February 9, 2026 Reference: 20-731

The Alton Development Inc.
1402 Queen Street West
Alton, ON
L7K 0C3

Attention: Jeremy Grant and Jordan Grant, Developer
Reference: Urbanization of Agnes Street, Alton –Stormwater Management Design Brief

Dear Mr. Jeremy Grant and Mr. Jordan Grant,

Greck and Associates (Greck) have been retained to prepare a Stormwater Management Design Brief for the urbanization of a portion of Agnes Street. Agnes Street is located in the Village of Alton, the Town of Caledon (Town), Region of Peel (Region) and is within the Credit Valley Conservation (CVC) jurisdiction. This design brief is in support of the development application at 0 Agnes Street and to demonstrate compliance with the Town's Consolidated Linear Infrastructure Environmental Compliance Approvals (CLI ECA) criteria. The portion of Agnes Street to be urbanized is approximately 152m long starting from Queen Street West going south.

This design brief provides an overview of the proposed urbanization plans and considers the Town's CLI ECA criteria, which pertains to drainage and stormwater management (SWM):

- Water Quality
- Water Quantity
- Water Balance
- Erosion Control

This memo has been prepared in accordance with accepted engineering practices and criteria from the Town of Caledon Development Standards Manual (2019) and Environmental Compliance Approval 324-S701 (CLI ECA, October 2022). This brief has been updated to address comments from the Town of Caledon dated April 2024.

Note that this project is in the draft plan stage and the proposed stormwater management is to be refined in the detailed design stage.

1. EXISTING CONDITIONS

Based on publicly available LiDAR data from Land Information Ontario (DTM Peel 2016 Package B), topographic survey prepared by Van Harten Surveying Inc. (September 16, 2022) and the provided Alton Sewershed Map from the Town, 5.27ha drains towards the south side of the intersection of Queen Street West and Agnes Street. Since this memo only pertains to the urbanization of Agnes Street south of Queen Street West, the north residential area (between

Queen Street and 0 Agnes Street) that drains to Queen Street West has been excluded from the SWM analysis. The Alton Sewershed Map has been included in the attachments.

Note that there is also a small 0.52ha area within the 0 Agnes Street property that drains towards Emeline Street. This area has been included in the overall study catchment as it is part of the property's development area. In the proposed conditions, all drainage from the property will discharge to Agnes Street. The topographic survey by Van Harten Surveying Inc. have been appended to the end of this memo.

The 5.78ha total drainage area has been further divided into six (6) catchments; all of which ultimately discharge to Shaw's Creek located northeast of the study area:

- Area 101 (3.53ha) is a part of the property to be developed by The Alton Development Inc. (0 Agnes Street). It currently consists of a grassed field and a driveway area. It drains in the northeasterly direction towards the intersection of Queen Street West and Agnes Street.
- Area 102 (0.51ha) is a part of the property to be developed by The Alton Development Inc. (0 Agnes Street). It currently consists of a grassed field and drains in the west direction towards Emeline Street. Runoff is then piped northeast along Queen Street West.
- Area 103 (1.23ha) consists of single detached dwellings, grassed lawns and private driveways. It generally drains in the northeasterly direction towards Agnes Street. This area will remain unchanged in the existing and proposed conditions.
- Area 104a (0.16ha) consists of the west side of the Agnes Street ROW. There is a roadside ditch that runs parallel to the road and directs drainage north to a ditch inlet catchbasin at the north end of Agnes Street.
- Area 104b (0.18ha) consists of the east side of the Agnes Street ROW. There is a depressed curb and gutter that runs parallel to the road and directs drainage north to a ditch inlet catchbasin at the north end of Agnes Street.
- Area 105 (0.16ha) consists of grassed lawns, private driveways, and a small portion of King Street which forms a T-junction with Agnes Street. It generally drains north, parallel to Agnes Street towards Queen Street. This area will remain unchanged in existing and proposed conditions.

Note that ultimately, all catchments drain to Shaw's Creek located north of Queen Street West. Agnes Street is currently a bidirectional two (2) lane street and has a 15m right of way (ROW)

Table 1 is an area breakdown of the existing land uses.

Table 1 Existing Area Breakdown

Surface	Area 101	Area 102	Area 103	Area 104a	Area 104b	Area 105
Asphalt and Hardscape (m^2)	1,574.9	0.0	732.4	947.9	1,186.9	467.0
Permeable Pavers (m^2)	0.0	0.0	0.0	0.0	0.0	0.0
Roof (m^2)	516.4	0.0	1,003.1	0.0	0.0	0.0
Grassed (m^2)	33,191.0	5,142.4	10,590.1	678.8	633.7	1,133.9
Total (m^2)	35,282.3	5,142.4	12,325.6	1,626.7	1,820.6	1,600.9
Percent Impervious	5.9%	0.0%	14.1%	58.3%	65.2%	29.2%
Runoff Coefficient	0.29	0.25	0.34	0.63	0.67	0.44

Table 2 presents the pre-development peak flows. Intensity was calculated using the intensity-duration-frequency curves from the Town of Caledon's Development Standards Manual (2019).

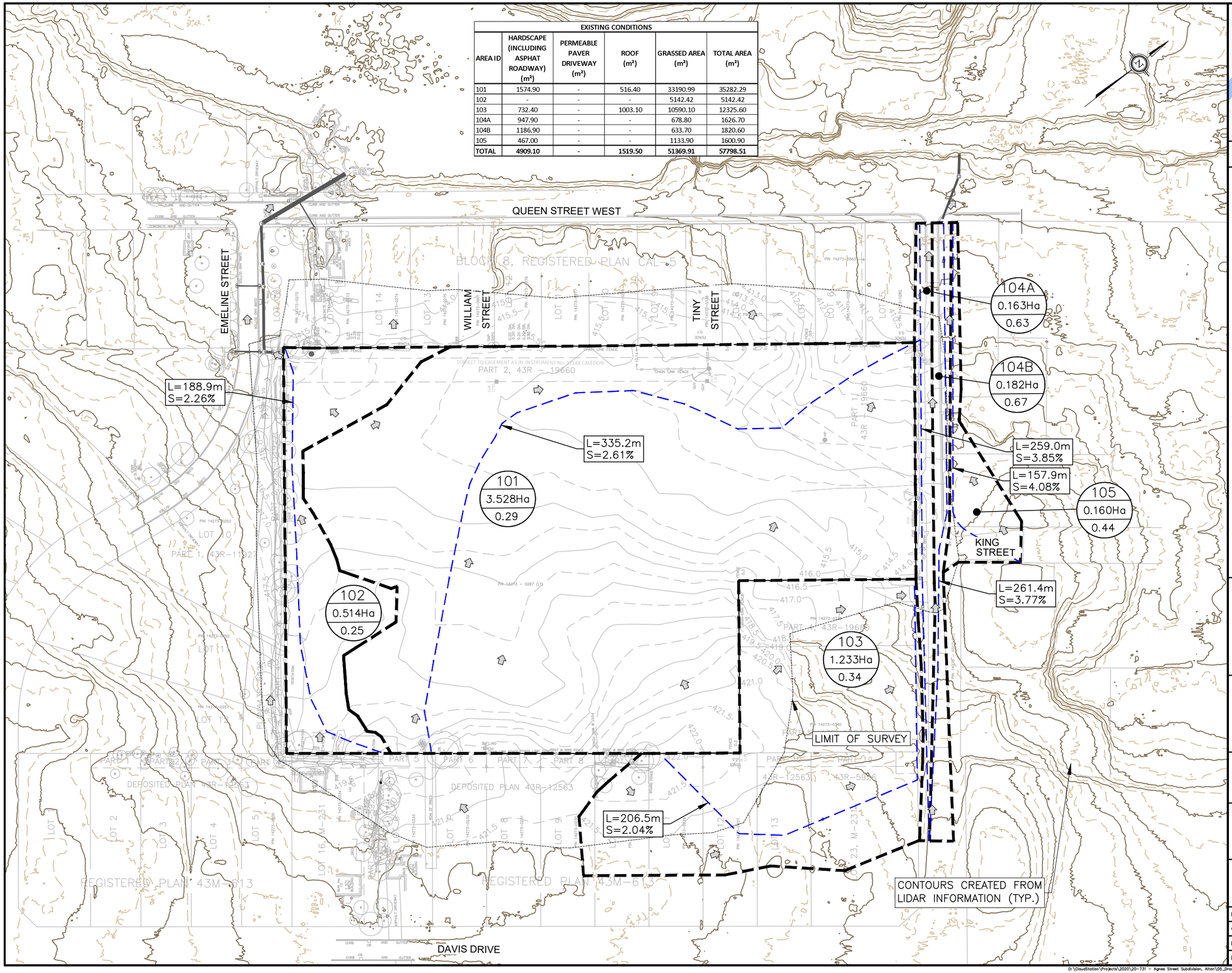
Table 2 Pre-Development Peak Flows

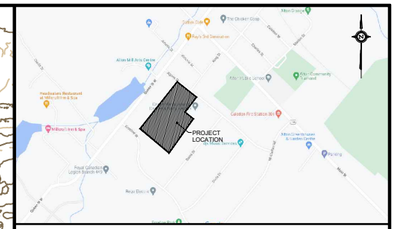
Storm Event	Area 101 (L/s)	Area 102 (L/s)	Area 103 (L/s)	Area 104a (L/s)	Area 104b (L/s)	Area 105 (L/s)	Total (L/s)
2	111.9	16.2	54.3	20.8	25.0	14.3	242.5
5	154.8	22.2	74.3	27.2	32.6	18.7	329.9
10	189.4	27.2	91.0	33.3	40.0	22.9	403.7
25*	253.5	36.2	121.1	43.2	47.2	29.8	530.9
50*	313.7	44.8	149.8	53.3	53.2	36.6	651.3
100*	367.8	52.4	175.4	62.0	59.5	42.7	759.8

*Incorporates runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25

Detailed calculations are included in the attachments at the end of this memo. See **Figure 1** below for the study area location and delineated catchments for existing conditions.

EXISTING CONDITIONS					
AREA ID	HARDSCAPE (INCLUDING ASPHAT ROADWAY) (m²)	PERMEABLE PAVER DRIVEWAY (m²)	ROOF (m²)	GRASSED AREA (m²)	TOTAL AREA (m²)
101	1574.90	-	516.40	33190.99	35282.29
102	-	-	-	5142.42	5142.42
103	732.40	-	1003.10	10590.10	12325.60
104A	947.90	-	-	678.80	1626.70
104B	1186.90	-	-	633.70	1820.60
105	467.00	-	-	1133.90	1600.90
TOTAL	**4909.10**	**-**	**1519.50**	**51369.91**	**57798.51**





KEY PLAN
N.T.S.

LEGEND

EXISTING
MH1
CBMH1
CB
DCB
FD

PROPOSED
STORM MANHOLE
STORM CATCHBASIN MANHOLE
SINGLE CATCHBASIN
DOUBLE CATCHBASIN
SINGLE FLOOR DRAIN
STORM SEWER
STORM SEWER SYSTEM TO CONCRETE CISTERN AND OUTLET
STORM SEWER SYSTEM TO GREENSTORM STORAGE
LIMIT OF SUBJECT PROPERTY
EASEMENT
RIGHT OF WAY
LOT LINE
FENCE LINE
CURB/SIDEWALK
BUILDING
RETAINING WALL
MAJOR CONTOUR LABEL
MINOR CONTOUR LABEL
ASPHALT
PAVING STONE (PERMEABLE PAVERS)
1.5m WIDE CONCRETE SIDEWALK
OVERLAND FLOW
TREE
TREE – TO REMAIN
STORM DRAINAGE BOUNDARY
LONGEST TRAVEL PATH
3 — DENOTES AREA NUMBER
0.023Ha — DENOTES AREA IN HECTARES
0.40 — DENOTES RUNOFF COEFFICIENT

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5. ORDER OF PRECEDENCE OF STANDARDS DRAWINGS IS FIRSTLY TOWN OF CALEDON, AND SECONDLY ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD).

BENCHMARK

BENCHMARK No. N/A
ELEVATION = N/A
DESCRIPTION:
ELEVATIONS ARE BASED ON GPS OBSERVATIONS FROM PERMANENT REFERENCE STATIONS IN THE NAD83 (CSRS-2010) COORDINATE SYSTEM, WITH HEIGHTS CONVERTED TO ORTHOMETRIC ELEVATION ON THE CVGD28 DATUM (1978 ADJUSTMENT) WITH GEOID MODEL HTV2.0, AS SUPPLIED BY NATURAL RESOURCES CANADA.

COMPLETED BY:
VAN HARTEN SURVEYING INC.
COMPLETED ON:
MAY 10, 2018

DEM SOURCE:
LIDAR DTM PEEL 2016 PACKAGE B AVAILABLE FROM LAND INFORMATION ONTARIO

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PROJECT NAME:
AGNES STREET SUBDIVISION
AGNES STREET CALEDON, ON

DRAINAGE PLAN EXISTING CONDITIONS (AGNES STREET URBANIZATION)

DESIGNED BY:	C.M.	SCALES:		PROJECT No.	20-731
CHECKED BY:	J.C.	HORIZONTAL:	1:1500	DRAWING No.	FIG. 1
DRAWN BY:	C.M.	VERTICAL:	N/A	SHEET No.	
DATE:	FEB 10, 2026	SHEET SIZE:	11"x17"		

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Date Plotted: Dec 8, 2025 – 8:26 PM

1.1 UNDERLYING SOILS

Englobe (previously Terraprobe) prepared a Geotechnical Investigation dated December 5, 2024, and a Hydrogeological Investigation Septic Impact Assessment dated October 15, 2025. Both of these reports pertain to the property at 0 Agnes Street. Since a site-specific report for Agnes Street has not been done, these two reports will be used for reference as the property fronts Agnes Street. The following is a summary of the report findings.

The work included drilling eight (8) boreholes equipped with monitoring wells to boreholes 2, 5, and 8 spread throughout the property. The soil conditions within the limits of the property consist primarily of the following:

- A surficial topsoil layer with a measured thickness of 150mm to 600mm, encountered at eight (8) boreholes.
- Fill consisting predominantly of silt fine sand with trave gravel and topsoil was encountered immediately beneath the ground covers in Boreholes 2,5,6,7, and 8. The fill extended to a depth generally varying from 0.8m to 2.1m below ground.
- Boreholes 1,5, and 6 penetrated a stratum of silty fine sand to depths ranging from 2.1m to 4.0m below ground.
- A deposit of silt sand and gravel with cobbles and boulders was encountered in all boreholes beneath the filly and silty fine sand to depths of about 2.5m to 6.7m below ground.

As shown within the hydrogeological investigation, monitoring wells were installed in boreholes 2, 5, and 8, and groundwater measurements were taken from March 4, 2019, to August 9, 2019. The seasonal high groundwater table at the site ranged from 1.1m to 6.4m below ground surface (BGS). The groundwater flow direction is easterly towards Shaw's Creek. The Groundwater Flow Direction Plan is appended to the end of this memo for reference.

Borehole 8 is the closest borehole to Agnes Street and where the urbanization is proposed; it has a seasonal high groundwater elevation of 411.1m or 1.1mBGS. The Groundwater Flow Direction Plan by Englobe has been included in the memo attachments. The full geotechnical and hydrogeological reports prepared by Englobe respectively are submitted under separate cover.

Since there is no available reference borehole within the portion of Agnes Street to be urbanized, it is assumed that the groundwater table will follow the slope of the existing ground at 1.1mBGS towards Shaws Creek.

2 PROPOSED CONDITIONS

In the proposed conditions, 152m of Agnes Street, south of Queen Street West will be urbanized with a 15m wide ROW with a sidewalk on the west side. A cross section detail of the ROW has been appended to the end of this memo. Overall drainage patterns will be maintained in proposed conditions as the delineated catchments will continue to drain in the northeasterly direction towards Agnes Street and ultimately discharge at Shaw's Creek.

The proposed condition study area has been delineated into six (6) catchments:

- Area 201 (2.22ha) is a part of the property to be developed by The Alton Development Inc. (0 Agnes Street). It will consist of townhome blocks, a 6.0m wide private roadway and an amenity area. Drainage from this area will be piped to the proposed storm sewer on Agnes Street.
- Area 202 (1.82ha) is a part of the property to be developed by The Alton Development Inc. (0 Agnes Street). It will consist of townhome blocks and a 6.0m wide private roadway. Drainage from this area will be piped to the proposed storm sewer on Agnes Street.
- Area 203 (1.23ha) consists of single detached dwellings, grassed lawns and private driveways. It generally drains in the northeast direction towards the intersection of Queen Street West and Agnes Street. This area will remain unchanged in the existing and proposed conditions.
- Area 204a (0.16ha) consists of the west side of the Agnes Street ROW. Approximately 152m of Agnes Street will be urbanized into a 15m wide ROW. The urbanized portion will include a sidewalk, curbs, gutters, and catchbasins on the west side of the street that will replace the existing roadside ditch. A new 525mm diameter storm sewer will be installed on Agnes Street. Runoff will continue to flow in a northern direction towards the ditch inlet catchbasin at the north side of Agnes Street. The remaining southern portion of Agnes Street will remain unchanged.
- Area 204b (0.18ha) consists of the east side of the Agnes Street ROW. This area will effectively remain unchanged in the existing and proposed conditions. Runoff will continue to flow in a northern direction towards the north side of Agnes Street; the existing ditch inlet catchbasin north of the catchment will be replaced with an oil grit separator with grate inlet.
- Area 205 (0.16ha) consists of grassed lawns, private driveways, and a small portion of King Street which forms a T-junction with Agnes Street. This area will remain unchanged in the existing and proposed conditions.

The development at 0 Agnes Street (Area 201 and Area 202) will provide its own stormwater management to meet water quality, water quantity and water balance criteria. A separate Functional Servicing and Stormwater Management Report for this development has been submitted under separate cover.

Regarding Area 203, the land use and drainage pattern will remain unchanged after the east side of Agnes Street is urbanized – this area can effectively be considered as an external area to Area 204a. Stormwater runoff will continue to flow north on Agnes Street overland. As such, the peak flows, water balance and erosion conditions will not change. However, since catchbasins are proposed at the northern end of Agnes Street, the catchbasins, proposed storm sewer, and water quality unit will be sized to accommodate the minor storm runoff in this area. The major storm event flows will continue to flow overland towards Shaw's Creek.

Since Area 204b and 205 will effectively remain unchanged in existing and proposed conditions, they are not part of the proposed urbanized area. These two catchments will only be considered in the sizing of the proposed storm sewer in Agnes Street for future connection and sizing of the water quality unit. They will be omitted from the rest of the SWM analysis.

Table 3 is an area breakdown of the proposed land uses.

Table 3 Proposed Area Breakdown

Surface	Area 201	Area 202	Area 203	Area 204a	Area 204b	Area 205
Asphalt (m^2)	4,196.1	1,977.9	732.4	1,184.2	1,186.9	467.0
Permeable Pavers (m^2)	1,618.3	898.5	0.0	0.0	0.0	0.0
Roof (m^2)	5,960.0	4,994.1	1,003.1	0.0	0.0	0.0
Grassed (m^2)	10,427.5	10,352.5	10,590.1	442.5	633.7	1,133.9
Total (m^2)	22,201.8	18,222.9	12,325.6	1,626.7	1,820.6	1,600.9
Percent Impervious	49.4%	40.7%	14.1%	72.8%	65.2%	29.2%
Runoff Coefficient	0.57	0.51	0.34	0.72	0.67	0.44

Table 4 presents the post-development peak flows without stormwater management controls. Intensity was calculated using the intensity-duration-frequency curves from the Town of Caledon's Development Standards Manual (2019).

Table 4 Post-Development Peak Flows without SWM from 0 Agnes Street Development

Storm Event	Area 201 (L/s)	Area 202 (L/s)	Area 203 (L/s)	Area 204a (L/s)	Area 204b (L/s)	Area 205 (L/s)	Total (L/s)
2	301.9	223.4	54.3	23.9	25.0	14.3	642.7
5	386.3	285.8	74.3	31.3	32.6	18.7	829.0
10	472.5	349.6	91.0	38.3	40.0	22.9	1014.3
25*	606.2	448.5	121.1	49.7	47.2	29.8	1302.4
50*	744.6	550.9	149.8	61.3	53.2	36.6	1596.4
100*	865.2	640.1	175.4	71.4	59.5	42.7	1854.3

*Incorporates Runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25

Table 5 presents the post-development peak flows with stormwater management from Area 201 and 202. See FSR submitted under separate cover for detailed calculations for the development at 0 Agnes Street.

