FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

272 INNISFIL STREET
CITY OF BARRIE

PREPARED FOR:
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TORONTO, ON M4R 1A3

DATE: APRIL 2022

PROJECT NO. 221278

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1.0 INTRODUCTION

The purpose of this report is to provide site servicing and stormwater management (SWM) design information in support of the Site Plan Approval application for the proposed development at 272 Innisfil Street in the City of Barrie.

Specifically, this report will demonstrate the SWM measures that will be undertaken to deal with the quantity, quality and water balance requirements for the site. As well, the proposed servicing for the site will be reviewed to confirm the impact on the existing municipal drainage systems.

1.1 Site Description

The site is bordered by detached residential development to the south and commercial on the north, east and west sides. The site is located at the southwest corner at the intersection of Innisfil Street and Jacobs Terrace. There is an existing two storey commercial building on the existing site that will be demolished as part of the development. The existing site area is 7,027m^2.

It is proposed to construct a 17 storey residential building consisting of 333 units. The total site area will be reduced to 6,845m^2 after a portion of the site is conveyed to the City for road widening. The site location is shown on **Figure 1**.

1.2 Background

The servicing and stormwater management design for the site has been prepared to meet the requirements of the City of Barrie and Lake Simcoe Region Conservation Authority (LSRCA). The following materials were referenced in the preparation of this report:

- City of Barrie, Development Manual, dated October 27, 2017.
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines (SWM Guidelines), dated February 2022.
- City of Barrie, Low Impact Development, Interim Guidance (LID Guidelines), 2019.
- City of Barrie, Sanitary Sewage Collection System Policies and Design Guideline (Sanitary Guideline), dated October 2017.
- City of Barrie, Water Transmission and Distribution Design Standard (Water Standards), dated February 2022.
- City of Barrie, Lot Grading and Drainage Standards and Design Manual (Lot Grading Standards), dated June 2016.
- The LSRCA Technical Guidelines for Stormwater Management Submissions, dated June 24, 2016.
- The LSRCA Phosphorus Offsetting Policy, dated July 2021.
- The Updated Hydrogeological Assessment Report 272 Innisfil Street, Barrie, Ontario, dated March 15, 2022, prepared by Cambium Inc.

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FIGURE 1
272 INNISFIL STREET
SITE LOCATION PLAN

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- The Updated Geotechnical Investigation Report 272 Innisfil Street, Barrie, Ontario, dated March 7, 2022, prepared by Cambium Inc.
- The Stormwater Management Planning and Design Manual (MECP Guidelines), prepared by the Ministry of the Environment, Conservation and Parks, March 2003, were referenced in the preparation of the stormwater management plan.
- As-constructed plan and profile drawings for Innisfil Street and Jacobs Terrace, as provided by the City of Barrie.

2.0 STORMWATER MANAGEMENT CRITERIA

As outlined in the LSRCA Guidelines, a treatment train approach is required to meet the multiple SWM objectives of water quality, water balance, erosion and flood control. Lot level and conveyance controls are best for achieving water balance objectives.

The requirements are as follows:

Water Balance – the LSRCA Watershed Development Policies state that a SWM plan must make every feasible effort to maintain the pre-development infiltration and evapotranspiration rates and temperatures to the receiving watershed. A water balance assessment may be required as per the MECP Guidelines.

Water Quality – the LSRCA Guidelines state that 80% of total suspended solids should be removed in the post development scenario, and that phosphorus loading should be reduced as much as feasible and not exceed predevelopment levels. The proposed landscaping and infiltration measures, along with the roof area, result in water quality requirements generally being addressed through the design.

Water Quantity – The flood flow requirement is to control the 2 through 100-year post development flows to the pre-development levels. For discharge to municipal infrastructure all flows up to the 100-year event are required to be controlled to the 5-year pre-development target.

3.0 STORM DRAINAGE

3.1 Existing Drainage

There is an existing 1050mm diameter storm sewer flowing north on Innisfil Street across the frontage of the site. The existing site is primarily pavement and rooftop area. Drainage from the south parking area is directed to a catchbasin, with overland flow directed to Innisfil Street. The north parking area sheet drains north toward Jacob's Terrace. All drainage is generally directed toward the intersection of Innisfil Street and Jacob's Terrace. Refer to **Figure 1** for the exciting drainage plan.

The proposed drainage plan should be designed to follow the existing drainage patterns to the extent feasible.

3.2 Site Grading

All grading will be completed in a manner to satisfy the following goals:

- Enable gravity servicing connections (as required) to the existing sewers on Innisfil Street.
- Provide minimal impact to abutting properties, as feasible.
- Achieve stormwater management and environmental objectives required for the site

The site will be graded to suit the City's design criteria and accommodate any constraints that may be imposed by the storm drainage and servicing objectives. Details can be referenced on **Drawing SW1.**

3.3 Minor System Drainage

The majority of the site will be rooftop area serviced by rooftop drains which will be routed to the storm sewer system located in the south parking lot area. The north and east perimeter of the site will be sloped towards the respective right-of-ways and drain overland uncontrolled. The remainder of the site grading in the south driveway area will be directed to catchbasins. Drainage from the south driveway will be captured in catchbasins and directed to a storage/infiltration facility.

The minor system has been sized to convey the 5-year storm event and connects to the Innisfil Street storm sewer system. The proposed storm servicing is shown on **Drawing SW2**.

3.4 Major System Drainage

In the event of blockage or a storm event exceeding the 100-year intensity, a major overland flow route has been designed to safely convey the flows towards the Innisfil Street and Jacobs Terrace right-of-ways. In the 100-year event, drainage in the south parking area will be directed overland with a maximum ponding depth of 0.24m. Upon reaching the southeast corner of the site, it will overtop the driveway at the property line and flow north along Innisfil Street. The landscape strip along the north side of the site will sheet drain toward Jacbob's Terrace.

Existing drainage patterns are maintained and peak flows are reduced compared to the existing conditions as discussed below in **Section 4.0**.

4.0 STORMWATER MANAGEMENT PLAN

The proposed stormwater management plan for the site is based on meeting the requirements of the LSRCA and the City.

The proposed stormwater management design for the site is shown on **Figure 3**. It comprises of the following:

- An orifice control at the site outlet, to control peak flows to the allowable rate.
- An infiltration/storage chamber system to meet peak flow and retention requirements.
- Pre-treatment measures on catchbasins to reduce sediment loading in the infiltration chambers.
- Increased landscaping in the uncontrolled areas around the perimeter of the site.

The above measures and how they are used to meet the SWM criteria, are described in the following sections.

The existing site catchment parameters are outlined in **Table 1** below.

Table 1. Site Imperviousness and Runoff Coefficient

Surface Type	Area (m^2)	Imperviousness (%)	Runoff Coefficient (RC)	RC x A
Pervious Area	0	0%	0.20	0.00
Impervious Area	6,845	100%	0.95	6,503
Total	**6,845**	**100%**	**0.95**	6,503

Refer to **Figure 2** for details of the existing site conditions.

4.1 Water Balance

The guidelines require retention of water on site, to the extent possible, to match pre-development runoff volumes. A water balance assessment for the site was prepared as part of the Hydrogeological Assessment. The water balance assessment was completed only taking into consideration the change in surfaces from the proposed development.

The water balance assessment determined the following:

- The increase in pervious area in the post development scenario will have a positive impact on groundwater infiltration and increase groundwater infiltration volume per annum by 271m^3.
- The increase in pervious area will also reduce runoff volumes by 13 percent.

Therefore, the proposed landscaping for the subject site is sufficient to satisfy water balance requirements. In addition to this, volume controls will be implemented to further reduce runoff volumes and increase groundwater infiltration, as discussed below in **Section 4.2.2**. The proposed infiltration system will infiltrate approximately 70 percent of annual runoff from impervious surfaces routed towards it.

4.2 Quantity Control

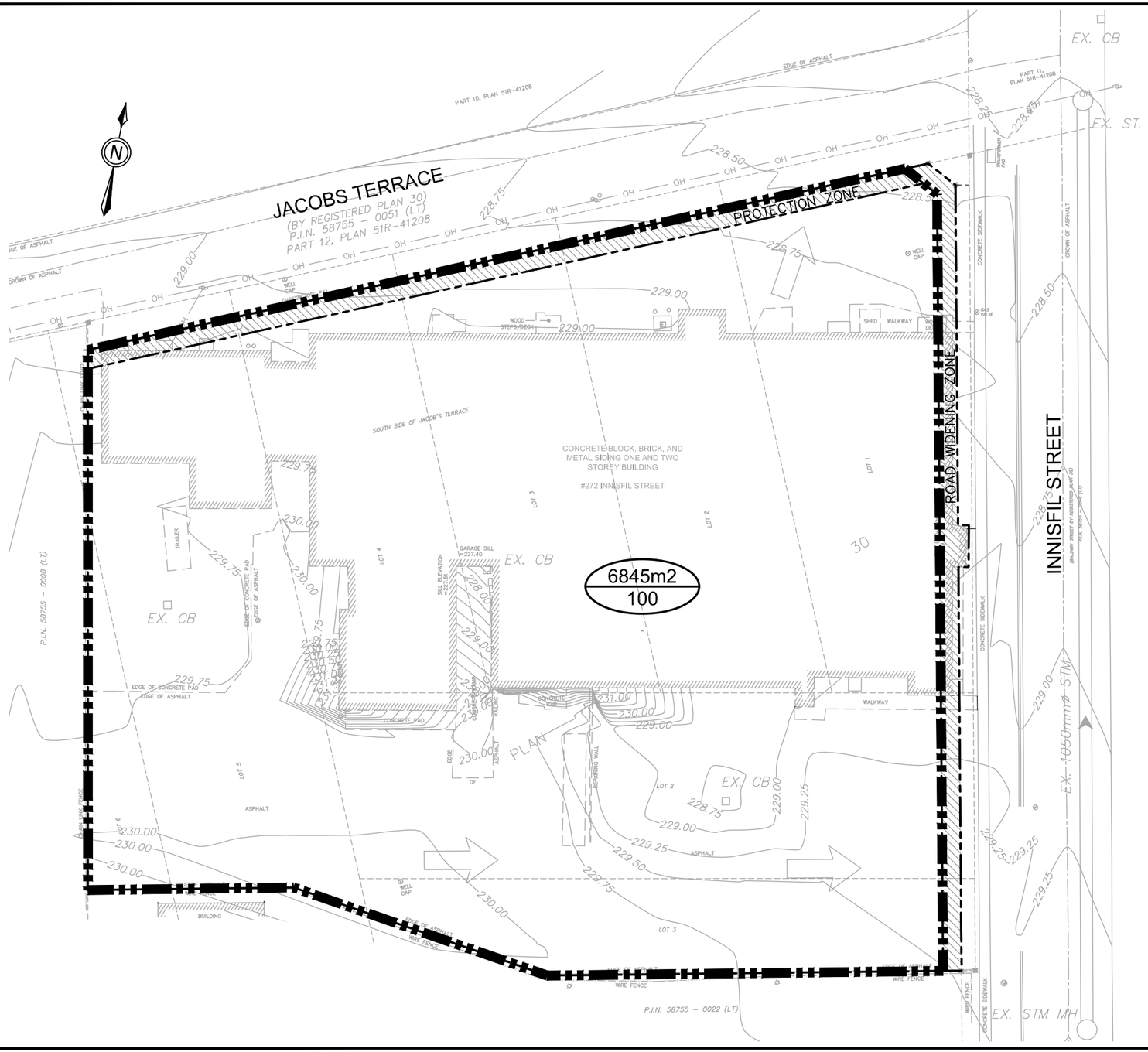
4.2.1 Peak Flow Controls

The guidelines require that the post development flows not exceed the predevelopment flows up to the 100-year storm event. Additionally, for discharge to municipal infrastructure the captured flow from the post development 100-year event must be controlled to the predevelopment 5-year target. The existing catchment parameters and target flows are summarized below in **Table 2**.

Table 2. Existing Site Parameters and Target Flows

Site Area	5-Year Runoff Coefficient	100-Year Runoff Coefficient	5-Year Peak Flow*	100-Year Peak Flow**
6,845m^2	0.95	1.00	**197.1L/s**	**579.8L/s**

* - Target release rate for discharge to municipal infrastructure.
** - Target release rate for the overall site (including overland flow)



272 INNISFIL STREET			
100	AREA	R.C.	AxR.C.
PERV.	0m²	0.20	0.00
IMPV.	3967m²	0.95	3768.65
BLDG.	2878m²	0.95	2734.10
TOTAL	6845m²	0.95	6502.75

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LEGEND

DRAINAGE BOUNDARY

DIRECTION OF OVERLAND FLOW

6845m2 / 100 — CATCHMENT AREA (m²) / CATCHMENT ID

FIGURE 2
272 INNISFIL STREET
EXISTING DRAINAGE PLAN

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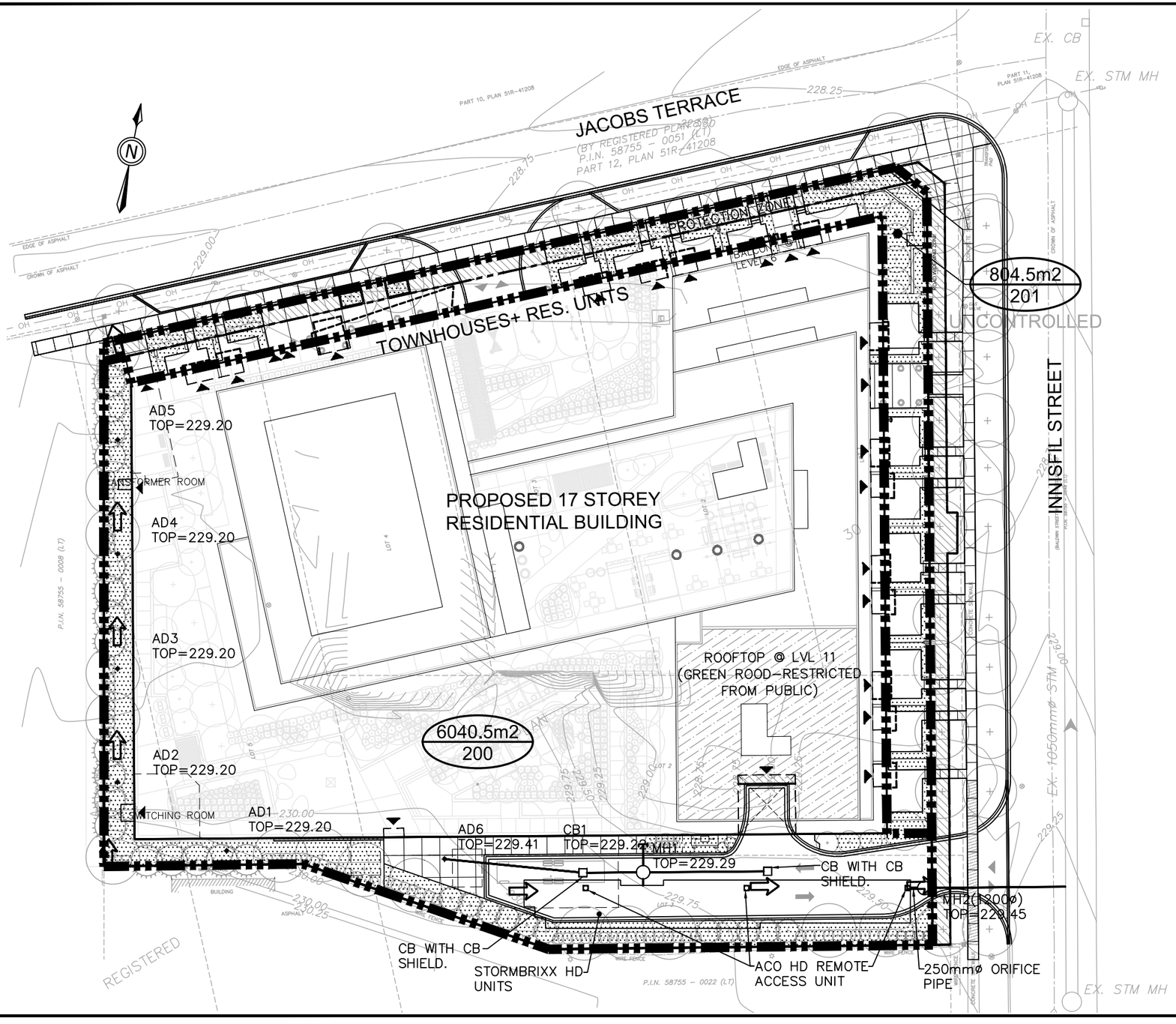

272 INNISFIL STREET - 200 CONTROLLED			
200	AREA	R.C.	AxR.C.
PERV.	478.8m²	0.20	95.8
IMPV.	511.3m²	0.95	485.7
BLDG.	4649.6m²	0.95	4417.1
GREEN ROOF	400.8m²	0.40	200.4
TOTAL	**6040.5m²**	**0.86**	5199.0

272 INNISFIL STREET - 201 UNCONTROLLED			
201	AREA	R.C.	AxR.C.
PERV.	315.2m²	0.20	63.0
IMPV.	489.3m²	0.95	464.8
BLDG.	0.0m²	0.90	0.0
TOTAL	**804.5m²**	**0.66**	527.8

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LEGEND

- DRAINAGE BOUNDARY
- DIRECTION OF OVERLAND FLOW
- 6040.5m2 / 200 — CATCHMENT AREA (m²) / CATCHMENT ID
- GREEN ROOF AREA

FIGURE 3
272 INNISFIL STREET
PROPOSED SWM PLAN

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As shown above, the target release rate to municipal infrastructure will be 197.1L/s for all storms up to the 100-year storm event, and the target release rate for the overall site is 579.8L/s in the 100-year storm event. In the post development scenario, the north and east perimeter of the site will drain uncontrolled to the adjacent right-of-ways. The uncontrolled flows are summarized below in **Table 3**.

Table 3. Proposed Uncontrolled Flows

Catchment Area	5-Year Runoff Coefficient	100-Year Runoff Coefficient[1]	5-Year Peak Flow*	100-Year Peak Flow**
804.5m^2	0.66	0.82	**16.0L/s**	**55.9L/s**

[1] – 100-year runoff coefficient as per the City of Barrie *Storm Drainage and Stormwater Management Policies and Design Guidelines-February 2022* (the runoff coefficient for 100 years return period: C_{100}=1.25*C_5). When applying the runoff coefficient adjustment, the maximum c-value should not exceed 1.0

The uncontrolled perimeter of the site will contribute a total of 16.0L/s and 55.9L/s to the sites total release rate in the 5 and 100-year storm events, respectively.

The overall post development 5-year runoff coefficient for the controlled portion of the site is 0.89. After the runoff coefficient adjustment is applied the 100-year runoff coefficient is 1.00. The runoff coefficient calculations can be referenced in **Appendix A**.

On-site quantity controls are required to limit the site release rates to meet the target flows. Three quantity control options were reviewed as follows:

- **Parking Lot Surface Storage** – An orifice could be installed near the site outlet to limit flows. Storage will be provided in depressions in the parking lot to attenuate the flow.
- **Underground Storage** – 125.2m^3 of storage will be provided in the detention portion of the underground storage chambers.
- **Rooftop Storage** – Small Sump Accutrol Weir roof drains could be installed on the proposed rooftop and water could be stored on the rooftop to attenuate peak flows. With the proposed roof design, the roof discharge could be limited to a maximum of approximately 4L/s (or 42L/s/ha).

Since limited surface area is available to provide storage surface storage, using the underground storage chambers in conjunction an orifice control is the preferred option. Controlled flow roof drainage is not required to meet the target flows.

The detention portion of the underground storage chambers will provide 125.2m^3 of storage. An additional 75.6m^3 of retention storage is provided below the outlet and is not considered for the purpose of quantity control calculations. To be conservative storage provided in the pipes and structures was not taken into consideration.

A 250mm diameter orifice pipe will be used to attenuate release rates. At a maximum storage depth of 0.51m, in the 100-year storm event, the controlled flow through the orifice is 124.8L/s.

Table 4 and **5** below summarizes the site release rates for the 5 and 100-year storm events.

Table 4. 5-Year Post Development Release Rates

Catchment	5 Year Target (L/s)	5 Year Post Development Release Rate (L/s)	Active Storage Required (m^3)	Active Storage Provided (m^3)
Controlled Site (200) +	197.1	**91.2(Sewer)**	54.8	125.2
Uncontrolled Site (201)		**16.0 (Overland)**	-	-
		107.2 (Total)		

Table 5. 100-Year Post Development Release Rates

Catchment	100 Year Target (L/s) (Surface Drainage)	5 Year Target (L/s) (Connection to Sewer)	100 Year Post Development Release Rate (L/s)	Active Storage Required (m^3)	Active Storage Provided (m^3)
Controlled Site (200) +	579.8	197.1	**124.8 (Sewer)**	106.8	125.2
Uncontrolled Site (201)			**55.9 (Overland)**	-	-
			180.7 (Total)		

As show above in **Tables 4** and **5** all post development flows can be controlled to predevelopment levels. The 100-year flow from the site discharging via the site connection to the municipal storm sewer will be controlled to less than the 5-year pre-development flow, and the total flow directed towards the right-of-way in the 100-year storm will be 180.7L/s (124.8L/s via sewer connection + 55.9L/s via overland drainage), which is less than the predevelopment flow of 579.8L/s. As storm events greater than the 5-year storm event are overcontrolled to meet the pre-development 5-year release rate, all post development flows will be reduced compared to the pre-development targets. Existing drainage patterns have been maintained, and there will be no adverse impacts on neighboring properties. Refer to **Figure 3** for post development drainage conditions.

Underground storage chamber specifications are included in **Appendix B**.

