter Unit Sizing Sheet

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Tuesday, July 8, 2025
Project Name	25 Dundas St.
Project Number	
Location	Belleville

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF8-8-2 is recommended to meet the water quality objective by treating a flow of 45.4 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 29 years of BELLEVILLE rainfall data for this site. This model has a sediment capacity of 512 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF8-8-2	8	2	2.4	45.4	512

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

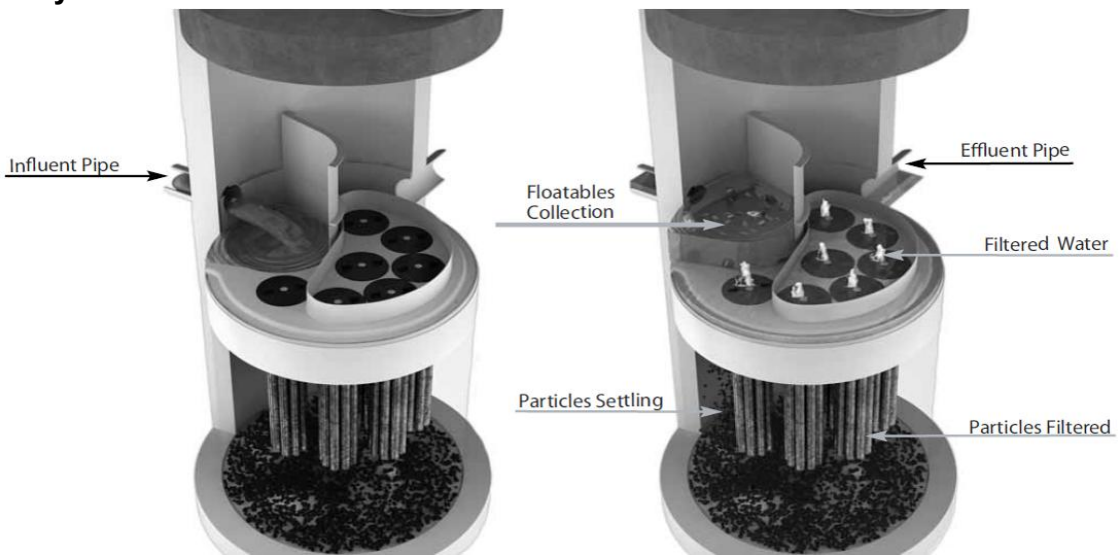
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 77% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TAPE qualifying rain events and field monitored according to the TAPE field test protocol, demonstrating:

- A median TSS removal efficiency of 90%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 77%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Project Information

Date:	Tuesday, July 8, 2025
Project Name:	25 Dundas St.
Project Number:	
Location:	Belleville

Designer Information

Company:	G.D. Jewell Engineering Inc.
Contact:	Matthew Warner
Phone #:	

Notes

Rainfall

Name:	BELLEVILLE
State:	ON
ID:	689
Record:	1975 to 2003
Co-ords:	44°09'N, 77°23'W

Drainage Area

Total Area:	2.943 ha
Imperviousness:	60%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 29 years of BELLEVILLE rainfall data:	**41.7 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 6775 m³, with a suspended sediment concentration of 60 mg/L.	**407 kg**

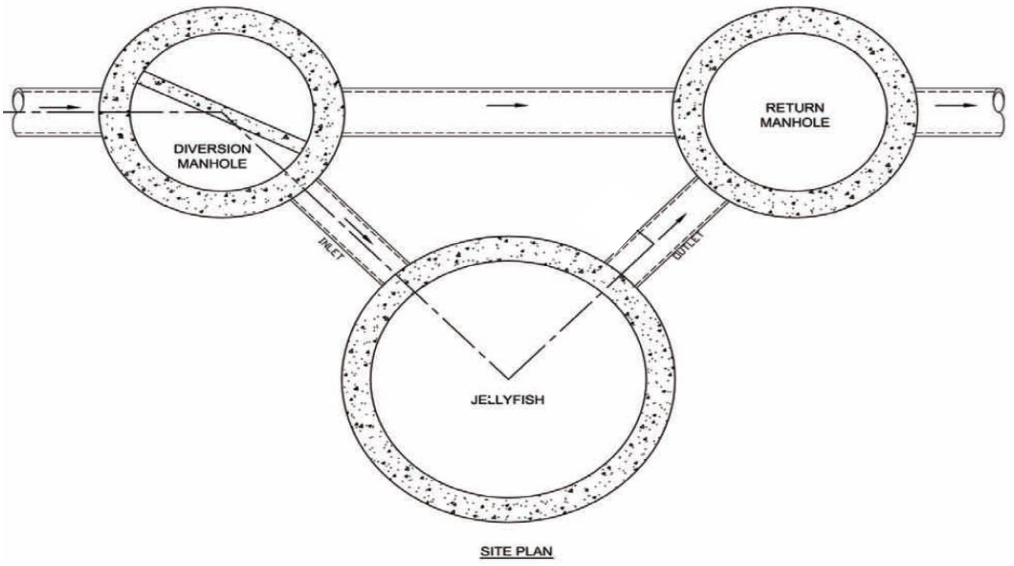
Recommendation

The Jellyfish Filter model JF8-8-2 is recommended to meet the water quality objective by treating a flow of 45.4 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 29 years of BELLEVILLE rainfall data for this site. This model has a sediment capacity of 512 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	**8**	**2**	**2.4**	**9252**	**1.42**	**1469**	**45.4**	**512**
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	62º	150	200
1.8	59º	200	250
2.4	**52º**	**250**	**300**
3.0	48º	300	450
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