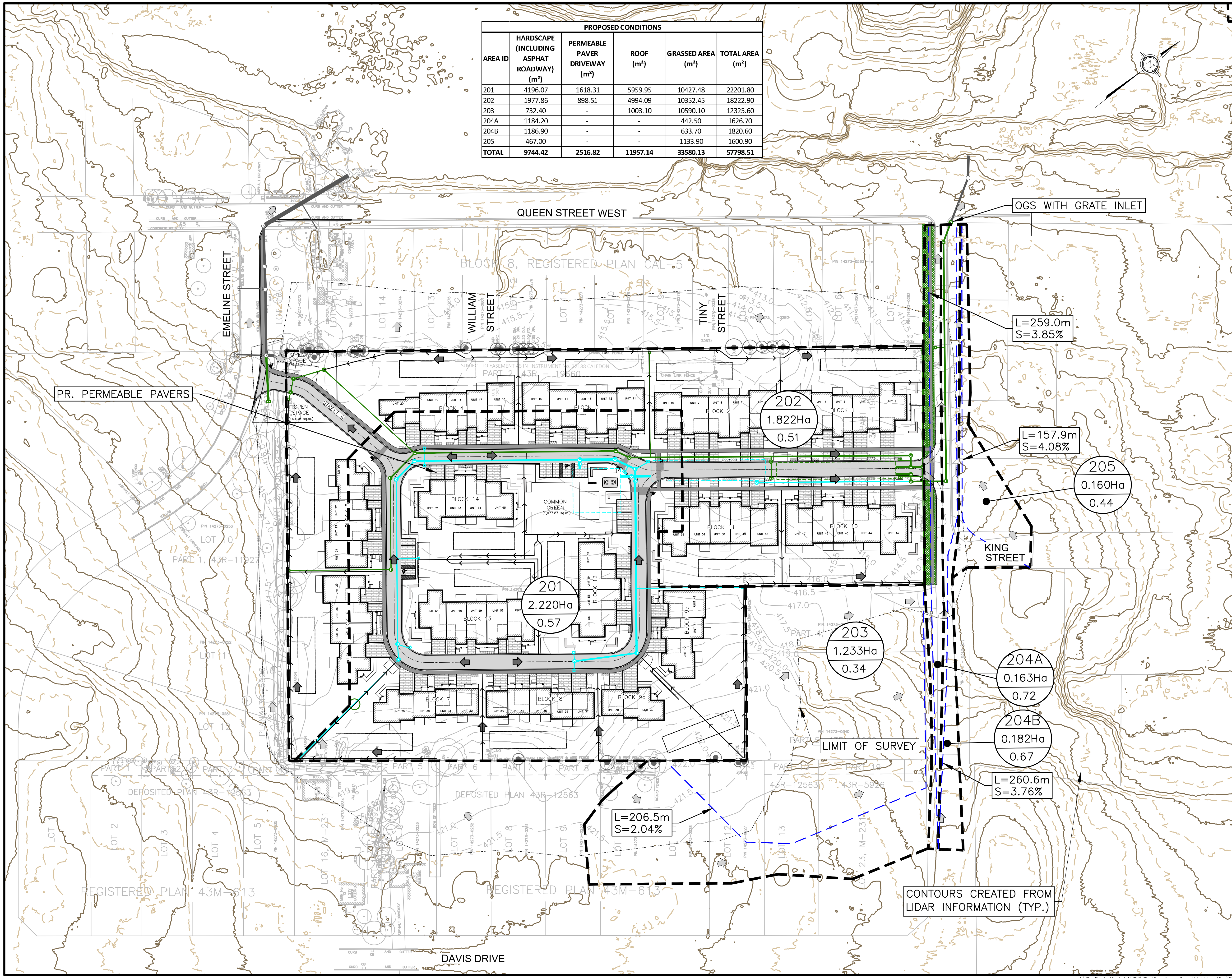
Table 5 Post-Development Peak Flows with SWM at 0 Agnes Street Development

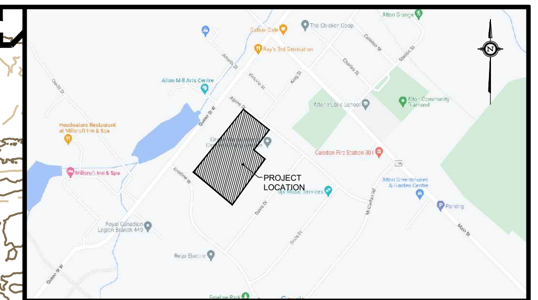
Storm Event	Area 201 (L/s)**	Area 202 (L/s)**	Area 203 (L/s)	Area 204a (L/s)	Area 204b (L/s)	Area 205 (L/s)	Total (L/s)
2	57.2	45.3	54.3	23.9	25.0	14.3	220.0
5	57.2	45.3	74.3	31.3	32.6	18.7	259.4
10	57.2	45.3	91.0	38.3	40.0	22.9	294.7
25*	57.2	45.3	121.1	49.7	47.2	29.8	350.3
50*	57.2	45.3	149.8	61.3	53.2	36.6	403.4
100*	57.2	45.3	175.4	71.4	59.5	42.7	451.5

*Incorporates Runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25
** With stormwater management quantity controls

Detailed calculations are included in the attachments at the end of this memo. See **Figure 2** below for the proposed drainage patterns and catchments.

AREA ID	HARDSCAPE (INCLUDING ASPHAT ROADWAY) (m²)	PERMEABLE PAVER DRIVEWAY (m²)	ROOF (m²)	GRASSED AREA (m²)	TOTAL AREA (m²)
PROPOSED CONDITIONS					
201	4196.07	1618.31	5959.95	10427.48	22201.80
202	1977.86	898.51	4994.09	10352.45	18222.90
203	732.40	-	1003.10	10590.10	12325.60
204A	1184.20	-	-	442.50	1626.70
204B	1186.90	-	-	633.70	1820.60
205	467.00	-	-	1133.90	1600.90
TOTAL	**9744.42**	**2516.82**	**11957.14**	**33580.13**	**57798.51**





KEY PLAN
N.T.S.

LEGEND

EXISTING / PROPOSED

- MH1 — STORM MANHOLE
- CBMH1 — STORM CATCHBASIN MANHOLE
- CB — SINGLE CATCHBASIN
- DCB — DOUBLE CATCHBASIN
- FD — SINGLE FLOOR DRAIN
- STORM SEWER
- STORM SEWER SYSTEM TO CONCRETE CISTERN AND OUTLET
- STORM SEWER SYSTEM TO GREENSTORM STORAGE
- LIMIT OF SUBJECT PROPERTY
- EASEMENT
- RIGHT OF WAY
- LOT LINE
- FENCE LINE
- CURB/SIDEWALK
- BUILDING
- RETAINING WALL
- MAJOR CONTOUR LABEL
- MINOR CONTOUR LABEL
- ASPHALT
- PAVING STONE (PERMEABLE PAVERS)
- 1.5m WIDE CONCRETE SIDEWALK
- OVERLAND FLOW
- TREE
- TREE – TO REMAIN
- STORM DRAINAGE BOUNDARY
- LONGEST TRAVEL PATH
- 3 — DENOTES AREA NUMBER
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COMPLETED ON:
MAY 10, 2018

DEM SOURCE:
LIDAR DTM PEEL 2016 PACKAGE B AVAILABLE FROM LAND INFORMATION ONTARIO

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PROJECT NAME:
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DRAINAGE PLAN PROPOSED CONDITIONS (AGNES STREET URBANIZATION)

DESIGNED BY:	C.M.	SCALES:		PROJECT No.	20-731
CHECKED BY:	J.C.	HORIZONTAL:	1:1500	DRAWING No.	FIG. 2
DRAWN BY:	C.M.	VERTICAL:	N/A	SHEET No.	
DATE:	FEB 10, 2026	SHEET SIZE:	11"x17"		

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Date Plotted: Dec 8, 2025 - 8:26 PM

2.1 MAJOR AND MINOR DRAINAGE SYSTEM

Overall, the existing drainage pattern will be maintained in proposed conditions. The existing catchbasin at the intersection of Agnes Street and Queen Street is proposed to be replaced with a filter-based water quality unit with catchbasin insert.

For Area 204b and 205, stormwater runoff will continue to drain overland and minor flows will be captured by the new catchbasin water quality unit. Major flows will follow the existing flow path and drain overland to Shaws Creek.

The proposed storm sewer on Agnes Street will be sized to convey the controlled flows from Area 201 and 202, and flows up to the 10-year event for Area 203 and 204a. It will also be sized to accommodate future 10-year storm drainage from Area 204b and 205 should catchbasins and storm laterals be installed on the east side of the street at a later time. The proposed catchbasins on the west side of Agnes Street will be sized to capture the minor storm events from Area 204a and 203. A storm sewer design sheet for the proposed storm sewer network will be provided at detailed design.

For major flows, the runoff will continue to follow the existing overland flow path and discharge to Shaws Creek.

3 STORMWATER MANAGEMENT

The following stormwater management criteria is to be addressed in accordance with regulatory policy and requirements set in the Town of Caledon's Environmental Compliance Approval 324-S701 (October 2022). Note that the urbanization of Agnes Street is considered a retrofit scenario.

- **Water Quality** – Improve current level of water quality control and consider the Town's water quality criteria in the Development Standards Manual (2019).
- **Water Quantity** – Post-development peak flows to be controlled to pre-development levels.
- **Water Balance** – Maintain pre-development infiltration volumes in post-development conditions.
- **Erosion Control** – Improve level of erosion control

As discussed in the previous section, the development at Area 201 and 202 will provide its own SWM to meet development criteria. Area 204b and 205 are omitted from the SWM strategy as only the east side of the north portion of Agnes Street will be urbanized.

Area 203 consists of private residential properties and will remain unchanged in proposed conditions. As such, runoff flows will also remain unchanged – no water quantity control, water balance and erosion control is required as this is effectively an external area to the urbanized portion of Agnes Street. Further, the land use for Area 203 consist majorly of roof areas and grassed lawns; these areas are considered clean with respect to water quality – no water quality controls are needed for these areas. However, since runoff from Area 203 will be captured by the proposed catchbasins on the west side of Agnes Street, this area is considered in the sizing of the downstream water quality unit.

3.1 AGNES STREET URBANIZATION AREA CONSTRAINTS

Based on the findings of the Hydrogeological Investigation prepared by Englobe dated October 15, 2025, there are key constraints for the northern portion of Agnes Street to be considered.

As per Table 3-7 and the Groundwater Flow Direction Plan in the hydrogeological report, there is high groundwater at MW8. The groundwater elevation at this monitoring well is 411.1m or 1.1m below ground level (BGL). Due to the high groundwater, subsurface infiltration facilities cannot be proposed as the bottom elevation of the facility will not achieve the minimum 1m separation from the groundwater table. Further, due to the limited width and space of the west side of the Agnes Street ROW, there are limited grading opportunities to fill or raise this portion of the road as the grades must match at the existing property lines and have no negative impact on adjacent properties.

Further, as per Section 3.6 of the hydrogeological report, this northern portion of Agnes Street has been identified as a Wellhead Protection Area (WHPA) with a high vulnerability score of 8. As such, only “clean” water can be infiltrated, and pre-treatment must be provided prior to infiltration of surface runoff from the roadway.

The last constraint is the horizontal space limitation on the Agnes Street ROW. There is a watermain that runs under Agnes Street. As per the Province of Ontario’s F-6-1 Procedure, *Sewers/sewage works and watermains located parallel to each other should be constructed in separate trenches maintaining a minimum clear horizontal separation distance of 2.5m*. This is to reduce the potential for health hazards in the event “dirty” surface water or contaminated groundwater enters the distribution system at leaks or breaks in the piping.

3.2 WATER QUALITY

As per the CLI ECA requirements for retrofit scenarios, the proposed urbanization works must improve the current level of water quality control and consider the Town’s water quality criteria in the Development Standards Manual (2019). The Town requires an Enhanced Level of Protection (80% TSS removal).

Stormwater from the development area can be characterized by the Agnes Street right of way (ROW), proposed sidewalk and landscaped areas. Given the relatively small area, water quality from the proposed development is likely to be relatively clean with the main contaminants of concern being:

- Suspended sediments
- Other (oil, grease, gas)

A number of water quality control options were considered, guided by the Draft Low Impact Development Stormwater Management Guidance Manual (LID SWM Manual) produced by the MECP, dated January 2022. It is understood that as per the LID SWM Manual, a hierarchical approach is to be followed. Control Hierarchy Priority (CHP) 1 – Retention which includes the use of LID methods for infiltration, evapotranspiration, and re-use. CHP 2 – LID Filtration utilizes filter media where a controlled volume is filtered and discharged at a reduced rate or volume, CHP 2 can also involve infiltration or evapotranspiration. CHP 3 – Conventional Treatment involves manufactured end-of-pipe water quality devices.

Due to the WHPA-E designation, the surface runoff from the roadway must be treated by filtration or a conventional treatment device prior to infiltration. As such, the control hierarchy cannot be followed. Due to the high groundwater condition, subsurface and surface infiltration facilities also cannot be proposed as the minimum 1m clearance to the groundwater table cannot be achieved with groundwater at 1.1mBGL. There are no opportunities for water reuse for this portion of Agnes Street.

A filter media option with a perforated pipe was also explored, however, due to the high groundwater in the area, there are buoyancy concerns with having the filter media system partially or fully submerged in groundwater. The filter media also cannot be installed in the roadway due to loading concerns from vehicles. Further, there is not enough horizontal nor vertical clearance from the watermain.

As such, a filter-based water quality unit is proposed to treat the runoff from Area 204a, with consideration for the controlled flows coming from Area 201 and 202 as well as Area 203, 204b and 205. The Jellyfish JF10-13-4 unit with a catchbasin insert from Imbrium is proposed; the manufacturer's specifications and ETV certification are attached at the end of this brief.

3.3 WATER QUANTITY

The Town's Environmental Compliance Approval 324-S701 (October 2022) and Development Standards Manual (2019) requires that for retrofit scenarios, post-development peak flows be controlled to the pre-development peak flows.

Note that the Town does not allow subsurface chamber storage within the public ROW. Further, due to the location of the watermain, there is limited space for underground storage while still meeting the required horizontal clearance.

The following **Table 6** presents a comparison of the pre- and post-development flow rates for Area 204a.

Table 6 Pre- to Post-Development Peak Runoff Comparison for Area 204a

Storm Event	Area 104a Peak Runoff (L/s)	Area 204a Peak Runoff (L/s)	Difference (L/s)
2	20.8	23.9	3.1
5	27.2	31.3	4.1
10	33.3	38.3	5.0
25*	43.2	49.7	6.5
50*	53.3	61.3	8.0
100*	62.0	71.4	9.3

*Incorporates Runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25

Note that the largest increase occurs in the 100-year event with a maximum increase of 9.3L/s.

Given the site constraints, implementation of water quantity control measures within the Agnes Street public ROW is not feasible, therefore, the 0 Agnes Street development will provide over control for Area 204a. **Table 7** presents a comparison of the pre- and post-development peak runoff rates from the study area with SWM controls at Area 201 and 202.

Table 7 Pre- to Post-Development Peak Runoff Comparison

Storm Event	Area 101, 103 and 104a Peak Runoff (L/s)	Area 201, 202, 203, 204a Peak Runoff (L/s)	Difference (Proposed – Existing) (L/s)
2	187.0	180.7	-6.3
5	256.3	208.1	-48.3
10	313.7	231.8	-81.9
25	417.8	273.3	-144.5
50	516.7	313.5	-203.2
100	605.2	349.3	-255.9

As such, it is demonstrated that the development at 0 Agnes Street can compensate to provide quantity control for Area 204a. Note that the proposed storm sewer on Agnes Street will be sized to accommodate the uncontrolled minor flows from 204a should the SWM facilities at 0 Agnes Street become compromised. Detailed peak flow calculations can be found in the memo attachments.

3.4 WATER BALANCE AND SOURCE WATER PROTECTION

Urbanization increases impervious cover, which, if left unmitigated, results in a decrease in infiltration. This decrease in infiltration reduces groundwater recharge and soil moisture replenishment. It also reduces stream baseflow needed for sustaining aquatic life. Therefore, it is important to maintain the natural hydrologic cycle. Groundwater recharge helps maintain aquifer water levels and supports significant watershed features that are necessary components to the maintenance of a healthy watershed. As a result, a water balance analysis is required to estimate the pre-development and post-development infiltration and runoff.

For retrofit scenarios, pre-development infiltration volumes should be maintained in post-development conditions as per the Town's CLI ECA, and Terms of Reference: Water Balance Assessment Draft document. There is no other higher-level study that dictates the water balance criteria in the urbanization area.

A site-specific water balance was completed for the urbanized area of Agnes Street, Area 204a, using MECP's Stormwater Management Planning and Design Manual dated March 2003. This approach uses the method developed by Thornthwaite and Mather. Note that Area 203 is not considered in this assessment as there is no change in land use and thus no change in infiltration volume in the urbanized condition. A summary of the pervious and impervious areas is provided below in **Table 8**.

Table 8 Existing and Proposed Land Cover

Area	Existing Area 104a (m^2)	Proposed Area 204a (m^2)
Pervious	678.8	442.5
Impervious	947.9	1,184.2
Total	1,626.7	1,626.7

The parameters used for the water balance analysis are provided in **Table 9**.

Table 9 MECP Water Balance Infiltration Parameters

	Comment	Factor
Topography	Hilly Land	0.1
Soils	Open Sandy Loam	0.4
Cover	Cultivated Land	0.1

A summary of the change in infiltration volumes is provided in **Figure 3**. Water balance calculations have been included at the end of this brief.

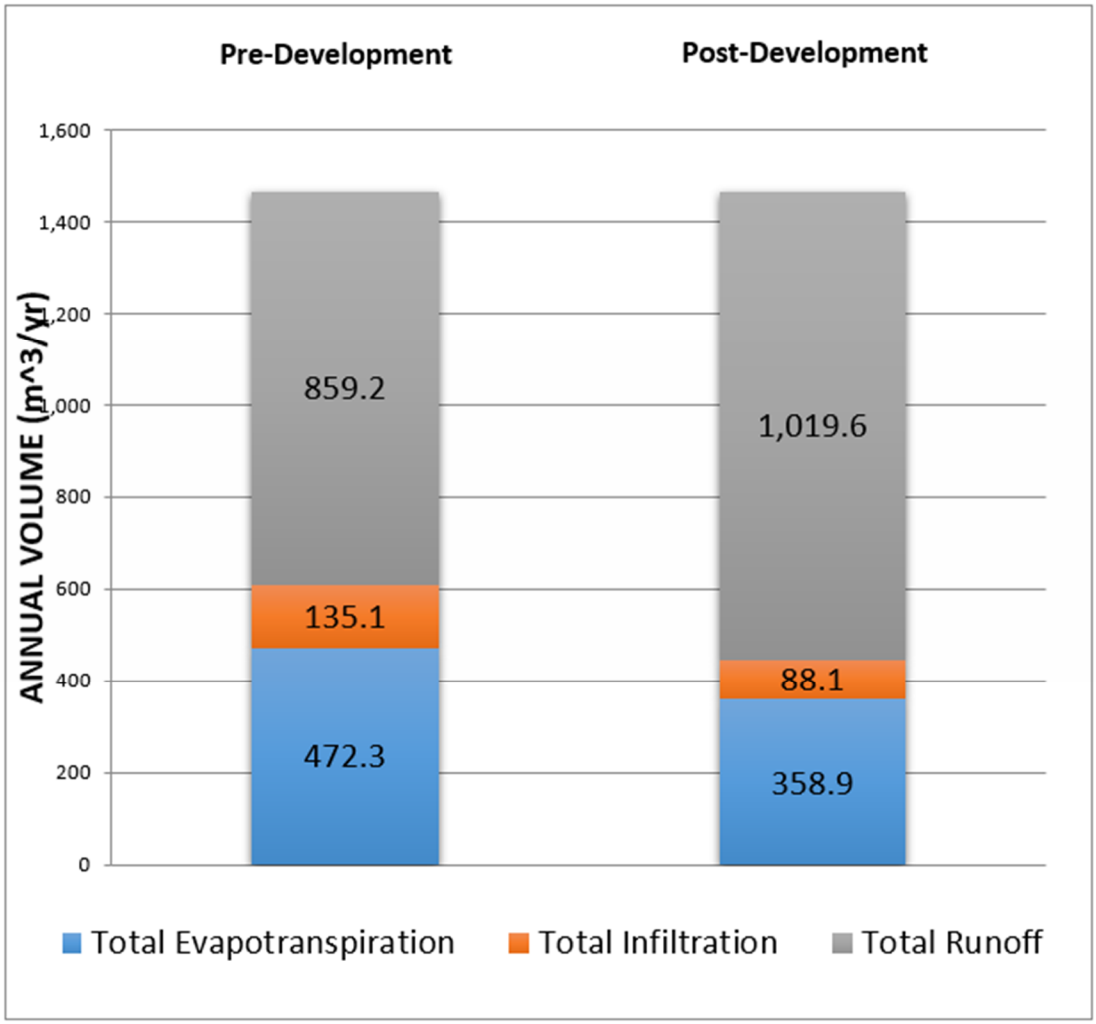


Figure 3: Water Balance Summary

A total deficit volume of 47m^3/year will not be infiltrated into the ground given the change in pervious cover from the urbanization plan.

As discussed previously, due to the high groundwater table, an infiltration facility for this area of Agnes Street is not feasible as the 1m clearance from the ground water elevation cannot be achieved. Further, the infiltration facility should have a 2.5m horizontal clearance from the watermain – space constraints do not allow for this. As a best practice effort, 300mm of topsoil will be added to all landscaped areas adjacent to the proposed sidewalk to increase initial abstraction, retention of rainwater and evapotranspiration.

As per the Stormwater Planning: Guidebook for British Columbia (May 2002) Section 7.4, *runoff from landscaped areas can be virtually eliminated by providing a 300mm layer of landscaped absorbent soil, even under very wet conditions where the hydraulic conductivity of low*. Figure 7-2 and 7-4 of the Guidebook demonstrates that with 300mm of absorbent topsoil, approximately 38% of stormwater will leave the area as runoff. This equates to 62% stormwater retention. As such, the grassed/landscaped areas with 300mm of topsoil have a higher initial abstraction volume than the typical 5mm. Excerpts from the British Columbia Guidebook have been included at the end of this brief for reference.