4.2.2 Volume Control

In addition to the peak flow controls proposed, additional runoff reduction measures are proposed to reduce the total runoff volume originating from the subject site. The LSRCA requires that runoff from the total impervious area be captured and retained or treated on site from a 25mm rainfall event. However, due to site restrictions, it will not be possible to satisfy the 25mm objective. The MECP and OBC require that infiltration facilities be located a minimum of 5.0m from building foundations and that a minimum separation of 1.0m be provided between the bottom of the infiltration facility and the seasonally high groundwater table. As a result, the footprint and depth available for storage and infiltration is limited on this site. Therefore, it is proposed to provide 12.5mm of storage for all impervious surfaces as per Alternative #1 listed in the LSCRA Guidelines Section 2.2.2.2 Flexible Treatment Alternative for Sites with Restrictions.

Infiltration facilities are proposed to be constructed in the southeast corner of the subject site and will accept drainage from the rooftop areas as well as the south parking lot. The post development impervious area is 5,650m^2 with a runoff coefficient of 0.95. To satisfy, Alternative #1 in the LSRCA Guidelines for volume control, a total of 67.1m^3 (5,650m^2 [Impervious Area] x 0.95 [Runoff Coefficient] x 12.5mm [Volume Control Requirement]) if retention volume is required. The proposed system provides 75.6m^3 of retention storage. Therefore, sufficient retention volume is provided.

To satisfy the drawdown requirements the total retention volume is required to drawdown within 48 hours as per LSRCA Criteria. The Geotechnical Investigation determined that the soils on site exhibited a hydraulic conductivity of 2.5 to 2.7 x 10^{-3} cm/s. Based on Appendix C of the LID SWM Planning and Design Guide, this is equal to an infiltration rate of 60mm/hour. In accordance the LID Guidelines, a factor of safety of 2.5 was applied to the infiltration rate to calculate a design infiltration rate of 24mm/hour. The total retention volume is proposed to be provided in the lower 0.61m of the chamber system. Therefore, the total retention volume will drawdown in approximately 25 hours which satisfies the drawdown requirements.

4.3 Quality Control

4.3.1 TSS Removal

Based on the LSRCA's requirements, the water quality criteria for this site is 80 percent average annual TSS removal from runoff originating onsite. The stormwater management design incorporates underground storage chambers providing sufficient retention volume to allow for quality requirements to be satisfied by infiltration. Pretreatment will be provided by installing CB Shields on the outlet of each CB and CBMH. These devices are ETV tested and provide TSS removal as well as scour protection.

The infiltration facility will be equipped with a sediment forebay to further remove TSS. The sizing of the infiltration system was based on the MECP SWM Planning and Design Manual criteria. The post development imperviousness for the total site is 94 percent, therefore a storage volume of 45m^3/ha was used in accordance with Table 3.2 of the MECP SWM Planning and Design Manual. **Table 6** below summarizes the infiltration volume requirements for quality control.

Table 6. MECP Infiltration Volume Requirements

Site Area (Controlled)	Site Imperviousness	Storage Volume Requirement for 80% TSS Removal*	Infiltration Volume Required	Infiltration Volume Provided
0.62ha	94%	45m^3/ha	**27.9m^3**	**75.6m^3**

* - Storage volume requirement is taken from Table 3.2 in the MECP SWM Planning & Design Manual and corresponds to an overall site imperviousness of 94%.

The drawdown time requirements, as per the MECP SWM Planning & Design Manual, section 3.3.2 Water Quality Sizing Criteria, are stated as a maximum of 24 hours. As discussed above in **Section 4.2.2** based on the Geotechnical Investigation a design infiltration rate of 24mm/hour was established. The required volume of 27.9m^3 represents a storage depth of approximately 0.23m. Therefore, the quality volume will draw down in approximately 10 hours which satisfies all criteria.

This will satisfy all MECP Sizing Criteria for infiltration SWMP types, and provides the site with 80% TSS removal.

CB Shield details are included in **Appendix C**.

The uncontrolled areas along the north and east sides of the site are primarily landscaped and walkway areas. These surfaces are generally clean and do not require additional quality controls.

4.3.2 Phosphorus Removal

Based on the LSRCA's requirements, the water quality criteria for this site is for post development phosphorus loading to be reduced to zero if feasible and to not exceed predevelopment loads. The Low Impact Development Treatment Train Tool (LID TTT) was used to estimate the pre and post development phosphorus loads for the site. The outgoing total phosphorus load from the existing site was estimated to be 0.791kg per year.

The proposed site consists of primarily rooftop area and will be treated by the Stormbrixx retention and detention system. A StormBrixx Sediment Forebay will be provided with detention storage and is credited with 25 percent phosphorus as per LSRCA Criteria. The retention portion of the chamber system was entered into the LID TTT model with zero percent phosphorus removal and reduces phosphorus loading by reducing runoff volumes. The post development site generates a total annual phosphorus load of 0.611kg per year which is reduced to a total outgoing load of 0.048kg per year by the onsite treatment train. Therefore, the proposed treatment train will reduce phosphorus loading by 94 percent compared to the existing conditions.

Refer to **Appendix D** for LID TTT outputs.

4.4 Low Impact Development Measures

4.4.1 Underground Storage Chambers

Underground storage chambers are proposed to detain and retain water on site to provide sufficient volume to attenuate peak flows as well as satisfy water balance and quality control requirements. The retention portion of the proposed chamber systems are part of a treatment train approach for water balance and quality control. For quality control pretreatment, runoff will be treated by CB Shields installed in each catchbasin. The CB Shield's are ETV tested and provide TSS removal as well as scour protection.

Downstream of the CBs and CBMHs equipped with CB Shields, the underground storage chambers are equipped with a sediment forebay to provide additional treatment. These rows, which are lined and horizontally separated from adjacent chambers, will allow additional suspended solids to settle out and remain contained for removal when maintenance is performed. After passing through the sediment forebays, retention storage is provided below the outlet where the water will infiltrate. The retention volume has been sized to meet MECP requirements for quality control as well as water balance requirements.

The maintenance requirements for the underground chamber system are listed below in **Section 4.5.1**.

Therefore, low impact development features are proposed to address stormwater quality, quantity and water balance requirements in accordance with the City's LID requirements.

4.5 Maintenance & Monitoring

4.5.1 Underground Storage Chambers

The chambers and catchbasins should be inspected every 6 months for the first two years and annually after that, once the sediment loading rate is determined. The catchbasins and chambers should be cleaned out when any accumulation of sediment is noted during inspection. Two inspection ports are located by the inlet and the outlet. Chamber cleanout should be completed by use of jetting equipment and vacuuming.

Extra care should be taken during the construction of the storm drainage system to prevent sediment from entering the storage chambers until the site has been stabilized. The connection from the catchbasins to the chambers should be blocked during construction.

5.0 EROSION AND SEDIMENT CONTROL

Erosion and sediment control plans have been prepared to meet the requirements of the City and LSRCA. The erosion and sediment control measures have been designed to limit sediment and debris from leaving the site during construction and from entering the adjacent lands. The following measures will be implemented:

- A sediment control fence will be installed along the perimeter of the site where the grade will direct flows off-site.
- Site access will be limited to one entrance. A gravel access pad will be installed to remove mud from vehicles leaving the site.
- Once the site has been stripped of topsoil and then pre-graded, the lot will generally be lower than the surrounding property. This will limit runoff from entering neighbouring properties until the storm sewers are installed.

Erosion measures will be in place prior to any grading on the site. A program will be in place to monitor and maintain the erosion and sediment controls. The sediment controls will be inspected by the Site Engineer and contractor every two weeks and after each significant rainfall event.

Proper construction sequencing will also help with erosion and sediment control. The following schedule is recommended:

1. Install sediment control fence and gravel access road.
2. Strip topsoil and export, as required.
3. Remove existing services.
4. Rough grade site to subgrade elevations.
5. Install services and sediment control devices on catchbasins.
6. Re-vegetate disturbed areas including lands left vacant for future development.

The Erosion and Sediment Control Plan can be referenced on **Drawing SW3**.

6.0 WASTEWATER

6.1 Receiving Systems

The following is a summary of the sanitary sewers on the boundary roads around the site.

- Jacob's Terrace – 300mm diameter sanitary sewer flowing east toward Innisfil Street.
- Innisfil Street – 300mm diameter sanitary sewer flowing north toward intersection of Innisfil Street and Tiffin Street.

The site is proposed to provide service connection from Jacobs Terrace, and construct a new 250mm diameter sanitary service which connecting to the existing sanitary manhole and the 300mm diameter sanitary sewer located on Jacobs Terrace for the proposed development.

The existing and proposed sanitary flows from the site are shown in **Table 7.** The City of Barrie Sanitary Sewage Collection System Policies and Design Guideline was used to calculate the contributing peak flow from the site to the existing sewer. The Harmon equation was used to calculate the peaking factor for the apartment building.

Table 7. Sanitary Flow Comparison

Land Use	Equivalent Population[1]	Peaking Factor[2]	Equivalent Peak Flow (L/s)[2]	Infiltration Flow (L/s)[3]	Total (L/s)
Pre-Development: • Commercial: 0.70ha	-	1.0	0.22	0.07	0.29
Post-Development: • Residential: 333 apartment units	556	3.95	5.72	0.07	5.79

[1] Equivalent population as per the latest City of Barrie *Sanitary Sewage Collection System Policies and Design Guideline* (1.67 persons/ unit – Apartment dwellings, Commercial: 28m^3/day/ha (0.32L/s/ha))

[2] Equivalent Flow as per the latest City of Barrie *Sanitary Sewage Collection System Policies and Design Guideline* (Average wastewater flow = 225 L/day/person)

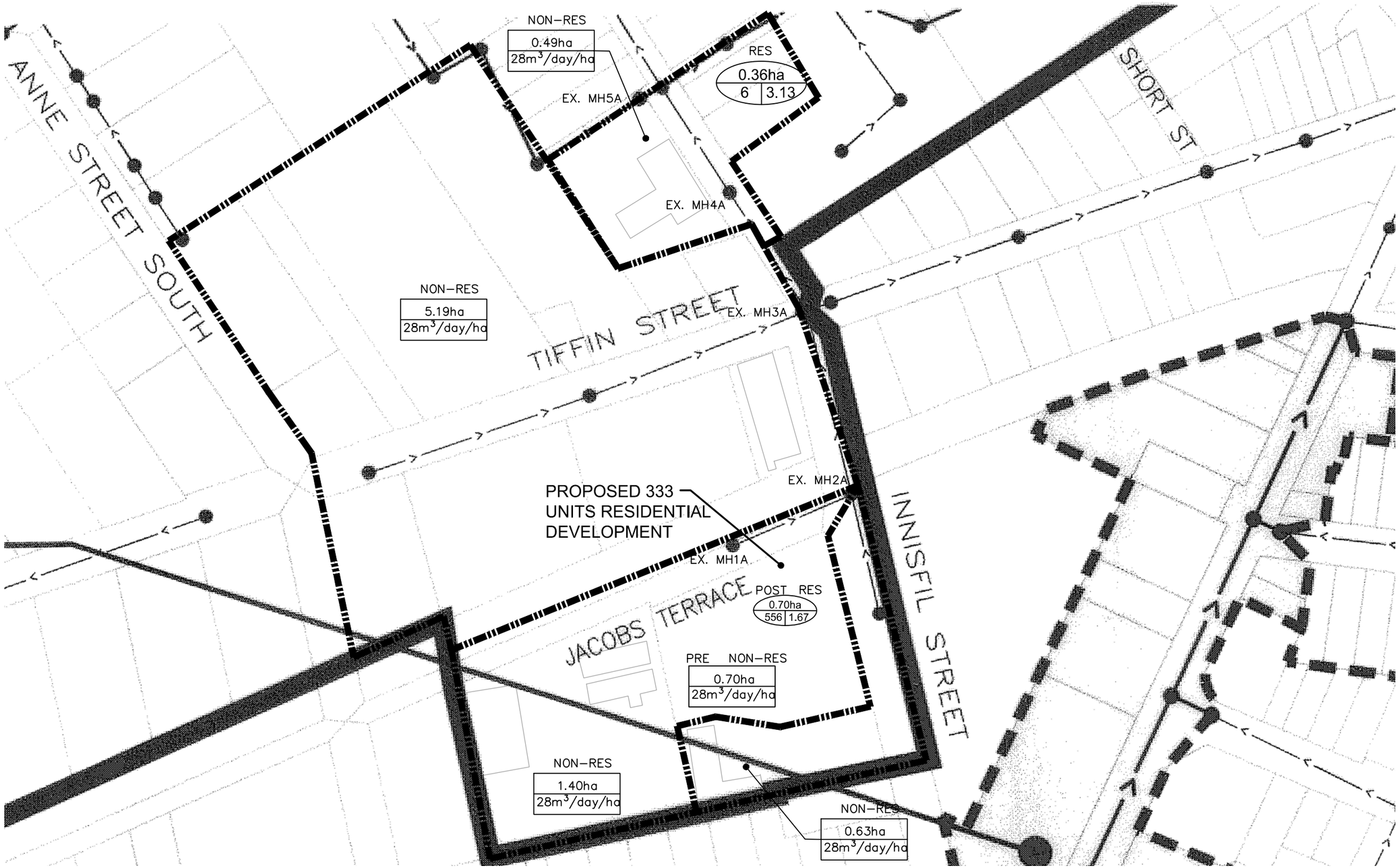
[3] Infiltration flows are based off a site area of 0.70ha and a design flow rate of 0.10L/s/ha.

For detailed site servicing information please refer to the Servicing Plan (**Drawing SW2**).

6.2 Sanitary Sewer Downstream Capacity Analysis

The sanitary sewer has been analyzed from the site outlet to the trunk sewer crossing Innisfil Street approximately 100m north of Tiffin Street, to confirm that it has capacity to accommodate the increased population. A sanitary sewer design sheet has been prepared following City of Barrie Sanitary Sewage Collection System Policies and Design Guideline and the existing land uses for the properties draining to the system. The design sheets showed that there is sufficient capacity in the downstream system. The proposed development will contribute a 5.50L/s in sanitary flow, which results in the critical pipe flowing at 12 percent full.

Figure 4 shows the proposed drainage area plan for the external sanitary sewer.



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LEGEND

RES
0.70ha
556 | 1.67
- DRAINAGE AREA (ha)
- PPL/UNIT
- POPULATION

NON–RES
0.70ha
28m³/day/ha
- DRAINAGE AREA (ha)
- FLOW RATE (m³/day/ha)

SANITARY DRAINAGE AREA BOUNDARY

FIGURE 4
272 INNISFIL STREER
SANITARY DRAINAGE PLAN

DATE: APRIL 2022 SCALE: 1:2000 PROJECT: 221278

The sanitary sewer design sheet is provided in **Appendix E**. As shown in the design sheet, all of the existing sanitary sewers between the site and trunk main will have capacity for the additional flow.

7.0 WATER DISTRIBUTION

There is a 150mm diameter watermain on the north side of Jacobs Terrace and a 150mm diameter watermain on Innisfil Street across the frontages of the site. There is a hydrant on the north west corner of the site on Jacobs Terrace and a hydrant on the west side of Innisfil Street on the east side of the site.

It is proposed to service the site off of the 150mm diameter watermain on Jacobs Terrace with a new 150mm diameter fire and 100mm diameter domestic water service and to remove/decommission the existing water service. The watermain design will follow the City's design criteria.

Refer to **Drawing SW2** for the proposed water design.

7.1 Water Design Criteria

Following the City's design criteria, the watermains are to be designed to meet the greater of the maximum day demand plus fire flow or the peak hour demand.

Criteria for Watermains:

Persons per unit (ppu):	High Density (apartment dwellings)	1.67
Average water consumption rate:		225L/capita/day

PEAKING FACTORS – peaking factors shall be based on MECP Design Guidelines for Drinking – Water Systems, 2008 (Table 3-1 and Table 3-3).

Peaking Factor (pf):	Peak Hour	4.13
	Maximum Day	2.75
Minimum Pressure (under non-fire demand scenario)		275kPa
Minimum Pressure (under max day + fire demand scenario)		140kPa

Fire Flow:

Minimum residential fire flow for apartment dwellings	200L/s

7.2 Watermain Analysis

Average Daily Demand:

Apartment = 333(units) x 1.67ppu x 225L/capita/day

=125,125L/day

Peak Hour Demand:

Apartment = 125,125L/day x 4.13(pf)

= 359L/min (94.8gal/min)

Maximum Day Demand:

Townhouses = 125,125L/day x 2.75(pf)

= 239L/min (63.1gal/min)

A hydrant flow test will need to be completed prior to the next submission to confirm that under peak hour and maximum day flow conditions the pressure in the watermain will meet the City's minimum pressure of 275kPa (40psi).

Fire Demand:

The minimum fire flow is 8,000L/min for a contiguous building according to the Fire Underwriters Study (FUS) and 200L/s (12,000L/min) for an apartment dwelling according to the City. The more detailed fire formula on page 17 of the FUS was also used to calculate the minimum fire flow. For the 17-storey residential development, the building areas are based on the largest floor area (6^{th} Floor – 2,478m^2), plus 25 percent of each of the two immediate adjoining floors (5^{th} Floor – 2,415m^2; 7^{th} Floor – 2,360m^2). The required fire flow for the residential tower is provided in **Table 9** and calculations are provided in **Appendix F.**

Table 9. Minimum Required Fire Flows

Building	Area (m^2)	Occupancy Reduction	Exposure Increase	Sprinkler Reduction	Fire Flow L/min
Residential Tower	3,625	0%	55%	50%	8,000

A hydrant flow test will need to be completed prior to the next submission to confirm that the theoretical fire flow at the minimum City's pressure of 140kPA (20psi) is at least 17,000L/min.

8.0 CONCLUSIONS

The proposed development meets the LSRCA and City of Barrie criteria as follows:

- Underground storage chambers will provide retention storage to enable infiltration to satisfy all quality and water balance requirements.
- Underground storage chambers, pipe storage, and structure storage will be used in conjunction with an orifice pipe to control up to the 100-year storm peak flow to predevelopment levels and the allowable flow to the storm sewer system.
- The proposed stormwater management facilities will reduce phosphorous loading from the site by 94 percent.
- A gravity sanitary sewer is proposed to the existing sanitary sewer on Jacob's Terrace. The sewer will extend along the private road to service the proposed development.
- A sanitary capacity analysis has been prepared to confirm that all of the existing sanitary sewers between the site and trunk main will have capacity for the additional flow.
- A water service will be provided to the existing watermain on Jacob's Terrace. The watermain will extend internally to each unit.
- A hydrant flow test will need to be completed prior to the next submission to confirm that the existing watermain has sufficient pressure to provide fire and domestic flows to the proposed development.

With the proposed controls in place, the site design will meet the requirements of the LSRCA Guidelines and City Standards. Therefore, based on the information provided herein, the Site Plan application is appropriate in respect of these matters.

APPENDIX A

STORMWATER MANAGEMENT CALCULATIONS

Rational Method Calc.

Project:	272 Innisfil Street
Project No.:	221278
Municipality:	City of Barrie
Catchment:	Pre-Development

	Catchment 100	
	5 Year	100 Year
Runoff Coefficient (C) =	0.95	1.00
Area (A) =	0.68	0.68
A:	843.02	1383.63
B:	4.58	4.91
C:	0.76	0.75
Tc:	10.00	10.00
Intensity (I) mm/hr =	109.1	304.9
Peak Flow (Q) L/s =	197.1	579.8

Composite RC (Catchment 100) - (5 Year)

	Area (m2)	C	CxA
Landscape	0	0.2	0.0
Building	2878	0.95	2734.4
Impervious Area	3967	0.95	3768.4
	6845	0.95	6502.8

Rational Method Calc.