APPENDIX E

Downstream Defender Unit Sizing Sheet

Hydro Downstream Defender®

Net Annual Water Quality Worksheet

Hydro International

Project Name:	**Belleville Marina**	*Report Date:*	**2/27/2018**
Street:	**Old Bay Bridge Road**	*City:*	**Belleville**
Province:	**Ontario**	*Country:*	**Canada**
Designer:	**Bryon Keene, P.Eng.**	*email:*	**bryon@jewelleng.ca**

Paste

Treatment Parameters

Structure ID:		
TSS Goal:	80	% Removal
TSS Particle Size:	Fine	
Area:	3.09	ha
Percent Impervious:	80%	
Rational C value:	0.78	Calc Cn
Rainfall Station:	Belleville, ON	
Peak Storm Flow:	0	L/s
Peak Storm Return:	10	yrs

RESULTS SUMMARY

Model	TSS	Volume
DD4	59.6%	100.0%
DD6	68.9%	100.0%
DD8	75.5%	100.0%
DD10	**80.5%**	**100.0%**
DD12	84.2%	100.0%

Model Specification

Select Model	**DD10**		
Diameter:	3000	mm	
No Bypass Flow:	708.00	L/s	
Peak Flow Capacity:	708.00	L/s	OK
Sediment Storage:	6.65	m^3	
Oil Storage:	3975.00	L	

Installation Configuration

Placement:	Offline		
Outlet Pipe Size:	750	mm	*OK*
Inlet Pipe 1 Size:	300	mm	*OK*
Inlet Pipe 2 Size:		mm	*OK*
Rim Level:	76.000	m	Calc Invs.
Outlet Pipe Invert:	72.700	m	*OK*
Invert Pipe 1:	72.395	m	*OK*
Invert Pipe 2:		m	

Net Annual Removal Model: DD10

Intensity[1]	Fraction of Rainfall[1]	DD10 Removal Efficiency[2]	Weighted Net Annual Efficiency
(mm/hr)	(%)	(%)	(%)
0.50	9.9%	100.0%	9.90%
1.00	10.8%	100.0%	10.80%
1.50	10.1%	97.5%	9.85%
2.00	9.1%	93.0%	8.46%
2.50	7.0%	89.7%	6.28%
3.00	6.9%	87.1%	6.01%
3.50	4.5%	84.9%	3.82%
4.00	4.6%	83.1%	3.82%
4.50	4.1%	81.5%	3.34%
5.00	3.8%	80.1%	3.04%
6.00	5.7%	77.8%	4.43%
7.00	4.5%	75.8%	3.41%
8.00	3.6%	74.2%	2.67%
9.00	2.3%	72.8%	1.67%
10.00	1.9%	71.5%	1.36%
15.00	6.1%	67.0%	4.09%
20.00	2.6%	63.9%	1.66%
25.00	2.0%	61.6%	1.23%
30.00	0.4%	59.8%	0.24%
35.00	0.4%	58.3%	0.23%
40.00	0.4%	57.1%	0.23%
45.00	0.4%	56.0%	0.22%
50.00	0.4%	55.0%	0.22%
		Net Annual Treatment:	86.8%
		60 Minute Rainfall Adjustment Factor[3]:	0.0%
		Total Net Annual Removal Efficiency:	**86.8%**
		Total Runoff Volume Treated:	**100.0%**

1. Rainfall data based on over 40 years of rainfall data for Belleville, ON
2. Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution
3. Adjustment for use of 60 minute time step data with Tc < 30 min. Refer to Help.

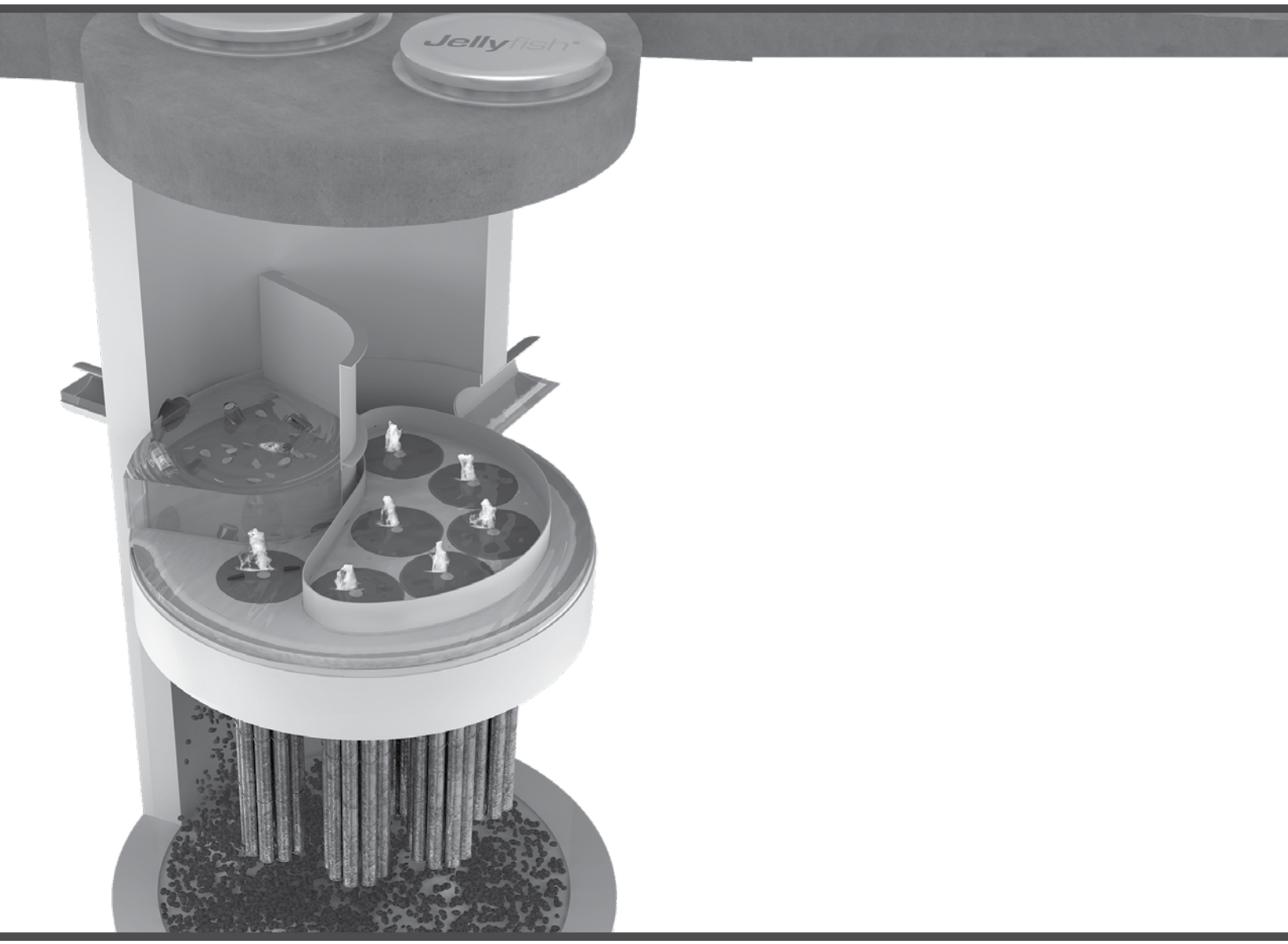
Designer Notes:

