BURNSIDE

Phase 1 Stormwater Management Report
1012 Yonge Street, City of Barrie

Crown (Barrie) Development Inc.
400 Creditstone Road, Unit 37
Concord ON L4K 3Z3

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R.J. Burnside & Associates Limited

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1.0 Introduction and Background

R.J. Burnside & Associates Limited (Burnside) has been retained by Crown (Barrie) Development Inc. (Crown) to prepare a Servicing and Stormwater Management Report in support of the proposed development of 1012 Yonge Street in the Hewitt's Secondary Plan Area (SPA) in the City of Barrie (City).

Based on the received site plan, the ultimate build out of the subject property is proposed as a mixed-use development, including approximately 1,092 residential condominium units, 8 townhouse units and 1,167.30 m^2 of commercial Gross Floor Area (GFA). The development will also include underground parking within the majority of the site. Additionally, a 24.0 m wide municipal right-of-way (ROW), namely Street A (future Lower Street), is proposed along the south limit of the property, to provide a connection from Yonge Street to future Moberly Drive, within the Rainsong Phase 2 lands to the west.

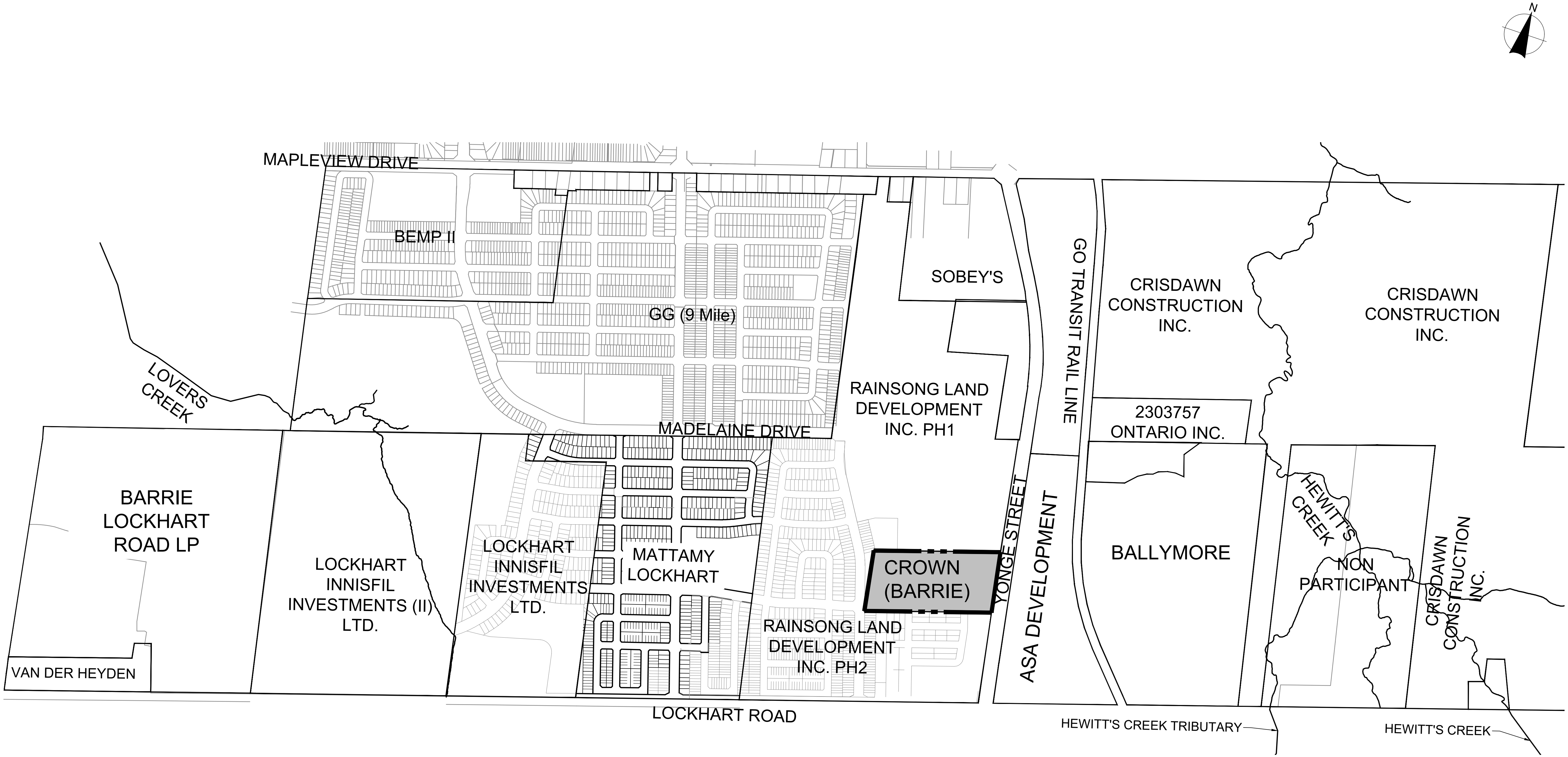
This report has been prepared to support the site plan application for Phase 1 of the subject development by demonstrating that the Site can be developed to meet the servicing and grading requirements of the regulatory agencies.