Typically, to maintain pre-development infiltration volumes in post-development conditions, the 5mm storm event is captured and retained for all impervious areas, which represents approximately 50% of all rainfall events in a given year (City of Toronto WWFMG Figure 1b, November 2006).

The 5mm volume for all impervious areas in Area 204a is 5.9m^3. As a best efforts approach, infiltration facility at the 0 Agnes Street development (located in Area 201) has been slightly oversized to accommodate the volume deficit on the urbanized portion of Agnes Street.

As per the FSR submitted under separate cover, the required infiltration volume for 0 Agnes Street is 91.9m^3, the proposed infiltration facility volume is 138.5m^3. As such, there is a surplus of 46.6m^3, and the facility has the capacity to infiltrate an additional 5.9m^3 volume.

3.5 EROSION CONTROL

The Town's Environmental Compliance Approval 324-S701 (October 2022) requires that for retrofit scenarios, the proposed condition should improve the level of erosion control.

The CVC Stormwater Management Guidelines (July 2022) state that "the minimum erosion control requirement for all watercourses within CVC's jurisdiction is retention of the first 5mm of every rainfall event. Industry-standard storage volumes for pervious areas of 5mm were applied, therefore, the erosion control storage volume requirement will be characterized by impervious surfaces. CVC correspondence confirming this criteria has been included at the end of this brief.

It is proposed to capture the equivalent of the 5mm event on the impervious area for Area 204a. See **Table 10** below for a summary of erosion control volume requirements.

Table 10 Erosion Control Volume Summary

Catchment ID	Post Dev. Impervious Area (m^2)	Required Capture Depth (mm)	Required Volume (m^3)
Area 204a	1,184.2	5	5.9

As discussed in the water balance section, infiltration is not feasible for this northern portion of Agnes Street. As such, as a best efforts approach, 300mm of topsoil will be provided on the landscaped areas adjacent to the proposed sidewalk to increase initial abstraction and retention of rainfall.

Further, the infiltration facility at the 0 Agnes Street development has been slightly oversized to accommodate an additional 5.9m^3. As such, the erosion requirement is achieved.

4 EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION

Erosion and sediment controls (ESC) will be implemented for all construction activities, including topsoil striping, material stockpiling, and grading operations. The following erosion and sediment control elements are proposed on site:

- Sediment control fence – Fencing will be constructed downslope of the proposed development area prior to all construction activities. Geotextile material should have a non-woven density of 270R or equivalent;
- Filtrexx Siltsoxx check dams are to be placed within drainage swales/ditches and low points to hold back water and reduce velocities to prevent erosion and promote sedimentation.
- Restoration of landscaped areas – all exposed soil after grading is to be immediately sodded to promote vegetation growth and protection for erosion and sediment control
- ESC's will be erected prior to the start of construction works and maintained through all phases of development. ESC strategies are not static and may need to be upgraded/amended as site conditions change to minimize sediment laden runoff from leaving the work areas;
- Sediment controls must be inspected on a regular basis and after every rain fall event. Repairs must be done in a timely manner to prevent movement of sediment.

5 CONCLUSIONS

Greck and Associates is confident that this memo and the analyses completed are consistent with the latest municipal and provincial standards and guidelines with respect to scientific analysis and engineering principles. In summary:

- 152m of the west side of Agnes Street is to be urbanized with a sidewalk, curb, gutter, and storm sewer

- The northern portion of Agnes Street has high groundwater and is within a wellhead protection area.
- Water quality control will be achieved with a filter-based water quality unit.
- The development at 0 Agnes Street will provide overcontrol for the increase in flows from Area 204a for water quantity control.
- The infiltration volume for the water balance and erosion control will be provided in the infiltration facility at 0 Agnes Street.
- Given the urbanization area constraints and limited feasibility of SWM strategies, SWM is provided to the maximum extent possible with the proposed infrastructure at 0 Agnes Street overcompensating as best practices. As such, the CLI ECA criteria is satisfied.

If you require additional information or have any questions, please feel free to contact me at (289) 657-9797 ext. 226.

Respectfully submitted,

Jennifer Chan, P.Eng.
Water Resources Engineer

ATTACHMENTS

- Alton Sewershed Map provided by the Town of Caledon
- Topographic Survey prepared by Van Harten Surveying Inc. dated September 16, 2022
- Groundwater Flow Direction Plan by Terraprobe from Hydrogeological Investigation dated October 2025
- Cross Section Detail of Agnes Street updated by Greck
- Water Quality Unit Specifications and Manual
- Stormwater Management Calculations by Greck
- Stormwater Planning: Guidebook for British Columbia excerpts, May 2002
- CVC Erosion Criteria Correspondence

Legend

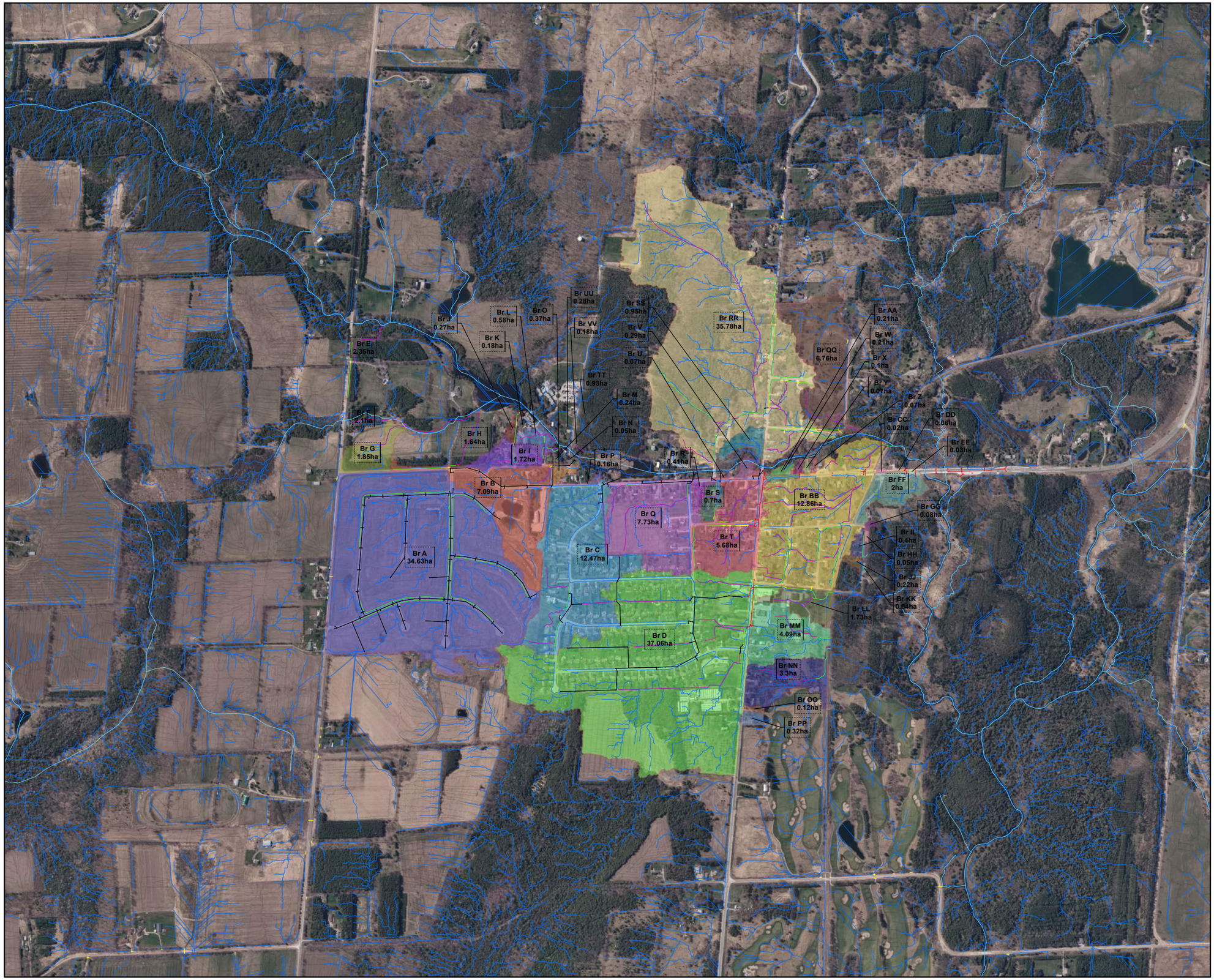
- Storm_Outflow
- Storm_Manhole
- Storm_Inlet
- Outfalls
- Manholes
- CatchBasins
- Rivers_and_streams
- Storm_Main
- Storm_Inlet_Lead
- STML_Pipes
- Pipes
- Lead_Pipes
- Minor system subcatchment/Branch
- Property lines
- Private swale
- Public swale
- Culverts

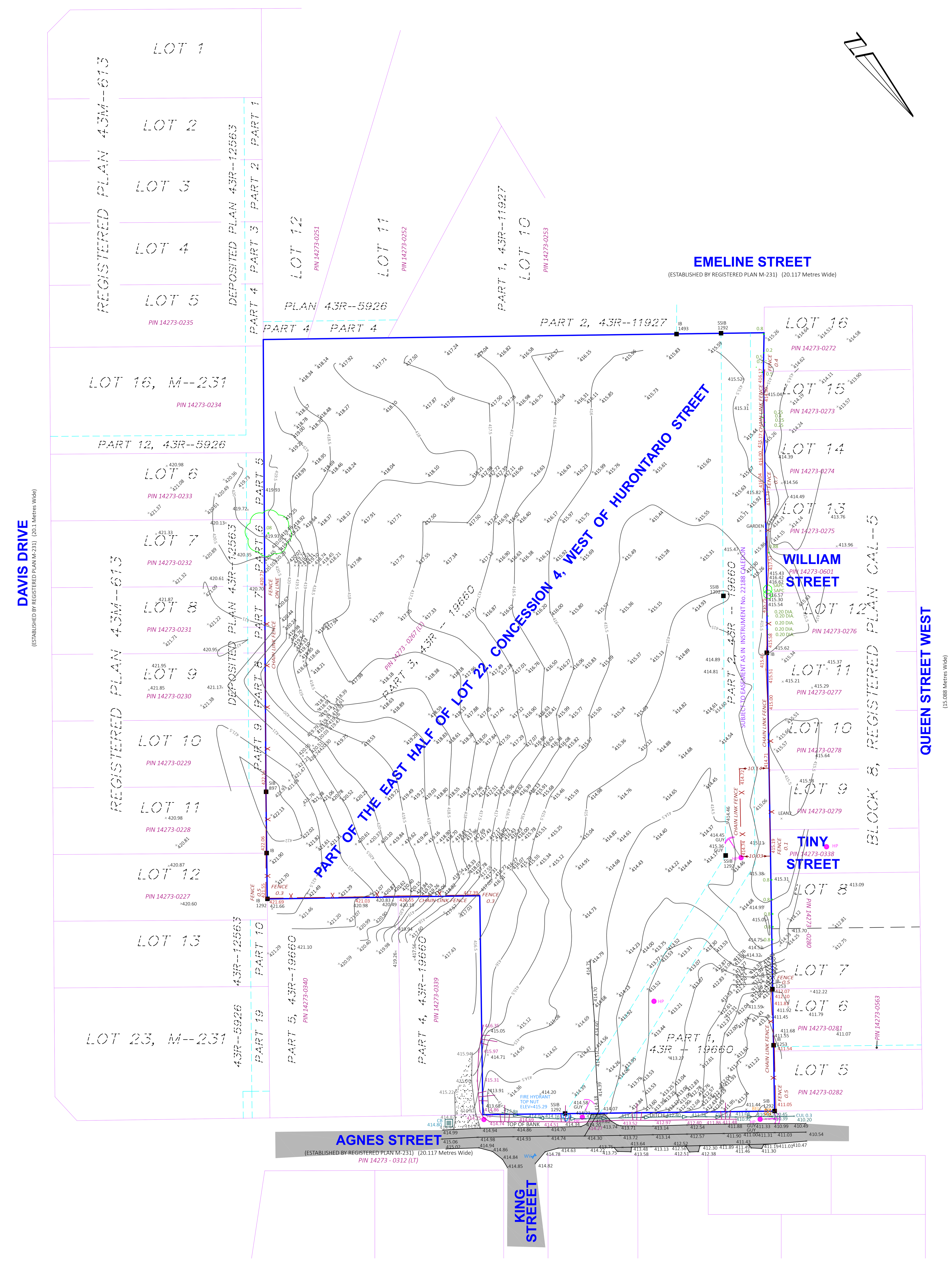
1937PEEL_15cm_2019.sid

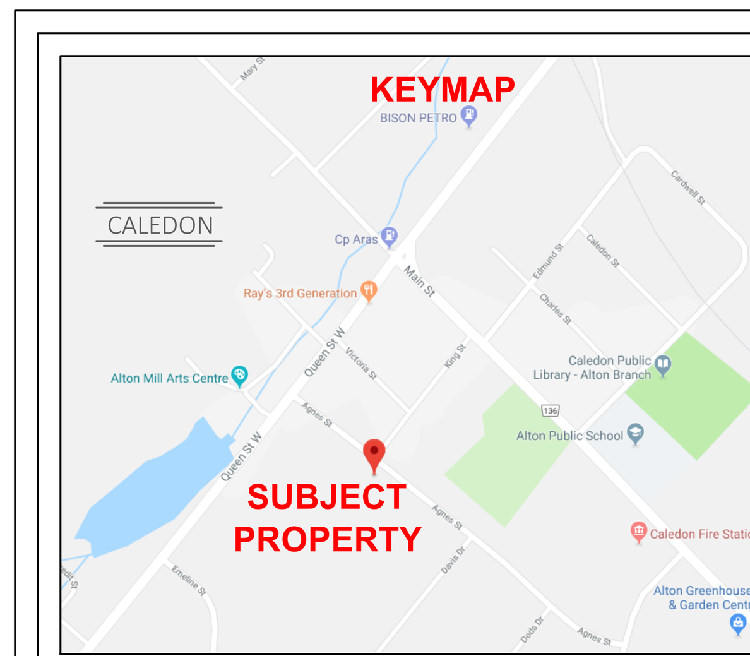
RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3

Branch ID
Total area in ha







TOPOGRAPHIC SURVEY OF PART OF EAST HALF OF LOT 22, CONCESSION 4, WEST OF HURONTARIO STREET

GEOGRAPHIC TOWNSHIP OF CALEDON, COUNTY OF PEEL

TOWN OF CALEDON

REGIONAL MUNICIPALITY OF PEEL

SCALE 1 : 750

0 5 10 20 30 40 50 metres

VAN HARTEN SURVEYING INC.

750

LEGEND

	DENOTES SURVEY MONUMENT SET
	DENOTES SURVEY MONUMENT FOUND
SIB	DENOTES .025 x .025 x 1.20 STANDARD IRON BAR
IB	DENOTES .015 x .015 x 0.60 IRON BAR
SSIB	DENOTES .025 x .025 x 0.60 SHORT STANDARD IRON BAR
RP	DENOTES .015 DIA. X 0.07 ROUND IRON BAR WITH STAMPED WASHER
PB	DENOTES .025 x .025 x 0.30 PLASTIC BAR
CC	DENOTES CUT CROSS
WIT	DENOTES WITNESS
OU	DENOTES ORIGIN UNKNOWN
VH	DENOTES VAN HARTEN SURVEYING INC., O.L.S.'s
1292	DENOTES WM. E. BENNETT SURVEYING LTD., O.L.S.'s
897	DENOTES WILLIAM J. QUINSEY, O.L.S.'s
1493	DENOTES YOUNG AND YOUNG SURVEYORS INC., O.L.S.
375	DENOTES D.J. CULLEN LTD., O.L.S.

EXISTING ELEVATION	× 206.55
GUY WIRE	GUY
HYDRO POLE	HP
FIRE HYDRANT	FH
CATCHBASIN	CB
BELL PEDESTAL	BELL

LINETYPES

OVERHEAD HYDRO	OH
FENCELINE	X
DITCH/SWALE	
CENTRELINE OF ROAD	
TOP OF BANK	

HATCHES

ASPHALT

GRAVEL

BENCHMARK:

ELEVATIONS ARE BASED ON GPS OBSERVATIONS FROM PERMANENT REFERENCE STATIONS IN THE NAD83 (CSRS-2010) COORDINATE SYSTEM, WITH HEIGHTS CONVERTED TO ORTHOMETRIC ELEVATIONS ON THE CVGD28 DATUM (1978 ADJUSTMENT) WITH GEOID MODEL HTv2.0, AS SUPPLIED BY NATURAL RESOURCES CANADA.

REFERENCE:

1. BEARINGS ARE GRID BEARINGS AND ARE DERIVED FROM GPS OBSERVATIONS AND ARE REFERRED TO THE UTM PROJECTION, ZONE 17. NAD 83-CSRS (2010) ADJUSTMENT.
2. DISTANCES SHOWN ON THE PLAN ARE ADJUSTED GROUND DISTANCES AND CAN BE CONVERTED TO UTM GRID DISTANCES BY MULTIPLYING BY AN AVERAGED COMBINED SCALE FACTOR OF 0.9996086

NOTE:

BOUNDARY INFORMATION SHOWN ON THIS PLAN WAS COMPILED FROM REGISTRY OFFICE INFORMATION AND PLAN FOR THE SUBJECT PROPERTY: 43R-19660

FIELD WORK FOR THIS SURVEY WAS COMPLETED ON THE 10th DAY OF MAY , 2018

JAMES M. LAWS
ONTARIO LAND SURVEYOR

METRIC:

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

REVISION SCHEDULE

No.	DATE	BY	COMMENTS
1	7/25/18	S.J.	INITIAL SUBMISSION

Van Harten SURVEYING INC.
LAND SURVEYORS and ENGINEERS

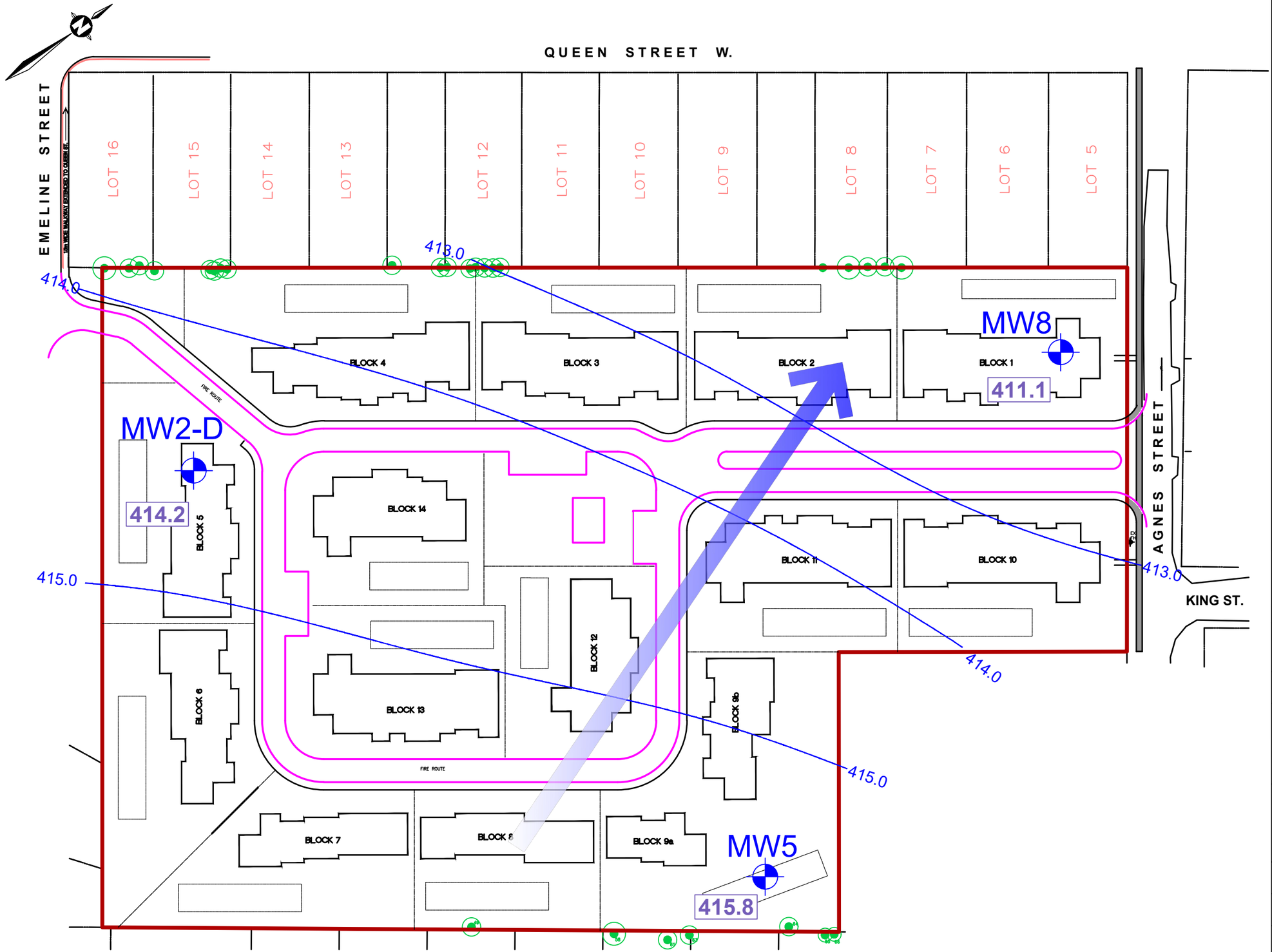
Kitchener	Guelph	Orangeville
Ph: 519-742-8371	Ph: 519-821-2763	Ph: 519-940-4110

www.vanharten.com info@vanharten.com

DRAWN BY: S.J. | CHECKED BY: JML | PROJECT No. 25228-17

Jul 25,2018-4:41pm
G:\CALEDON\CON4WHS\AGNES ST DEVELPOMENT\ACAD\TOPO-ROBB UTM 2010 NR.dwg

SEATON GROUP



Note

1. This drawing shall be read in conjunction with the associated technical report.
2. Drawing scale may be distorted. Measurements/locations taken from the drawing must be verified in the field.
3. CONCEPT PLAN
   SEATON GROUP
   AGNES STREET TOWNHOMES
   Villate of Alton, Caledon, ON
   Orchard Design Studio Inc.
   Project No. 14948 Drwg A1.01

Legend

- Site Boundary
- Monitoring Well Location
- 414.2 Ground Water Elevation(masl) November xx, 202x
- Ground Water Flow Direction
- 415.0 Contour Lines

1:1 000

0 10 20 30 40 50 m

Revision	Date	Issue	Approval
A		Final	

Client: The Alton Development Inc.