APPENDIX F

O+M Information – OGS Unit

CONTECH®
ENGINEERED SOLUTIONS

Jellyfish® Filter Maintenance Guide



Jellyfish®

JELLYFISH® FILTER
INSPECTION & MAINTENANCE GUIDE

Jellyfish units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the Jellyfish filter to be successful, it is imperative that all other components be properly maintained. The maintenance and repair of upstream facilities should be carried out prior to Jellyfish maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

TABLE OF CONTENTS

1.0 Inspection and Maintenance Overview

The primary purpose of the Jellyfish® Filter is to capture and remove pollutants from stormwater runoff. As with any filtration system, these pollutants must be removed to maintain the filter's maximum treatment performance. Regular inspection and maintenance are required to insure proper functioning of the system.

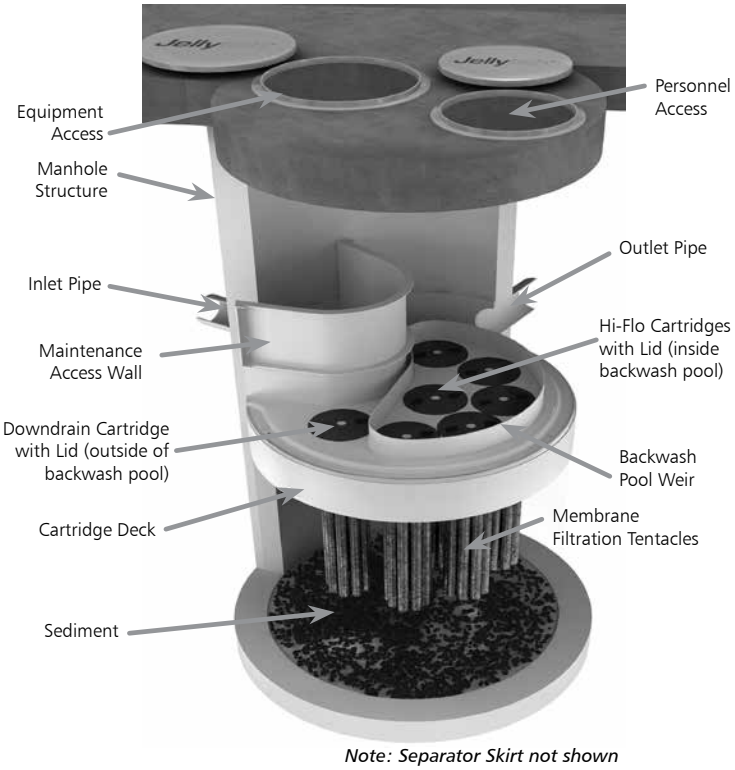
Maintenance frequencies and requirements are site specific and vary depending on pollutant loading. Additional maintenance activities may be required in the event of non-storm event runoff, such as base-flow or seasonal flow, an upstream chemical spill or due to excessive sediment loading from site erosion or extreme runoff events. It is a good practice to inspect the system after major storm events.

Inspection activities are typically conducted from surface observations and include:

- Observe if standing water is present
- Observe if there is any physical damage to the deck or cartridge lids
- Observe the amount of debris in the Maintenance Access Wall (MAW) or inlet bay for vault systems

Maintenance activities include:

- Removal of oil, floatable trash and debris
- Removal of collected sediments
- Rinsing and re-installing the filter cartridges
- Replace filter cartridge tentacles, as needed



Note: Separator Skirt not shown

2.0 Inspection Timing

Inspection of the Jellyfish Filter is key in determining the maintenance requirements for, and to develop a history of, the site's pollutant loading characteristics. In general, inspections should be performed at the times indicated below; *or per the approved project stormwater quality documents (if applicable), whichever is more frequent*.

1. A minimum of quarterly inspections during the first year of operation to assess the sediment and floatable pollutant accumulation, and to ensure proper functioning of the system.
2. Inspection frequency in subsequent years is based on the inspection and maintenance plan developed in the first year of operation. Minimum frequency should be once per year.
3. Inspection is recommended after each major storm event.
4. Inspection is required immediately after an upstream oil, fuel or other chemical spill.