1.1 Site Description and Context

The subject property is located west of Yonge Street, south of Mapleview Drive East, and north of Lockhart Road in the City of Barrie. The site is approximately 4.94 ha and is bound by Yonge Street to the east, Rainsong Land Development Inc. (Rainsong) Phase 1 lands to the north, and Rainsong Phase 2 lands to the west and south. As mentioned previously, the site is located within the Hewitt's SPA, more specifically within the Hewitt's Creek and Lovers Creek Subwatersheds. Please refer to Figure 1 for more details.

The Site is already zoned Neighbourhood Mixed-Use (NMU) therefore, no re-zoning is necessary.

The development is proposed to be constructed in three phases. The Phase 1 lands, which total 1.97 ha, occupy the central part of the site. The Phase 2 lands, which total 1.46 ha, occupy the east part of the site. The Phase 3 lands, which total 1.51 ha, occupy the west part of the site. The phase discussed within this report will be Phase 1, with commentary on the future Phases 2 and 3 that will be deviating from the strategy outlined within the Functional Servicing and Stormwater Management Report (FSSR) prepared by GHD Limited. Some discussion with regards to the full build-out of Phase 3 and how it can be accommodated with the interim SWM strategy will be provided.



LIMIT OF SUBJECT SITE

BURNSIDE

Figure Title

CROWN COMMUNITIES - PHASE 1

SITE LOCATION FIGURE

Client

CROWN COMMUNITIES

Drawn	Checked	Date	Figure No.
MH	JS	24/08/12	**FIG1**
Scale		Project No.	
1:10,000		057940	

File Name: 057940_SITE LOCATION PLAN.dwg Date Plotted: August 16, 2024 - 9:33 PM

1.2 Background Studies and Documents

The servicing concepts presented within this report have been developed to comply with the infrastructure and Stormwater Management (SWM) servicing framework that has been established for the Hewitt's Secondary Plan Area. The following documents, studies, and reports have been reviewed / incorporated unless otherwise noted:

Document Title	Prepared By	Date
Hewitt's Secondary Plan Area Subwatershed Impact Study, Lovers, Hewitts and Sandy Cove Creeks (SIS)	Burnside	September 2016
Hewitt's Secondary Plan Area Subwatershed Impact Study, Lovers, Hewitts and Sandy Cove Creeks (SIS) Report Addendum No. 1	Burnside	November 2017
Functional Servicing & Stormwater Management Report, Rainsong Development Inc., Phase 2	SCS Consulting Group Ltd.	February 2022
Project Statistics, Crown Communities Developments Inc.	SRN Architects Inc.	August 2022
Functional Servicing and Stormwater Management Report	GHD Limited	February 2023
As Constructed Drawing Set and Design Sheets, Mattamy (Lockhart) Limited Subdivision, Phase 1	Burnside	September 2023
Redline Revised Overlay Draft Plan of Subdivision, Rainsong Development Inc., Phase 2	Jones Consulting Group Ltd.	January 2024
Third Submission Drawings and Design Sheets, Mattamy (Lockhart) Limited Subdivision, Phase 2	Burnside	February 2024
Interim Feasibility Investigation	Burnside	May 2024
Architectural Plans	SRN Architects Inc.	June 2024

The current report has been prepared in accordance with, and in consideration of, the information and recommendations provided in the following documents.