Project:	272 Innisfil Street
Project No.:	221278
Municipality:	City of Barrie
Catchment:	Proposed Development

Uncontrolled Site to Innisfil Street and Jacob's Terrace - 201

	5 Year	100 Year
Runoff Coefficient (C) =	0.66	0.82
Area (A) =	0.0804	0.0804
A:	843.02	1383.63
B:	4.58	4.91
C:	0.76	0.75
Tc:	10.000	10.000
Intensity (I) mm/hr =	109.1	304.9
Peak Flow (Q) L/s =	16.0	55.9

Uncontrolled Site (Catchment 201) - (5 Year)

	Area (m2)	C	CxA
Landscape	315.2	0.20	63.0
Impervious Roof	0	0.95	0.0
Green Roof	0	0.50	0.0
Impervious Area	489.3	0.95	464.8
	804.5	0.66	527.8

Controlled Site (Catchment 200) - (5 Year)

	Area (m2)	C	CxA
Landscape	478.8	0.20	95.8
Impervious Roof	4649.6	0.95	4417.1
Green Roof	400.8	0.50	200.4
Impervious Area	511.3	0.95	485.7
	6040.5	0.86	5199.0

Modified Rational Method - 5-Year Post Development

Project:	272 Innisfil Street			
Project No.:	221278			
Municipality:	City of Barrie			
Catchment:	Controlled Area			
				100-Year
Area:	0.6041	ha	Rainfall $I=A*(T+B)^C$	
Runoff Coefficient:	0.86		A:	976.90
			B:	4.58
Target Flow:	0.0912	m^3/s	C:	-0.76
Storage Required	54.8	m^3		
Storage Provided	125.2	m^3		
Initial Time	10	min	Increment	5 min

Time (min)	Intensity (mm/hr)	Peak Flow (m^3/s)	Runoff Volume (m^3)	Discharge Volume (m^3)	Storage Volume (m^3)
10	126.4	0.183	109.55	54.73	54.8
15	101.0	0.146	131.23	82.10	49.1
20	84.9	0.123	147.10	109.46	37.6
25	73.7	0.106	159.65	136.83	22.8
30	65.4	0.094	170.06	164.19	5.9
35	59.0	0.085	178.98	191.56	-12.6
40	53.9	0.078	186.80	218.92	-32.1
45	49.7	0.072	193.78	246.29	-52.5
50	46.2	0.067	200.09	273.65	-73.6
55	43.2	0.062	205.86	301.02	-95.2
60	40.6	0.059	211.18	328.38	-117.2
65	38.4	0.055	216.13	355.75	-139.6
70	36.4	0.053	220.75	383.11	-162.4
75	34.6	0.050	225.09	410.48	-185.4
80	33.1	0.048	229.19	437.84	-208.7
85	31.6	0.046	233.07	465.21	-232.1
90	30.4	0.044	236.77	492.57	-255.8
95	29.2	0.042	240.29	519.94	-279.6
100	28.1	0.041	243.65	547.30	-303.6
105	27.1	0.039	246.88	574.67	-327.8
110	26.2	0.038	249.98	602.03	-352.1
115	25.4	0.037	252.96	629.40	-376.4
120	24.6	0.036	255.84	656.76	-400.9
125	23.9	0.034	258.62	684.13	-425.5

Orifice Flow Calculation

Pipe Diameter	250	mm
Area	0.049	m^2
Maximum WL	228.27	m
Invert	227.87	m
Head (h)	0.28	m
Co-efficient	0.80	
Flow (Q) : $CA(2gh)^{0.5}$		
	0.0912	m^3/s

Modified Rational Method - 100-Year Post Development

Project:	272 Innisfil Street			
Project No.:	221278			
Municipality:	City of Barrie			
Catchment:	Controlled Area			
				100-Year
Area:	0.6041	ha	Rainfall $I=A*(T+B)^C$	
Runoff Coefficient:	1.00		A:	1383.63
			B:	4.91
Target Flow:	0.1248	m^3/s	C:	-0.75
Storage Required	106.8	m^3		
Storage Provided	125.2	m^3		
Initial Time	10	min	Increment	5 min

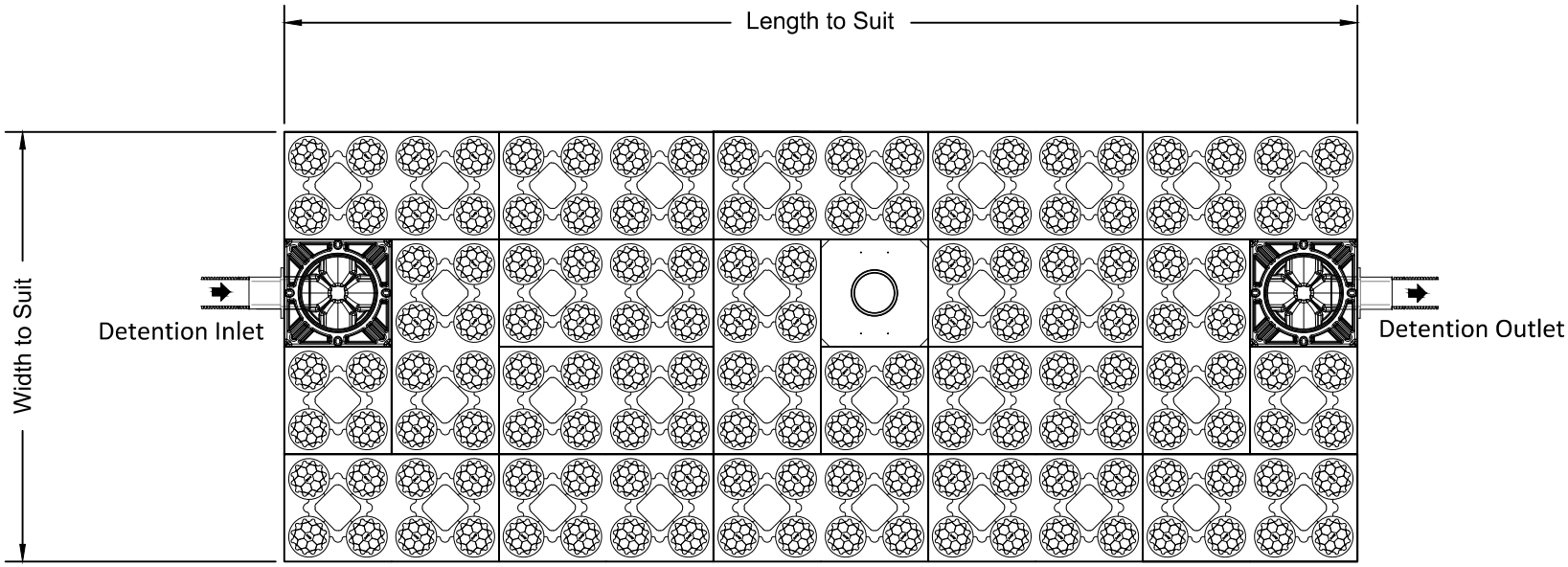
Time (min)	Intensity (mm/hr)	Peak Flow (m^3/s)	Runoff Volume (m^3)	Discharge Volume (m^3)	Storage Volume (m^3)
10	180.4	0.303	181.66	74.90	106.8
15	145.1	0.243	219.09	112.35	106.7
20	122.5	0.206	246.70	149.79	96.9
25	106.7	0.179	268.64	187.24	81.4
30	95.0	0.159	286.90	224.69	62.2
35	85.9	0.144	302.58	262.14	40.4
40	78.6	0.132	316.35	299.59	16.8
45	72.5	0.122	328.66	337.04	-8.4
50	67.5	0.113	339.82	374.48	-34.7
55	63.2	0.106	350.02	411.93	-61.9
60	59.5	0.100	359.45	449.38	-89.9
65	56.3	0.094	368.21	486.83	-118.6
70	53.4	0.090	376.41	524.28	-147.9
75	50.9	0.085	384.12	561.73	-177.6
80	48.6	0.082	391.40	599.18	-207.8
85	46.5	0.078	398.30	636.62	-238.3
90	44.7	0.075	404.86	674.07	-269.2
95	43.0	0.072	411.13	711.52	-300.4
100	41.4	0.070	417.12	748.97	-331.9
105	40.0	0.067	422.87	786.42	-363.6
110	38.7	0.065	428.39	823.87	-395.5
115	37.5	0.063	433.71	861.32	-427.6
120	36.3	0.061	438.83	898.76	-459.9
125	35.3	0.059	443.79	936.21	-492.4

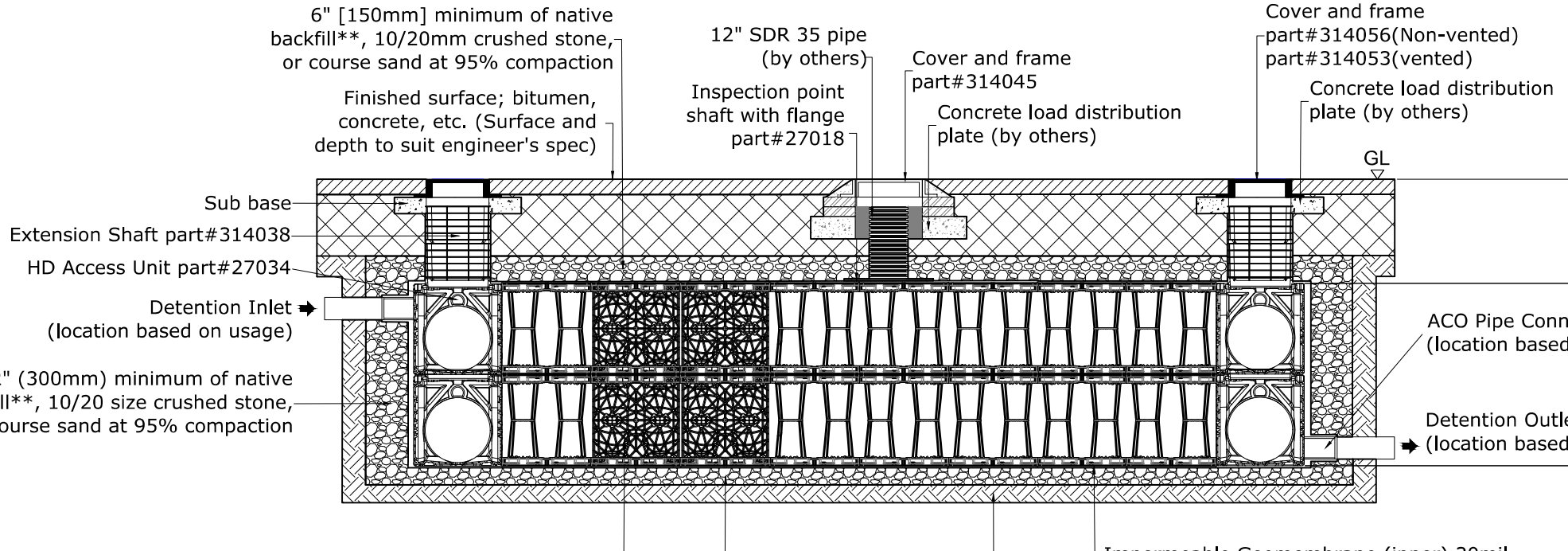
Orifice Flow Calculation

Pipe Diameter	250	mm
Area	0.049	m^2
Maximum WL	228.51	m
Invert	227.87	m
Head (h)	0.51	m
Co-efficient	0.80	
Flow (Q) : $CA(2gh)^{0.5}$		
	0.1248	m^3/s

APPENDIX B

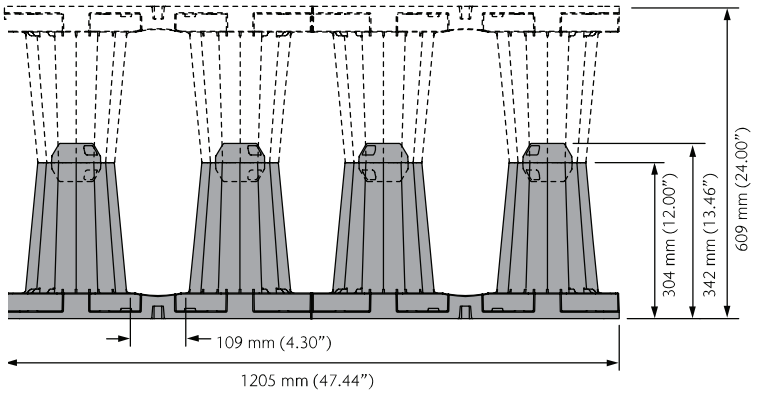
UNDERGROUND STORAGE SPECIFICATIONS

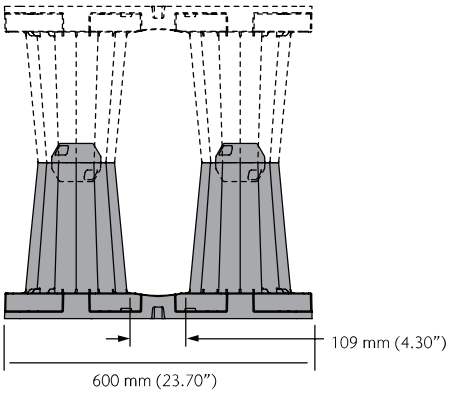

Length to Suit
Width to Suit
Detention Inlet
Detention Outlet

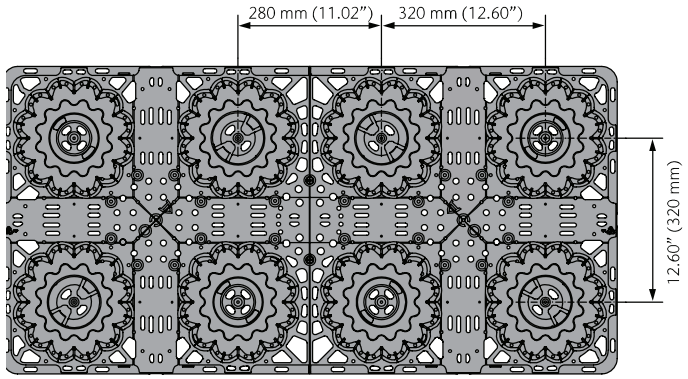

6" [150mm] minimum of native backfill**, 10/20mm crushed stone, or course sand at 95% compaction
Finished surface; bitumen, concrete, etc. (Surface and depth to suit engineer's spec)
12" SDR 35 pipe (by others)
Inspection point shaft with flange part#27018
Cover and frame part#314045
Concrete load distribution plate (by others)
Cover and frame part#314056(Non-vented) part#314053(vented)
Concrete load distribution plate (by others)
GL
Sub base
Extension Shaft part#314038
HD Access Unit part#27034
Detention Inlet (location based on usage)
12" (300mm) minimum of native backfill**, 10/20 size crushed stone, or course sand at 95% compaction
ACO Pipe Conn (location based
Detention Outle (location based

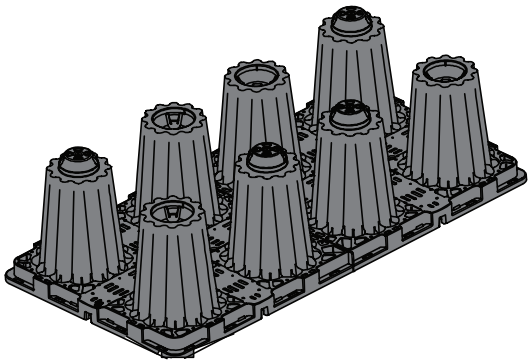
Stormwater Detention/Infiltration/Retention System

Half module unit

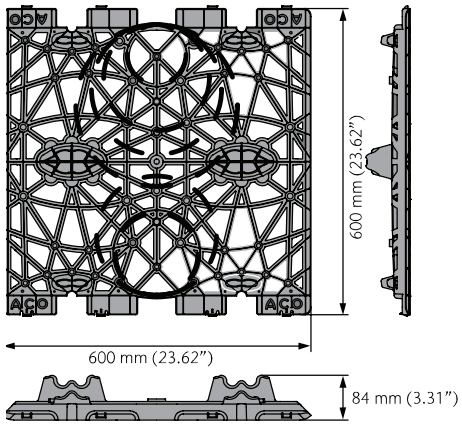




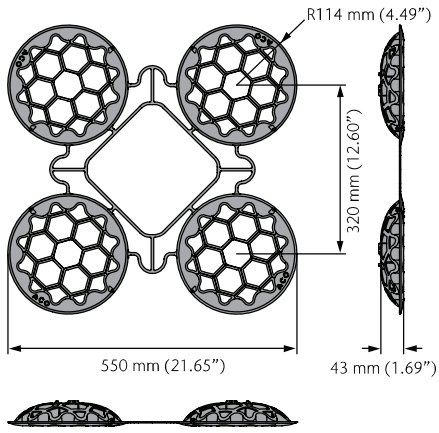




Side panel



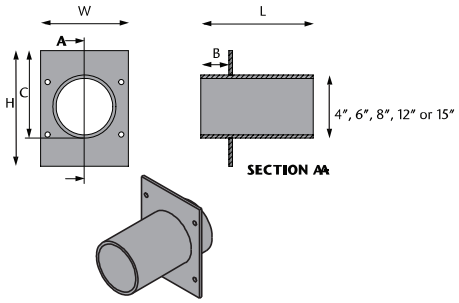
Top cover



ACO Specification Information

ACO Specification Information

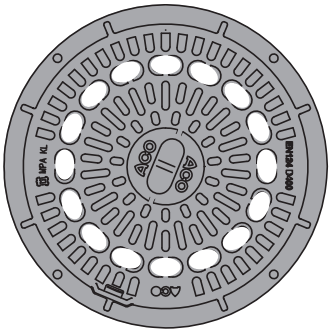
Horizontal pipe connector



	B mm (in)	C mm (in)	H mm (in)	W mm (in)	L mm (in)
SDR35 - 4"	51 (2.00)	186 (7.33)	210 (8.29)	170 (6.70)	203 (8.00)
SDR35 - 6"	51 (2.00)	227 (8.95)	252 (9.93)	259 (10.22)	203 (8.00)
SDR35 - 8"	51 (2.00)	265 (10.46)	289 (11.39)	295 (11.64)	203 (8.00)
SDR35 - 12"	51 (2.00)	342 (13.48)	363 (14.30)	423 (16.66)	203 (8.00)
SDR35 - 15"	51 (2.00)	471 (18.61)	493 (19.44)	493 (19.44)	203 (8.00)

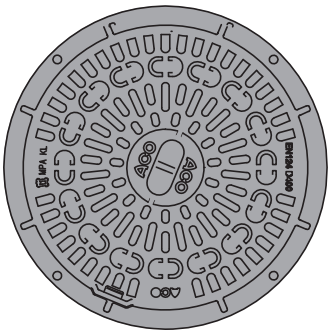
Access cover and frame

Vented



Part No. 314053

Non vented



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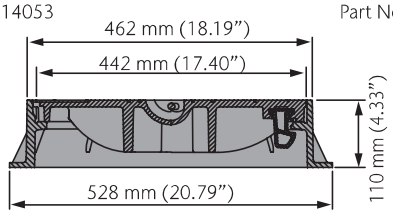
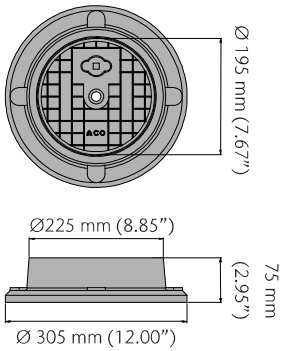


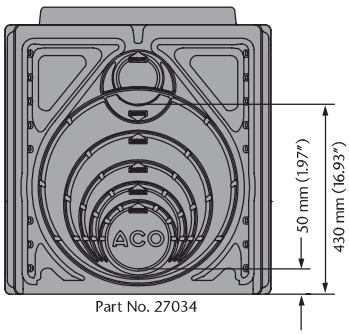
Inspection point cover and frame



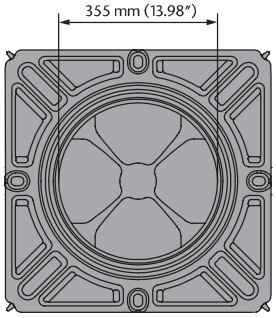
Part No. 314044

Remote access unit

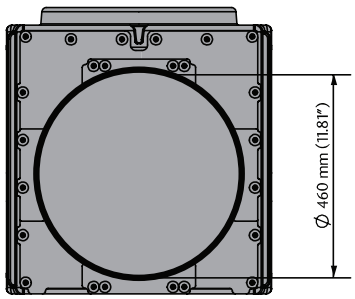
Remote access unit



Part No. 27034



Remote access unit with adapter plate



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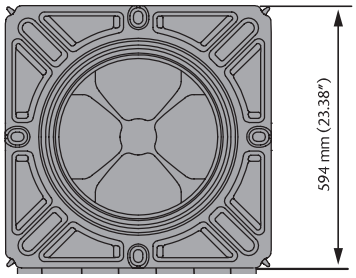
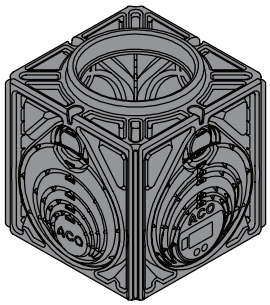
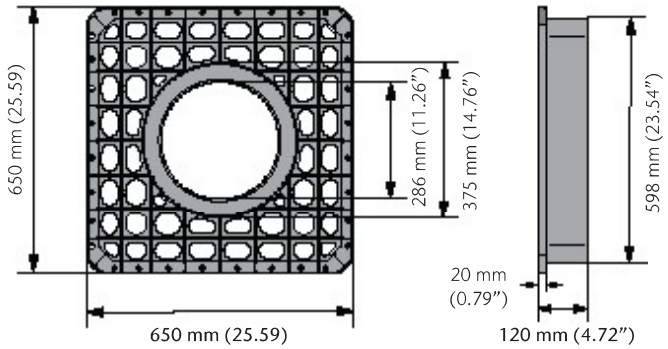
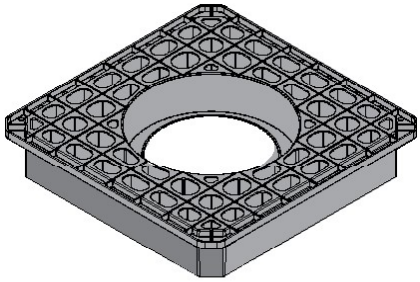