3.0 Inspection Procedure

The following procedure is recommended when performing inspections:

1. Provide traffic control measures as necessary.
2. Inspect the MAW or inlet bay for floatable pollutants such as trash, debris, and oil sheen.
3. Measure oil and sediment depth in several locations, by lowering a sediment probe until contact is made with the floor of the structure. Record sediment depth, and presences of any oil layers.
4. Inspect cartridge lids. Missing or damaged cartridge lids to be replaced.
5. Inspect the MAW (where appropriate), cartridge deck and receptacles, and backwash pool weir, for damaged or broken components.

3.1 Dry weather inspections

- Inspect the cartridge deck for standing water, and/or sediment on the deck.
- No standing water under normal operating conditions.
- Standing water inside the backwash pool, but not outside the backwash pool indicates, that the filter cartridges need to be rinsed.

Inspection Utilizing Sediment Probe

- Standing water outside the backwash pool is not anticipated and may indicate a backwater condition caused by high water elevation in the receiving water body, or possibly a blockage in downstream infrastructure.
- Any appreciable sediment (≥1/16") accumulated on the deck surface should be removed.

3.2 Wet weather inspections

- Observe the rate and movement of water in the unit. Note the depth of water above deck elevation within the MAW or inlet bay.
- Less than 6 inches, flow should be exiting the cartridge lids of each of the draindown cartridges (i.e. cartridges located outside the backwash pool).
- Greater than 6 inches, flow should be exiting the cartridge lids of each of the draindown cartridges and each of the hi-flo cartridges (i.e. cartridges located inside the backwash pool), and water should be overflowing the backwash pool weir.
- 18 inches or greater and relatively little flow is exiting the cartridge lids and outlet pipe, this condition indicates that the filter cartridges need to be rinsed.

4.0 Maintenance Requirements

Required maintenance for the Jellyfish Filter is based upon results of the most recent inspection, historical maintenance records, or the site specific water quality management plan; whichever is more frequent. In general, maintenance requires some combination of the following:

1. Sediment removal for depths reaching 12 inches or greater, or within 3 years of the most recent sediment cleaning, whichever occurs sooner.
2. Floatable trash, debris, and oil removal.
3. Deck cleaned and free from sediment.
4. Filter cartridges rinsed and re-installed as required by the most recent inspection results, or within 12 months of the most recent filter rinsing, whichever occurs sooner.
5. Replace tentacles if rinsing does not restore adequate hydraulic capacity, remove accumulated sediment, or if damaged or missing. It is recommended that tentacles should remain in service no longer than 5 years before replacement.
6. Damaged or missing cartridge deck components must be repaired or replaced as indicated by results of the most recent inspection.
7. The unit must be cleaned out and filter cartridges inspected immediately after an upstream oil, fuel, or chemical spill. Filter cartridge tentacles should be replaced if damaged or compromised by the spill.

5.0 Maintenance Procedure

The following procedures are recommended when maintaining the Jellyfish Filter:

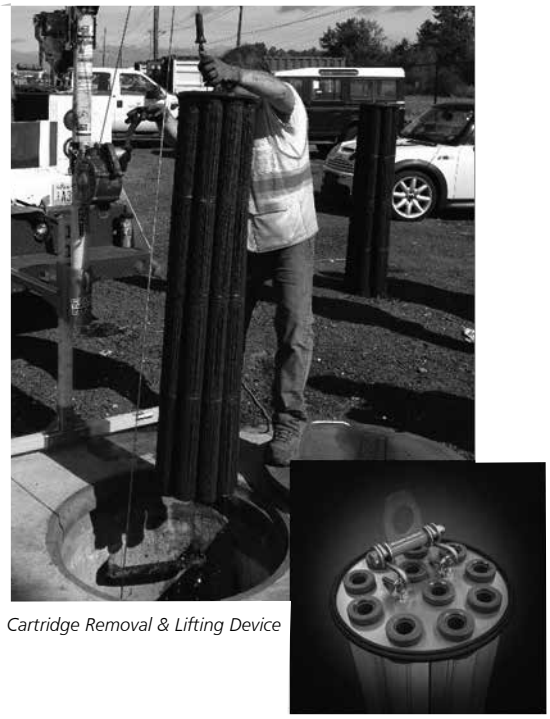
1. Provide traffic control measures as necessary.
2. Open all covers and hatches. Use ventilation equipment as required, according to confined space entry procedures. *Caution: Dropping objects onto the cartridge deck may cause damage*.
3. Perform Inspection Procedure prior to maintenance activity.
4. To access the cartridge deck for filter cartridge service, descend into the structure and step directly onto the deck. Caution: Do not step onto the maintenance access wall (MAW) or backwash pool weir, as damage may result. Note that the cartridge deck may be slippery.
5. Maximum weight of maintenance crew and equipment on the cartridge deck not to exceed 450 lbs.

5.1 Filter Cartridge Removal

1. Remove a cartridge lid.
2. Remove cartridges from the deck using the lifting loops in the cartridge head plate. Rope or a lifting device (available from Contech) should be used. *Caution: Should a snag occur, do not force the cartridge upward as damage to the tentacles may result. Wet cartridges typically weigh between 100 and 125 lbs*.
3. Replace and secure the cartridge lid on the exposed empty receptacle as a safety precaution. Contech does not recommend exposing more than one empty cartridge receptacle at a time.

5.2 Filter Cartridge Rinsing

1. Remove all 11 tentacles from the cartridge head plate. Take care not to lose or damage the O-ring seal as well as the plastic threaded nut and connector.



Cartridge Removal & Lifting Device

2. Position tentacles in a container (or over the MAW), with the threaded connector (open end) facing down, so rinse water is flushed through the membrane and captured in the container.
3. Using the Jellyfish rinse tool (available from Contech) or a low-pressure garden hose sprayer, direct water spray onto the tentacle membrane, sweeping from top to bottom along the length of the tentacle. Rinse until all sediment is removed from the membrane. *Caution: Do not use a high pressure sprayer or focused stream of water on the membrane. Excessive water pressure may damage the membrane*.