Site: Agnes Street, Alton, Ontario

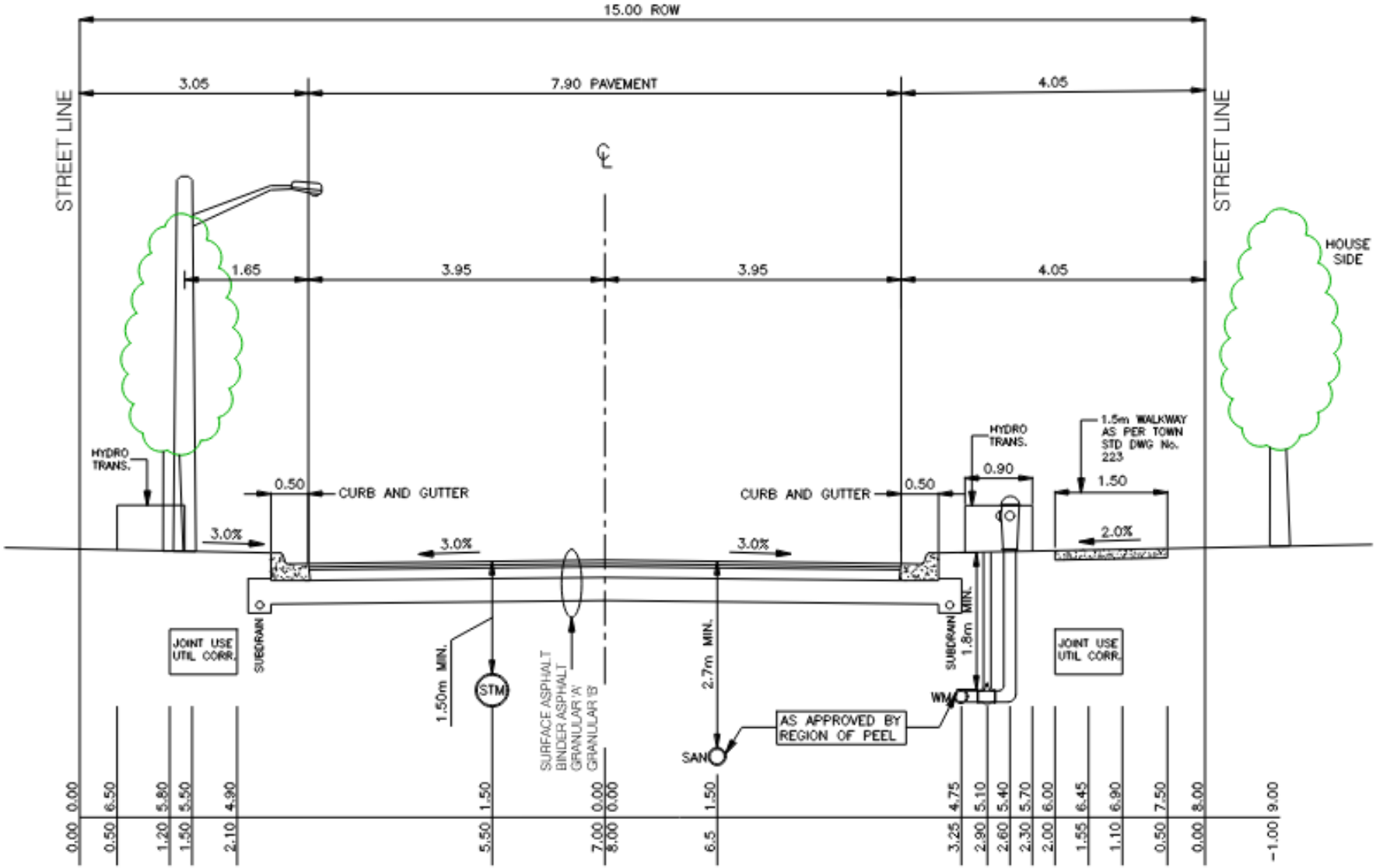
Report Title: Hydrogeological Investigation

Drawing Title: Groundwater Flow Direction Plan

Designed By	Scale
P.R	As Shown
Drawn By	Date
J.B	October 2024
Approved By	Project No.
B.W	T1220087.000

Figure No. 3

20 Carlson Court, Etobicoke, Ontario | M9W 7K6 | Tel: (905) 796-2650 | Website: www.englobecorp.com



TYPICAL ROAD CROSS SECTION

15m LOCAL WINDOW STREET

7.90m PAVEMENT

SCALE 1:75

NOTE:

THIS CROSS SECTION IS BASED ON A STANDARD CROSS SECTION PROVIDED BY THE TOWN THAT INCLUDES A SANITARY SEWER. IN THIS PROJECT THERE IS NO SANITARY SEWER BENEATH AGNES STREET. THE LOCATION OF THE WATERMAIN IS TO BE CONFIRMED AT THE DETAILED DESIGN STAGE.

AGNES STREET CROSS SECTION

(QUEEN STREET WEST TO KING STREET)

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Thursday, February 5, 2026
Project Name	Agnes St.
Project Number	Urbanization Area
Location	Alton

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 JF10-13-4 is recommended to meet the water quality objective by treating a flow of 75.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 33 years of WATERLOO WELLINGTON A rainfall data for this site. This model has a sediment capacity of 853 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)
JF10-13-4	13	4	3.0	75.7	853

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:

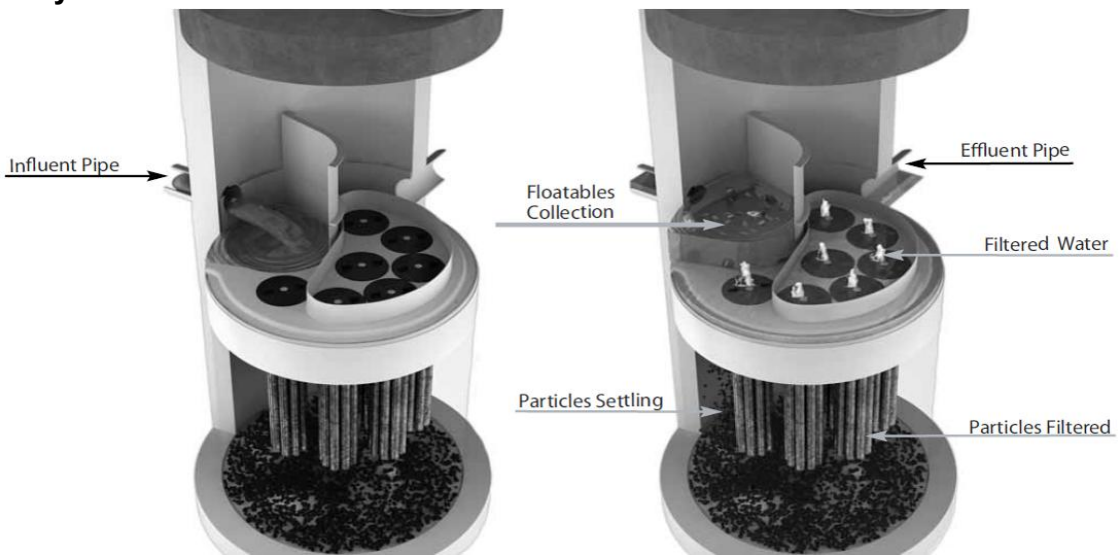
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 77% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash 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:	Thursday, February 5, 2026
Project Name:	Agnes St.
Project Number:	Urbanization Area
Location:	Alton

Designer Information

Company:	Greck and Associates Ltd.
Contact:	Jennifer Chan
Phone #:	

Notes

Pre-Treatment of 1.82229 ha (I=41%) with JF6-5-1

Rainfall

Name:	WATERLOO WELLINGTON A
State:	ON
ID:	9387
Record:	1970 to 2003
Co-ords:	43°27'N, 80°23'W

Drainage Area

Total Area:	5.77985 ha
Imperviousness:	40%

Upstream Detention

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

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 33 years of WATERLOO WELLINGTON A rainfall data:	**72.5 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 9395 m³, with a suspended sediment concentration of 60 mg/L.	**380 kg**

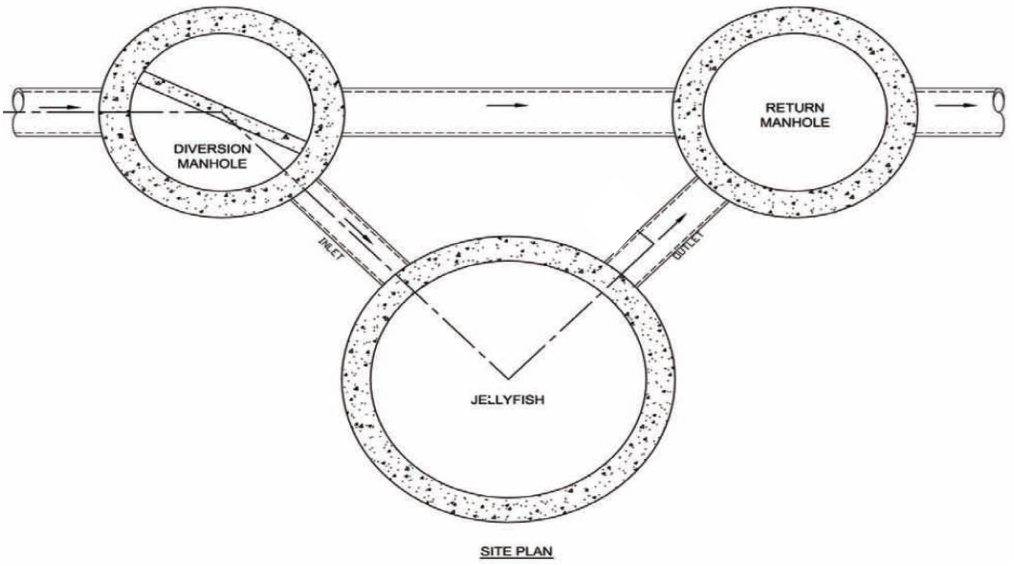
Recommendation

The Jellyfish Filter model JF10-13-4 is recommended to meet the water quality objective by treating a flow of 75.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 33 years of WATERLOO WELLINGTON A rainfall data for this site. This model has a sediment capacity of 853 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

STANDARD PERFORMANCE SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing 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 & PROCEDURES

ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV)

1.3 SUBMITTALS

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

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

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

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 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 internal components. 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 their installed placement for the entire length of the cartridge.

2.1.2 Pollutant Storage: The Filter device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter treatment device shall have been field tested in accordance with either TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements – Amendments to TARP Tier II Protocol (NJDEP, 2009) or Washington State Technology Assessment Protocol – Ecology (TAPE), 2011 or later version. The field test shall have been verified in accordance with ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV). See Section 3.2 of this specification for field test performance requirements.

3.2 FIELD TEST PERFORMANCE

The field test (as specified in section 3.1.1)shall have monitored a minimum of twenty (20) TARP or TAPE qualifying storm events, and report at **minimum** the following results:

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have ISO 14034 ETV verified load based median TSS removal efficiency of at least 85% and load based median SSC removal efficiency of at least 98%.

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, and 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 turbidity such that effluent turbidity is 15 NTU or lower.

3.2.5 Nutrients & Metals – The stormwater quality filter treatment device shall have ISO 14034 ETV Verified minimum load based removal efficiencies for the following:

3.2.5.1 Total Phosphorus (TP) Removal - Median TP removal efficiency of at least 49%.

3.2.5.2 Total Nitrogen (TN) Removal - Median TN removal efficiency of at least 39%.

3.2.5.3 Total Zinc (Zn) Removal - Median Zn removal efficiency of at least 69%.

3.2.5.4 Total Copper (Cu) Removal - Median Cu removal efficiency of at least 91%.

END OF SECTION

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Jellyfish® Filter

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

Registration: GPS-ETV_VR2025-03-15

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 15, 2025
Vancouver, BC, Canada

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

Technology description and application

The Jellyfish® Filter is an engineered stormwater quality treatment technology designed to remove a variety of stormwater pollutants including floatable trash and debris, oil, coarse and fine suspended sediments, and particulate-bound pollutants such as nutrients, heavy metals, and hydrocarbons. The Jellyfish Filter combines gravitational pre-treatment (sedimentation and floatation) and membrane filtration in a single compact structure. The system utilizes membrane filtration cartridges comprised of multiple detachable pleated filter elements ('filtration tentacles") that provide high filtration surface area with the associated advantages of high flow rate, high sediment capacity, and low filtration flux rate.

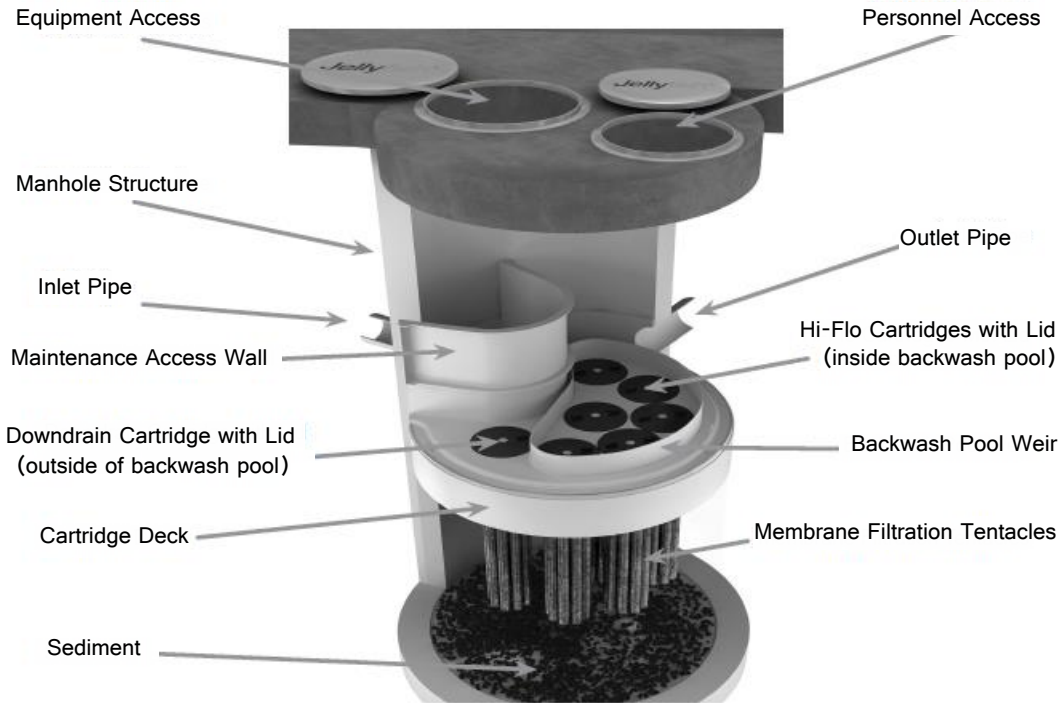


Figure 1. Cut-away graphic of a Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge

Figure 1 depicts a cut-away graphic of a typical 6-ft diameter Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge (JF6-6-1). Stormwater influent enters the system through the inlet pipe and builds a pond behind the maintenance access wall, with the pond elevation providing driving head. Flow is channeled downward into the lower chamber beneath the cartridge deck. A flexible separator skirt surrounds the filtration zone where the filtration tentacles of each cartridge are suspended, and the volume between the vessel wall and the outside surface of the separator skirt comprises a pre-treatment channel. As flow spreads throughout the pre-treatment channel, floatable pollutants accumulate at the surface of the pond behind the maintenance access wall and also beneath the cartridge deck in the pre-treatment channel, while coarse sediments settle to the sump. Flow proceeds under the separator skirt and upward into the filtration zone, entering each filtration tentacle and depositing fine suspended sediment and associated particulate-bound pollutants on the outside surface of the membranes. Filtered water proceeds up the center tube of each tentacle, with the flow from each tentacle combining under the cartridge lid, and discharging to the top of the cartridge deck through the cartridge lid orifice. Filtered effluent from the hi-flo cartridges enters a pool enclosed by a 15-cm high weir, and if storm intensity and resultant driving head is sufficient, filtered water overflows the weir and proceeds across the cartridge deck to the outlet pipe. Filtered effluent discharging from the draindown cartridge(s) passes directly to the outlet pipe, and requires only a minimal amount of driving head (2.5 cm) to provide forward flow. As

storm intensity subsides and driving head drops below 15 cm, filtered water within the backwash pool reverses direction and passes backward through the hi-flo cartridges, and thereby dislodges sediment from the membrane which subsequently settles to the sump below the filtration zone. During this passive backwashing process, water in the lower chamber is displaced only through the draindown cartridge(s). Additional self-cleaning processes include gravity, as well as vibrational pulses emitted when flow exits the orifice of each cartridge lid, and these combined processes significantly extend the cartridge service life and maintenance cleaning interval. Sediment removal from the sump by vacuum is required when sediment depths reach 30 cm, and cartridges are typically removed, externally rinsed, and recommissioned on an annual basis, or as site-specific maintenance conditions require. Filtration tentacle replacement is typically required every 3 – 5 years.

Performance conditions

The data and results published in this Verification Statement were obtained from the field testing conducted on a Jellyfish Filter JF6-6-1 (6-ft diameter manhole with 6 hi-flo cartridges and 1 draindown cartridge), in accordance with the requirements outlined by the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) as written by the Washington State Department of Ecology, (WADOE, 2011). The drainage area providing stormwater runoff to the test unit was 86 acres and was 32% impervious. Throughout the monitoring period (March 2017 – April 2020), a total of 25 individual storm events were sampled. The Basic Treatment standard outlined in the TAPE requires ≥ 80% total suspended solids (TSS) removal at influent TSS concentrations ranging from 100 to 200 mg/L. In addition, the Phosphorus Treatment standard outlined in the TAPE requires ≥ 50% removal of total phosphorus (TP) at influent concentrations ranging from 0.10 to 0.5 mg/L. For this verification, the performance claim for TSS removal is for influent TSS concentration ≥ 100 mg/L, and the performance claim for TP removal is for influent TP concentration ≥ 0.1 mg/L. Based on these requirements, 15 and 18 sample pairs deemed qualified for evaluating the removal performance of TSS and TP, respectively. Prior to starting the performance testing program, a quality assurance project plan (QAPP) was submitted to and approved by the State of Washington Department of Ecology.

Table 1 shows the specified and achieved TAPE criteria for storm selection and sampling.

Table 1. Specified and achieved TAPE criteria for storm selection and sampling

Description	TAPE criteria value	Achieved value
Total rainfall	> 3.8 mm (0.15 in)	> 3.8 mm (0.15 in)[1]
Minimum inter-event period	6 hours	6 hours
Minimum flow-weighted composite sample storm coverage	Minimum 70% including as much of the first 20% of the storm	> 70%
Minimum influent/effluent samples	10, but a minimum of 5 subsamples for composite samples	10, except for two events that had 9 aliquots
Total sampled rainfall	N/A	8.29 in
Number of storms	Minimum 15 (preferably 20)	25

[1]N.B. Storm event depth was greater than the TAPE rainfall depth guideline of 0.15 inches for all events sampled, except for the 3/21/2017, 3/22/2019, 3/26/2019, and 04/13/2019 events. Given the size of the drainage basin, storm events below this threshold produced adequate runoff volume for sampling. Only two of these events were used to evaluate performance, and all had rainfall depths of 0.11 inches or greater. These events were included as their runoff volumes, precipitation durations, and influent TSS concentrations were all within range of the total data set.

The 6-ft diameter test unit has sedimentation surface area of 2.62 m2 (28.26 ft2). Each of the seven filter cartridges employed in the test unit uses filtration tentacles of 137 cm (54 in) length, with filter surface area of 35.4 m2 (381 ft2) per cartridge, and total filter surface area of 247.8 m2 (2667 ft2) for the seven cartridges combined. The design treatment flow rate is 5 L/s (80 gal/min) for each of the six hi-flo

cartridges and 2.5 L/s (40 gal/min) for the single draindown cartridge, for a total design treatment flow rate of 32.5 L/s (520 gal/min) at design driving head of 457 mm (18 in). This translates to a filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m² (0.21 gal/min/ft²) for each hi-flo cartridge and 0.07 L/s/m² (0.11 gal/min/ft²) for the draindown cartridge. The design flow rate for each cartridge is controlled by the sizing of the orifice in the cartridge lid. The distance from the bottom of the filtration tentacles to the sump is 61 cm (24 in).