Document Title	Prepared By	Date
SWM Planning and Design Manual	MECP	March 2003
Ministry of the Environment, Lake Simcoe Protection Plan	MECP	July 2009
LSRCA Technical Guidelines for SWM Submissions	LSRCA	April 2022
Stormwater Infrastructure Design Standard	City of Barrie	June 2023

It should be noted where criteria conflicted, the more conservative criteria were utilized in the design.

1.3 Historical Servicing Strategy

The 2016 Hewitt's SIS originally proposed a stormwater drainage divide between Hewitt's Creek and Lovers Creek to run approximately halfway through the proposed development, with the west potion of the site draining west to SWMF3 and the east portion draining to SWMF5. A proposed storm sewer on Street A (future Lower Street), fronting the subject site, was intended to be sized to accommodate flows from the 100-year storm event. This 100-year storm sewer was planned to begin on Street A, connect to another 100-year storm sewer proposed on Yonge Street and be conveyed to SWMF5, on Ballymore's lands, located east of Yonge Street. A memo, namely Addendum 2 of the SIS, was then prepared in December 2021, which proposed a revision to the drainage divide within the subject site to coincide with the property boundaries. Therefore, SWMF5's tributary drainage area was increased to include the entirety of the subject site.

Burnside completed an interim servicing feasibility investigation in May 2024 when Crown expressed concerns about the timeline of the ultimate construction of both Yonge Street (and the associated 100-year storm sewer) and SWM Facility 5. The interim servicing investigation recommended an interim condition strategy to provide on-site controls until the ultimate outlet is constructed and online.

Refer to Appendix A for excerpts from the SIS and the full technical memo referenced above can be found under separate cover.

2.0 Catchment Characteristics

The following sections describe the existing site conditions and discuss further details from the Hewitt's Annexed Lands SIS that are applicable to the SWM strategy.

2.1 Existing Site Conditions

The subject site is currently being utilized as agricultural land and is occupied by one 2-storey residential building, two stone and farm barns, a metal garage and a plastic green house. Current vehicle access to the site is provided by an existing gravel driveway connected to Yonge Street.

Based on the existing topographic surveys prepared by Krcmar, the northwest corner of the site drains northwest towards the existing external agricultural lands, while the remainder of the site drains from northwest to southeast, and into the existing ditch running along the west side of Yonge Street. Based on additional topographic survey of Yonge Street, a low point on Yonge Street, adjacent to Street A within the subject site, exists.

To confirm the existing drainage area to the low point on Yonge Street, external LIDAR information was obtained from Land Information Ontario and assembled by the Burnside GIS team. Based on the LIDAR information, an external drainage area of 8.71 ha, excluding the subject site, includes drainage from Lockhart Road and drains to the low point. Based on the future Phase 1 design of Yonge Street, the contributing drainage area extends north to include the Mapleview Drive East and Yonge Street intersection.

Note, topographic data confirms there is minimal ponding depth provided within the Yonge Street ditch prior to spilling over onto the adjacent agricultural land east of Yonge Street (owned by ASA Developments).

Refer to Figure 2 for more information.

2.2 Existing Storm Drainage

Under existing conditions, the site drainage is split between two different watersheds, Hewitt's Creek and Lovers Creek. Runoff from the northwest corner of the site (approximately 0.71 ha) flows overland to the north and west, runoff from the southern portion of the site (approximately 2.45 ha) sheet flows south of the site then southwest, and the remainder of the site (approximately 1.78 ha) flows into an existing ditch running along the west side of Yonge Street. Please refer to Figure 2 for more details.

2.3 Soils Conditions

A geotechnical investigation was completed in 2021 by Soil Engineers Ltd., which included the advancement of seven boreholes throughout the site to a maximum depth of 9.3 m below ground surface (bgs). GHD completed a review of Soil Engineers report and concluded that additional information was needed for design purposes. Therefore, an additional five boreholes were advanced within the area of the proposed buildings to an approximate depth of 16 mbgs, and four of these boreholes were installed with monitoring wells.

The borehole data indicated that the site generally consisted of 200 to 350 mm of topsoil underlain by fill material consisting of sandy silt to silty sand trace clay to some sand silt with thicknesses up to 2.30 mbgs overlying native silty sand, sand, sandy silt and silt depending on the location.