4. Collected rinse water is typically removed by vacuum hose.
5. Reassemble cartridges as detailed later in this document. Reuse O-rings and nuts, ensuring proper placement on each tentacle.

5.3 Sediment and Flotables Extraction

1. Perform vacuum cleaning of the Jellyfish Filter only after filter cartridges have been removed from the system. Access the lower chamber for vacuum cleaning only through the maintenance access wall (MAW) opening. Be careful not to damage the flexible plastic separator skirt that is attached to the underside of the deck on manhole systems. Do not lower the vacuum wand through a cartridge receptacle, as damage to the receptacle will result.
2. Vacuum floatable trash, debris, and oil, from the MAW opening or inlet bay. Alternatively, floatable solids may be removed by a net or skimmer.

Vacuuming Sump Through MAW

3. Pressure wash cartridge deck and receptacles to remove all sediment and debris. Sediment should be rinsed into the sump area. Take care not to flush rinse water into the outlet pipe.
4. Remove water from the sump area. Vacuum or pump equipment should only be introduced through the MAW or inlet bay.
5. Remove the sediment from the bottom of the unit through the MAW or inlet bay opening.

Vacuuming Sump Through MAW

6. For larger diameter Jellyfish Filter manholes (≥8-ft) and some vaults complete sediment removal may be facilitated by removing a cartridge lid from an empty receptacle and inserting a jetting wand (not a vacuum wand) through the receptacle. Use the sprayer to rinse loosened sediment toward the vacuum hose in the MAW opening, being careful not to damage the receptacle.

5.4 Filter Cartridge Reinstallation and Replacement

1. Cartridges should be installed after the deck has been cleaned. It is important that the receptacle surfaces be free from grit and debris.
2. Remove cartridge lid from deck and carefully lower the filter cartridge into the receptacle until head plate gasket is seated squarely in receptacle. ***Caution: Do not force the cartridge downward; damage may occur.***
3. Replace the cartridge lid and check to see that both male threads are properly seated before rotating approximately 1/3 of a full rotation until firmly seated. Use of an approved rim gasket lubricant may facilitate installation. See next page for additional details.
4. If rinsing is ineffective in removing sediment from the tentacles, or if tentacles are damaged, provisions must be made to replace the spent or damaged tentacles with new tentacles. Contact Contech to order replacement tentacles.

5.5 Chemical Spills

Caution: If a chemical spill has been captured, do not attempt maintenance. Immediately contact the local hazard response agency and contact Contech.

5.6 Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Jellyfish Filter Components & Filter Cartridge Assembly and Installation