Performance claim(s)

The Jellyfish® Filter demonstrated the removal efficiencies indicated in **Table 2** for TSS and TP during field monitoring conducted in accordance with the Washington State Department of Ecology's Technology Assessment Protocol – Ecology (TAPE), and using the following design parameters:

- System hydraulic loading rate (system treatment flow rate per unit of sedimentation surface area) of 12.5 L/s/m² (18.4 gal/min/ft²) or lower
- Filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m² (0.21 gal/min/ft²) or lower for each hi-flo cartridge and 0.07 L/s/m² (0.11 gal/min/ft²) or lower for each draindown cartridge
- Distance from the bottom of the filtration tentacles to the sump of 61 cm (24 in) or greater
- Driving head of 457 mm (18 in) or greater

Table 2. Bootstrapped mean, median, and 95% confidence interval (median) for removal efficiencies of Total Suspended Solids (TSS) and Total Phosphorus (TP)

Parameter	Mean (%)	Median (%)	Median – 95% Lower Limit	Median – 95% Upper Limit
TSS [1]	87.6	90.1	85.1	91.6
TP [2]	77.3	77.5	70.8	85.6

[1] TSS influent concentration ≥ 100 mg/L
[2] TP influent concentration ≥ 0.1 mg/L

N.B. As with any field test of stormwater treatment devices, removal efficiencies will vary based on pollutant influent concentrations and other site-specific conditions.
The performance claims can be applied to other Jellyfish® Filter models smaller or larger than the tested model as long as the untested models are designed in accordance with the design parameters specified in the performance claims.

Performance results

Performance Claims – Removal Efficiency for Total Suspended Solids

Raw data summarizing the percent removal of total suspended solids (TSS) by the Jellyfish® Filter at the design system hydraulic loading rate of 12.5 L/s/m² (18.4 gal/min/ft²) for 15 sample pairs deemed qualified are presented in **Table 3**. Data were analyzed and evaluated using a bootstrap approach of random sampling by replacement to estimate population distribution and thereby the upper and lower limit of the confidence interval.

Table 3. Raw data summarizing the percent removal of total suspended solids (TSS)

Event ID	TSS Influent (mg/L)	TSS Effluent (mg/L)	TSS Removal (%) (Inf ≥ 100 mg/L)
3/21/2017	102.0	22.0	78.4
4/7/2017	201.0	30.8	84.7
4/12/2017	108.0	24.4	77.4
4/19/2017	452.0	44.6	90.1
4/26/2017	257.0	10.0	96.1

6/15/2017	134.0	10.4	92.2
3/8/2018	755.0	47.2	93.8
3/14/2018	181.0	27.0	85.1
3/22/2018	224.0	20.0	91.1
4/5/2019	171.0	23.0	86.6
4/13/2019	117.0	25.0	78.6
5/18/2019	254.0	20.0	92.1
12/7/2019	200.0	17.0	91.5
3/30/2020	605.0	51.0	91.6
4/20/2020	210.0	29.0	86.2
n	15	15	15
Min	102.0	10.0	77.4
Max	755.0	51.0	96.1
Median	201.0	24.4	90.1
Mean	264.7	26.8	87.7
SD	190.9	12.3	5.9

Performance Claims – Removal Efficiency for Total Phosphorus

Raw data summarizing the percent removal of total phosphorus (TP) by the Jellyfish® Filter at the design system hydraulic loading rate of 12.5 L/s/m^2 (18.4 gal/min/ft^2) for 18 sample pairs deemed qualified are presented in **Table 4**. Data were analyzed and evaluated using a bootstrap approach of random sampling by replacement to estimate population distribution and thereby the upper and lower limit of the confidence interval.

Table 4. Raw data summarizing the percent removal of total phosphorus (TP)

Event ID	TP Influent (mg/L)	TP Effluent (mg/L)	TP Removal (%) (Inf ≥ 0.1 mg/L)
4/7/2017	0.706	0.092	87.0
4/12/2017	0.338	0.076	77.5
4/19/2017	0.500	0.036	92.8
4/26/2017	0.504	0.042	91.7
5/13/2017	0.256	0.110	57.0
6/8/2017	0.256	0.104	59.4
6/15/2017	0.362	0.052	85.6
3/8/2018	1.75	0.130	92.6
3/14/2018	0.652	0.094	85.6
3/22/2018	0.364	0.072	80.2
3/27/2019	0.226	0.070	69.1
4/5/2019	0.337	0.092	72.9
4/13/2019	0.249	0.087	65.1
5/18/2019	1.09	0.173	84.1
12/7/2019	0.335	0.105	68.7
12/19/2019	0.211	0.093	56.2
3/30/2020	1.05	0.092	91.2
4/20/2020	0.451	0.112	75.2
n	18	18	18
Min	0.211	0.036	56.2
Max	1.75	0.173	92.8
Median	0.363	0.092	78.9
Mean	0.535	0.091	77.3
SD	0.400	0.032	12.5

Verification

The verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Imbrium Systems to support the performance claim included the performance monitoring report "General Use Level Designation Technical Evaluation Report" prepared by CONTECH Engineered Solutions, Portland, OR, USA, and dated December 28, 2020. This report is based on a field testing completed by CONTECH personnel at a site in Dundee, Oregon between March 2017 and April 2020 in accordance with the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) as written by the Washington State Department of Ecology (WADOE, 2011).

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

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

For more information on the Jellyfish® Filter please contact:

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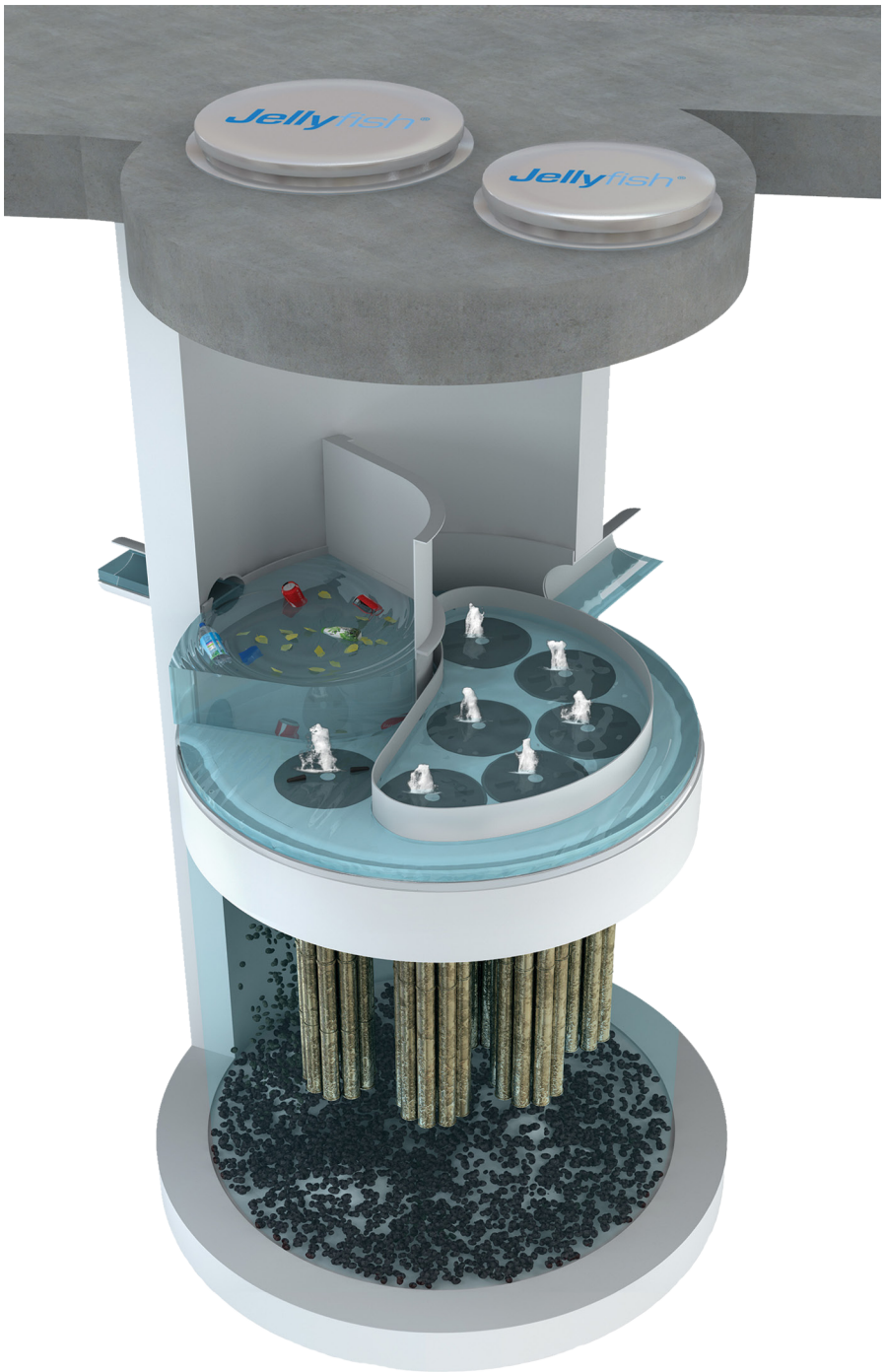
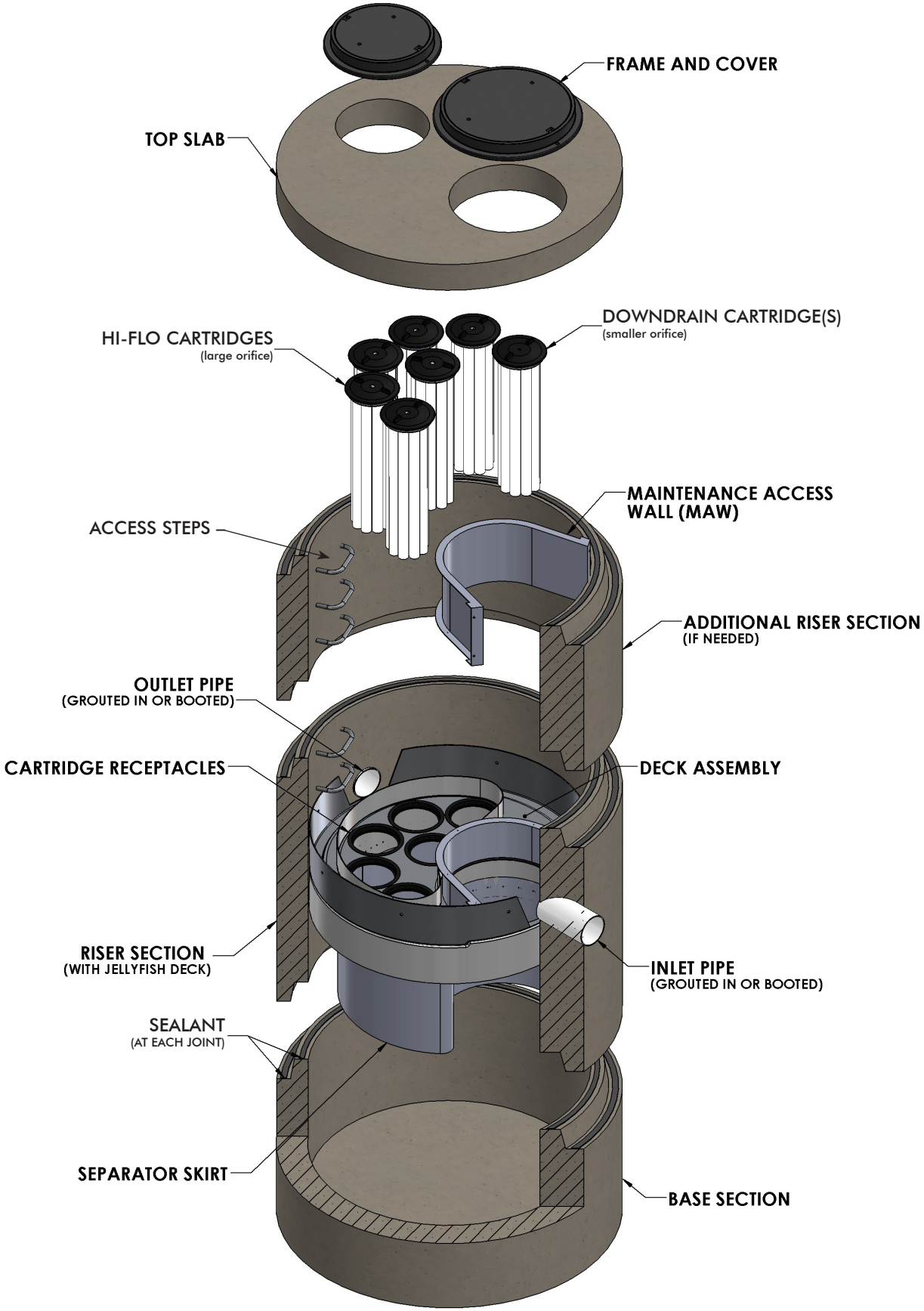
Jellyfish® Filter
Owner's Manual



imbrium®


FRAME AND COVER
TOP SLAB
DOWNDRAIN CARTRIDGE(S)
(smaller orifice)
HI-FLO CARTRIDGES
(large orifice)
MAINTENANCE ACCESS
WALL (MAW)
ACCESS STEPS
ADDITIONAL RISER SECTION
(IF NEEDED)
OUTLET PIPE
(GROUTED IN OR BOOTED)
CARTRIDGE RECEPTACLES
DECK ASSEMBLY
RISER SECTION
(WITH JELLYFISH DECK)
INLET PIPE
(GROUTED IN OR BOOTED)
SEALANT
(AT EACH JOINT)
SEPARATOR SKIRT
BASE SECTION

WARNINGS / CAUTION

1. FALL PROTECTION may be required.
2. WATCH YOUR STEP if standing on the Jellyfish Filter Deck at any time; Great care and safety must be taken while walking or maneuvering on the Jellyfish Filter Deck. Attentive care must be taken while standing on the Jellyfish Filter Deck at all times to prevent stepping onto a lid, into or through a cartridge hole or slipping on the deck.
3. The Jellyfish Filter Deck can be SLIPPERY WHEN WET.
4. If the Top Slab, Covers or Hatches have not yet been installed, or are removed for any reason, great care must be taken to NOT DROP ANYTHING ONTO THE JELLYFISH FILTER DECK. The Jellyfish Filter Deck and Cartridge Receptacle Rings can be damaged under high impact loads. *This type of activity voids all warranties. All damaged items to be replaced at owner's expense*.
5. Maximum deck load 2 persons, total weight 250 lbs. per person.

Safety Notice

Jobsite safety is a topic and practice addressed comprehensively by others. The inclusions here are intended to be reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). OSHA and Canadian OSH, and Federal, State/Provincial, and Local Jurisdiction Safety Standards apply on any given site or project. The knowledge and applicability of those responsibilities is the Contractor's responsibility and outside the scope of Imbrium® Systems.

Confined Space Entry

Secure all equipment and perform all training to meet applicable local and OSHA regulations regarding confined space entry. It is the Contractor's or entry personnel's responsibility to proceed safely at all times.

Personal Safety Equipment

Contractor is responsible to provide and wear appropriate personal protection equipment as needed including, but not limited to safety boots, hard hat, reflective vest, protective eyewear, gloves and fall protection equipment as necessary. Make sure all equipment is **staffed with trained and/or certified personnel**, and all equipment is checked for proper operation and safety features prior to use.

- Fall protection equipment
- Eye protection
- Safety boots
- Ear protection
- Gloves
- Ventilation and respiratory protection
- Hard hat
- Maintenance and protection of traffic plan

Thank You for purchasing the Jellyfish® Filter!

Imbrium® Systems would like to thank you for selecting the Jellyfish Filter to meet your project's stormwater treatment needs. With proper inspection and maintenance, the Jellyfish Filter is designed to deliver ongoing, high levels of stormwater pollutant removal.

If you have any questions, please feel free to call us or e-mail us at info@imbriumsystems.com.

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Jellyfish Filter Patents

The Jellyfish Filter is protected by one or more of the following patents:

U.S. Patent No. 8,123,935; U.S. Patent No. 8,287,726; U.S. Patent No. 8,221,618
Australia Patent No. 2008,286,748
Canadian Patent No. 2,696,482
Korean Patent No. 10-1287539
New Zealand Patent No. 583,461; New Zealand Patent No. 604,227
South African Patent No. 2010,01068
**other patents pending*

Table of Contents

Chapter 1

1.0 – Owner Specific Jellyfish Filter Product Information

Below you will find your specific Jellyfish Filter unit information to help you easily inspect, maintain and order parts for your system.

Owner Name:	
Phone Number:	
Site Address:	
Site GPS Coordinates/unit location:	
Unit Location Description:	
Jellyfish Filter Model No.:	
Cartridge Installation Date:	
No. of Hi-Flo Cartridges	
Length of Hi-Flo Cartridges:	
Lid Orifice Diameter on Hi-Flo Cartridge:	
No. of Draindown Cartridges:	
Length of Draindown Cartridges:	
Lid Orifice Diameter on Draindown Cartridge:	
No. of Blank Cartridge Lids:	
Online System (Yes/No):	
Offline System (Yes/No):	

Notes:

Chapter 2

2.0 – Jellyfish Filter System Operations and Functions

The Jellyfish Filter is an engineered stormwater quality treatment technology that removes a high level and wide variety of stormwater pollutants. Each Jellyfish Filter cartridge consists of multiple membrane - encased filter elements ("filtration tentacles") attached to a cartridge head plate. The filtration tentacles provide a large filtration surface area, resulting in high flow and high pollutant removal capacity.

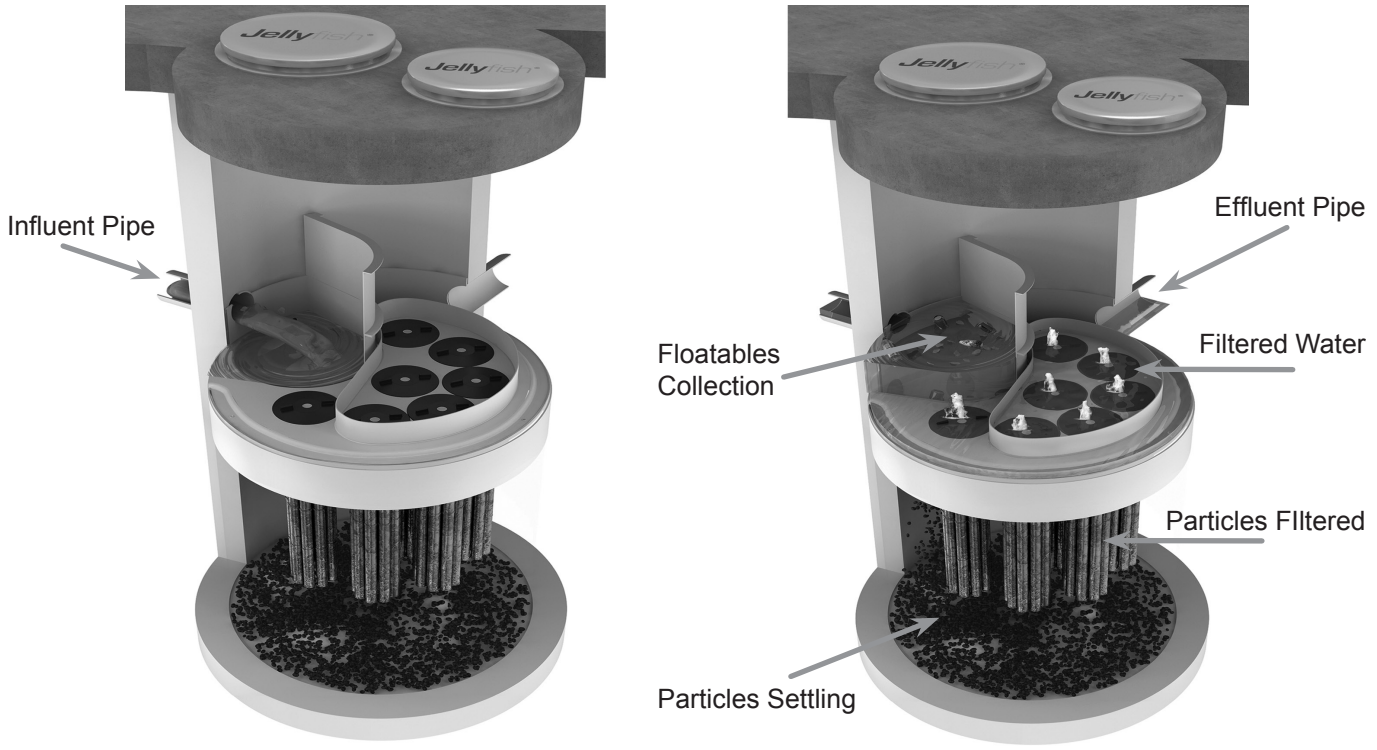
The Jellyfish Filter functions are depicted in **Figure 1** below.