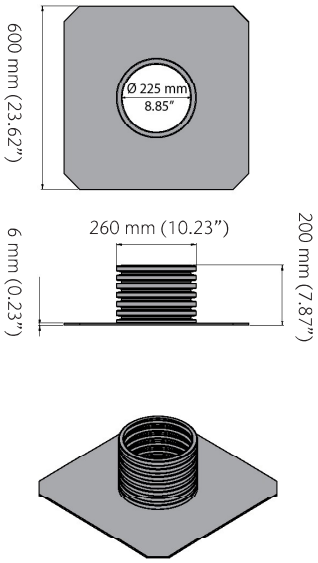
Remote access plate



Part no. 314075

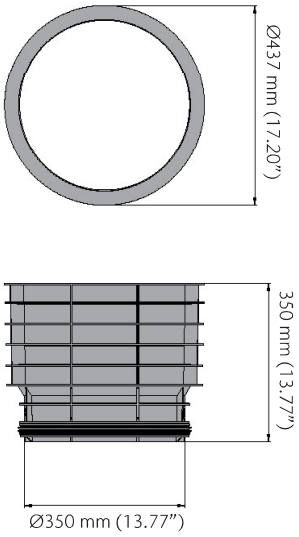


Inspection point connecter



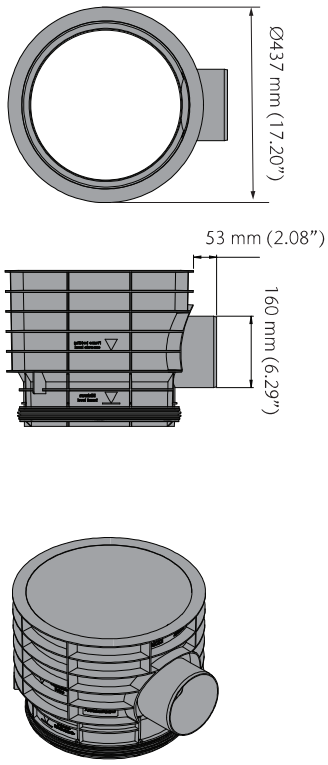
Part no. 27018

Inspection shaft



Part no. 314038

Inspection shaft with socket



Part no. 314039

ACO Specification Information

ACO STORMBRIXX HD

Stormwater Detention/Infiltration/Retention System

Parts Table

	Dimensions				
	Length mm (in)	**Width** mm (in)	**Depth** mm (in)	**Weight** kg (lbs)	**Part No.**
StormBrixx HD Half-module	1205 (47.44)	600 (23.62)	342 (13.46)	9.9 (22.0)	**314061**
StormBrixx HD Side Panel	600 (23.63)	600 (23.62)	55 (2.17)	1.6 (3.50)	**314062**
StormBrixx HD Top Cover	548 (21.57)	548 (21.57)	43 (1.70)	0.80 (1.7)	**314022**
Layer connectors	100 (3.94)	40 (1.58)	46 (1.82)	0.10 (0.2)	**314023**
Remote Access Plate	660 (25.99)	660 (25.99)	120 (4.73)	6.21 (13.70)	**314075**
Remote Access Unit	595 (23.39)	595 (23.39)	610 (24.02)	31.93 (70.4)	**27034**
Remote Access Unit with Adaptor Plate	620 (24.41)	594 (23.39)	610 (24.02)	31.93 (70.4)	**138140**
Remote Access Cover - Ductile Iron (Load Class D400)	528 (20.79)	528 (20.79)	110 (4.34)	39.30 (86.46)	**314043**
Remote Access Vented Cover - Ductile iron (Load Class D400)	528 (20.79)	528 (20.79)	110 (4.34)	37.92 (83.6)	**314053**
Inspection Point Cover - Ductile iron	Ø160* (6.30)	Ø160* (6.30)	-	52.00 (114.6)	**314044**
Access Shaft Module	437 (17.21)	437 (17.21)	350 (13.78)	2.50 (5.5)	**314038**
Access Shaft Module with Socket	437 (17.21) DND/OD 160	437 (17.21) DND/OD 160	350 (13.78)	2.80 (6.1)	**314039**
Vertical Inspection Point Connector	-	Ø8.86* (225)	200 (7.88)	2.50 (5.5)	**27018**
Horizontal Pipe Connectors					
SDR35 - 4"	-	102* (4.00)	-	0.87 (1.93)	**93139**
SDR35 - 6"		152* (6.00)	-	1.49 (3.29)	**93140**
SDR35 - 8"		203* (8.00)	-	1.95 (4.31)	**93141**
SDR35 - 12"		305* (12.00)	-	3.17 (7.00)	**93142**
SDR35 - 15"		381* (15.00)	-	4.89 (10.80)	**93144**

Specifications

General
The storm water Detention*/Infiltration*/ Retention* system shall be ACO Stormbrixx HD as distributed by ACO Systems, Ltd. Meets AASHTO H-25 and HS-25 loading conditions.

Materials
The half module body shall be manufactured from polypropylene and have minimum properties as follows:
Tensile impact strength:
319 kj/m^2 (152 ft-lb/in^2)
Tensile strength, ultimate:
23,994 kpa (3,480 psi)
Water absorption: 0.01%
Frost proof, salt proof and fuels and oils resistant

The stormwater tank shall provide an average 95% open area[1], holding up to 0.41[1] m^3 (14.71 cubic feet[1])per cell (2 half modules assembled) and offer full access to all areas and levels for maintenance.

Geomembranes/Geotextiles
The StormBrixx system shall be wrapped in appropriate permeable geotextile* or impermeable geomembrane with geotextile protection* (supplied by others) as indicated by project design engineer.

Accessories
The StormBrixx system shall be used in conjunction with inspection shaft**/access chamber**. See separate Spec Info sheets and related drawings for further details.

Installation
The StormBrixx storm water system shall be installed in strict accordance with the manufacturer's installation instructions and recommendations.

* Choose one /** Choose none, one or more
[1] Configuration and use of side/top panels will marginally impact these figures

ACO Specification Information

ACO Systems, Ltd

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2910 Brighton Rd.
Oakville, ON L6H 5S3
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Fax: (905) 829-2908

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112-1750 Coast Meridian Rd.
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Electronic Contact
info@acocan.ca
www.acostormbrixx.ca

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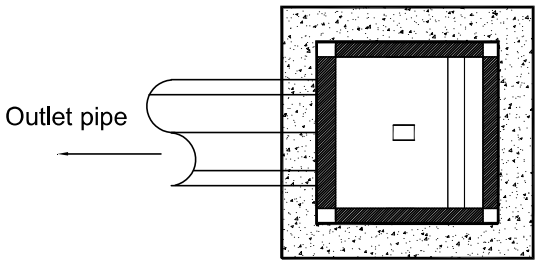
APPENDIX C

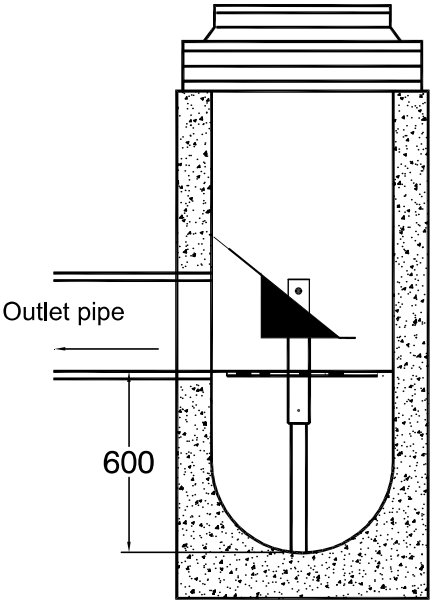
CB SHIELD SPECIFICATIONS

Notes

1. CB Shield to be installed in non frozen conditions.
2. The frame and cover should be well aligned with the catchbasin for proper installation
3. The sump must be clean before installation
4. The grate is at the same elevation as pipe invert.
5. Pipes must be cut flush with inside walls



Top view



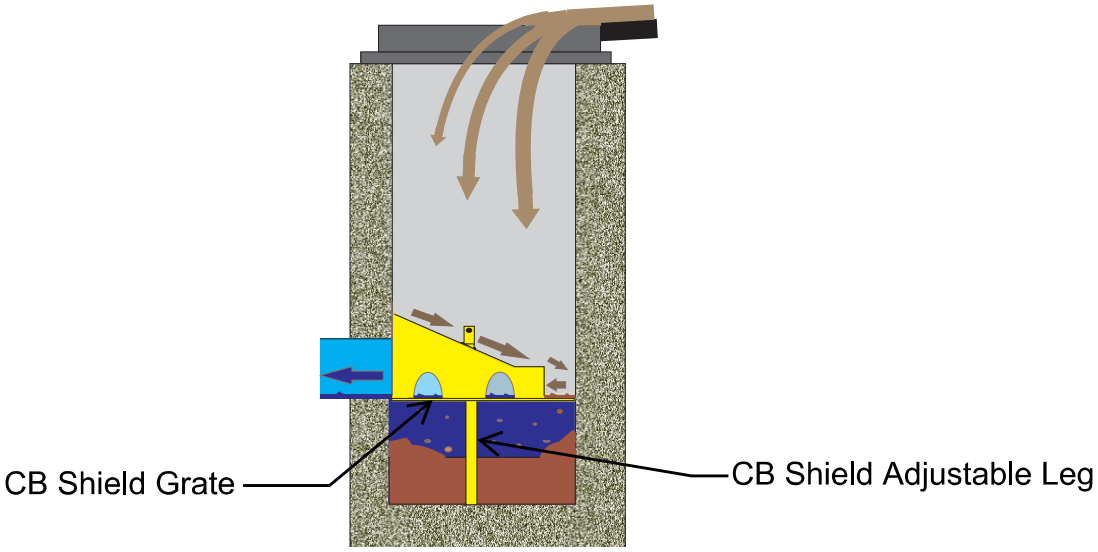
Profile view

600 x 600 CB
CB Shield (600mm Sump)

CB Shield Operations Manual

Installing CB Shield

It is important the catch basin frame and cover is aligned properly with the catch basin below
If it is misaligned it may be difficult to install the CB Shield insert
Determine the depth of the sump (i.e. the distance from the invert of the outlet pipe to the bottom of the catch basin). If the catch basin is in service the sump depth will be the depth of the water. The grate section of the CB Shield insert should be the same elevation as the water depth in the sump.



Adjust the leg of the CB Shield to achieve the appropriate elevation
The CB Shield is lowered into place with the rope attached to the top of the leg. The high side of the sloped plate should face the wall with the outlet pipe. (The incoming water should be directed to the wall furthest from the outlet)
The flexible plastic skirt around the outer edges of the CB Shield insert may interfere with some misaligned frame and grates. If so a slice can be cut into the skirt with a utility knife at the point of interference.
Make sure the grate is at the desired level or remove CB Shield and re-adjust the leg length.

Inspecting a CB Shield Enhanced Catch Basin

Open grate
A lifting rope is attached to the top of the centered leg of the CB Shield insert. Lift and remove the insert.
Inspect CB Shield for any possible damage. Quite often leaves will accumulate on the grate. This can actually improve the Shield's ability to capture sediment and assist in preventing leave litter from being washed down stream.
Use a Sludge Judge to measure the sediment depth in 4 - 6 locations of the sump.
If the sediment depth is 300mm – 600mm deep it is recommended that the unit be cleaned.

Cleaning a CB Shield Enhanced Catch Basin

Open grate and remove CB Shield with lift rope.
Clean catch basin as usual with a Vacuum truck.
Clean CB Shield (if needed) and re-install into catch basin.
If there is any significant damage to a CB Shield please send a picture and its location to CB Shield Inc. (info@cbshield.com).

Canadian ETV Verification Report

Performance Testing of Catch Basin Shield Technol

FINAL – STRICTLY CONFIDENT

Date: 17 October 2016

Prepared For:
GLOBE Performance Solutions

Prepared By:
Toronto and Region Conservation Au

Authentication

Dated: 17 October 2016
Approved by:

Name: Tim Van Seters
Title/Position: Senior Manager
Department: Sustainable Technologies,
Organization: Toronto and Region Conservation Authority

Verification Report Outline for CB Shield Inc.

Catch Basin Shield Technology

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Disclaimer

The Toronto and Region Conservation Authority ("TRCA") including its employees and Directors, (the participated in the Canadian Environmental Technology Verification (ETV) Program verification of the "Vendor") Catch Basin Shield Technology.

Any reference to the "Technology" refers to the Vendor's Catch Basin Shield Technology.

The Verifier is in no way affiliated with the Vendor.

The Vendor shall not edit or modify the report in any way or make any attempt to misrepresent data to the Vendor. Selectively using sections of the report in order to change or misrepresent its overall mea prohibited.

Claim verification by the Verifier does not represent any guarantee of the performance or safety of the

The Verifier shall not be liable in any way in the event that the Technology fails to perform as advertise and/or CB Shield Technology does not meet government-mandated health and safety standards.

To the extent permitted by law, the Verifier denies all liability to the Vendor or to any other person or loss, damage, costs, expenses and/or other compensation, arising directly or indirectly from the use of whole or on part) and/or any information contained therein.

The Vendor is wholly responsible for ensuring that the Technology complies with all applicable legisla and other authorities.

Executive Summary

The CB Shield Technology was subjected to verification in accordance with the Canadian ETV Program Verification Protocol, and taking into account the current draft of the proposed FDIS ISO 14034.

The verification process was mutually agreed upon by GLOBE Performance Solutions, the Verification Toronto and Region Conservation Authority ("TRCA"), the subcontracted Verification Expert. The purp verification is to provide objective and quality-assured performance data on environmental technologi developers, regulators, and consultants can make informed decisions about purchasing and applying t technologies.

This report, prepared by TRCA according to the criteria and guidelines set out in the Canadian ETV Pro Verification Protocol (GVP) of June 2012, is an official audit of the testing report generated through the testing of the CB Shield technology. The report is based on the Canadian ETV Program.

In addition, through guidance provided by GPS, the TRCA completed its verification of the CB Shield te performance taking into account the principles and requirements of FDIS ISO 14034.

Performance testing for this verification took place at Good Harbour Laboratories in Mississauga, Onta Harbour Laboratories conducted the testing and followed the test sediment particle size distribution a methods outlined in the *Procedure for Laboratory Testing of Oil-Grit Separators* developed by Toronto Conservation Authority for the Canadian ETV Program.

CB Shield Technology is based on established scientific and technical principles in the field of fluid dyn sedimentation/settling, hydrology and sediment transport.

The technology incorporates an insert for catchbasins that aims to deflect and reduce the energy of inf increase capture and reduce scour of sediment found in stormwater runoff.

After examination and audit of the test report and based on the test data submitted, the TRCA has conc CB Shield insert provides an environmental benefit related to capture and scour prevention of suspend stormwater runoff.

Accordingly, the TRCA recommends that the performance claims be worded as follows:

1. During the sediment capture test, for a catch basin with a false floor set to 50% of the manufact recommended maximum sediment storage depth and a constant influent sediment concentration of 20 catch basin with a CB Shield insert removed 64, 59.9, 52.4, 42.6, 25.2, and 26.7 percent of influent sedi inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s, respectively.

2. For a catchbasin filled to three quarters of the manufacturer's recommended maximum sedime with the CB Shield™ insert, scouring of test sediment is at most 8% of the control catchbasin during a minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

1. Introduction

GLOBE Performance Solutions (GPS) which operates the Canadian ETV Program on behalf of Environn engaged the Toronto and Region Conservation Authority ("TRCA") to verify the performance of CB Shi within the framework of a subcontracted agreement. The CB Shield technology is a technology for cap from storm water runoff when inserted inside street drains (catchbasins) and retaining sediment by p and re-suspension.

GLOBE Performance Solutions, in collaboration with the TRCA, has further agreed to prepare a verifica verification statement that will meet the requirements of the Canadian ETV Program.

This verification report, prepared by the TRCA (the Verifier), in its capacity as a Canadian ETV Progran Expert (VE), constitutes a review of the application of the CB Shield technology based on the Canadian General Verification Protocol (GVP) and taking into account the principles and requirements of FDIS IS

The verification report is a summary record of the audit undertaken by the TRCA to verify the Vendor' performance claim.

CB Shield applied for technology verification through GLOBE Performance Solutions. Testing was carri Good Harbour Laboratories in accordance with ISO 17025 requirements. TRCA examined the test rep the verification report.

The CB Shield Technology is based on established scientific and technical principles in the field of _flui sedimentation/settling, hydrology and sediment transport. The technology incorporates an insert for deflects incoming water to the sidewalls dissipating its energy and passing it over a grate where veloci and residence time is increased allowing sediments to drop out of suspension and be captured. The dis influent water energy also reduces scouring of already captured sediment during subsequent storms.

CB Shield's performance claims as submitted were:

1. For a catch basin containing sediment up to 150mm below the outlet invert, use of a CB Shield™ scour of ETV sediment by a factor of at least 20 for stormwater inflows from 1.2-15.6L/s.
2. In addition use of CB Shield™ increases capture of ETV test sediment in all cases and by at least respectively for flows of 2.4L/s and 8.4L/s.

Results showed that the initial claim for capture test could not be verified for individual flow rates as i between samples of different flow rates could not be maintained since the captured sediment was not between the tests of different flow rates. A re-test was requested for the capture test. The re-test was c catchbasin with CB Shield insert without reference to a control catch basin. Results showed removal e ranging from 64.0 - 26.7% for inflow rates ranging from 0.24 - 8.40 L/s respectively.

The scour test was evaluated as a continuous test. Comparing the CB Shield to the Control treatment i CB Shield scoured much less than the control catch basin at 5 minute duration inflow rates of 1.2, 4.8, 8 L/s.

1.1 Objectives

The objective of this report is to verify the performance claim made by CB Shield for the Catch Basin Sh This report summarizes the findings of the Canadian ETV Program Verification Expert, the TRCA, base and data contained in the Formal Application submitted by CB Shield to GLOBE Performance Solutions

Canada

2.3 Documents Reviewed

The technology and all information provided by the Applicant with the Formal Application, the formal binder and all subsequent transmittals to the Verification Expert were reviewed. The results of this Ap are summarized in the Application Review Checklist (Table 1) below.

Table 1: Application Review Checklist – Mandatory Information

Ref.	Criteria		Yes	No	Verifier Comments
1.1	Signed Formal Application.		☑	☐	
1.2	Signed Declaration Regarding Codes & Standards submitted with signed formal application.		☑	☐	
1.3	Technology provides an environmental benefit.		☑	☐	When installed in storm wa device reduces souring and retained sediment, thereby of sediment into the enviro
1.4	A copy of "Claim to be Verified" for each performance claim to be verified included with the Formal Application.		☑	☐	"Claim to be Verified" subm application.
1.5	Performance Claim composed in a way that satisfies "Criteria for Specifying Claims":		☐	☐	
	1.5.1	Include Technology name (and model number)	☑	☐	CB Shield™
	1.5.2	Include application of the technology	☑	☐	Applied as an insert into cat improve capture and reduc stormwater runoff sedimen
	1.5.3	Include specific operating conditions during testing	☑	☐	Test sediment: ETV test sed <u>Capture (Claim 1):</u> Constant influent concentra False floor set to 50% of the recommended maximum se (300 mm below the outlet i Inflow rates of 0.24, 0.48, 1. 8.40 L/s. <u>Scour (Claim 2):</u> Catchbasin filled to ¾ of the recommended maximum se depth Claim based on continuous 5 minute duration inflows o and 15.6 L/s.
	1.5.4	Does it meet the minimum requirement for the majority of	☑	☐	Signed Declaration Regardi

	1.5.6	Is the performance measurable?	☑	☐	Capture: To measure the capture per flow rate, a modified mass b is required, which can be do the sediment added to the s mass of sediment remaining mass of captured sediment. Scour: To compare scouring potent continuous test between the Shield treatments the total e calculated for the entire dur based on flow rate, duration concentration of individual
1.6	Standard operating practices and a description of operating conditions for each individual performance claim specified.		☑	☐	Tests are done in a lab on a scape with catchbasins clea In the field, on average there per hectare. Therefore, the r maximum flow rate (15.6L/ test will be meaningful for r 78 L/s per hectare. The rang anticipated to match the ran expected at most installatio ETV test sediment: AGSCO 1 silica sediment blend. Background samples are tak all sources of sediment inpu Capture Test (Claim 1) Background samples taken per run to account for all so input Influent sediment concentra 200 mg/L (+/- 25mg/L) Tested flows: 0.24, 0.48, 1.2 These flow rates comply wit rates specified in the CETV procedures (40, 80, 200, 40 L/min/m^2), based on the eff area (0.36m^2) of the device. loading rate of 600 L/min/r Conducted with a false bott below the outlet invert. Effluent was not recirculate through. Sediment injected 16.5 mm

1.7	The proponent has supplied significant references describing or supporting scientific and engineering principles of the technology.	☐	☐	Proponent claimed that scie underlying the CB Shield ar accepted knowledge of fluid sedimentation/settling, hyd sediment transport. Link to broken.
1.8	Two or more names and contact information of independent experts (with no vested interest in the technology), qualified (backgrounds of experts are needed) to review the scientific and engineering principles on which the technology is based. These experts must be willing to be contacted by the VE.	☑	☐	Greg Williams (Ph.D., P.Eng) Jenn Drake (Ph.D)
1.9	Brief summary of significant human or environmental health and safety issues associated with the technology. (Note: this criterion complements but does not replace the obligation for the applicant to submit a duly signed "Declaration Regarding Codes and Standards")	☑	☐	Brief descriptions given abo safety issues associated wit environment during installa cleanout of catchbasins (co confined spaces), and sedim Persons involved with insta and or maintaining CB Shiel be trained in accordance wi for servicing regular catchb
1.10	Brief summary of training requirements needed for safe, effective operation of technology, and a list of available documents describing these requirements. (Note: this criterion complements but does not replace the obligation for the applicant to submit a duly signed "Declaration Regarding Codes and Standards")	☑	☐	Link to video instructions th installation and removal of provided; a list of general p given.
1.11	Process flow diagram(s), design drawings, photographs, equipment specification sheets (including response parameters and operating conditions), and/or other information identifying the unit processes or specific operating steps in the technology. If feasible, a site visit to inspect the process should be part of the technology assessment.	☑	☐	Photographs of lab setup, fl water flow through the simu and links to videos showing sampling methods were pro
1.12	Supplemental materials (optional) have been supplied which offer additional insight into the technology application integrity and performance, including one or more of the following:	☐	☑	
	A copy of patent(s) for the technology, patent pending or submitted.	☐	☑	
	User manual(s).	☐	☑	
	Maintenance manuals.	☐	☑	
	Operator manuals.	☐	☑	
	Quality assurance procedures.	☐	☑	
	Sensor/monitor calibration program.	☐	☑	
	Certification for ISO 9001, ISO 14000, or similar.	☐	☑	
	Material Safety Data Sheet (MSDS) information.	☐	☑	