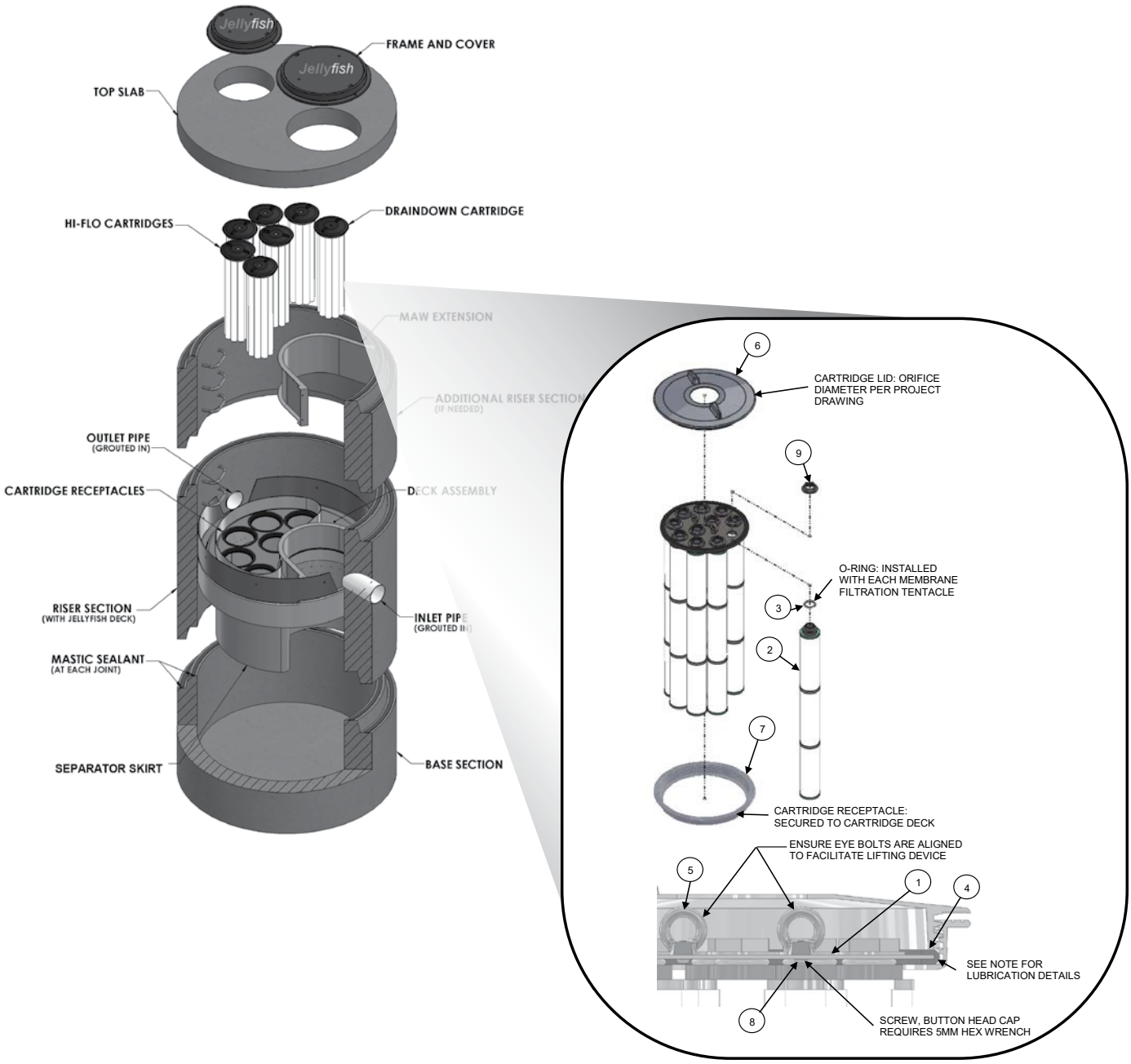


TABLE 1: BOM

ITEM NO.	DESCRIPTION
1	JF HEAD PLATE
2	JF TENTACLE
3	JF O-RING
4	JF HEAD PLATE GASKET
5	JF CARTRIDGE EYELET
6	JF 14IN COVER
7	JF RECEPTACLE
8	BUTTON HEAD CAP SCREW M6X14MM SS
9	JF CARTRIDGE NUT

TABLE 2: APPROVED GASKET LUBRICANTS

PART NO.	MFR	DESCRIPTION
78713	LA-CO	LUBRI-JOINT
40501	HERCULES	DUCK BUTTER
30600	OATEY	PIPE LUBRICANT
PSLUBXL1Q	PROSELECT	PIPE JOINT LUBRICANT

NOTES:

Head Plate Gasket Installation:
Install Head Plate Gasket (Item 4) onto the Head Plate (Item 1) and liberally apply a lubricant from Table 2: Approved Gasket Lubricants onto the gasket where it contacts the Receptacle (Item 7) and Cartridge Lide (ITem 6). Follow Lubricant manufacturer's instructions.

Lid Assembly:
Rotate Cartridge Lid counter-clockwise until both male threads drop down and properly seat. Then rotate Cartridge Lid clock-wise approximately one-third of a full rotation until Cartridge Lid is firmly secured, creating a watertight seal.

Jellyfish Filter Inspection and Maintenance Log

Owner:				Jellyfish Model No:		
Location:				GPS Coordinates:		
Land Use:	Commercial:		Industrial:		Service Station:	
	Roadway/Highway:		Airport:		Residential:	

Date/Time:						
Inspector:						
Maintenance Contractor:						
Visible Oil Present: (Y/N)						
Oil Quantity Removed:						
Floatable Debris Present: (Y/N)						
Floatable Debris Removed: (Y/N)						
Water Depth in Backwash Pool						
Draindown Cartridges externally rinsed and recommissioned: (Y/N)						
New tentacles put on Draindown Cartridges: (Y/N)						
Hi-Flo Cartridges externally rinsed and recommissioned: (Y/N)						
New tentacles put on Hi-Flo Cartridges: (Y/N)						
Sediment Depth Measured: (Y/N)						
Sediment Depth (inches or mm):						
Sediment Removed: (Y/N)						
Cartridge Lids intact: (Y/N)						
Observed Damage:						
Comments:						

Jellyfish®

CONTECH ENGINEERED SOLUTIONS

Support

- Drawings and specifications are available at www.conteches.com/jellyfish.
- Site-specific design support is available from Contech Engineered Solutions.
- Find a Certified Maintenance Provider at www.conteches.com/ccmp

800.338.1122
www.ContechES.com

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, wastewater treatment and earth stabilization products. For information on other Contech segment offerings, visit ContechES.com or call 800.338.1122

Hydro International®

Operation and Maintenance Manual

Downstream Defender® hydrodynamic separator with 5mm Screen

Vortex Separator for Stormwater Treatment

Turning Water Around ...®

Table of Contents

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Downstream Defender® by Hydro International

The Downstream Defender® is an advanced Hydrodynamic Vortex Separator designed to provide high removal efficiencies of settleable solids and their associated pollutants, oil, and floatables over a wide range of flow rates.

The Downstream Defender® has unique, flow-modifying internal components developed from extensive full-scale testing, CFD modeling and over thirty years of hydrodynamic separation experience in wastewater, combined sewer and stormwater applications. These internal components distinguish the Downstream Defender® from simple swirl-type devices and conventional oil/grit separators by minimizing turbulence and headlosses, enhancing separation, and preventing washout of previously stored pollutants.

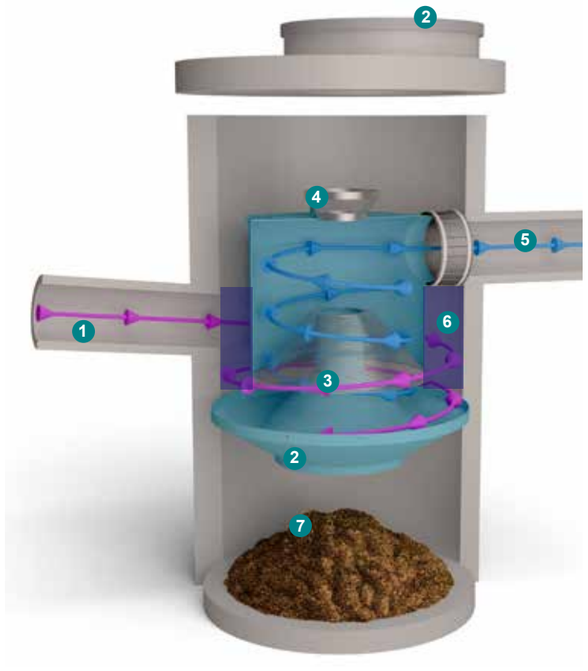
The high removal efficiencies and inherent low headlosses of the Downstream Defender® allow for a small footprint making it a compact and economical solution for the treatment of non-point source pollution.