FIGURE 1

Jellyfish Filter Treatment Functions

Membrane Filtration

Section View with Maintenance Access Wall (MAW) Cutaway



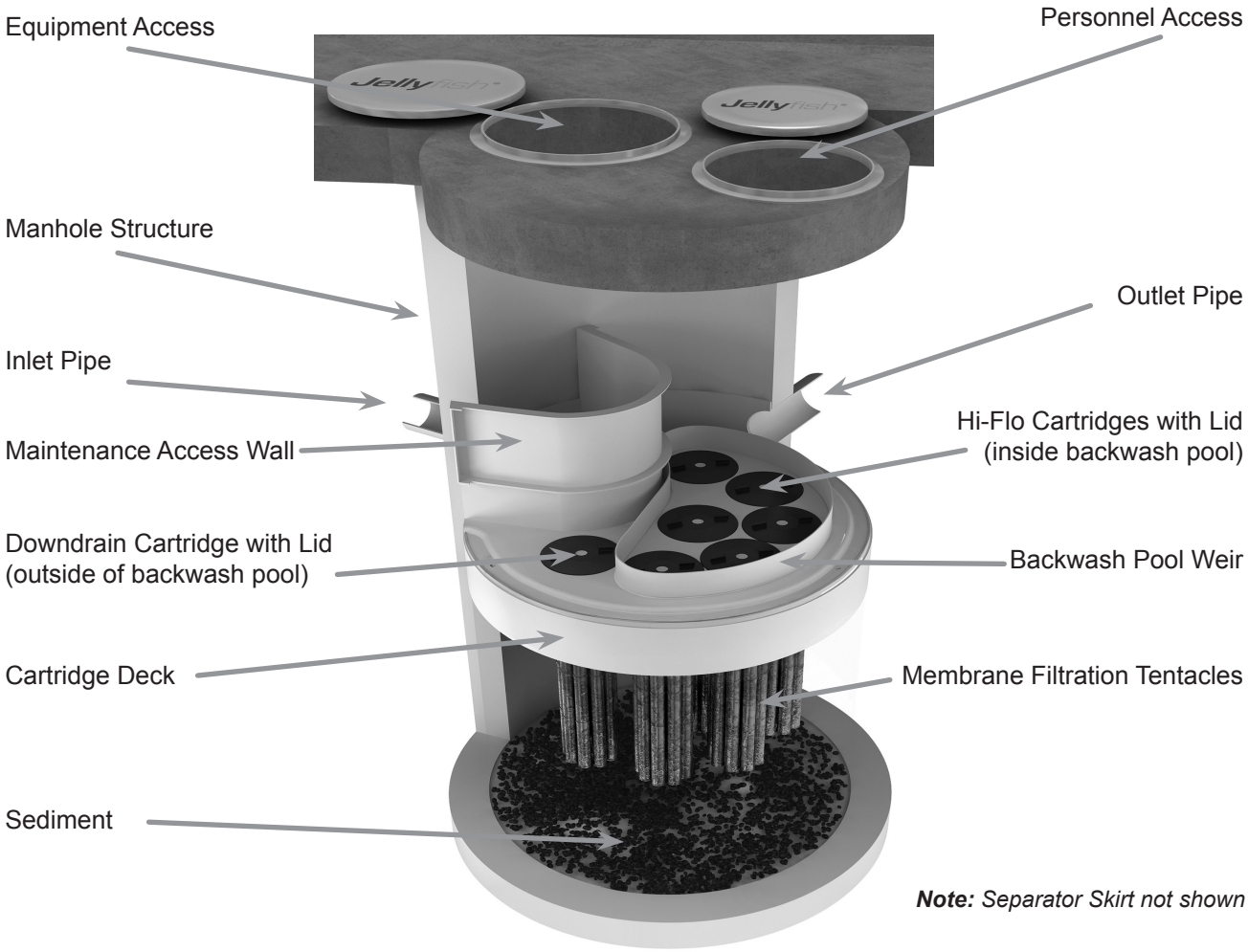
Jellyfish Filter cartridges are backwashed after each peak storm event, which removes accumulated sediment from the membranes. This backwash process extends the service life of the cartridges and increases the time between maintenance events.

For additional details on the operation and pollutant capabilities of the Jellyfish Filter please refer to additional details on our website at www.imbriumsystems.com.

2.1 – Components and Cartridges

The Jellyfish Filter and components are depicted in Figure 2 below.

FIGURE 2 **Jellyfish Filter Components**



Note: *Separator Skirt not shown*

Tentacles are available in various lengths as depicted in Table 1 below.

Table 1 – Cartridge Lengths / Weights and Cartridge Lid Orifice Diameters

Cartridge Lengths	Dry Weight	Hi-Flo Orifice Diameter	Draindown Orifice Diameter
15 inches (381 mm)	10 lbs (4.5 kg)	35 mm	20 mm
27 inches (686 mm)	14.5 lbs (6.6 kg)	45 mm	25 mm
40 inches (1,016 mm)	19.5 lbs (8.9 kg)	55 mm	30 mm
54 inches (1,372 mm)	25 lbs (11.4 kg)	70 mm	35 mm

A Jellyfish membrane filtration cartridge is depicted in Figure 3 below.

FIGURE 3

Jellyfish Membrane Filtration Cartridge

2.2 – Jellyfish Membrane Filtration Cartridge Assembly

The Jellyfish Filter utilizes multiple membrane filtration cartridges. Each cartridge consists of removable cylindrical filtration "tentacles" attached to a cartridge head plate. Each filtration tentacle has a threaded pipe nipple and o-ring. To attach, insert the top pipe nipples with the o-ring through the head plate holes and secure with locking nuts. Locking nuts to be hand tighten and checked with a wrench as shown below.

2.3 – Jellyfish Membrane Filtration Cartridge Installation

- After the upstream catchment and site have stabilized, remove any accumulated sediment and debris from the Jellyfish Filter structure and upstream diversion structure (if applicable). Failure to address this step completely will reduce the time between required maintenance.
- Descend to the cartridge deck (see Safety Notice and page 3).
- Lower the Jellyfish membrane filtration cartridges into the cartridge receptacles within the cartridge deck. A filter cartridge should be placed into each of the draindown cartridge receptacles outside the backwash pool weir. It is possible dependent on the Jellyfish Filter model purchased that not all cartridge receptacles will be filled with a filter cartridge. In that case, a blank headplate and blank cartridge lid (has no orfice) would be installed.

Cartridge Assembly

Avoid snagging the cartridge membranes on the recpticle lip when inserting the Jellyfish membrane filtration cartridges into the cartridge receptacles. Use a gentle twisting or sideways motion to clear any potential snag. Do not force the tentacles down into the cartridge receptacle, as this may damage the membranes. Apply downward pressure on the cartridge head plate to seat the rim gasket (thick circular gasket surrounding the circumference of the head plate) into the cartridge receptacle.

- Examine the cartridge lids to differentiate lids with a small orifice, a large orifice, and no orifice.
  - Lids with a small orifice are to be inserted into the draindown cartridge receptacles, outside of the backwash pool weir.
  - Lids with a large orifice are to be inserted into the hi-flo cartridge receptacles within the backwash pool weir.
  - Lids with no orifice (blank cartridge lids) and a blank headplate are to be inserted into unoccupied cartridge receptacles.
- **To install a cartridge lid, align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110º to seat the filter cartridge snugly in place, with a proper watertight seal.**

Chapter 3

3.0 – 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, captured 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. Maintenance activities may be required in the event of 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)

Maintenance activities typically include:

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

It is recommended that Jellyfish Filter inspection and maintenance be performed by professionally trained individuals, with experience in stormwater maintenance and disposal services. Maintenance procedures may require manned entry into the Jellyfish structure. Only professional maintenance service providers trained in confined space entry procedures should enter the vessel. Procedures, safety and damage prevention precautions, and other information, included in these guidelines, should be reviewed and observed prior to all inspection and maintenance activities.

3.1 – Inspection

3.1.1 – 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.*

- Post-construction inspection is required prior to putting the Jellyfish Filter into service. All construction debris or construction-related sediment within the device must be removed, and any damage to system components repaired.
- A minimum of two inspections during the first year of operation to assess the sediment and floatable pollutant accumulation, and to ensure proper functioning of the system.

- 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.
- Inspection is recommended after each major storm event.
- Immediately after an upstream oil, fuel or other chemical spill.

3.1.2 – Inspection Tools and Equipment

The following equipment and tools are typically required when performing a Jellyfish Filter inspection:

- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve)
- Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

3.1.3 – Inspection Procedure

The following procedure is recommended when performing inspections:

- Provide traffic control measures as necessary.
- Inspect the MAW for floatable pollutants such as trash, debris, and oil sheen.
- Measure oil and sediment depth by lowering a sediment probe through the MAW opening until contact is made with the floor of the structure. Retrieve the probe, record sediment depth, and presences of any oil layers and repeat in multiple locations within the MAW opening. **Sediment depth of 12 inches or greater indicates maintenance is required**.
- Inspect cartridge lids. Missing or damaged cartridge lids to be replaced.
- Inspect the MAW, cartridge deck, and backwash pool weir for cracks or broken components. If damaged, repair is required.
- **Dry weather inspections:** inspect the cartridge deck for standing water.
  - No standing water under normal operating condition.
  - Standing water **inside** the backwash pool, but not outside the backwash pool, this condition indicates that the filter cartridges need to be rinsed.
  - Standing water **outside** the backwash pool may indicate a backwater condition caused by high water elevation in the receiving water body, or possibly a blockage in downstream infrastructure.
- **Wet weather inspections:** observe the rate and movement of water in the unit. Note the depth of water above deck elevation within the MAW.
  - **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 are occluded with sediment and need to be rinsed.

The depth of sediment and oil can be measured from the surface by using a sediment probe or dipstick tube equipped with a ball check valve and inserted through the Jellyfish Filter's maintenance access wall opening. The large opening provides convenient access for inspection and vacuum removal of water and pollutants.

3.2 – Maintenance

3.2.1 – Maintenance Requirements

Required maintenance for Jellyfish Filter units 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:

- **Sediment removal for depths reaching 12 inches or greater, or within 3 years of the most recent sediment cleaning, whichever occurs sooner.**
- Floatable trash, debris, and oil must be removed.
- 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 first.
- Replace filter cartridge if rinsing does not remove accumulated sediment from the tentacles, or if tentacles are damaged or missing. It is recommended that tentacles should remain in service no longer than 5 years before replacement.
- Damaged or missing cartridge deck components must be repaired or replaced as indicated by results of the most recent inspection.
- 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 by the spill.

3.2.2 – Maintenance Tools and Equipment

The following equipment and tools are typically required when performing Jellyfish Filter maintenance:

- Vacuum truck
- Ladder
- Garden hose and low pressure sprayer
- Rope or cord to lift filter cartridges from the cartridge deck to the surface
- Adjustable pliers for removing filter cartridge tentacles from cartridge head plate
- Plastic tub or garbage can for collecting effluent from rinsed filter cartridge tentacles
- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve)
- Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Proper safety equipment for confined space entry
- Replacement filter cartridge tentacles if required

3.2.3 – Maintenance Procedure

The following procedures are recommended when maintaining the Jellyfish Filter:

- Provide traffic control measures as necessary.
- 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.
- Perform **Inspection Procedure** prior to maintenance activity.
- To access the cartridge deck for filter cartridge service, descend the ladder 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.

3.2.4 – Filter Cartridge Rinsing Procedure

- Remove a cartridge lid.
- Remove the cartridge from the receptacle using the lifting loops in the cartridge head plate. **Caution:** Should

a snag occur, do not force the cartridge upward as damage to the tentacles may result. Rotate the cartridge with a slight sideways motion to clear the snag and continue removing the cartridge.

- Thread a rope or cord through the lifting loops and lift the filter cartridge from the cartridge deck to the top surface outside the structure.
- **Caution:** Immediately replace and secure the lid on the exposed empty receptacle as a safety precaution. Never expose more than one empty cartridge receptacle.
- Repeat the filter cartridge removal procedure until all of the cartridges are located at the top surface outside the structure.
- Disassemble the tentacles from each filter cartridge by rotating counter-clockwise. Remove the tentacles from the cartridge head plate.
- Position a receptacle in a plastic tub or garbage can such that the rinse water is captured. Using a low-pressure garden hose sprayer, direct a wide-angle water spray at a downward 45° angle 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. Turn membran upside down and pour out any residual rinsewater to ensure center of tentacle is clear of any sediment.

Rinsing of dirty filter cartridge tentacles with a low-pressure garden hose sprayer, and using a plastic garbage container to capture rinse water.

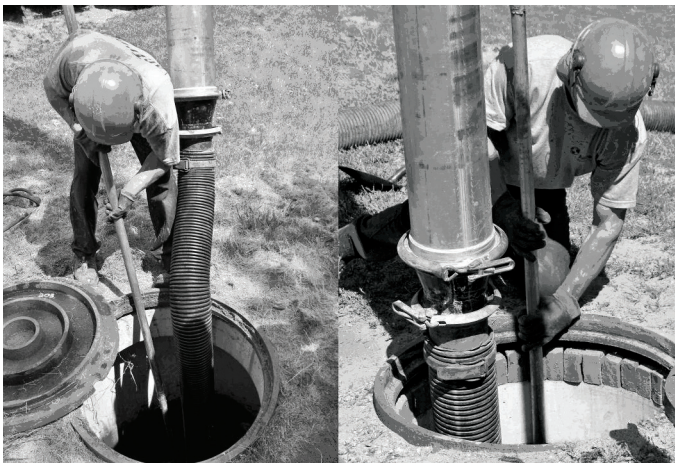
- Remove rinse water from rinse tub or garbage can using a vacuum hose as needed.
- Slip the o-ring over the tentacle nipple and reassemble onto the cartridge head plate; hand-tighten.
- If rinsing is ineffective in removing sediment from the tentacles, or if tentacles are damaged, provisions must be made to replace the spent or damaged tentacles with new tentacles. Contact Imbrium Systems to order replacement tentacles.
- Lower a rinsed filter cartridge to the cartridge deck. Remove the cartridge lid on a receptacle and carefully lower the filter cartridge into the receptacle until the head plate gasket is seated squarely on the lip of the receptacle. **Caution:** Should a snag occur when lowering the cartridge into the receptacle, do not force the cartridge downward; damage may occur. Rotate the cartridge with a slight sideways motion to clear the snag and complete the installation.
- Replace the cartridge lid on the exposed receptacle. Rinse away any accumulated grit from the receptacle threads if needed to get a proper fit. **Align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110º to seat the filter cartridge snugly in place, with a proper watertight seal**.
- Repeat cartridge installation until all cartridges are installed.

3.2.5 – Vacuum Cleaning Procedure

- **Caution:** 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**, being careful not to damage the flexible plastic separator skirt that is attached to the underside of the deck. The separator skirt surrounds the filter cartridge zone, and could be torn if contacted by the wand. **Do not lower the vacuum wand through a cartridge receptacle**, as damage to the receptacle will result.
  - To remove floatable trash, debris, and oil, lower the vacuum hose into the MAW opening and vacuum floatable pollutants off the surface of the water. Alternatively, floatable solids may be removed by a net or skimmer.
  - Using a vacuum hose, remove the water from the lower chamber to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank.
  - Remove the sediment from the bottom of the unit through the MAW opening.
  - For larger diameter Jellyfish Filter manholes (8-ft, 10-ft, 12-ft diameter), 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..
  - After the unit is clean, re-fill the lower chamber with water if required by the local jurisdiction, and re-install filter cartridges.
  - Dispose of sediment, floatable trash and debris, oil, spent tentacles, and water according to local regulatory requirements.

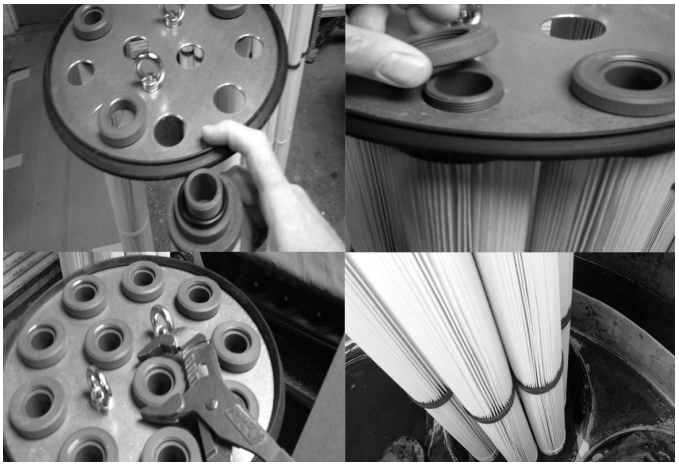
3.2.6 – Chemical Spills

- **Caution**: If a chemical spill has been captured by the Jellyfish Filter, do not attempt maintenance. Immediately contact the local hazard response agency.



A maintenance worker stationed on the surface uses a vacuum hose to evacuate water, sediment, and floatables from the Jellyfish Filter by inserting the vacuum wand through the maintenance access wall opening.

A view of a Jellyfish Filter cartridge deck from the surface showing all the cartridge lids intact and no standing water on the deck (left image), and inspection of the flexible separator skirt from inside the maintenance access wall opening (right image).



Assembly of a Jellyfish Filter cartridge (left) and installation of a filter cartridge into a cartridge receptacle in the deck (right).

3.3 – Disposal Procedures

Disposal requirements for recovered pollutants and spent filtration tentacles may vary depending on local guidelines. In most areas the sediment and spent filtration tentacles, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.

Petroleum-based pollutants captured by the Jellyfish Filter, such as oil and fuels, should be removed and disposed of by a licensed waste management company.

Although the Jellyfish Filter captures virtually all free oil, a sheen may still be present at the MAW. A rainbow or sheen can be visible at oil concentrations of less than 10 mg/L (ppm).

Chapter 4

4.0 – Recommended Safety Procedures

Jobsite safety is a topic and a practice addressed comprehensively by others. The inclusions here are merely reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). OSHA and Canadian OSH, and Federal, State/Provincial, and Local Jurisdiction Safety Standards apply.

4.1 – Confined Space/Personal Safety Equipment/Warning and Cautions

Please see reference on Page 3.

Chapter 5

5.0 – Jellyfish Filter Replacement Parts

Jellyfish membrane filtration cartridges, cartridge components, cartridge lids, other replacement parts can be ordered by contacting Imbrium Systems at:

United States: 888-279-8826 or 301-279-8827

Canada/International: 800-565-4801 or +1-416-960-9900

info@imbriumsystems.com

5.1 – Jellyfish Filter Replacement Parts List

Note: Jellyfish Cartridges and/or Filtration tentacles are available in the following lengths:

• 15 Inch (381 mm) • 27 Inch (686 mm) • 40 Inch (1,016 mm) • 54 Inch (1,372 mm)

- Jellyfish Cartridge (specify length). Includes head plate with lifting loops, rim gasket, eleven (11) filtration tentacles, eleven (11) o-rings, and eleven (11) locking nuts
- Standard Head plate
- Blank head plate
- Rim gasket (for head plate)
- Locking nuts (for tentacles)
- O-rings (for tentacles)
- Cartridge lids are available with the following orifice sizes: 70mm, 55mm, 45mm, 35mm, 30mm, 25mm, 30mm, blank lid (no orifice)
- Maintenance Access Wall (MAW) extension (18-inch segment)

** Nothing in this catalog should be construed as an expressed warranty or implied warranties, including the warranties of merchantability and of fitness for any particular purpose.*

Jellyfish Filter Inspection and Maintenance Log

Owner: _____ Jellyfish Model No.:_____

Location: _____ GPS Coordinates: _____

Land Use: Commercial:_____ Industrial: _____ Service Station:_____

Road/Highway:____ Airport: _____ Residential: _____ Parking Lot:_____

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 re-commissioned: (Y/N)						
New tentacles put on 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:						

Site Characteristics

Site: Agnes Street Urbanization, Alton, Ontario
February 3, 2026

Pre-Development

Land-Use	Impervious Ratio	Area 101 (m^2)	Area 102 (m^2)	Area 103 (m^2)	Area 104a (m^2)	Area 104b (m^2)	Area 105 (m^2)	Total (m^2)	Coverage
Asphalt and Hardscape	1.00	1,574.9	0.0	732.4	947.9	1,186.9	467.0	4,909.1	8%
Permeable Pavers	0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0%
Roof	1.00	516.4	0.0	1,003.1	0.0	0.0	0.0	1,519.5	3%
Grassed	0.00	33,191.0	5,142.4	10,590.1	678.8	633.7	1,133.9	51,369.9	89%
Total		35,282.3	5,142.4	12,325.6	1,626.7	1,820.6	1,600.9	57,798.6	100%
	Area (ha) =	3.528	0.514	1.233	0.163	0.182	0.160	5.780	
	% Impervious =	5.9%	0.0%	14.1%	58.3%	65.2%	29.2%	11.1%	
	Runoff Coefficient* =	0.29	0.25	0.34	0.63	0.67	0.44	0.32	

*Pervious areas were assigned a runoff coefficient of 0.25 and impervious areas were assigned a runoff coefficient of 0.90