3. Review of the Technology

3.1 Technology Review Criteria

The results of the Technology Review are summarized in the Technology Review Criteria Checklist (Ta

Table 2: Technology Review Criteria Checklist

Ref	Criteria	Yes	No	Verifier Comments
2.1	The technology is based on scientific and technical principles. (Note: It will be necessary for the Verifier to read the key articles and citations listed in the Formal Application. It may also be necessary to contact the independent experts listed in the Formal Application to obtain additional information)	☑	☐	The technology is a flow def dissipates the energy of infl scour and increasing captur principles underlying the te based on well-known areas sedimentation/settling, hyd sediment transport.
2.2	The technology is supported by peer review technical literature or references. (Note: Peer review literature and texts must be supplied with the Formal Application as well as relevant regulations and standards that are pertinent to the performance claim)	☐	☐	Currently the link to peer re inaccessible.
2.3	The technology is designed, manufactured, and/or operated reliably. (Note: Historical data from the applicant, not conforming to all data criteria, may be useful for the Verifier to review to assess the viability of the technology not for verification, but for insight purposes)	☑	☐	CB Shield is said to be const using quality fiberglass. No term studies to comment or reliability.
2.4	The technology is designed to provide an environmental benefit and not create an alternative environmental issue. (e.g., It does not create a more hazardous and/or unmanaged byproduct and it does not result in the transfer of an environmental problem from one media to another media without appropriate management of the subsequent contaminated media)	☑	☐	The technology provides an benefit of controlling sedim upstream locations by captu sediment from stormwater catchbasin. However, long t specifically about the cloggi by debris which would decr capacity requires further at
2.5	The technology conforms to standards for health and safety of workers and the public. (Note: The vendor must submit a signed "Declaration Regarding Codes & Standards", with the Formal Application. The Verifier should ensure that this signed document is included with the information that is reviewed for the performance claim verification)	☑	☐	Signed Declaration Regardi Standards was submitted.
Environmental Standards				
2.6	Technology achieves federal, provincial, and/or municipal regulations or guidelines for management of contaminated and/or treated soils, sediments, sludges, or other solid-phase materials.	☑	☐	
2.7	Technology achieves federal, provincial, and/or municipal	☑	☐	

2.10	Technology is a final prototype design prior to manufacture or supply of commercial units, or alternatively see 2.11. (Note: Verification of the performance claim for the technology is valid if based on a prototype unit, if that prototype is the final design and represents a pre- commercial unit. The verification will apply to any subsequent commercial unit that is based on the prototype unit design. The verification will not be valid for any commercial unit that includes any technology design change from the prototype unit used to generate the supporting data for the verification.	☐	☐	NA
2.11	Technology is a pilot scale unit used to provide data which when used with demonstrated scale up factors, proves that the commercial unit satisfies the performance claim.	☐	☐	NA
Operating Conditions				
2.12	All operating conditions affecting technology performance and the performance claim have been identified.	☑	☐	Operating conditions affecti performance were identifie Ref. 1.6.
2.13	The relationships among operating conditions and their impacts on technology performance have been identified. (Note: It is the responsibility of the Verifier to understand the relationship between the operating conditions and the performance of the technology, and to ensure that the impacts of the operating conditions and the responses of the technology are compatible)	☑	☐	Background concentration - mg/L to allow for accurate a performance in the laborato Water temperature – needs higher water temperatures viscosity allowing suspende settle quicker. However, wa has a negligible impact on s Standardized test sediment comparability between unit assessment of performance sediment sizes. Flow rates - lower flow rate higher percentage of captur False floor (used storage ca false floor will lower captur performance as sediment w the outlet invert <u>Capture test</u> Influent sediment concentra constant at 200 mg/L; studi to be a reasonable average s concentration in stormwate paved surfaces. Higher or l concentrations may change efficiencies
2.14	Technology designed to respond predictably when operated at	☑	☐	Based on the test results, th

2.16	Effects of variable contaminant loading or throughput rate must be assessed and input/output limits established for the technology. Note: If the application of the technology is to a variable waste source or expected (designed) variable operating conditions, then it will be necessary to establish acceptable upper and lower ranges for the operating conditions, applications and/or technology responses. Sufficient, quality data must be supplied to validate the performance of the technology at the upper and lower ranges for the operating conditions, applications and or technology responses detailed in the performance claim.	☑	☐	Scour: The tested flow rates were l 15.6 L/s. The catch basins w Shield were pre-loaded with Influent was clean water. Te continuous from one flow ra 1 minute transition periods Capture: The tested lower and upper are 0.24 and 8.40 L/s. Conta rates were controlled to hav inflow sediment concentrat
Other Relevant Parameters/Variables/Operating Conditions Note: The Verifier is expected to understand the technology and identify and record all relevant criteria, parameters, variables or operating conditions that potentially can or will affect the performance of the technology under assessment. It is practical to include all of these variables in Table 2 (i.e., from 2.17 to …).		☑	☐	Parameters mentioned from also affect field performanc the false floor represents th amount of sediment). Addit debris may accumulate and which was not evaluated in can be evaluated in a field c
2.17				
2.18				

4. Review of Test Plan, Test Execution and Data

4.1 Review of Test Plan and Execution of Test Plan

The results of the Test Plan Review are summarized in the Test Plan Design Assessment Criteria Check below.

Table 3: Test Plan Design Assessment Criteria Checklist

Ref.	Criteria			Verifier Comments
3.1	Was a statistician, or an expert with specialized capabilities in the design of experiments, consulted prior to the completion of the test program, and if so please provide the contact details	☑	☐	Greg Williams 416-624-2007 gwilliams@goodharbourla
3.2	Is a statistically testable hypothesis or hypotheses provided? (such that an objective, specific test is possible)	☑	☐	The testable hypothesis is with the CB Shield insert w sediment in stormwater ru basin without the insert. T be tested by a capture and test as follows:

3.3a	Does the test measure the parameters used in the performance claim hypothesis?	☑	☐	Capture test: Total amount of sediment a feeder is measured as well amount captured after eac modified mass balance is u calculate exactly how muc through the feeder as influ catchbasin and what perce for both treatments. Scour test: Performance test measure concentrations of control a treatments.
3.3b	Does the performance test control for extraneous variability?	☑	☐	The test was conducted un laboratory conditions, follo procedures, thereby limiti variability. More specifica was sampled to account fo concentrations that would controlled influent sedime concentration was measur rate to ensure auger feed r to influent flow rate to ach concentrations. When conc samples were analyzed, a b standard, and 100 mg/L st tested to account for instru systematic errors. For sedi suspension test, pre-loade allowed to settle for 12-24 are started. Water tempera monitored to not exceed 2 temperature can decrease and thereby increase sedim velocity.
3.3c	Does the performance test include only those effects attributable to the technology being evaluated?	☑	☐	To ensure effects are attrib technology evaluated, the c CB shield insert is evaluate catchbasin without the ins part of the scour test.
3.4	Does the performance test generate data suitable for analysis using the SAWs? (Note: It is preferable that tests are designed with the SAWS in mind before test plans are written)	☐	☑	The mixed model approach compare control and CB Sh scour test results requires recommended SAWs (the F program was used)
3.5	Does the performance test generate data suitable for analysis using other generic experimental designs? (Note: Performance testing and verification studies should be designed with the final data analysis in mind to facilitate interpretation and reduce costs)	☑	☐	Capture and scour tests ge the experimental design pr testing protocol which do n statistical analysis. Howeve compares control and CB S

3.7a	Are samples collected in a manner representative of typical process characteristics at the sampling locations? (e.g., the samples are collected from the source stream fully mixed, etc.)	☑	☐	Capture test: Sampling dor test Procedure. Upon comp remaining water from the decanted over a period of l The total sediment capture dried and weighed. Mass o remaining in the feeder is v subtracted from total mass at the beginning of the test amount fed. Scour test: Effluent grab samples are t basin outlet which will refl concentrations. A minimur samples was taken in 1000 attempted to be held under stream or passed under the the sample collection woul a single pass.
3.7b	Is data representative of the current technology?	☑	☐	The data reflects the effect inserted into a normal catc any other alterations to the inserted CB Shield is the ur commercially available.
3.7c	Have samples been collected after a sufficient period of time for the process to stabilize?	☑	☐	Samples were collected acc testing procedure, which w based on scientific principl among other things, sampl a representative and replic Capture test: Sediment is only fed once t reached and stabilized. A maximum of 30hrs is giv remaining water after a tes captured sediment is remo weighed. Scour: Once sediment is pre-loade filled up with water to the to sit for 12-24 hours befor tests. Changes in flow rates were and an effluent sample was approximately 30s to deter scouring was taking place were stabilizing.
3.7d	Have samples been collected over a sufficient period of time to	☑	☐	Capture test:

3.8	Are samples representative of operating conditions? (Note: A time lag occurs between establishing steady state conditions and stabilization of the observed process performance. This time lag depends in part on the time scale of the process)	☑	☐	Long term operating condi evaluated. The effect of deb in an in situ field setting ne considered as affecting the <u>Capture test:</u> Flow rates are monitored a sediment is only added onc is stabilized in order to ma specific flow rates that cov range of catchbasin inflow. Performance is representa that has used up 50% of th recommended Maximum S Depth and a constant inflo 200 mg/L. Because the sed at the end of each run, it ac performance of the unit du shut down as well. <u>Scour test:</u> Samples are representative operating condition of havi ¾ full of sediment. Scourin a continuous test where sc previous flow will affect su rates. After pre-loading the given for agitated sedimen period of 12-24 hours. Flo within 1 minute and a sam approximately 30s to captu potential when altering flo
3.9	Are samples representative of known, measured and appropriate operating conditions? (Note: This includes technologies that operate on short cycles and so have start and stop cycles which affects the operation of the technology. If the operating conditions are not vital but are recommended, then the reviewer must evaluate operating conditions)	☑	☐	The device is a passive dev deflect and reduce the ener inflow, which increases cap scour. The data were coll controlled laboratory co test sediment that includ sand sized particles char stormwater runoff. The on performance were no
3.10	Were samples and data prepared or provided by a third party? (Note: In some cases, where the expertise rests with the applicant, an independent unbiased third party should witness and audit the collection of information and data about the technology. The witness auditor must not have any vested interest in the technology.)	☑	☐	Data samples were analyze a third party laboratory (G Laboratories). Good Harbour Laboratorie 2596 Dunwin Drive, Missis 905 696 7276 goodharbourlabs.com

3.11c	The test plan design should have defined the acceptable values or ranges of values for key operating conditions, and the data collection and analysis methodology	☑	☐	Operating conditions: Flows tested (operating co expected general range of f catchbasin: capture test (0 test: (1.2-15.6 L/s). Water temperature needs t Unit tested having 50% of storage capacity filled. Data collection and analysi testing protocol. However, run additionally with a con comparison.

4.3 Data Validity Checklist

The results of the Data Validity Review are summarized in the Data Validity Checklist (Table 4) below.

Table 4: Data Validity Checklist

Ref.	Criteria	Yes	No	Verifier Comments
4.1	Were appropriate sample collection methods used (e.g. random, judgmental, systematic etc)? For example: simple grab samples are appropriate if the process characteristics at a sampling location remain constant over time. Composites of aliquots instead may be suitable for flows with fluctuating process characteristics at a sampling location. (Note: Sampling methods appropriate for specific processes may sometimes be described in federal, provincial or local monitoring regulations)	☑	☐	Capture test: The mass of sediments fed catchbasin and captured is to carry out a modified ma Scour test: Multiple effluent grab samp appropriate to evaluate the concentrations and thereby potential at each flow rate.
4.2	Were apparatus and/or facilities for the test(s) adequate for generation of relevant data? (i.e. testing was performed at a location and under operating conditions and environmental conditions for which the performance claim has been defined)	☑	☐	Facility/apparatus sufficien streetscape with a catchba without a CB Shield insert. calibrated and the auger fe monitored. The facility had manage the large amounts for testing.

4.5	Were acceptable protocols used for sample collection, preservation and transport? (Note: Acceptable protocols include those developed by a recognized authority in environmental testing such as a provincial regulatory body, ASTM, USEPA, Standard Methods)	☑	☐	
4.6	Were Quality Assurance/Quality Control (QA/QC) (e.g. use of field blanks, standards, replicates, spikes etc) procedures followed during sample collection? A formal QA/QC program, although highly desirable, is not essential, if it has been demonstrated by the vendor's information that quality assurance has been applied to the data generation and collection.	☑	☐	Replicates were taken and (refrigerated) for each sam Blank, 20 mg/L standard, a standard run during sampl
4.7	Were samples analyzed using approved analytical protocols? (e.g. samples analyzed using a protocol recognized by an authority in environmental testing such as Standard Methods, EPA. ASTM etc. Were the chemical analyses at the site in conformance with the SOPs (Standard Operating Procedures)?	☑	☐	The SSC samples were anal detailed in ASTM D3977-97 Test Methods for Determin Concentration in Water Sar
4.8	Were samples analysed within recommended analysis times (especially for time sensitive analysis such as bacteria)	☑	☐	Recommended storage tim samples were analyzed wit
4.9 a-e	Were QA/QC procedures followed during sample analysis? Namely:	☐	☐	
4.9a	Maintaining control charts	☑	☐	QA/QC (e.g., flow rates mor more than expected COV (<
4.9b	Establishing minimum detection limits	☑	☐	MDL is 1.26 mg/L.
4.9c	Establishing recovery values	☐	☑	
4.9d	Determining precision for analytical results	☐	☑	
4.9e	Determining accuracy for analytical results	☐	☑	
4.10 a-c	Was a chain-of-custody (full tracing of the sample from collection to analysis) methodology used for sample handling and analysis - Namely:	☐	☐	
4.10a	Are completed and signed chain-of-custody forms used for each sample submitted from the field to the analytical lab provided for inspection by the Verifier?	☑	☐	Chain of custody provided f sediment analysis. Samplin were done by GHL in their l
4.10b	Are completed and easily readable field logbooks available for the Verifier to inspect?	☑	☐	Field logbook from GHL wa the verifier.
4.10c	Are there other chain-of-custody methodology actions and documentation recorded/available (e.g. sample labels, sample seals, sample submission sheet, sample receipt log and assignment for analysis)?	☑	☐	GHL provided certificate of effluent concentration of th
4.11	Experimental Data Set is Acceptable (i.e., the quality of the data submitted is established using the best professional judgment of the Verifier)	☑	☐	The Verifier believes that th data quality set is acceptab Good Harbour Laboratories

4.5 Data Analysis Checklist

The intent of the data analysis checklist is to ensure that the appropriate statistical tools can be used
defensible manner (Environment Canada 2012). The checklist also emphasizes that an initial performan

5.1	Does the analysis test the performance claim being postulated? (Note: When conducting performance evaluations, under the Canadian ETV program, the alternative hypothesis of a "significant difference" without stating the direction of the expected difference will usually be unacceptable)	☑	☐	Capture test: analysis not r modified mass balance wil Scour test: mixed model is whether there is a significa effluent concentrations bet and Control treatments. A confidence interval for th means between the contro treatment will be calculate The standard error of the d required to calculate the co is calculated using a bootst statistical program. This m stringent on the assumptio which the data set does no
5.2	Does the analysis fit into a generic verification study design? For example, many other "generic" designs exist that are not explicitly covered by the Canadian ETV Program (e.g. ANOVA, ANCOVA, regression, etc.) that are potentially useful.	☑	☐	Capture test: Since there ar results of the tests are pres Scour test: Mixed model ar determine if there is a sign type of comparison of mea account non-independence between the Control and th treatments are used to com treatments.
5.2 a-c	Are the assumptions of the analysis met? Namely: (Note: A negative response means the Verifier needs to request further information)	☑	☐	Scour test: assumptions for include: 1. Linearity –depende result of a linear co independent variab 2. Absence of collinea should not be colli 3. Homoskedasticity - data should be app across the range of 4. Normality or residu important) – residu regression need to distributed 5. Absence of influent 6. Independence – mo linear model. Samp independent. Since not satisfied, a mix place of a linear mo model allows for no samples.
5.2.a	Did the data analyst check the assumptions of the statistical test used?	☑	☐	
5.2.b	Are the tests of assumptions presented?	☑	☐	

6.1a	Are the results statistically or operationally significant? Did the performance test result in a statistically significant test of hypothesis?	☑	☐	Capture test: Results are op significant. Removal efficie 64 to 26.7% for flow rates Scour test: results reflect c between control and CB Sh continuous scour test of di (0.24-8.4L/s) at 5 minute i mixed model analysis that non-independence betwee is a continuous test, the pr affect subsequent sample) the treatment (control vs. C significant effect on scouri
6.1b	To be operationally significant, does the technology meet regulatory guidelines and applicable laws?	☑	☐	Declaration regarding code have been signed.
6.2	Does the performance test have sufficient power to support the claim being made? Note: For performance test designs where acceptance of the null hypothesis results in a performance claim being met, the statistical power of the test must be determined (Note: A statistical power of at least 0.8 is the target. If the power of the verification experiment is less than this value, the Verifier should contact the Canadian ETV Program to discuss an appropriate course of action)	☑	☐	Capture test: No statistical conducted. Instead, a mass was used, which is regarde robust and scientifically va evaluating capture in storm sedimentation devices. Scour test: No suitable met power of a mixed model st available. However, the di the control catch basin and basin were very significant of effluent samples collecte the selected statistical met
6.3	Is the interpretation phrased in a defensible manner? Note: The final performance claim should reflect any changes to the claim made during the course of the analyses, variations or restrictions on operating conditions, etc. that changed the scope of the performance claim. The initial performance claim should be viewed as a tentative claim that is subject to modification as the verification progresses. A thoughtful open-minded verification will in the end, prove to be of greatest benefit to the technology developer.	☑	☐	Both claims were revised Capture test: Results for the capture test statistical test due to a lack However, since the analysi a control laboratory setting results would be replicable interpreted as results for a conditions. Scour test: Since the scour test was ru test, comparison between s cannot be made, but rather series. Using mixed models non-independence betwee significant difference was f two treatments. The interp to testing conditions, but ca to state the CB Shield scour the control catchbasin.
6.4	Data Interpretation is Acceptable	☑	☐	In general, the data interpr

5. Statistical Evaluation of Claims

The statistical evaluation of the claims put forward by the Vendor was carried out using the R statistica on some of the principles presented in Statistical Analysis Worksheets (SAWs) provided by GPS (as pe Canada 2012). The first claim (capture test) does not require a statistical evaluation since the entire "p sampled (total mass of influent and captured sediments are accounted for) and n = 1 for each flow rate follows the OGS protocol published by CETV and the analysis of which specifies a modified mass balan

The data set resulting from the scour test does not satisfy the assumption of independence. Therefore, (scour test) cannot be evaluated statistically using the provided standard SAWs that require normality approach is taken to confirm significant difference between results of control catchbasin and one with bootstrap simulation method is used in R to calculate the standard deviation from which confidence in quotient is derived to make estimates of the minimum performance limit.

5.1 Statistical Evaluation of Claim #1: Capture test

A modified mass balance approach is taken to analyze the treatment performance of capturing suspen various loading rates. Each flow rate is run only once due to feasibility related to testing duration and c influent sediment and total captured sediment is weighed and accounted for. Since there are no repeat statistical analysis is not carried out but rather the results of the modified mass balance is given as is.

5.1.1 Raw Data

The raw data provided by the Vendor is presented in Appendix D of the formal application.

5.1.2 Assessing Normality

This procedure is used to determine if the data variable is normally distributed or log-normally distrib important as the assumption of normality is often invoked in subsequent calculations.

– Not applicable

Assumptions:
- Not applicable

5.1.3 Testing if the Mean is Equal to Specified Value

This test is used to determine at a level of 95% confidence that the mean is not equal to some pre- μ_o. The value μ_o will often be the performance that a technology is claiming to achieve.
$H_0 : \mu_1 = \mu_o$

– Not applicable

Assumptions:
- Not applicable

Inferences:
No statistical inferences are made. Based on the modified mass balance approach, under specified oper of a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and influent sediment concentration of 200 mg/L, the catch basin with a CB Shield insert removed 64, 59.9 and 26.7 percent of influent sediment by mass at inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/

Table Z1: Summary of Acceptable Data Sets for Verification

Acceptable Data Set(s) Identification	SAWs Used	Supports Claim (Y/N)

each other, put forth as the assumption of independence. Since data from the scour test fails to meet th
mixed model approach is taken.

A mix model is a linear model that includes a "mix" of fixed and random effects. Effects that are consta
sample are fixed effects (i.e., the treatment) while effects that are variable for each sample(run/flow ra
effects and in part treated as a random error term. A "full" model is created with all fixed and random e
a "null" model that excludes the fixed effect that is in question of having a significant effect. The treatm
Shield vs. control) will be excluded in the null model. An ANOVA is used to compare the two models wh
determined to be significantly different from each other identifies the fixed effect in question (i.e., trea
significant effect.

Assumptions:

- Linearity: The dependent variable has to be a result of a linear combination of the independent var
  plot can be used as an indicator. Residuals should not exhibit a recognizable pattern (e.g., exhibit a
  decrease or a curved relationship)

- Homoscedasticity: Variance of the data should be approximately equal across the range of predicte
  Residuals on a residual plot should be approximately equal distance from the Y=0 line.

- Absence of collinearity: Fixed effects should not be collinear (very closely related) to each other so
  be difficult to distinguish between their effects.

- Normality of residuals: Linear model are relatively robust against violations of normality assumpti
  least important assumption to satisfy. Normality of residuals can be checked using a q-q plot.