Benefits of the Downstream Defender®

- Removes sediment, floatables, oil and grease
- No pollutant washouts
- Small footprint
- No loss of treatment capacity between clean-outs
- Low headloss
- Efficient over a wide ranges of flows
- Easy to install
- Low maintenance

Applications

- New developments and retrofits
- Utility yards
- Streets and roadways
- Parking lots
- Pre-treatment for filters, infiltration and storage
- Industrial and commercial facilities
- Wetlands protection



Downstream Defender® Components

1. Tangential inlet
2. Benching skirt
3. Bypass Screen
4. Inline Screen
5. Outlet Pipe
6. Floatables Storage
7. Isolated Sediment Storage Zone

Hydro Maintenance Services

Hydro International has been engineering stormwater treatment systems for over 30 years. We understand the mechanics of removing pollutants from stormwater and how to keep systems running at an optimal level.

Nobody Knows our Systems Better than we do

Avoid Service Negligence

Sanitation services providers not intimately familiar with stormwater treatment systems are at risk of the following:

- Inadvertently breaking parts or failing to clean/replace system components appropriately.
- Charging you for more frequent maintenance because they lacked the tools to service your system properly in the first place.
- Billing you for replacement parts that might have been covered under your Hydro warranty plan
- Charging for maintenance that may not yet have been required.

Leave the Dirty Work to us

Trash, sediment and polluted water is stored inside treatment systems until they are removed by our team with a vactor truck. Sometimes teams must physically enter the system chambers in order to prepare the system for maintenance and install any replacement parts. Services include but are not limited to:

- Solids removal
- Removal of liquid pollutants
- Replacement media installation (when applicable)

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Downstream Defender® Operation and Maintenance Manual

Better Tools, Better Results

Not all vactor trucks are created equal. Appropriate tools and suction power are needed to service stormwater systems appropriately. Companies who don't specialize in stormwater treatment won't have the tools to properly clean systems or install new parts.

Service Warranty

Make sure you're not paying for service that is covered under your warranty plan. Only Hydro International's service teams can identify tune-ups that should be on us, not you.

Treatment Systems Serviced by Hydro:

- Stormwwater filters
- Stormwater separators
- Baffle boxes
- Biofilters/biorention systems
- Storage structures
- Catch basins
- Stormwater ponds
- Permeable pavement

SAVE TIME & MONEY: CALL HYDRO FOR A QUOTE

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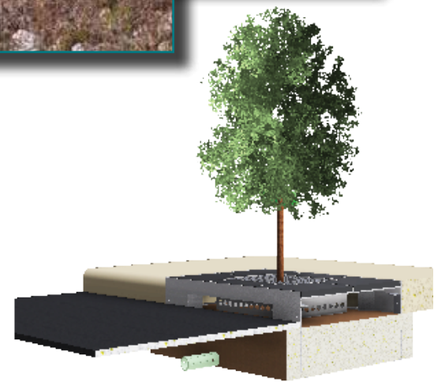

Operation

Introduction

The Downstream Defender® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The Downstream Defender® has been designed to allow for easy and safe access for inspection/monitoring and clean-out procedures. Entry into the unit or removal of the internal components is not necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention

The internal components of the Downstream Defender® have been designed to protect the oil, floatables and sediment storage volumes so that separator performance is not reduced as pollutants accumulate between clean-outs. Additionally, the Downstream Defender® is designed and installed into the storm drain system so that the vessel remains wet between storm events. Oil and floatables are stored on the water surface in the outer annulus separate from the sediment storage volume in the sump of the unit providing the option for separate oil disposal, and accessories such as adsorbant pads. Since the oil/floatables and sediment storage volumes are isolated from the active separation region, the potential for re-suspension and washout of stored pollutants between clean-outs is minimized.

Wet Sump

The sump of the Downstream Defender® retains a standing water level between storm events. The water in the sump prevents stored sediment from solidifying in the base of the unit. The clean-out procedure becomes more difficult and labor intensive if the system allows fine sediment to dry-out and consolidate. Dried sediment must be manually removed by maintenance crews. This is a labor intensive operation in a hazardous environment.

Maintenance

Overview

The Downstream Defender® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the Downstream Defender®. The Downstream Defender® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the Downstream Defender® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

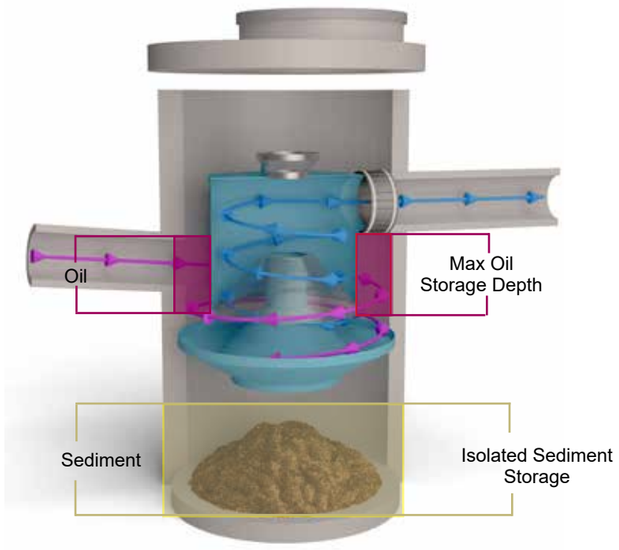

Fig.1 Pollutant storage volumes of the Downswtream Defender®.

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The Downstream Defender® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole. On the 6-ft, 8-ft and 10-ft units, the floatables access port is above the outlet pipe between the concrete manhole wall and the dip plate. The sediment removal access ports for all Downstream Defender® models are located directly over the bypass screen.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the Downstream Defender®, nor do they require the internal components of the Downstream Defender® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Determining Your Maintenance Schedule

The frequency of cleanout is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil/flotables removal, for a 6-ft Downstream Defender® typically takes less than 30 minutes and removes a combined water/oil volume of about 500 gallons.