Post-Development

Land-Use	Impervious Ratio	Area 201 (m^2)	Area 202 (m^2)	Area 203 (m^2)	Area 204a (m^2)	Area 204b (m^2)	Area 205 (m^2)	Total (m^2)	Coverage
Asphalt and Hardscape	1.00	4,196.1	1,977.9	732.4	1,184.2	1,186.9	467.0	9,744.5	17%
Permeable Pavers	0.50	1,618.3	898.5	0.0	0.0	0.0	0.0	2,516.8	4%
Roof	1.00	5,960.0	4,994.1	1,003.1	0.0	0.0	0.0	11,957.1	21%
Grassed	0.00	10,427.5	10,352.5	10,590.1	442.5	633.7	1,133.9	33,580.2	58%
Total		22,201.8	18,222.9	12,325.6	1,626.7	1,820.6	1,600.9	57,798.6	100%
	Area (ha) =	2.220	1.822	1.233	0.163	0.182	0.160	5.780	
	% Impervious =	49.4%	40.7%	14.1%	72.8%	65.2%	29.2%	39.7%	
	Runoff Coefficient* =	0.57	0.51	0.34	0.72	0.67	0.44	0.51	

*Pervious areas were assigned a runoff coefficient of 0.25 and impervious areas were assigned a runoff coefficient of 0.90

Peak Runoff Assessment

Site: Agnes Street Urbanization, Alton, Ontario
February 3, 2026

Greck

Peak Runoff Assessment

Town of Caledon Intensity-Duration Frequency Curves (from Development Standards Manual 2019)

Return Period	A	B	C
2	1,070	0.8759	7.85
5	1,593	0.8789	11
10	2,221	0.908	12
25	3,158	0.9335	15
50	3,886	0.9495	16
100	4,688	0.9624	17

$$I = \frac{A}{(t + C)^B}$$

a, b, c = IDF Parameters
I = Intensity (mm/h)
t = Storm Duration, 10 minutes minimum (min)

Time of Concentration
Airport
If Runoff Coefficient < 0.4

$$T_c = \frac{3.26\,(1.1 - C)\,L^{0.5}}{S_w^{0.33}}$$

where, L = Flow length (m)
Sw = slope (%)
C = Runoff Coefficient

Bransby
If Runoff Coefficient > 0.4

$$T_c = \frac{0.057\,L}{S_w^{0.2}\,A^{0.1}}$$

where, L = Flow length (m)
Sw = slope (%)

Parameter	Existing 101	Existing 102	Existing 103	Existing 104a	Existing 104b	Existing 105*
C	0.29	0.25	0.34	0.63	0.67	0.44
L	335.2	188.9	206.5	259.0	261.4	157.90
A	3.528	0.514	1.233	0.2	0.182	0.160
S_w	2.61	2.26	2.04	3.9	3.77	4.08
Method	Airport	Airport	Airport	Bransby	Bransby	Bransby
T	35	29	28	14	14	10

**10 minute mininum time of concentration as per Town of Caledon Development Standards* *1921.8%*

Parameter	Proposed 201*	Proposed 202*	Proposed 203	Proposed 204a	Proposed 204b	Proposed 205*
C	0.57	0.51	0.34	0.72	0.67	0.44
L	233.5	194.0	206.5	259.0	260.6	157.9
A	2.220	1.822	1.233	0.163	0.182	0.160
S_w	0.81	2.74	2.04	3.85	3.76	4.08
Method	Bransby	Bransby	Airport	Bransby	Bransby	Bransby
T	10	10	28	14	14	10

**10 minute mininum time of concentration as per Town of Caledon Development Standards Manual 2019,*

Rational Method

$$Q = 2.778CIA$$

C = Runoff Coefficient
I = Intensity (mm/h)
A = Area (ha)

Existing Condition

Return Period	Existing 101		Existing 102		Existing 103		Existing 104			Existing 105		Total Runoff (L/s)
							104a	104b				
	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	
2	39.6	111.9	45.3	16.2	46.4	54.3	73.2	20.8	25.0	85.7	14.3	242.5
5	54.8	154.8	62.1	22.2	63.5	74.3	95.7	27.2	32.6	109.7	18.7	329.9
10	67.0	189.4	76.1	27.2	77.8	91.0	117.3	33.3	40.0	134.2	22.9	403.7
25*	81.5	253.5	92.1	36.2	94.1	121.1	138.4	43.2	47.2	156.5	29.8	530.9
50*	92.4	313.7	104.4	44.8	106.7	149.8	156.2	53.3	53.2	176.2	36.6	651.3
100*	104.0	367.8	117.4	52.4	120.0	175.4	174.7	62.0	59.5	196.5	42.7	759.8

Proposed Condition

Return Period	Proposed 201		Proposed 202		Proposed 203		Proposed 204			Proposed 205		Total Runoff (L/s)
							204a	204b				
	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	Runoff (L/s)	Intensity (mm/hr)	Runoff (L/s)	
2	85.7	301.9	85.7	223.4	46.4	54.3	73.2	23.9	25.0	85.7	14.3	642.7
5	109.7	386.3	109.7	285.8	63.5	74.3	95.7	31.3	32.6	109.7	18.7	829.0
10	134.2	472.5	134.2	349.6	77.8	91.0	117.3	38.3	40.0	134.2	22.9	1014.3
25*	156.5	606.2	156.5	448.5	94.1	121.1	138.4	49.7	47.2	156.5	29.8	1302.4
50*	176.2	744.6	176.2	550.9	106.7	149.8	156.2	61.3	53.2	176.2	36.6	1596.4
100*	196.5	865.2	196.5	640.1	120.0	175.4	174.7	71.4	59.5	196.5	42.7	1854.3

*Incorporates Runoff coefficient adjustment factor of: 25 year = 1.1, 50 year = 1.2, 100 year = 1.25

Pre- and Post-Development Peak Flow Comparison

Return Period	Area 104a Existing Runoff (L/s)	Area 204a Proposed Runoff (L/s)	Difference (L/s)
2	20.8	23.9	3.1
5	27.2	31.3	4.1
10	33.3	38.3	5.0
25*	43.2	49.7	6.5
50*	53.3	61.3	8.0
100*	62.0	71.4	9.3

	Existing	Proposed					
Storm Event	Area 101, 103 and 104a Peak Runoff (L/s)	Area 201 (L/s)*	Area 202 (L/s)*	Area 203 (L/s)	Area 204a (L/s)	Total (L/s)	Difference (Proposed - Existing) (L/s)
2	187.0	57.2	45.3	54.3	23.9	180.7	-6.3
5	256.3	57.2	45.3	74.3	31.3	208.1	-48.3
10	313.7	57.2	45.3	91.0	38.3	231.8	-81.9
25	417.8	57.2	45.3	121.1	49.7	273.3	-144.5
50	516.7	57.2	45.3	149.8	61.3	313.5	-203.2
100	605.2	57.2	45.3	175.4	71.4	349.3	-255.9

*Controlled release rates with stormwater management from 0 Agnes Street development see FSR submitted under separate cover

Water Balance/Infiltration Targets

Site: Agnes Street Urbanization, Alton, Ontario
February 3, 2026

Infiltration Target Volume

As per the Town of Caledon Design Standards Manual 2019, infiltrate the 5 mm event for water balance over impervious surfaces as pervious surfaces have an initial abstraction of 5mm.

Rainfall Depth =	5	mm
Area 204a Impervious Area =	1184.2	m^2
Required Infiltration Volume =	5.9	m^3

Climate Data								Pervious Area			Impervious Area		
Month	**Days in the month**	**Hours of Sunlight* ****	**Mean Temperature ****	**Heat Index**	**Potential Evapo-transpiration***	**Daylight Correction Value**	**Total Precipitation* ***	**Adjusted Potential Evapo-transpiration**	**Surplus**	**Deficit**	**Evaporation**	**Surplus**	**Deficit**
			(T) #	**I**	**mm/month**		**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**
January	31	9.3	-7.5	0.00	0.0	0.80	64.3	0.00	64.3	0.0	6.4	57.9	0.0
February	28	10.5	-6.5	0.00	0.0	0.82	54.5	0.00	54.5	0.0	5.5	49.1	0.0
March	31	12.1	-2.1	0.00	0.0	1.04	60.9	0.00	60.9	0.0	6.1	54.8	0.0
April	30	13.6	5.3	1.09	25.9	1.13	70.1	29.36	40.7	0.0	7.0	63.1	0.0
May	31	14.7	11.7	3.62	58.4	1.27	86.6	73.91	12.7	0.0	8.7	77.9	0.0
June	30	15.0	16.9	6.32	85.1	1.25	81.3	106.44	0.0	25.1	8.1	73.2	0.0
July	31	14.8	19.4	7.79	98.1	1.27	80.8	125.02	0.0	44.2	8.1	72.7	0.0
August	31	14.2	18.4	7.19	92.9	1.22	88.2	113.61	0.0	25.4	8.8	79.4	0.0
September	30	13.1	14.3	4.91	71.7	1.09	87.0	78.31	8.7	0.0	8.7	78.3	0.0
October	31	10.7	7.8	1.96	38.5	0.92	76.6	35.49	41.1	0.0	7.7	68.9	0.0
November	30	9.7	2.0	0.25	9.5	0.81	87.1	7.70	79.4	0.0	8.7	78.4	0.0
December	31	8.8	-4.1	0.00	0.0	0.76	64.2	0.00	64.2	0.0	6.42	57.8	0.0
TOTAL	365			33.1	480.2		**901.6**	**570**	**426.5**	**95**	**90.2**	**811.4**	**0**

Notes

* PET = 16 [10 T / I]$^{\alpha}$

where, $\alpha = (675 * 10^{-9} * I^3) - (771 * 10^{-7} * I^2) + (1792 * 10^{-5} * I) + 0.49239 = 1.112$

**Canadian Climate Normals 1981-2010 Station Data - Orangeville MOE - located 9 km nor th of the site
https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=orangeville&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=4991&dispBack=1

***Canadian Climate Normals 1981-2010 Station Data - Toronto Lester B Pearson Int'l A -located 59 km southwest of the site
https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=pearson&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=5097&dispBack=1

Pervious Surplus: **331.8** **mm**

Impervious Surplus: **811.4** **mm**

Assumes 10% of rainfall is evaporated (no evapotranspiration occurs)

Impervious Factor = 0.10

Water Balance Design Sheet **Pre-Development**

Site: Agnes Street Urbanization, Alton, ON

February 3, 2026

Existing Drainage Area 104a

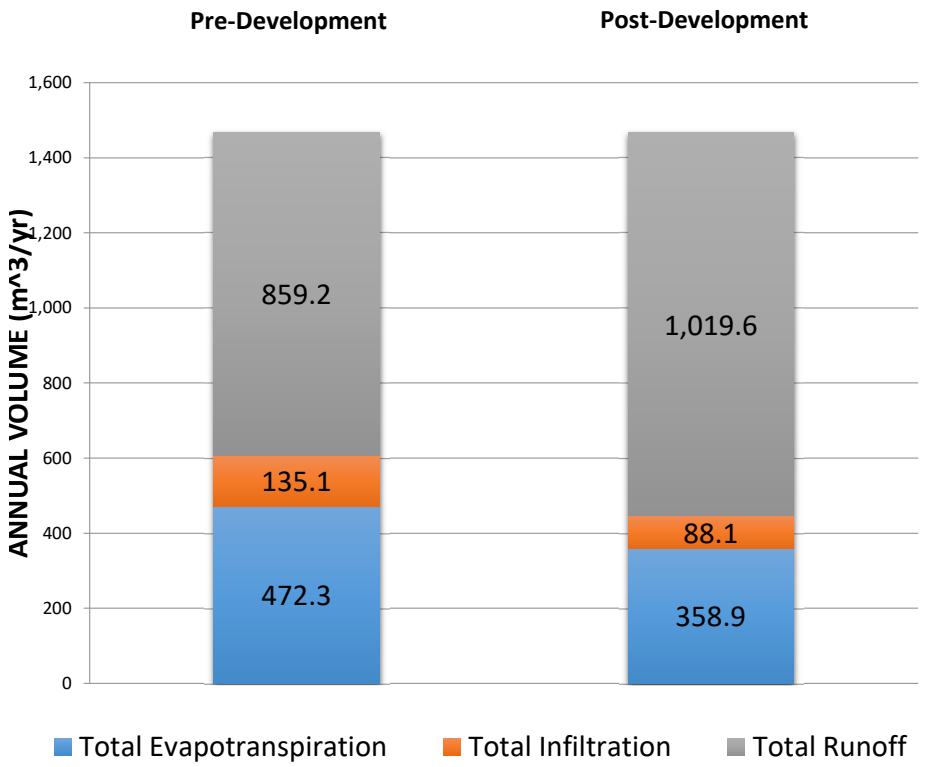
Catchment Parameter	Units	Perv	Imperv	Total
Area	m^2	678.8	947.9	1,626.7
Pervious Area	m^2	678.8	0.0	678.8
Impervious Area	m^2	0.0	947.9	947.9
Infiltration Factors				
Topography		0.1	0.1	0.10
Soil		0.4	0.4	0.40
Land Cover		0.1	0.1	0.10
MECP Infiltration Factor		0.60	0.60	0.60
Actual Infiltration Factor		0.60	0.00	0.25
Runoff Coefficient		0.25	0.95	0.66
Runoff from Impervious Surfaces*		0%	0%	0%
Inputs (per Unit Area)				
Precipitation	mm/yr	902	902	902
Run- on	mm/yr	0	0	0
Other	mm/yr	0	0	0
Total Inputs	mm/yr	902	902	902
Outputs (per Unit Area)				
Precipitation Surplus	mm/yr	332	811	
Net Surplus	mm/yr	0	0	
Total Evapotranspiration	**mm/yr**	**570**	**90**	
Infiltration	mm/yr	199	0	
Rooftop Infiltration	mm/yr	0	0	
Total Infiltration	**mm/yr**	**199**	**0**	
Runoff Pervious Areas	mm/yr	133	811	
Runoff Impervious Areas	mm/yr	0	0	
Total Runoff	**mm/yr**	**133**	**811**	
Total Outputs	**mm/yr**	**902**	**902**	
Difference (input - output)	mm/yr	0	0	
Inputs (Volumes)				
Precipitation	m^3/yr	612	855	1,467
Run-on	m^3/yr	0	0	0
Other Inputs	m^3/yr	0	0	0
Total Inputs	m^3/yr	612	855	1,467
Outputs (Volumes)				
Precipitation Surplus	m^3/yr	225	769	994
Net Surplus	m^3/yr	0	0	0
Total Evapotranspiration	**m^3/yr**	**387**	**85**	**472**
Infiltration	m^3/yr	135	0	135
Rooftop Infiltration	m^3/yr	0	0	0
Total Infiltration	**m^3/yr**	**135**	**0**	**135**
Runoff Pervious Areas	m^3/yr	90	769	859
Runoff Impervious Areas	m^3/yr	0	0	0
Total Runoff	**m^3/yr**	**90**	**769**	**859**
Total Outputs	**m^3/yr**	**612**	**855**	**1,467**
Difference (input - output)	m^3/yr	0	0	0

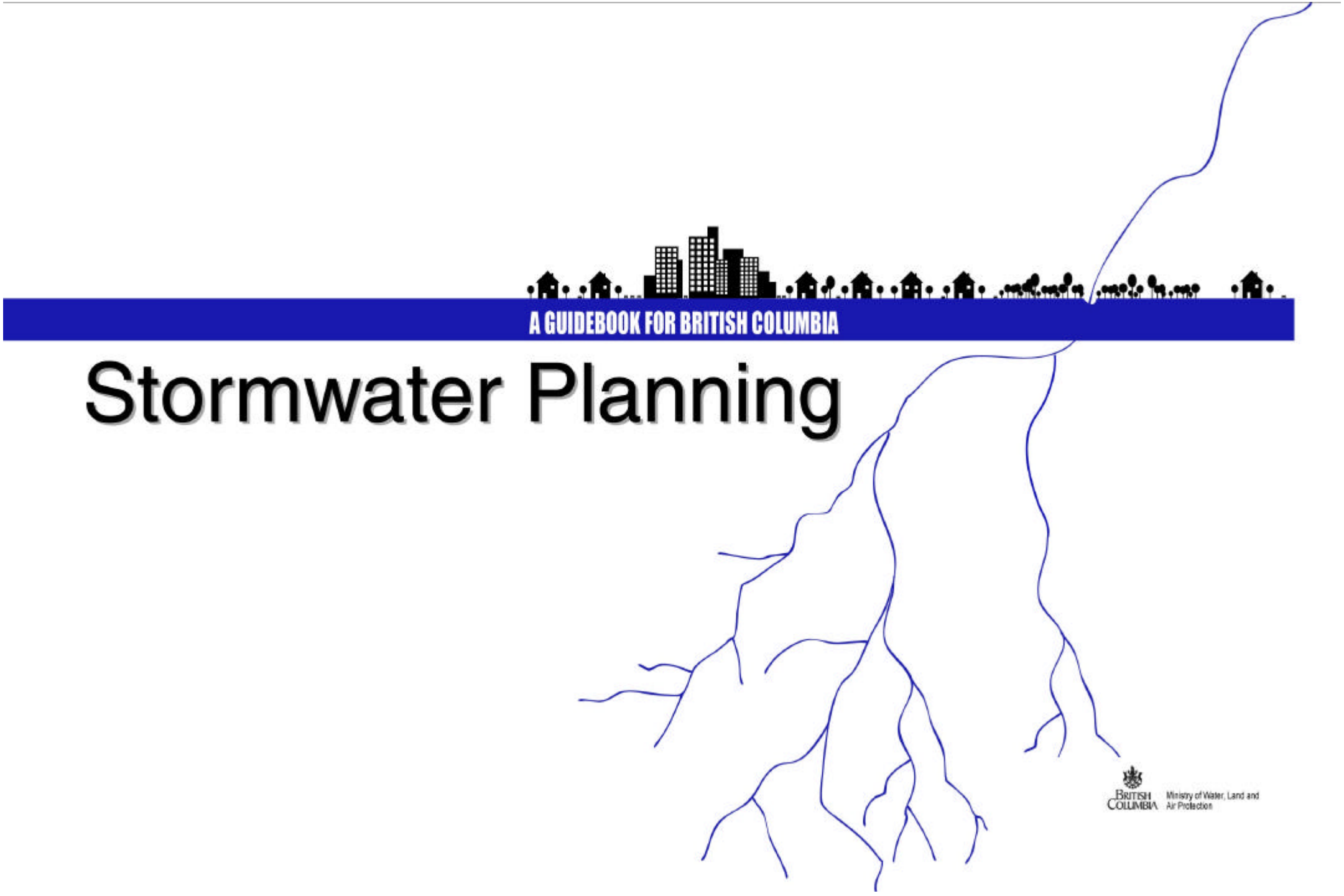
Water Balance Design Sheet		**Post Development**		
Site: Agnes Street Urbanization, Alton, ON				
February 3, 2026				
		Proposed Drainage Area 204a		
Catchment Parameter	**Units**	**Perv**	**Imperv**	**Total**
Area	m^2	442.5	1,184.2	1,626.7
Pervious Area	m^2	442.5	0.0	442.5
Impervious Area	m^2	0.0	1,184.2	1,184.2
Infiltration Factors				
Topography		0.1	0.1	0.10
Soil		0.4	0.4	0.40
Land Cover		0.1	0.1	0.10
MECP Infiltration Factor		0.60	0.60	0.60
% Impervious		0%	100%	73%
Actual Imperv Factor		0.60	0.00	0.16
Inputs (per Unit Area)				
Precipitation	mm/yr	902	902	
Run- on	mm/yr	0	0	
Other	mm/yr	0	0	
Total Inputs	mm/yr	902	902	
Outputs (per Unit Area)				
Precipitation Surplus	mm/yr	332	811	
Net Surplus	mm/yr	332	811	
Total Evapotranspiration	**mm/yr**	**570**	**90**	
Infiltration	mm/yr	199	0	
LID Infiltration	mm/yr	0	0	
Total Infiltration	**mm/yr**	**199**	**0**	
Runoff Pervious Areas	mm/yr	133	0	
Runoff Impervious Areas	mm/yr	0	811	
Total Runoff	**mm/yr**	**133**	**811**	
Total Outputs	**mm/yr**	**902**	**902**	
Difference (input - output)	mm/yr	0	0	
Inputs (Volumes)				
Precipitation	m^3/yr	399	1068	1467
Run-on	m^3/yr	0	0	0
Other Inputs	m^3/yr	0	0	0
Total Inputs	m^3/yr	399	1,068	1,467
Outputs (Volumes)				
Precipitation Surplus	m^3/yr	147	961	1,108
Net Surplus	m^3/yr	147	961	1,108
Total Evapotranspiration	**m^3/yr**	**252**	**107**	**359**
Infiltration	m^3/yr	88	0	88
Rooftop Infiltration	m^3/yr	0	0	0
Total Infiltration	**m^3/yr**	**88**	**0**	**88**
Runoff Pervious Areas	m^3/yr	59	0	59
Runoff Impervious Areas	m^3/yr	0	961	961
Total Runoff	**m^3/yr**	**59**	**961**	**1,020**
Total Outputs	**m^3/yr**	**399**	**1,068**	**1,467**
Difference (input - output)	m^3/yr	0	0	0

Water Balance Summary Sheet

Site: Agnes Street Urbanization, Alton, ON
February 3, 2026

	Units	Pre-Development	Post-Development	Change (Pre- to Post-)
Inputs (Volumes)				
Precipitation	m^3/yr	1,466.6	1,466.6	0%
Run-on	m^3/yr	0.0	0.0	0%
Other Inputs	m^3/yr	0.0	0.0	0%
Total Inputs		**1,466.63**	**1,466.63**	0%
Outputs (Volumes)				
Precipitation Surplus	m^3/yr	994.4	1,107.7	11%
Net Surplus	m^3/yr	0.0	1,107.7	0%
Total Evapotranspiration	**m^3/yr**	472.3	358.9	-24%
Infiltration	m^3/yr	135.1	88.1	-35%
LID Infiltration	m^3/yr	0.0	0.0	0%
Total Infiltration	**m^3/yr**	**135.1**	**88.1**	-35%
Runoff Pervious Areas	m^3/yr	859.2	58.7	-93%
Runoff Impervious Areas	m^3/yr	0.0	960.9	0%
Total Runoff	**m^3/yr**	**859.2**	**1,019.6**	19%
Total Outputs	**m^3/yr**	1,466.6	1,466.6	0%





A GUIDEBOOK FOR BRITISH COLUMBIA

Stormwater Planning

BRITISH COLUMBIA Ministry of Water, Land and Air Protection

7.4 Type 1 Source Control - Absorbent Landscaping

The Importance of Surface Soil and Vegetation

Surface soil structure plays a fundamental role in stormwater management. Minimizing surface soil disturbance and using absorbent landscaping can significantly reduce the volume and rate of runoff from developed areas.