- Absence of influential data points

5.2.3 Calculating the 95% confidence interval for the effluent load mean quotient of the two treatments

To make a claim on the effluent load performance of the CB Shield relative to the control treatment, th
mean effluent loads is calculated and expressed as a percentage. The 95% confidence interval of the qu
is calculated and the lower limit is used in the claim to reference the minimum performance as require
instead of the mean performance.

A bootstrap simulation method is used in R to calculate the standard deviation of the distribution of ef
the two treatments as an effective means of correcting for non-normal distribution. The calculated sta
is used with GraphPad's web application (http://www.graphpad.com/quickcalcs/errorProp1/) to esti
confidence intervals of the quotient. The application assumes normal distributions for the datasets, wh
satisfied, the robust bootstrapping method used to calculate the standard deviations is believed to give
estimates of the minimum performance without introducing complications of transforming and retran
variables.

Assumptions:

- Data set is normally distributed: although not satisfied, the robust bootstrapping method used to c
  standard deviations is believed to give good estimates of the calculated minimum performance wit
  abstractions of transforming and retransforming variables.

Inferences:

Based upon the above inferences, it can be concluded that for a catchbasin filled to three quarters of th
recommended maximum sediment storage depth, with the CB Shield™ insert, scouring of test sedimen
of the control catchbasin during a continuous 30 minute scour test run with 5 minute duration inflows

Table 2. Scour test results for CB Shield protected and control catch basins (from Environmental Technology Verification (ETV): Supporting documentation for Canadian ETV program formal application – October 2015)	GraphPad web application is used to calculate 95% confidence interval of the quotient of mean effluent loads of the two treatments.	Y

6. Audit Trail

The items in Table 8 are useful in determining reasons for data discrepancies.

Table 8: Key documents

Raw data sheets and summary data	Yes
Signature pages	Yes
Signed Formal Application	Yes
Declaration Regarding Codes & Standards	Yes
Patent(s)	NA (Patent Pending)
Sample security: e.g. chain of custody sheets for each sample	Chain of custody for sediment effluent sample since collected analyzed by same lab.
Operation and maintenance manual	Operation and maintenance v
Field notebooks	Provided
Certificate of accreditation of laboratories	GHL not accredited but allowe verifier since an internal verif documented in the validation AA20120409-01.

7. Conclusion

CB Shield's technology performance claims have been verified as follows:

1. Capture test:

   During the sediment capture test, for a catch basin with a false floor set to 50% of the manufacture
   maximum sediment storage depth and a constant influent sediment concentration of 200 mg/L, the
   a CB Shield insert removed 64, 59.9, 52.4, 42.6, 25.2, and 26.7 percent of influent sediment by mass
   0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s, respectively.

2. Scour Test:

   For a catchbasin filled to three quarters of the manufacturer's recommended maximum sediment s
   with the CB Shield™ insert, scouring of test sediment is lowered by at least 81% compared to a con
   during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, a

The verified claims concur with the verification report.

8. References

Environment Canada. 2012. Environmental Technology Verification – General Verification Protocol (G
Application & Assessment of Technology. [online] http://etvcanada.ca/wp-content/uploads/2013/05
Verification-Protocol_Canadian-ETV-Program_June2012-May2013.pdf [accessed June 2016]. Environn
Science and Technology Programs, Science and Technologies Strategies Directorate, Science and Techn
Gatineau, QC.

ISO/FDIS 14034:2015, Environmental management – Environmental technology verification (ETV)

ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories

Appendices

Appendix A. Statistical Analysis

Appendix A contains the detailed worksheets of the statistical analysis undertaken to confirm the CB S
performance claims.

A.1 Claim 1: Capture Test

No statistical analysis performed. It is not feasible to do repeated tests for the capture test. Instead, a r
balance is calculated by weighing the mass of all influent and captured materials to arrive at removal e

A.2 Claim 2: Scour Test

A.2.1 Mixed model analysis: Testing for significant difference between scour test effluent loads of control and CB S using

A "linear mixed model" approach is taken to compare the effluent loads of the CB Shield and Control tr

The scour test is run continuously with test sediment of a specified PSD preloaded and having flow rat
minute intervals (1.2, 4.8, 8.4, 12.0, and 15.6 L/s). Effluent loads of the two treatments cannot be comp
at each flow rate since preceding flow rates affect the amount of sediment left to scour during subsequ
a result, for each treatment all collected effluent concentrations are treated as part of a single dataset.
conventional statics used for comparison of means analysis (i.e., t-test) requires each sample to be ind
other, put forth as the assumption of independence. Since data from the scour test fails to meet this ass
mixed model approach is taken.

A mixed model can represent a "mix" of fixed and random variables. In our study, treatment will be a fi
each run (different flow rate) will be treated as a random effect. More specifically, we account for the i
treatment and run factor as the random effect. The analysis is carried out in "R" statistical software usi
function of the "lme4" package. To assess if the fixed factor "treatment" (CB Shield, Control) has a signi
the model, both a "full" model and a "null" model are created, with and without the fixed effect of "trea
respectively. An ANOVA is run to compare the "full" and "null" model and a significant difference betw
models indicates that the fixed factor "treatment" is a significant effect. This indicates a significant diffe
responses (effluent loads) of the two treatments.

There are 6 assumptions for linear models:

1. Linearity: The dependent variable has to be a result of a linear combination of the independent
   residual plot can be used as an indicator. Residuals should not exhibit a recognizable pattern (e
   increase or decrease or a curved relationship)

2. Homoscedasticity: Variance of the data should be approximately equal across the range of pred
   Residuals on a residual plot should be approximately equal distance from the Y=0 line.

3. Absence of collinearity: Fixed effects should not be collinear (very closely related) to each other
   not be difficult to distinguish between them.

4. Normality of residuals: Linear model are relatively robust against violations of normality assum

```
plot(fitted(model_full), residuals(model_full))
]
```

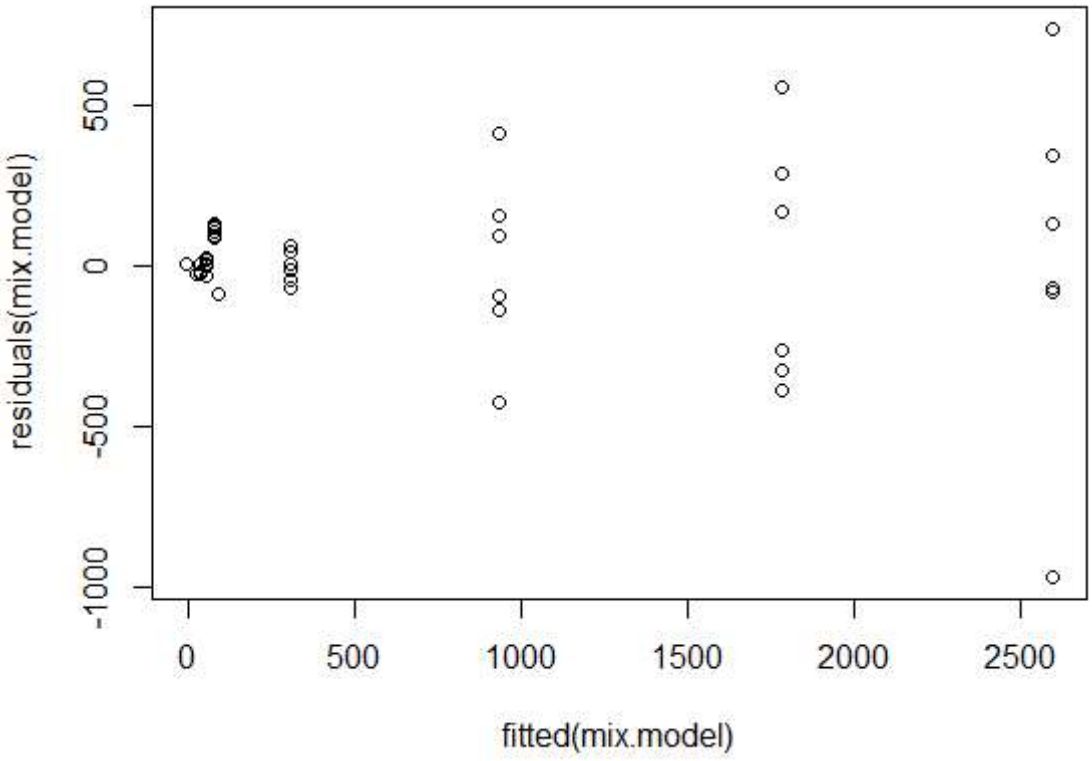
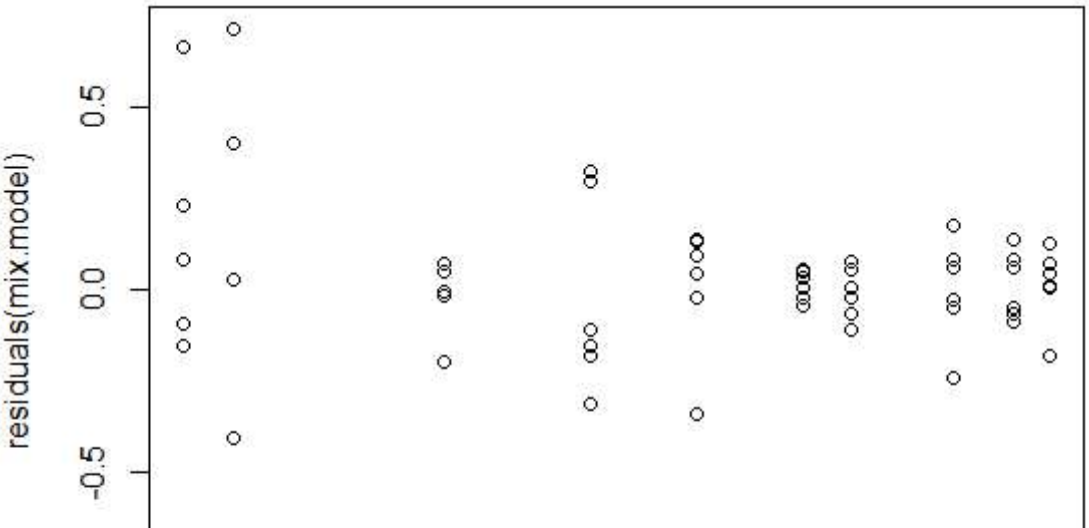


Figure A1. Residual vs. fitted model.

There seems to be a pattern where the residuals of this model are increasingly dispersed. As a result, t
variable (loads) is transformed logarithmically and the assumptions are re-tested.

```
Code [
model_full = lmer(loads_g_log ~ treatment + (treatment|run), data=test.data, REM
model_null = lmer(loads_g_log ~ (1|run), data=test.data, REML=FALSE)

plot(fitted(model_full), residuals(model_full))
]
```



```
plot(fit.norm)
]
```

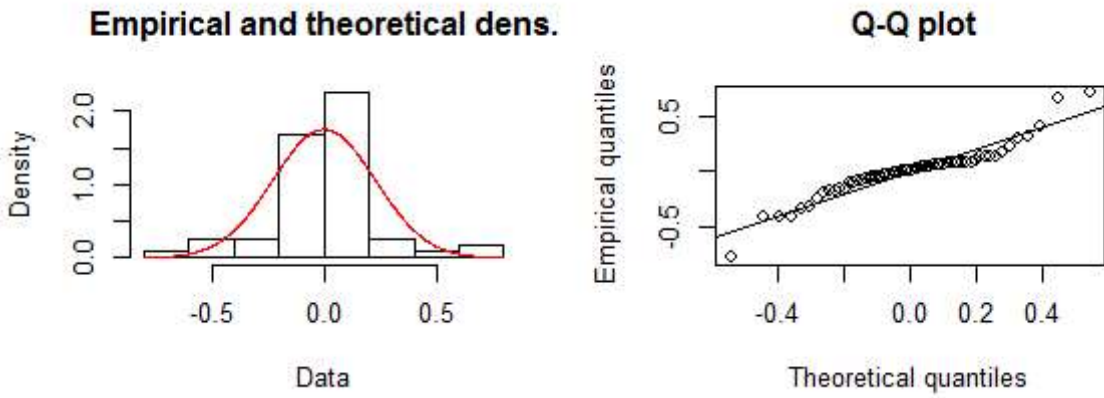


Figure A3. Histogram and Q-Q plot of residuals

Based on figure A3, the model satisfies assumption 4.

Assumption 5: Absence of influential data points

```
Code[
#LOAD LIBRARY
library(influence.ME)

# DFBETA VALUES SHOULD NOT BE MORE THAN 2/sqrt of n;  "n" BEING NUMBE
FOR THE GROUPING FACTOR (THERE ARE 5 RUNS/FLOW RATES)
2/(sqrt(5)) # equals 0.8944272

estex.mix.model <- influence(mix.model, "run")
dfbetas(estex.mix.model, parameter =c(0))
]
```

Table A1. DFBETAS values fixed factor by runs.

Run/flow rates	Intercept	treatmentControl
S1	-0.64651330	-0.02705247
S2	-0.50157391	0.88798512
S3	-0.05102875	0.34856408
S4	0.45949187	-0.29719975
S5	0.81812841	-0.93360428

All DFBETA values are less than 2/sqrt of n (2/(sqrt(5)) = 0.8944272); "n" being number of values fo
factor (there are 5 runs/flow rates). Assumption 5 is also satisfied.

ANOVA comparing the full and null model, with and without the fixed factor of treatment respectively

```
Code[
anova(model_full, model_null)
]
```

Table A2. Results for ANOVA comparing the full and null model with and without

Mean of CB Shield/ Mean of Control
= 52.150/1131.910
=0.046
= The mean effluent load of the CB Shield treatment is 5% of the Control treatment.

Confidence Interval:
Using the standard deviation calculated in Table A1, the following GraphPad web application was used
confidence interval:
http://www.graphpad.com/quickcalcs/errorProp1/

CI of a sum, difference, quotient or product
Mean of CB Shield **divided by** Mean of Control = 0.046

Table A2. Confidence intervals calculated using bootstrapped standard error at the 90, 95, and 99 perc
GraphPad web application)

90% CI:	0.026	to	0.073
95% CI:	**0.023**	**to**	**0.080**
99% CI:	0.016	to	0.096

"These results assume that both variables follow a Gaussian distribution and that the measurements o
not paired or matched to measurements of Control. Although the datasets are not entirely normally dis
standard error used to calculate the standard deviation was derived using a bootstrap method which i
decrease the stringency on the requirement of normality.

Results computed by the method of EC Fieller, Suppl to
J.R.Statist.Soc, 7,1-64 summarized here. "

Based on the calculated confidence interval, the effluent load of the CB Shield during the scour test is a
of the Control treatment.

Appendix B. Supplemental Verification Checklist Pursuant to ISO/FDIS 14034:2015

Appendix B provides a supplemental verification checklist pursuant to ISO/FDIS 14034:2015. It may b
verifier to include this completed Appendix in the final Verification Report.

ISO/FDIS 14034:2015 Checklist Principles, procedures and requirements for ETV		
Reference	Requirements (Criteria)	Verifier Comments
1. Applicant Information	1.1 Applicant name(s), address(es) and physical location(s)	Applicant names and addresses prov
2. Technology Description	2.1 A unique identifier for the technology (e.g., a commercial name,	The technology is uniquely identifie Shield™.

	technology proposed for verification and its readiness for market (Note: Technology proposed for verification shall be either already available on the market or available at least at a stage where no substantial change affecting its performance will be implemented before market entry)	line is set up to make 100s at a time.
	3.6 Information on relevant alternatives of the technology, including relevant performance and environmental impacts	Current alternatives are in some for either as a guard surrounding the ca or as a pouch directly under the inle which all inflow passes through. Mo alternatives to the CB shield include are more expensive to install or retr CB Shield can be simply inserted int catch basin.
	3.7 Information on significant environmental impacts of the technology proposed for verification and its environmental added value, if applicable.	Yes, the technology will reduce dow transport of suspended sediment wi stormwater runoff received in the ca
	3.8 Does the technology fulfil the definition of environmental technology?	Definition: "technology that either re environmental added value or meas parameters that indicate an environ impact". The CB Shield inserted into results in an environmental added v decreased effluent suspended sedim concentration from catchbasins.
4. Operational aspects	4.1 Are the Installation and operating requirements and conditions described?	Yes, installation, operating requirem conditions are detailed within the ap addition to links for videos that show and lab testing.
	4.2 Are the service and maintenance requirements described?	Yes, service and maintenance would required by normal catchbasins in te cleanout. The technology is manufac strong fiberglass material making it
	4.3 Is information provided on the expected length of time for which the technology functions under normal operating conditions?	The applicant expects the technolog normally given its durability combin regular cleanout cycle of less than 2 specific life expectancy is provided.
5. Legal and regulatory context	5.1 Is information provided on the relevant legal requirements and/or standards related to the technology and its use?	Yes.

	7.4 Are the performance parameters relevant and sufficient for verification of the performance of the environmental technology, and the environmental added value, if applicable?	Yes, the performance parameters inc improvement to sediment capture a
	7.5 Can the performance claims be quantitatively verified through testing?	For the claim regarding removal effi determined through the capture test will be simply stated in the form of a For the scour analysis, a significance between control and CB shield catch verified and the absolute difference
	7.6 Can their numerical values be verified under set operating conditions, using existing verification plans and relevant technical references, including standardized testing methods, preferably based on international standards?	Their numerical values and analysis performance claims were attained b Good Harbour Laboratory under set conditions following for the greater testing protocol published by TRCA.
8. Test data	8.1 Are relevant test data and the methods for acquiring these data provided to support the performance claim?	Testing methodology, videos taken d and relevant test data were provided the performance claims.
	8.2 Are specifications of the requirements for the test data provided, including quality and quantity and testing conditions?	Specific testing conditions were liste regarding flow rates, time for each r the sump (false floor), and amount o added to list a few.
	8.3 Is a description provided of the methods for the assessment of the test data and their quality?	Description of the methods used to a and its quality were provided.
	8.4 Are the data at a quality level generally accepted by the scientific community for the technology and/or the industrial sector concerned?	Yes.

	9.2 Do the test data confirm the performance of the technology, achieved under the same conditions, constraints and limitations as those specified?	Yes. Few requests made for proof of for alteration of claim composition v
	9.3 Are the performance claims verified as originally stated?	No.
	9.4 If the performance claims are not verified as originally stated, how should they be modified?	Capture test: During the sediment ca a catch basin with a false floor set to manufacturer's recommended maxi storage depth and a constant influen concentration of 200 mg/L, the catch CB Shield insert removed 64, 59.9, 5 and 26.7 percent of influent test sedi at inflow rates of 0.24, 0.48, 1.20, 2.4 8.40 L/s, respectively. Scour test: For a catchbasin filled to of the manufacturer's recommended sediment storage depth, with the CB insert, scouring of test sediment is a the control catchbasin during a cont minute scour test run with 5 minute inflows of 1.2, 4.8, 8.4, 12.0, and 15.6

Appendix C. Verification Guidance Pursuant to ISO/FDIS 14034:2015

Appendix C provides guidance on performance testing and verification of technologies pursuant to ISO 14034:2015

1. Definition of Roles:

Verifier - Organization that performs environmental technology verification

Test body - Organization that performs testing, test-implementation and reporting on the testing of an technology

Applicant – Organization proposing a technology for which performance will be verified through envir technology verification

2. Terminology

2.1 Terms related to verification

Verification - Confirmation through the provision of objective evidence

Verification Plan - Detailed planning document for implementation of the environmental technology ve

Verification Report - Document detailing the environmental technology verification and its results

Verification Statement - Document summarizing the results of the environmental technology verificati

Test Plan - Detailed planning document specifying the principles, testing methods, conditions and proc to carry out testing and to produce test data

Data Quality - Characteristics of data that relate to their ability to satisfy stated requirements [SOURCE 14040:2006]

Test Report - Document describing conditions and results of testing

2.2 Terms related to technology

Technology - Application of scientific knowledge, tools, techniques, crafts, or systems in order to solve achieve an objective, which can result in a product or process

Product - Any goods or service [SOURCE: ISO 14050:2009]

Process - Set of interrelated or interacting activities that transforms inputs into outputs [SOURCE: ISO

Environmental Technology - Technology that either results in an environmental added value or measu that indicate an environmental impact

3.1 Principles

General - The purpose of environmental technology verification is to provide a credible and impartial a
performance of environmental technologies. Environmental technology verification is based on a num
to ensure that verifications are performed and reported accurately, clearly, unambiguously and objecti

Factual approach - Verification statements are based on factual and relevant evidence collected throug
confirmation of the performance of environmental technologies.

Sustainability - Environmental technology verification is a tool in support of sustainability, by providin
information on the performance of environmental technologies.

Transparency and credibility - Environmental technology verification is based on reliable test results a
procedures. The process is facilitated such that, to the greatest extent feasible, methods and data are fu
reports are clear, complete, objective and useful to the interested parties.

Flexibility - Environmental technology verification allows for flexibility in the specification of performa
and test methods. This is achieved through dialogue among the applicant, verifier and interested partie
utility of environmental technology verification.

3.2 Requirements

When verifying performance of environmental technologies, the requirements of ISO/FDIS 14034 and
version of ISO/IEC 17020 Conformity assessment – requirements for the operation of various types of
performing inspection - shall be applied and demonstrated.

4. Application review

4.1 Administrative review

Administrative review shall ensure that all information requested for the application has been provide
with the requirements specified.

4.2 Technical review

Technical review shall ensure that:
a) The technology fulfils the definition of environmental technology
b) The performance claim for the intended application of the technology addresses the needs of the int
c) The information on the technology is sufficient to review the performance claim.