Inspection Procedures

Inspection is a simple process that does not involve entry into the Downstream Defender®. Maintenance crews should be familiar with the Downstream Defender® and its components prior to inspection.

Scheduling

- It is important to inspect your Downstream Defender® every six months during the first year of operation to determine your site-specific rate of pollutant accumulation
- Typically, inspection may be conducted during any season of the year
- Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1

Recommended Equipment

- Safety Equipment and Personal Protective Equipment (traffic cones, work gloves, etc.)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net
- Sediment probe (such as a Sludge Judge®)
- Trash bag for removed floatables

Table 1. Downstream Defender® Pollutant Storage Capacities and Max. Cleanout Depths.

Unit Diameter	Total Oil Storage	Oil Clean-out Depth	Total Sediment Storage	Sediment Clean-out Depth	Max. Liquid Volume Removed
(feet)	(gallons)	(inches)	(gallons)	(inches)	(gallons)
4	70	<16	141	<18	384
6	216	<23	424	<24	1,239
8	540	<33	939	<30	2,884
10	1,050	<42	1,757	<36	5,546
12	1,770	<49	2,970	<42	9,460

NOTES

1. Refer to Dowmstream Defender® Clean-out Detail (Fig. 1) for measurement of depths.

2. Oil accumulation is typically less than sediment, however, removal of oil and sediment during the same service is recommended.

3. Remove floatables first, then remove sediment storage volume.

4. Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1.


Fig.4


Fig.5


Fig.6

Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the Downstream Defender® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the lids to the manhole (Fig. 4). NOTE: The 4-ft Downstream Defender® will only have one lid.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. See Fig.7 and 8 for typical inspection views.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the outer annulus of the chamber.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel (Fig.5).

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

Floatables and Sediment Cleanout

Floatables cleanout is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.6).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose and skimmer pole to be lowered to the base of the sump.

Scheduling

- Floatables and sump cleanout are typically conducted once a year during any season.
- If sediment depths are greater than 75% of maximum clean-out depths stated in Table 1, sediment removal is required.
- Floatables and sump cleanout should occur as soon as possible following a spill in the contributing drainage area.


Fig.7 View over center shaft into sediment storage zone.


Fig.8 View of outer annulus of floatables and oil collection zone.

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Recommended Equipment

- Safety Equipment (traffic cones, etc)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge Judge®)
- Vactor truck (6-inch flexible hose recommended)
- Downstream Defender® Maintenance Log

1. Set up any necessary safety equipment around the access port or grate of the Downstream Defender® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the lid to the manhole (NOTE: The 6-ft, 8-ft, 10-ft and 12-ft Downstream Defender® will have 2 lids).

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.

4. Using the Floatables Port for access, remove oil and floatables stored on the surface of the water with the vactor hose or the skimmer net (Fig.9).

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (Pg.9).

6. Once all floatables have been removed, drop the vactor hose to the base of the sump via the Central Access Port. Vactor out the sediment and gross debris off the sump floor (Fig.6).

7. Retract the vactor hose from the vessel.

8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

9. Securely replace the grate or lid.

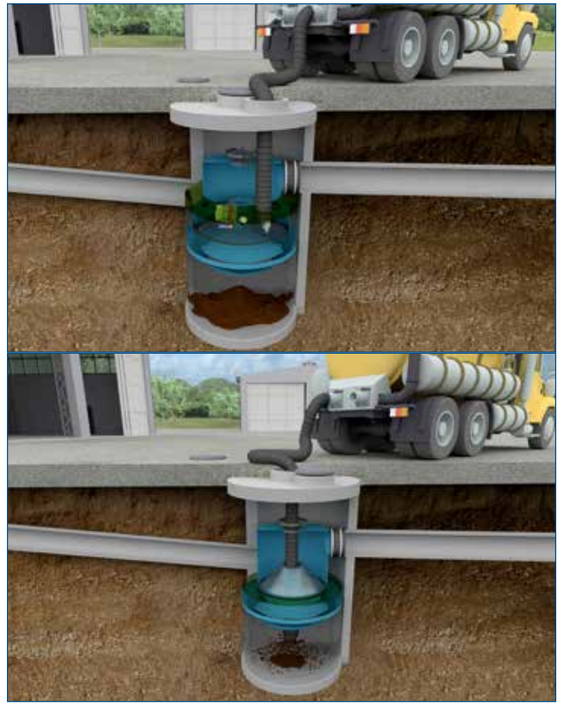
Fig.9 Floatables and sediment are removed with a vactor hose

Maintenance at a Glance

Activity	Frequency
Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, with sediment removal - Following a spill in the drainage area
Sediment Removal	- Once per year or as needed - Following a spill in the drainage area
NOTE: For most cleanouts it is not necessary to remove the entire volume of liquid in the vessel. Only removing the first few inches of oils/floatables and the sediment storage volume is required.	

Downstream Defender® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:	
SITE NAME:	
SITE LOCATION:	
OWNER:	CONTRACTOR:
CONTACT NAME:	CONTACT NAME:
COMPANY NAME:	COMPANY NAME:
ADDRESS:	ADDRESS:
TELEPHONE:	TELEPHONE:
FAX:	FAX:

INSTALLATION DATE: / /

MODEL (CIRCLE ONE): **4-FT** **6-FT** **8-FT** **10-FT** **CUSTOM**

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Downstream Defender® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment * Depth Measured	Volume of Sediment Removed	Site Activity and Comments

*Note: Sediment removal is not required unless sediment depths exceed 75% of maximum clean-out depths stated in Table 1.

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Notes

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