In a natural condition, surface soil layers are highly permeable. Surface plants provide a layer of organic matter which populations of earthworms and microbes stir and mix into the soil. This soil ecosystem provides high infiltration rates and a basis for interflow that supports the baseflow needs of aquatic ecosystems.

In an urbanized condition, it is common practice to remove the surface soil layers, to regrade and heavily compact the site, and then to replace only a thin layer (often 50mm or less) of imported topsoil. This practice creates a surface condition that results in significant amount of runoff from lawn and landscape areas.

Absorbent Soil and Vegetation Characteristics

Vegetation and organic matter improve soil structure and contribute to macropore development. This is essential for promoting and maintaining infiltration and evapo-transpiration capacity. To optimize infiltration, the surface absorbent soil layer should have high organic content (about 10 to 25%). Surface vegetation should be either herbaceous with a thickly matted rooting zone (shrubs or grass), deciduous trees (high leaf density is best), or evergreens.

A range of soil and vegetation characteristics is acceptable depending on whether the area is to be covered by lawn, shrubs or trees. The soils required by the BC Landscape Standard for medium or better landscape will provide the required hydrologic characteristics. Often this standard can be achieved by adding organic matter to existing top soils on a residential site.

Figure 7-1 shows the mixing of soil and organic matter to create a good landscape soil.

A range of acceptable absorbent soil compositions are shown in Section 7.9.

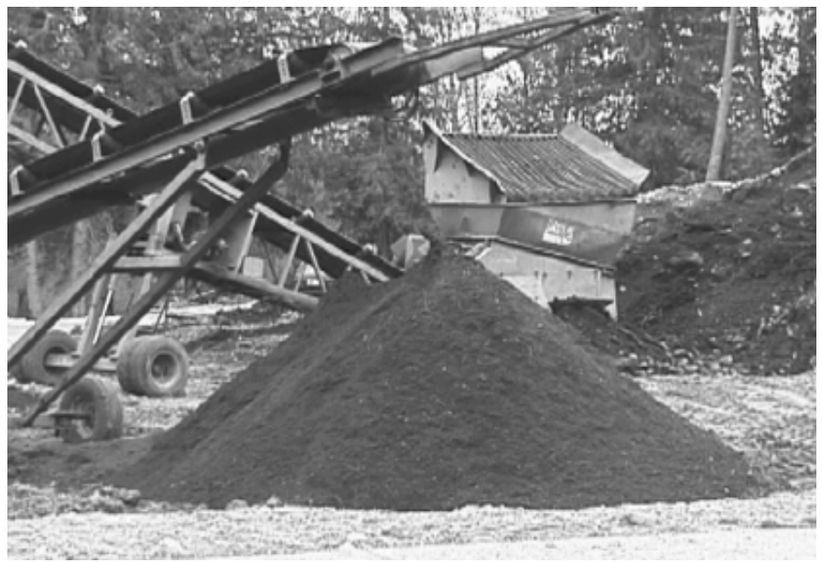


Figure 7-1 Creation of Landscape Soil

Absorbent Soil Depth

Figure 7-2 shows that runoff from landscaped areas can be virtually eliminated by providing a 300 mm layer of landscaped absorbent soil, even under very wet conditions where the hydraulic conductivity of the underlying soil is low.

The Figure assumes that the rooting zone of the surface vegetation extends to the depth of the absorbent soil layer, and that absorbent landscaping covers all undeveloped areas.

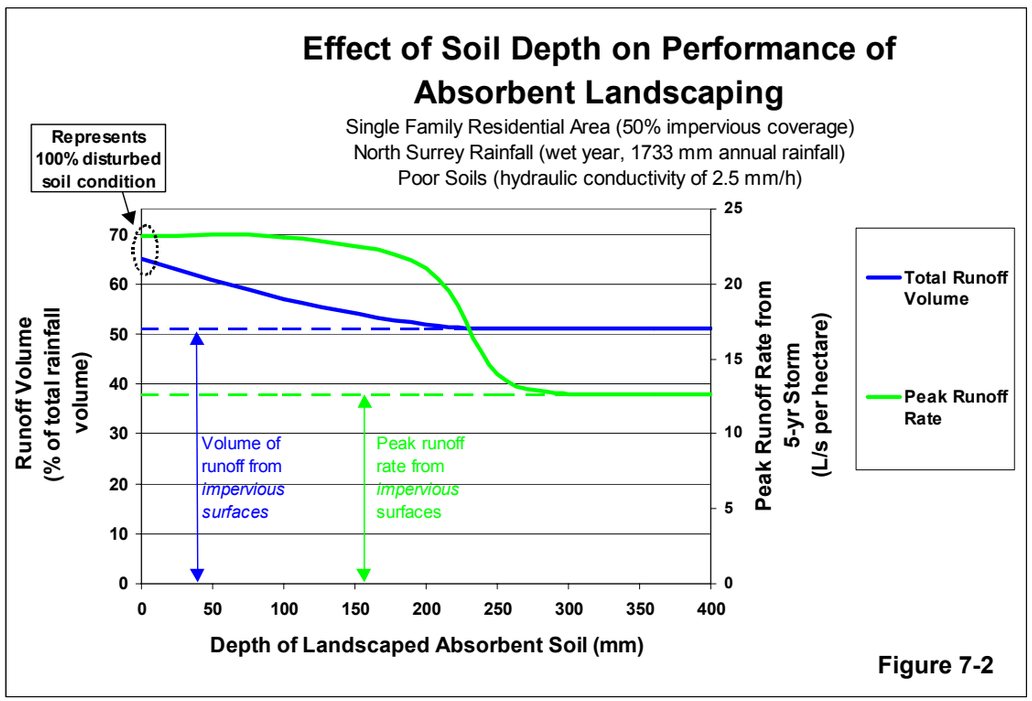


Figure 7-2

The Importance of Forests

Forests are the most effective form of absorbent landscaping. Since trees typically have very deep rooting zones (often in the range of 2 metres), there is virtually no surface runoff from forested areas. Tree canopies that shade impervious surfaces (e.g. roadways) can reduce the runoff from these surfaces by intercepting rainfall.

Preserving and/or restoring as much forested area as possible through implementation of an urban forestry strategy is an effective way to reduce runoff volumes and rates.

The thick layers of absorbent soil in forested areas typically have the capacity to retain and infiltrate large volumes of runoff (in addition to direct rainfall). Dispersing runoff from rooftops or paved surfaces over forested areas can be an effective infiltration strategy, as discussed in Section 7.5.

The Benefits of Absorbent Landscaping for Different Rainfall Conditions

Figure 7-3 shows that absorbent landscaping is most beneficial for high rainfall locations. This is because increased rainfall typically leads to greater volumes of runoff from disturbed soil, but not from absorbent landscaping.

Absorbent landscaping (300 mm soil depth or more) can virtually eliminate surface runoff from undeveloped areas, even in the wettest conditions. This has significant benefits in terms of reducing peak runoff rates from extreme rainfall events, as shown on the following page.

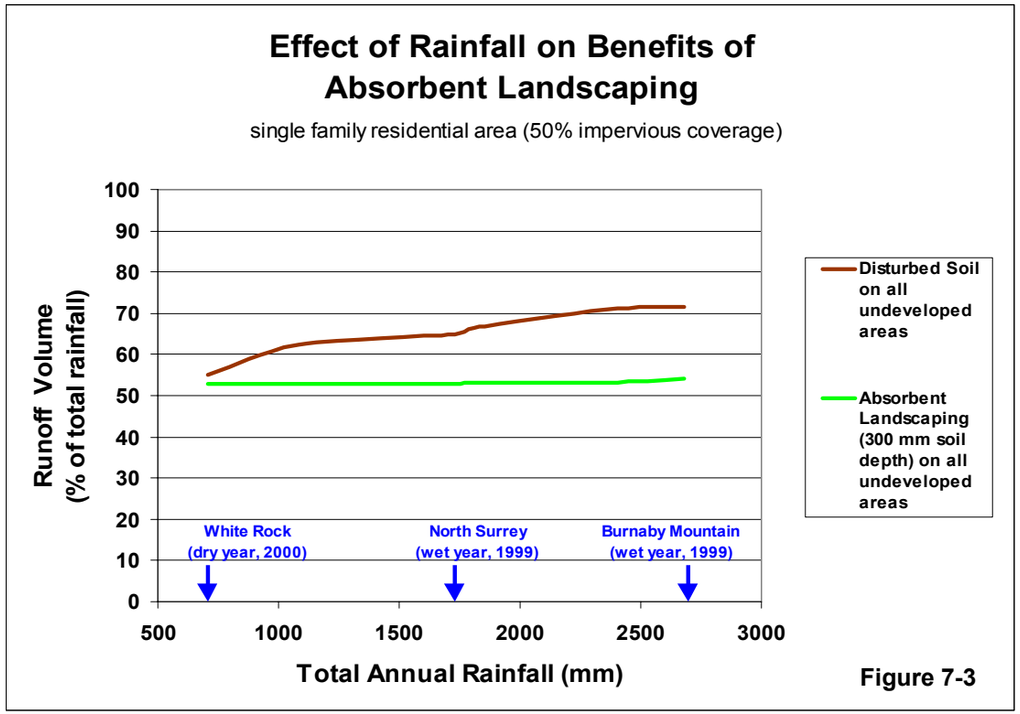


Figure 7-3

Benefits of Absorbent Landscaping for Different Land Use Types

The benefits of absorbent landscaping are more significant for land uses with lower levels of impervious site coverage and higher proportions of undeveloped area (e.g. single family residential), as shown in Figures 7-4 and 7-5.

These figures show the simulated runoff volumes and peak runoff rates during a very wet year (1999) in North Surrey. A total of 1733 mm of rainfall fell during this year, and the most extreme rainfall event was a long duration, wet weather storm with a 5-year return period.

Figure 7-4 shows that absorbent landscaping is particularly beneficial in terms of reducing peak runoff rates. During large rainfall events (e.g. a 5-year storm), disturbed soil can generate nearly as much runoff as impervious surfaces, whereas an absorbent soil layer (300 mm depth) can continue to absorb rainfall. Therefore, absorbent soil can significantly reduce peak runoff rates from large storms, especially for land uses with large amounts of undeveloped space.

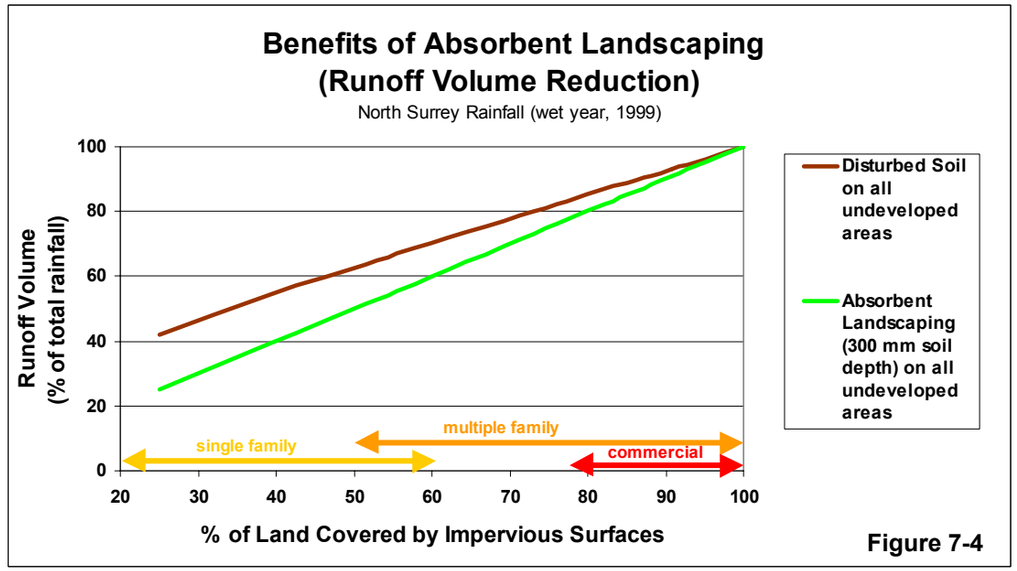


Figure 7-4

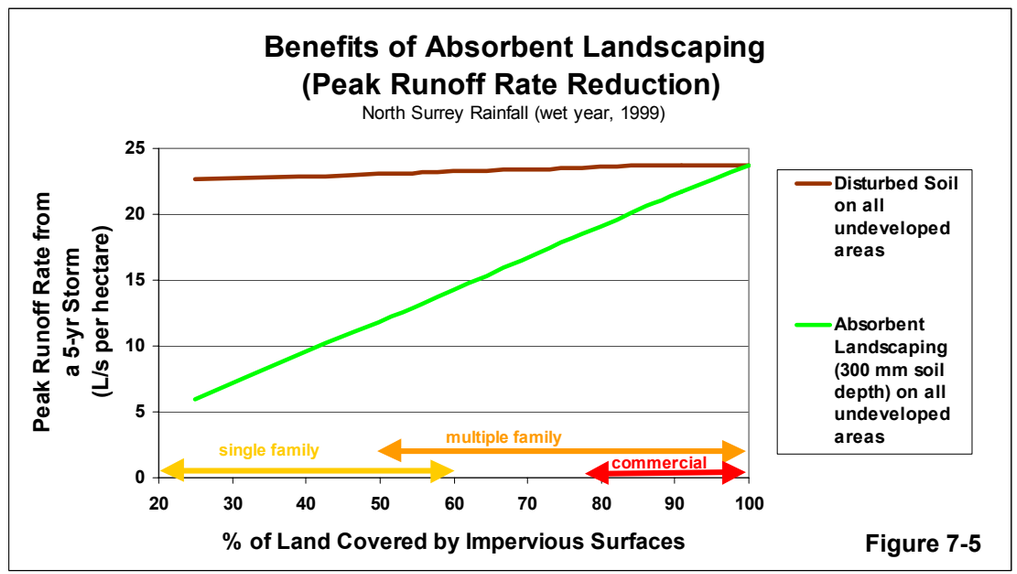


Figure 7-5

Cost Implications of Absorbent Landscaping

The costs of absorbent landscaping are highly variable and depend on site-specific conditions such as vegetation type. This reflects the customized nature of individual site landscaping plans.

Typical costs for absorbent landscaping range from about $25 - $70 per m^2. In the lower cost ranges, the absorbent soil depth would be about 150 mm, with turf cover and some trees. In the upper ranges, soil depth would be about 450mm, with shrubs or groundcover and trees.

Maintenance Tips for Absorbent Landscaping

- Maintaining the absorbency of soils is an advantage both to turf and plant health and to stormwater management. Normal landscape maintenance of absorbent soils will generally produce an absorbent landscape surface.
- In shrub beds, regular application of bark mulch, natural leaf drop or other organic inputs will keep burrowing insect populations high and maintain soil permeability.
- In lawn areas, use of proper sandy topsoil will avoid compaction problems. Aerating techniques can assist air and water exchange in locally compacted areas.
- Bare soils should not be left uncovered (e.g. during construction) because rainfall impact can create a relatively impermeable surface crust, even in sandy soils.
- Dry season watering of plants is essential, especially when plants are first becoming established.
- Maintenance requirements (and costs) are typically highest in the first year when plants may require more watering, weeding and some replacement.

Rehabilitation of Disturbed Soil

There are a number of ways to convert a disturbed surface soil layer into absorbent soil that has good hydrologic properties, including:

- Mixing in organic content (e.g. compost); this is the most effective soil rehabilitation technique
- Mechanical tilling or scarifying of the surface soil
- Soil aeration, which requires specialized equipment

Immediate replanting of the surface soil layer is an essential part of any soil rehabilitation project.

Jennifer Chan

From: Jennifer Chan
Sent: October 15, 2025 9:30 AM
To: 'Pakulski, Beata'
Cc: Khalid Mahmood
Subject: RE: [External] RE: Agnes Street Erosion Control Requirements

Thank you for confirming Beata. The townhouse development at 0 Agnes Street (also shown on the figure I sent earlier) will be providing its own stormwater management as per the Town and CVC requirements.

Best,

Greck

Jennifer Chan, P.Eng.

Water Resource Engineer

289-904-5060
jchan@greck.ca
www.greck.ca
Unit 3, 5770 Highway 7, Woodbridge, Ontario L4L 1T8

From: Pakulski, Beata <beata.pakulski@cvc.ca>
Sent: October 10, 2025 5:00 PM
To: Jennifer Chan <jchan@greck.ca>
Subject: RE: [External] RE: Agnes Street Erosion Control Requirements

Hi Jennifer,

Yes, minimum erosion control requirement within our watershed is 5mm (section 5.2, SWM Guidelines CVC, 2022) and the proposed development work appears to be a sidewalk of 150m length. Hence, in this case we can consider our erosion control requirements can be met with 5mm retention.

Is there any other work associated with this project?

Thank you,
Beata

Beata Pakulski | M.E.S., M. Pl. | she/her/hers
Planner, Planning and Policy, Watershed Management and Development Services | Credit Valley Conservation
905-670-1615 ext. 2680 | M: 437-881-2349

beata.pakulski@cvc.ca| cvc.ca

Our working hours may be different. Please do not feel obligated to reply outside of your scheduled working hours. Let's work together to help foster healthy work-life boundaries.

Credit Valley Conservation
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From: Jennifer Chan <jchan@greck.ca>
Sent: Monday, October 6, 2025 12:01 PM
To: Pakulski, Beata <beata.pakulski@cvc.ca>
Subject: RE: [External] RE: Agnes Street Erosion Control Requirements

Hello Beata,

The development is at 0 Agnes Street, please see attached figure for your reference.

Best,

Greck

Jennifer Chan, P.Eng.

Water Resource Engineer

289-904-5060
jchan@greck.ca
www.greck.ca
Unit 3, 5770 Highway 7, Woodbridge, Ontario L4L 1T8

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From: Pakulski, Beata <beata.pakulski@cvc.ca>
Sent: October 2, 2025 4:44 PM
To: Jennifer Chan <jchan@greck.ca>
Subject: RE: [External] RE: Agnes Street Erosion Control Requirements

Hi Jennifer,

Thank you for your inquiry. I will be happy to help you.

May I please ask what file this is associated with just to provide more context?

Thank you,
Beata

Beata Pakulski | M.E.S., M. Pl. | she/her/hers
Planner, Planning and Policy, Watershed Management and Development Services | Credit Valley Conservation
905-670-1615 ext. 2680 | M: 437-881-2349
beata.pakulski@cvc.ca| cvc.ca

From: Jennifer Chan <jchan@greck.ca>
Sent: September 29, 2025 11:09 AM
To: Patel, Bhrugisha <Bhrugisha.Patel@cvc.ca>
Cc: DiBerto, Dorothy <Dorothy.DiBerto@cvc.ca>; Khalid Mahmood <kmahmood@greck.ca>
Subject: [External] RE: Agnes Street Erosion Control Requirements

FYI, just including Dorothy as per Trisha's autoreply email.

Best,

Jennifer Chan, P.Eng.

Water Resource Engineer

289-904-5060

jchan@greck.ca

www.greck.ca

Unit 3, 5770 Highway 7, Woodbridge, Ontario L4L 1T8

Proudly Celebrating 25 Years of Business!

From: Jennifer Chan
Sent: September 29, 2025 11:06 AM
To: Patel, Bhrugisha <bhrugisha.patel@cvc.ca>
Cc: Hughes, Trisha <trisha.hughes@cvc.ca>; Khalid Mahmood <kmahmood@greck.ca>
Subject: Agnes Street Erosion Control Requirements

Hello Bhrugisha,

I am working on a development that requires the urbanization of a portion of Agnes Street in Alton. With regards to land use, we are essentially adding a ~150m long sidewalk on the west side of the road. The catchment area is less than 2ha for this portion of the road and the drainage ultimately discharges to Shaw's Creek. Currently we have designed the stormwater management to capture and retain the first 5mm of every rainfall event as per the CVC SWM Guidelines (2022):

> **5.2 Erosion Control Criteria**
>
> As a minimum, where conditions
> 5.3, CVC requires on-site retentic
> of the
>
> - The minimum erosion control requirement for all watercourses within CVC's jurisdiction is retention of the first 5mm of every rainfall event.

Given the small scale of these works could you please confirm that this is sufficient with regards to erosion control?

Thanks,

Jennifer Chan, P.Eng.

Water Resource Engineer

289-904-5060

jchan@greck.ca

Greck

www.greck.ca

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