4.3 Feedback to Applicant

Any issues related to the acceptance or rejection of the application that may arise from the administrat
technical review shall be resolved prior to the verification. Acceptance or rejection of the application s
communicated to the applicant with justification.

b) Identification of the applicant;
c) Unique identification of the verification plan and date of issue;
d) Description of the technology;
e) A list of performance parameters and their assigned numerical values and the description of how th
verified;
f) Technical and operational details of the planned verification;
g) Specification of the requirements for the test data, including quality and quantity and testing condit
h) Description of methods for the assessment of the test data and their quality.

NOTE:
- Requirements on data and data quality should refer to the quality level (e.g. regarding reproducibility
ranges of confidence, accuracy, uncertainties,) generally accepted by the scientific community for the t
default) in the industrial sector concerned.
- Other existing verification plans, similar relevant technical references including applicable legislation
standardized test methods, preferably international standards, should be used or referred to whereve

6. Verification

The verification of the performance shall be organized as follows: i) acceptance of existing test data; ii)
additional test data if needed and iii) confirmation of the performance based on the results of test data

6.1 Acceptance of existing test data

Test data provided by the applicant which were generated prior to verification may be accepted for th
they meet the following requirements:
a) They are relevant for the performance to be verified;
b) They are produced and reported according to the requirements of ISO/IEC 17025;
c) They meet the requirements specified in the verification plan.

If the existing test data do not meet the above requirements then additional test data shall be generate
communicated to the applicant.

6.2 Generation of additional test data

If any additional test data is required, they shall be produced meeting the requirements specified. This
communicated to the applicant.

6.3 Confirmation of performance

Existing test data, that is accepted and additional test data that is generated shall be assessed against t
specified in the verification plan. The result of the assessment shall be a confirmation of the performan
technology, achieved under the same conditions, constraints and limitations as those specified for the
test data used for verification.

7. Reporting

a) Identification of the verifier;
b) Identification of the applicant;
c) Unique identification of the statement and date of issue;
d) A summary description of the technology;
e) A summary description on how the requirements specified in the verification plan were met;
f) Verification results including the verified performance;
g) Description on how the requirements of the verification specified in the verification plan were met i
reporting of any deviations
h) A summary of the verification results including the verified performance, test conditions, constraint
under which they are met;
i) A statement that the verification plan has been addressed,
j) Any other information necessary to understand and use the verification statement
k) Signature or other indication of approval by the verifier.

If it is necessary to include, information not verified under the environmental technology verification t
clearly stated and explained. The statement shall be submitted to the applicant for review and commer
may be incorporated as deemed appropriate.

8. Post-verification

8.1 Publication

At a minimum, the verification statement should be made available publicly. The publication shall be in
publicly available directory (e.g. website).

The applicant shall make the statement available to interested parties in full and shall not use parts of
any purpose.

8.2 Validity of the verification report / verification statement

The applicant shall:
a) Ensure that the technology which performance has been verified is conforming to the conditions as
verification, published verification statement and report, if relevant;
b) Inform the verifier, in writing, of any changes that are made to the technology.

Based on the information provided by the applicant, the verifier shall determine the impact of any char
verified performance of the technology to the verification conditions, and therefore the validity of the v
statement and the verification report.

If it is determined that the verification statement and verification report are no longer valid, it shall be
to the applicant and made publicly available

8.3 Expiration

An expiration date may be established on the verification statement. After the defined time period, upo
that no changes affecting the verified performance have occurred in the technology, the validity of the
statement could be extended under the same conditions.

Appendix D. Raw data

Capture test raw data

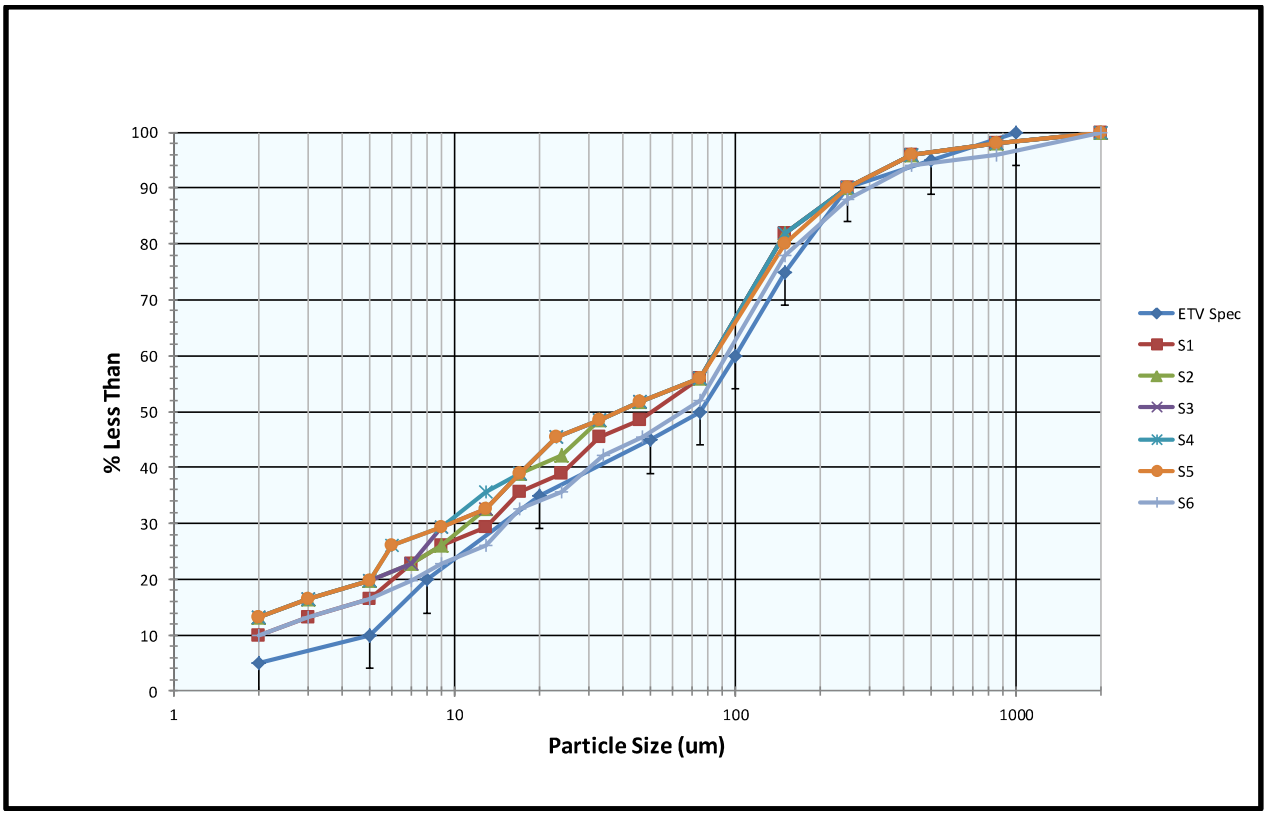


Figure D1. Feed sediment particle size distribution.

Table D1. Removal efficiency based on mass balance.

Run		S1	S2	S3	S4	S5	S6
Target Flow Rate	(L/s)	0.24	0.48	1.2	2.4	6.0	8.4
	(gpm)	3.8	7.7	19.0	38.0	95.1	133
Sediment Mass Added	(kg)	1.217	2.302	5.072	5.150	4.921	4.812
Sediment Captured in Catch Basin	(kg)	0.765	1.368	2.643	2.184	1.238	1.287
Sediment Captured on FCS and Grate	(kg)	0.013	0.010	0.016	0.012	0	0
Total Mass Captured	(kg)	0.778	1.378	2.659	2.196	1.238	1.287
Removal Efficiency	(%)	64.0	59.9	52.4	42.6	25.2	26.7

Scour test raw data

Run Summary for CB Shield – Simulated Streetscape - Control (No CB Shield Installed)

Run Date: March 6th, 2015

Sediment Pre-load:

- The test sediment was the AGSCO silica sand (1-1000 micron)
- Sediment was pre-loaded on March 5th
- The total sediment load was 53 kg
- Following the preload, the sump was filled with water and allowed to sit overnight

Water Temperature:

Temperature at 1:00 minutes into run: 18.1 °C
Temperature at 7:00 minutes into run: 12.3 °C
Temperature at 13:00 minutes into run: 11.7 °C
Temperature at 52:30 minutes into run: 12.5 °C

Run Data:

Target Flow Rate	Run Time	Flow Rate
1.2 L/S (19 GPM)	0:00	19.3[1]
	0:30	19.7[1]
	1:00	19.8
	1:30	19.9
	2:00	19.9
	2:30	19.9
	3:00	19.9
	3:30	19.9
	4:00	19.8
	4:30	19.9
	5:00	19.9
	5:30	20.0
	6:00	22.3
Average Flow Rate (US GPM):		20.1
4.8 L/S (76 GPM)	6:30	74.2[1]
	7:00	76.3
	7:30	76.3
	8:00	76.3
	8:30	76.2
	9:00	76.2
	9:30	76.2
	10:00	76.0
	10:30	76.2
	11:00	76.1

	11:30	76.0
	12:00	80.7
Average Flow Rate (US GPM):		76.6
[1] Transition flow rate, not included in the average		
Target Flow Rate	Run Time	Flow Rate
8.4 L/S (133 GPM)	12:30	134.6[1]
	13:00	132.6
	13:30	132.9
	14:00	132.4
	14:30	132.5
	15:00	132.9
	15:30	132.8
	16:00	132.5
	16:30	132.7
	17:00	132.4
	17:30	132.6
	18:00	132.4
Average Flow Rate (US GPM):		132.6
12.0 L/S [2] (190 GPM)	25:00	185.2[1]
	25:30	188.7
	26:00	189.3
	26:30	189.5
	27:00	191.0
	27:30	191.0
	28:00	190.8
	28:30	190.8
	29:00	190.6
	29:30	191.0
	30:00	190.7
	30:30	191.2
Average Flow Rate (US GPM):		190.4
15.6 L/S [3] (247 GPM)	52:00	245.7[1]
	52:30	249.1
	53:00	248.2
	53:30	248.6
	54:00	248.0
	54:30	247.9
	55:00	247.9
	55:30	247.7
	56:00	248.1
	56:30	247.9
	57:00	247.8
	57:30	247.7
Average Flow Rate (US GPM):		248.1

[1] Transition flow rate, not included in the average

[2] The system was shut down between flow 8.4 L/s and flow 12.0 L/s due to standpipe overflow

[3] The system was shut down between flow 12.0 L/s and flow 15.6 L/s due to standpipe overflow

Effluent Analysis:

Run Time (minutes)	Sample ID	Sample Description	SSC (mg/L)	
			Measured	Correc
0:00	Background 1-1	Background sample taken at 1.2 L/s	< MDL	-
0:30	Effluent 1-1	1.2 L/s transition sample #1	94.3	94.3
1:00	Effluent 2-1	1st sample taken at 1.2 L/s	129.2	129.
2:00	Effluent 3-1	2nd sample taken at 1.2 L/s	185.3	185.
3:00	Effluent 4-1	3rd sample taken at 1.2 L/s	206.0	206.
4:00	Effluent 5-1	4th sample taken at 1.2 L/s	176.0	176.
5:00	Effluent 6-1	5th sample taken at 1.2 L/s	523.6	523.
6:00	Effluent 7-1	6th sample taken at 1.2 L/s	495.7	495.
7:00	Background 2-1	Background sample taken at 4.8 L/s	< MDL	-
6:30	Effluent 8-1	4.8 L/s transition sample #1	6420	642
7:00	Effluent 9-1	1st sample taken at 4.8 L/s	7164	716
8:00	Effluent 10-1	2nd sample taken at 4.8 L/s	8094	809
9:00	Effluent 11-1	3rd sample taken at 4.8 L/s	6762	676
10:00	Effluent 12-1	4th sample taken at 4.8 L/s	4842	484
11:00	Effluent 13-1	5th sample taken at 4.8 L/s	5266	526
12:00	Effluent 14-1	6th sample taken at 4.8 L/s	4768	476
13:00	Background 3-1	Background sample taken at 8.4 L/s	1.8	-
12:30	Effluent 15-1	8.4 L/s transition sample #1	6665	666
13:00	Effluent 16-1	1st sample taken at 8.4 L/s	5431	542
14:00	Effluent 17-1	2nd sample taken at 8.4 L/s	6649	664
15:00	Effluent 18-1	3rd sample taken at 8.4 L/s	5027	502
16:00	Effluent 19-1	4th sample taken at 8.4 L/s	5861	585
17:00	Effluent 20-1	5th sample taken at 8.4 L/s	5021	501
18:00	Effluent 21-1	6th sample taken at 8.4 L/s	3251	324
The system was shut down due to standpipe overflow				
25:30	Background 4-1	Background sample taken at 12.0 L/s	41.2	-
25:00	Effluent 22-1	12.0 L/s transition sample #1	1569	152
25:30	Effluent 23-1	1st sample taken at 12.0 L/s	1927	188
26:30	Effluent 24-1	2nd sample taken at 12.0 L/s	1474	143
27:30	Effluent 25-1	3rd sample taken at 12.0 L/s	1208	116
28:30	Effluent 26-1	4th sample taken at 12.0 L/s	1550	150
29:30	Effluent 27-1	5th sample taken at 12.0 L/s	1141	110
30:30	Effluent 28-1	6th sample taken at 12.0 L/s	749.5	708
The system was shut down due to standpipe overflow				
52:00	Effluent 29-1	15.6 L/s transition sample #1	Not tested	
52:30	Background 5-1	1st Background sample taken at 15.6 L/s	145.6	-
52:30	Effluent 30-1	1st effluent sample taken at 15.6 L/s	532.5	386.
53:30	Background 6-1	2nd Background sample taken at 15.6 L/s	179.2	-
53:30	Effluent 31-1	2nd effluent sample taken at 15.6 L/s	432.0	252.
54:30	Background 7-1	3rd Background sample taken at 15.6 L/s	182.4	-

56:30	Background 9-1	5th Background sample taken at 15.6 L/s	200.3	-
56:30	Effluent 34-1	5th effluent sample taken at 15.6 L/s	480.1	279.8
57:30	Background 10-1	6th Background sample taken at 15.6 L/s	210.0	-
57:30	Effluent 35-1	6th effluent sample taken at 15.6 L/s	520.2	310.2

MDL – Method detection limit

[4] $SSC_{corrected} = SSC_{measured} - SSC_{background}$

Run Summary for CB Shield Scour Testing

– Simulated Streetscape - With CB Shield Insert

Run Date: March 13th, 2015

Sediment Pre-load:

- The test sediment was the AGSCO silica sand (1-1000 micron)
- Sediment was pre-loaded on March 12th
- The total sediment load was 53 kg
- Following the preload, the sump was filled with water and allowed to sit overnight

Water Temperature:

Temperature at 1:00 minutes into run: 17.1 °C
Temperature at 7:00 minutes into run: 10.6 °C
Temperature at 13:00 minutes into run: 10.0 °C
Temperature at 19:00 minutes into run: 10.4 °C
Temperature at 25:00 minutes into run: 10.7 °C

Run Data:

Target Flow Rate	Run Time	Flow Rate
1.2 L/S (19 GPM)	0:00	17.7[1]
	0:30	18.8[1]
	1:00	18.8
	1:30	18.9
	2:00	18.9
	2:30	19.0
	3:00	18.9
	3:30	19.0
	4:00	18.9
	4:30	18.9
	5:00	18.9
	5:30	18.9
	6:00	18.9
Average Flow Rate (US GPM):		18.9
4.8 L/S (76 GPM)	6:30	50.9[1]
	7:00	76.6
	7:30	76.5
	8:00	76.2
	8:30	76.0
	9:00	75.8
	9:30	76.0
	10:00	76.0
	10:30	75.8

	11:00	75.8
	11:30	76.0
	12:00	75.9
Average Flow Rate (US GPM):		76.1
[1] Transition flow rate, not included in the average		
Target Flow Rate	Run Time	Flow Rate
8.4 L/S (133 GPM)	12:30	131.0[1]
	13:00	132.6
	13:30	132.5
	14:00	132.8
	14:30	132.7
	15:00	132.6
	15:30	133.0
	16:00	132.8
	16:30	132.8
	17:00	132.8
	17:30	132.8
	18:00	132.6
Average Flow Rate (US GPM):		132.7
12.0 L/S (190 GPM)	25:00	181.9[1]
	25:30	187.6
	26:00	188.5
	26:30	189.8
	27:00	189.4
	27:30	189.2
	28:00	190.0
	28:30	189.4
	29:00	189.6
	29:30	190.0
	30:00	189.9
	30:30	189.9
Average Flow Rate (US GPM):		189.4
15.6 L/S (247 GPM)	52:00	247.5[1]
	52:30	248.0
	53:00	247.8
	53:30	247.6
	54:00	247.5
	54:30	247.6
	55:00	247.7
	55:30	247.6
	56:00	247.6
	56:30	247.7
	57:00	247.6
	57:30	247.5
Average Flow Rate (US GPM):		247.7

Effluent Analysis:

Run Time (minutes)	Sample ID	Sample Description	SSC (mg/L)	
			Measured	Correc
0:00	Background 1-1	Background sample taken at 1.2 L/s	< MDL	-
0:30	Effluent 1-1	1.2 L/s transition sample #1	31.5	31.5
1:00	Effluent 2-1	1st sample taken at 1.2 L/s	17.7	17.7
2:00	Effluent 3-1	2nd sample taken at 1.2 L/s	6.5	6.5
3:00	Effluent 4-1	3rd sample taken at 1.2 L/s	2.7	2.7
4:00	Effluent 5-1	4th sample taken at 1.2 L/s	3.1	3.1
5:00	Effluent 6-1	5th sample taken at 1.2 L/s	4.6	4.6
6:00	Effluent 7-1	6th sample taken at 1.2 L/s	< MDL	< MD
7:00	Background 2-1	Background sample taken at 4.8 L/s	< MDL	-
6:30	Effluent 8-1	4.8 L/s transition sample #1	3.0	3.0
7:00	Effluent 9-1	1st sample taken at 4.8 L/s	8.2	8.2
8:00	Effluent 10-1	2nd sample taken at 4.8 L/s	4.0	4.0
9:00	Effluent 11-1	3rd sample taken at 4.8 L/s	< MDL	< MD
10:00	Effluent 12-1	4th sample taken at 4.8 L/s	< MDL	< MD
11:00	Effluent 13-1	5th sample taken at 4.8 L/s	1.7	1.7
12:00	Effluent 14-1	6th sample taken at 4.8 L/s	< MDL	< MD
13:00	Background 3-1	Background sample taken at 8.4 L/s	< MDL	-
12:30	Effluent 15-1	8.4 L/s transition sample #1	2.5	2.5
13:00	Effluent 16-1	1st sample taken at 8.4 L/s	5.4	5.4
14:00	Effluent 17-1	2nd sample taken at 8.4 L/s	10	10
15:00	Effluent 18-1	3rd sample taken at 8.4 L/s	9.5	9.5
16:00	Effluent 19-1	4th sample taken at 8.4 L/s	10	10
17:00	Effluent 20-1	5th sample taken at 8.4 L/s	8.4	8.4
18:00	Effluent 21-1	6th sample taken at 8.4 L/s	8.2	8.2
19:00	Background 4-1	Background sample taken at 12.0 L/s	1.6	-
18:30	Effluent 22-1	12.0 L/s transition sample #1	21.1	19.5
19:00	Effluent 23-1	1st sample taken at 12.0 L/s	40.0	38.4
20:00	Effluent 24-1	2nd sample taken at 12.0 L/s	81.0	79.4
21:00	Effluent 25-1	3rd sample taken at 12.0 L/s	115	113
22:00	Effluent 26-1	4th sample taken at 12.0 L/s	104	103
23:00	Effluent 27-1	5th sample taken at 12.0 L/s	116	114
24:00	Effluent 28-1	6th sample taken at 12.0 L/s	93.9	92.3
25:00	Background 5-1	1st Background sample taken at 15.6 L/s	2.0	-
24:30	Effluent 29-1	15.6 L/s transition sample #1	131.3	128.
25:00	Effluent 30-1	1st sample taken at 15.6 L/s	180.8	177.
26:00	Effluent 31-1	2nd sample taken at 15.6 L/s	214.9	211.
27:00	Effluent 32-1	3rd sample taken at 15.6 L/s	223.7	220.

28:00	Effluent 33-1	4th sample taken at 15.6 L/s	191.1	187.
29:00	Effluent 34-1	5th sample taken at 15.6 L/s	227.7	224.
30:00	Effluent 35-1	6th sample taken at 15.6 L/s	202.5	199.
30:00	Background 6-1	2nd Background sample taken at 15.6 L/s	4.6	-

MDL – Method detection limit

[2] $SSC_{corrected} = SSC_{measured} - SSC_{background}$

APPENDIX D

PHOSPHORUS LOADING CALCULATIONS

Summary

Site	Project Name	Project Title	Storm Type
Pre-Development	272 Innisfil Street	272 Innisfil Street	avg-annual
Post-Development	272 Innisfil Street	272 Innisfil Street	avg-annual

Water Balance Comparison

Site	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
Pre-Development Total	0.69 ha	847.60 mm 5,823.01 m^3	0.00 mm 0.00 m^3	172.04 mm 1,181.91 m^3	672.49 mm 4,620.00 m^3	175.11 mm 20.66 %
Post-Development Total	0.68 ha	847.60 mm 5,797.58 m^3	583.16 mm 3,988.83 m^3	196.03 mm 1,340.87 m^3	65.35 mm 447.00 m^3	782.25 mm 92.29 %
Difference	**0.00 ha**	**0.00 mm** **-25.43 m^3**	**583.16 mm** **3,988.83 m^3**	**23.99 mm** **158.96 m^3**	**-607.14 mm** **-4,173.00 m^3**	**607.14 mm** **71.63 %**
Difference	**-0.44 %**	**0.00 %**	**Infinity %**	**13.95 %**	**-90.28 %**	**346.72 %**

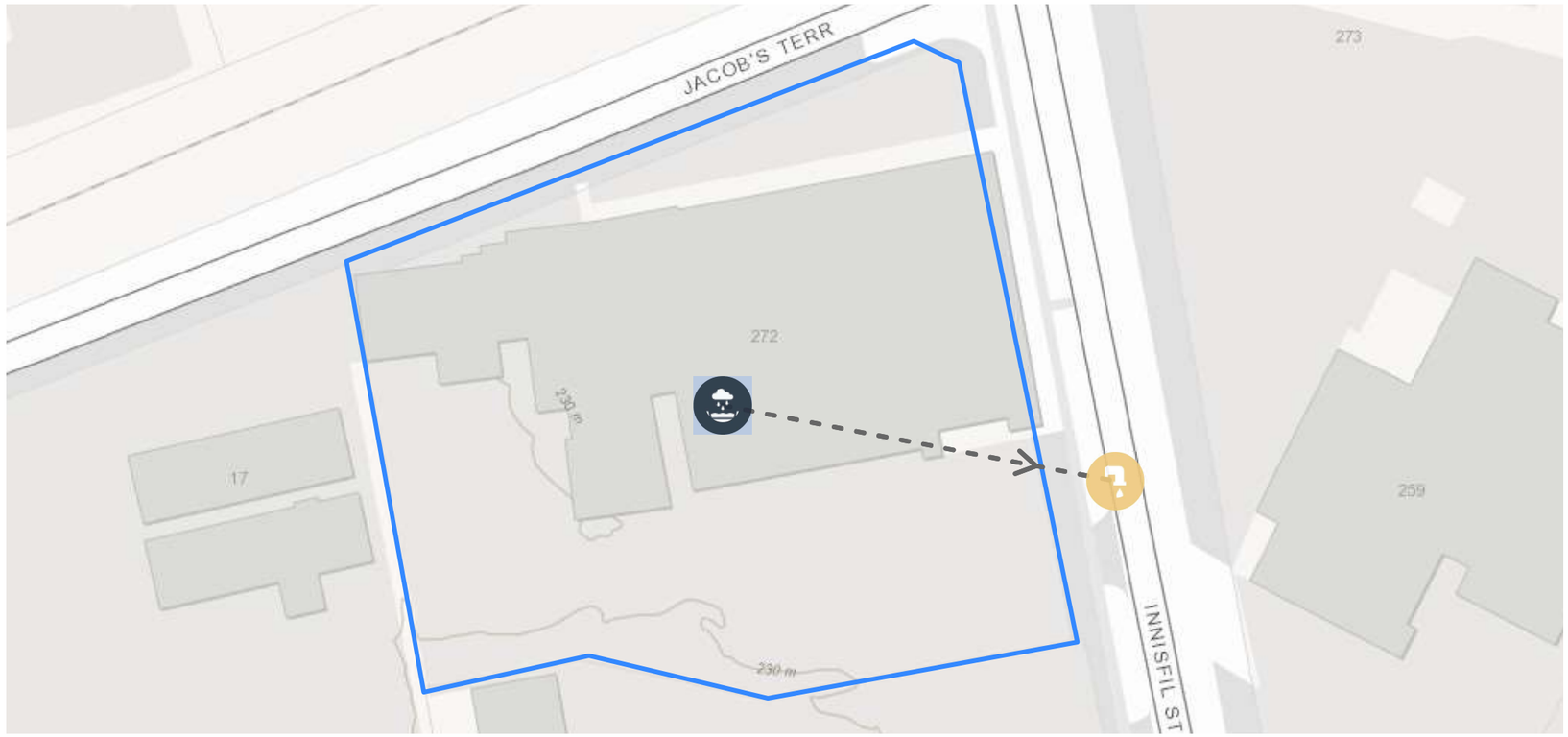
Water Balance | Pre-Development

Catchment	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
1	0.69 ha	847.60 mm 5,823.01 m^3	0.00 mm 0.00 m^3	172.04 mm 1,181.91 m^3	672.49 mm 4,620.00 m^3	175.11 mm 20.66 %
TOTAL	**0.69 ha**	**847.60 mm** **5,823.01 m^3**	**0.00 mm** **0.00 m^3**	**172.04 mm** **1,181.91 m^3**	**672.49 mm** **4,620.00 m^3**	**175.11 mm** **20.66 %**

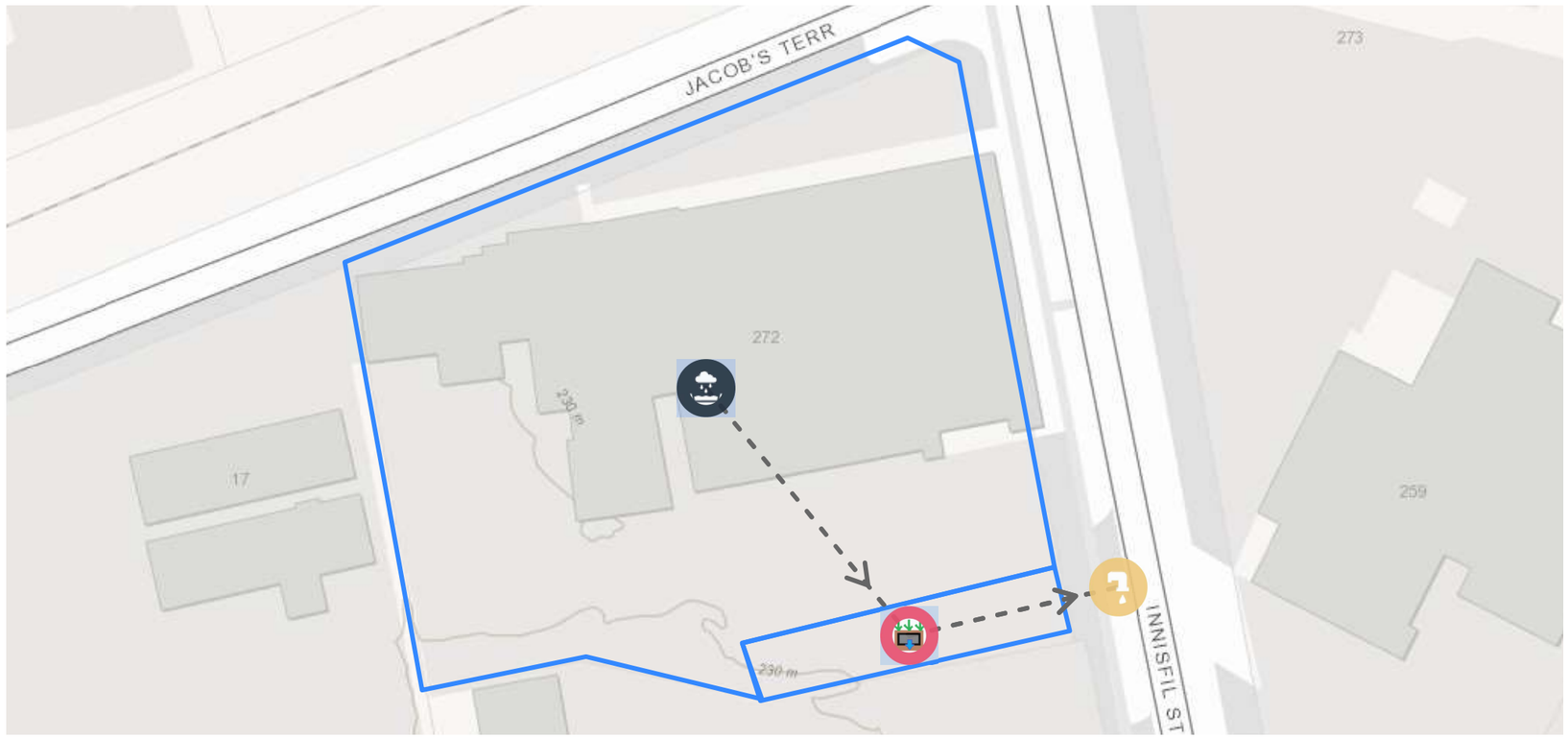
Water Balance | Post-Development

Catchment	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
1	0.68 ha	847.60 mm 5,797.58 m^3	583.16 mm 3,988.83 m^3	196.03 mm 1,340.87 m^3	65.35 mm 447.00 m^3	782.25 mm 92.29 %
TOTAL	**0.68 ha**	**847.60 mm** **5,797.58 m^3**	**583.16 mm** **3,988.83 m^3**	**196.03 mm** **1,340.87 m^3**	**65.35 mm** **447.00 m^3**	**782.25 mm** **92.29 %**

Map | Pre-Development



Map | Post-Development



LID Summary | Post-Development

Element	Type	LID Area	Drawdown Time	Effective Impervious to Pervious Ratio	FLOW	TSS	TP
					Flow In (m^3)	Load In (kg)	Load In (kg)
					Flow Out (m^3)	Load Out (kg)	Load Out (kg)
					Actual Reduction (%)	Actual Reduction (%)	Actual Reduction (%)
Infiltration	Infiltration	0.040 ha	2.977 hrs	12.621	4,279.040 m^3	147.059 kg	0.611 kg
					450.000 m^3	3.093 kg	0.048 kg
					89.484 %	97.897 %	92.113 %

Loading Summary TSS | Pre Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.044 m^3/s	4,620.000 m^3 55.140 mg/l 254.747 kg	4,618.000 m^3 55.164 mg/l 254.747 kg
Total	**0.000 %**	**0.044 m^3/s**	**4,620.000 m^3** **55.140 mg/l** **254.747 kg**	**4,618.000 m^3** **55.164 mg/l** **254.747 kg**

Loading Summary TSS | Post Development

Catchment	Total Catchment TSS Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	97.897 %	0.034 m^3/s	4,279.040 m^3 34.367 mg/l 147.059 kg	447.000 m^3 6.920 mg/l 3.093 kg
Total	**97.897 %**	**0.034 m^3/s**	**4,279.040 m^3** **34.367 mg/l** **147.059 kg**	**447.000 m^3** **6.920 mg/l** **3.093 kg**

Loading Summary TP | Pre Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.044 m^3/s	4,620.000 m^3 0.171 mg/l 0.791 kg	4,618.000 m^3 0.171 mg/l 0.791 kg
Total	**0.000 %**	**0.044 m^3/s**	**4,620.000 m^3** **0.171 mg/l** **0.791 kg**	**4,618.000 m^3** **0.171 mg/l** **0.791 kg**

Loading Summary TP | Post Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	92.113 %	0.034 m^3/s	4,279.040 m^3 0.143 mg/l 0.611 kg	447.000 m^3 0.108 mg/l 0.048 kg
Total	**92.113 %**	**0.034 m^3/s**	**4,279.040 m^3** **0.143 mg/l** **0.611 kg**	**447.000 m^3** **0.108 mg/l** **0.048 kg**

Peak Flow | Pre-Development

Catchment	Element	Description	Peak outflow
1	Existing Site Innisfil Street	PEAK RUNOFF FLOW from MAXIMUM FLOW at	0.04 m^3/s 0.044 m^3/s

Peak Flow | Post-Development

Catchment	Element	Description	Peak outflow
1	Proposed Site	PEAK RUNOFF FLOW from	0.04 m^3/s
	Infiltration	PEAK RUNOFF FLOW from	0.03 m^3/s
	Innisfil Street	MAXIMUM FLOW at	0.034 m^3/s

Loading TSS | Pre Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Existing Site	0 %	0.04 m^3/s	5,823.012 m^3 55.140 mg/l 321.081 kg	4,620.000 m^3 55.140 mg/l 254.747 kg
Innisfil Street	0 %	0.044 m^3/s	4,618.000 m^3 55.164 mg/l 254.747 kg	4,618.000 m^3 55.164 mg/l 254.747 kg

Loading TSS | Post Development

TSS - Catchment 1

Name	LID Type (removal)	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Proposed Site	0 %	0.04 m^3/s	5,458.544 m^3 29.580 mg/l 161.464 kg	3,940.000 m^3 29.580 mg/l 116.545 kg
Infiltration	80 %	0.03 m^3/s	4,279.040 m^3 34.367 mg/l 147.059 kg	450.000 m^3 6.873 mg/l 3.093 kg
Innisfil Street	0 %	0.034 m^3/s	447.000 m^3 6.920 mg/l 3.093 kg	447.000 m^3 6.920 mg/l 3.093 kg

Loading TP | Pre Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Existing Site	0 %	0.04 m^3/s	5,823.012 m^3 0.171 mg/l 0.997 kg	4,620.000 m^3 0.171 mg/l 0.791 kg
Innisfil Street	0 %	0.044 m^3/s	4,618.000 m^3 0.171 mg/l 0.791 kg	4,618.000 m^3 0.171 mg/l 0.791 kg

Loading TP | Post Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
Proposed Site	0 %	0.04 m^3/s	5,458.544 m^3 0.135 mg/l 0.739 kg	3,940.000 m^3 0.135 mg/l 0.533 kg
Infiltration	25 %	0.03 m^3/s	4,279.040 m^3 0.143 mg/l 0.611 kg	450.000 m^3 0.107 mg/l 0.048 kg
Innisfil Street	0 %	0.034 m^3/s	447.000 m^3 0.108 mg/l 0.048 kg	447.000 m^3 0.108 mg/l 0.048 kg

Detailed Report Parameters | Pre Development

Existing Site

Field	Value
Subcatchment name	Existing Site
Catchment	1
Total AREA (HA)	0.687
Impervious area (HA)	0.39846
Roof area (HA)	0.28854
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	0

Innisfil Street

Field	Value
Name	Innisfil Street
Catchment	1
Outfall Elevation (m)	0

Detailed Report Parameters | Post Development

Proposed Site

Field	Value
Subcatchment name	Proposed Site
Catchment	1
Total AREA (HA)	0.644
Impervious area (HA)	0.10304
Roof area (HA)	0.47656
Landscaped area (HA)	0.0644
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	74

Infiltration

Field	Value
Name	Infiltration
LID type	infiltration
Catchment	1
Outlet (name)	3
% Imperv	100
Width (m)	100
Paved surface (HA)	0.04
Roof (HA)	0
Landscaped Area (HA)	0
Row Crop (HA)	0
Open Space/Parkland (HA)	0
Forest (HA)	0
Wetland (HA)	0
(HA)	0
Berm Height (mm)	10
Surface Slope (%)	1
Thickness (mm)	188
Void Ratio	0.95

Impervious Surface Fraction	
Permeability (mm/hr)	
Clogging Factor	0
Soil	
Porosity (Fraction)	
Field Capacity (Fraction)	
Wilting Point (Fraction)	
Conductivity (mm/hr)	
Conductivity Slope (Dimensionless)	
Suction Head (mm)	
Seepage Rate (mm/hr)	60
Flow Coefficient	0
Flow Exponent	0
Offset Height (mm)	0
Mannings Roughness	

Innisfil Street

Field	Value
Name	Innisfil Street
Catchment	1
Outfall Elevation (m)	0

HUSSON

APPENDIX E

SANITARY SEWER ANALYSIS

Minimum Dia. = 250 mm
Mannings "n"= 0.013
Minimum Velocity = 0.6 m/s
Minimum Grade = 0.4 %
Avg. Proposed Domestic Flow = 225 l/c/d
Avg. Existing Domestic Flow = 225 l/c/d
Avg. Com/Ind/Inst Flow = 0.32 l/s per ha (28m^3/day/ha)
Infiltration = 0.1 l/s/ha
Peaking Factors calculated as per City Criteria
Harmon equation: PF=1 + (14/(4+(P/1000)½))

272 Innisfil Street
Pre-Development Sanitary Sewer Design Sheet

Project No: 221278
Date: 22-Mar-22
Designed by: MA

STREET	FROM	TO	RESIDENTIAL						COMMERCIAL/INDUSTRIAL/INSTITUTIONA			EXTERNAL				FLOW CALCULATIONS							PIPE DATA					% FULL
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENSITY (P/unit)	POP	ACC. RES. POP.	AREA (ha)	ACC. AREA (ha)	ACC. RES. POP.	EXT. AREA (ha)	EXT. FLOW RATE (l/s/ha)	EXT. FLOW (l/s)	ACC. EXT. FLOW (l/s)	INFILTRATION ALLOWANCE (l/s)	TOTAL ACC. POP.	PEAKING FACTOR (Res Only)	RES. FLOW (l/s)	COM./IND./ INST. FLOW (l/s)	EXT. FLOW (l/s)	TOTAL FLOW (l/s)	DIA. (mm)	SLOPE (%)	Q FULL (L/s)	V FULL (m/s)	V ACT (m/s)	
Jacobs Terrace	EX. MH1A	EX. MH2a							2.1	2.10						0.21		1.00		0.67		0.88	300	0.20	43.2	0.61	0.23	2%
Innisfil Street	EX. MH2A	EX. MH3A							0.36	2.46						0.25		1.00		0.79		1.03	300	0.20	43.2	0.61	0.25	2%
Tiffin Street	EX. MH3A	EX. MH4A							5.19	7.65						0.77		1.00		2.45		3.21	300	1.50	118.4	1.67	0.71	3%
Innisfil Street	EX. MH4A	EX. MH5A	0.36	0.36	2	3.13	6	6	0.49	8.14						0.85	6	4.43	0.07	2.60		3.53	300	1.00	96.7	1.37	0.65	4%

Minimum Dia. = 250 mm
Mannings "n"= 0.013
Minimum Velocity = 0.6 m/s
Minimum Grade = 0.4 %
Avg. Proposed Domestic Flow = 225 l/c/d
Avg. Existing Domestic Flow = 225 l/c/d
Avg. Com/Ind/Inst Flow = 0.32 l/s per ha (28m^3/day/ha)
Infiltration = 0.1 l/s/ha
Peaking Factors calculated as per City Criteria
Harmon equation: PF=1 + (14/(4+(P/1000)½))

272 Innisfil Street
Post-Development Sanitary Sewer Design Sheet

Project No: 221278
Date: 22-Mar-22
Designed by: MA

STREET	FROM	TO	RESIDENTIAL						COMMERCIAL/INDUSTRIAL/INSTITUTIONA			EXTERNAL				FLOW CALCULATIONS							PIPE DATA					% FULL
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENSITY (P/unit)	POP	ACC. RES. POP.	AREA (ha)	ACC. AREA (ha)	ACC. RES. POP.	EXT. AREA (ha)	EXT. FLOW RATE (l/s/ha)	EXT. FLOW (l/s)	ACC. EXT. FLOW (l/s)	INFILTRATION ALLOWANCE (l/s)	TOTAL ACC. POP.	PEAKING FACTOR (Res Only)	RES. FLOW (l/s)	COM./IND./ INST. FLOW (l/s)	EXT. FLOW (l/s)	TOTAL FLOW (l/s)	DIA. (mm)	SLOPE (%)	Q FULL (L/s)	V FULL (m/s)	V ACT (m/s)	
Jacobs Terrace	EX. MH1A	EX. MH2a	0.7	0.70	333	1.67	556	556	1.40	1.40						0.21	556	3.95	5.72	0.45		6.38	300	0.20	43.2	0.61	0.43	15%
Innisfil Street	EX. MH2A	EX. MH3A							0.36	1.76						0.18		1.00		0.56		0.74	300	0.20	43.2	0.61	0.23	2%
Tiffin Street	EX. MH3A	EX. MH4A							5.19	6.95						0.70		1.00		2.22		2.92	300	1.50	118.4	1.67	0.67	2%
Innisfil Street	EX. MH4A	EX. MH5A	0.36	0.36	2	3.13	6	562	0.49	7.44						0.78	562	3.95	5.78	2.38		8.94	300	1.00	96.7	1.37	0.84	9%

HUSSON

APPENDIX F

WATER DEMAND CALCULATIONS

Fire Flow Requirements

Project:	272 Innisfil Street
Project No.:	221278
Municipality:	City of Barrie

Residential Tower

GUIDE FOR DETERMINATION OF REQUIRED FIRE FLOW
(as per the Water Supply for Public Fire Protection 1999 manual by the Fire Underwriters Survey)

STEP 1
Determine the fire flow.

Required Fire Flow (F)	F = 220 x C x sqrt(A)		The required fire flow in litres per minute.
Maximum Floor Area (A) =	3625	m2	If the vertical openings and exterior vertical communications are properly protected (one hour rating), consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors.
		6th Floor	2478.0 m2
		5th Floor	2415.0 m2
		7th Floor	2360.0 m2
Coefficient (C) =	0.6		Coefficient related to the type of construction. = 1.5 for wood frame construction (structure essentially all combustible). = 1.0 for ordinary construction (brick or other masonry walls, combustible floor = 0.8 for non-combustible construction (unprotected metal structural) = 0.6 for fire-resistive construction (fullyprotected frame,floors, roof).
F =	8000	L/min.	

STEP 2
Determine the increase or decrease for occupancy.

	0%		Reduction for Low Hazard Occupancy (Dwellings).
Decrease	0	L/min.	

STEP 3
Determine the decrease, if any, for automatic sprinkler protection.

	50%		30% for sprinklered as per NFPA 13.
Decrease	4000	L/min.	50% for fully automatic sprinkler.

STEP 4
Determine the total increase for exposures.

0 -3m (25%), 3-10m (20%), 10-20m (15%), 20-30m (10%), 30-45m (5%)

North	5%		42
East	5%		38
South	20%		5
West	25%		3
	55.0%		Maximum exposure increase is 75%.
Increase	4400	L/min.	

STEP 5
Determine the minimum required fire flow.

F =	**8,000**	**L/min.**	**Round to the nearest 1000L/min.**