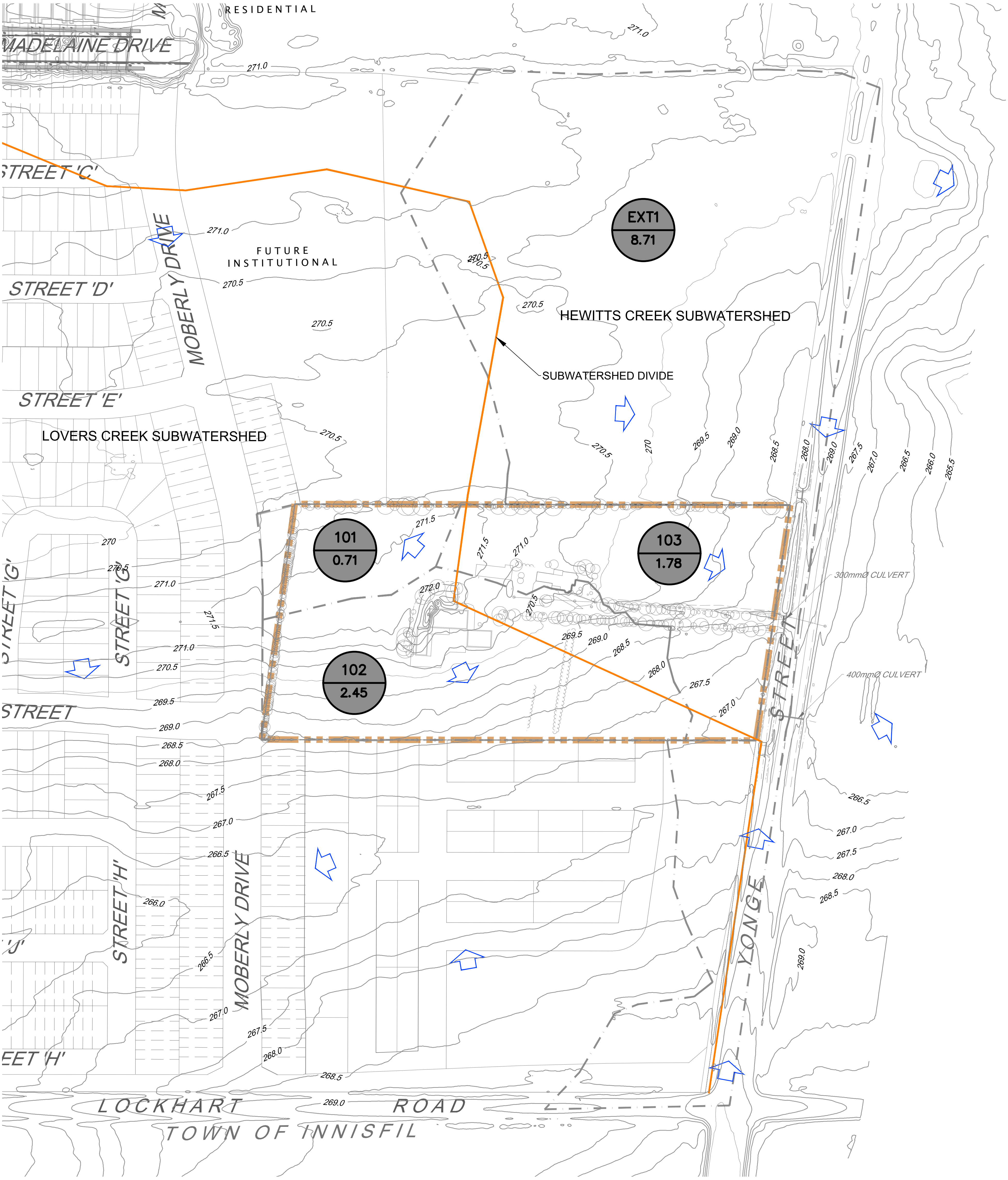
Refer to Appendix A for the detailed reports.

2.4 Groundwater Conditions

A hydrogeological investigation was completed by GHD in 2022, with previous investigations completed in 2021 by IBI Group (formerly Cole Engineering Group).

In total, 12 boreholes were advanced to a maximum depth of 9.3 m below ground surface (bgs) and eight monitoring wells were installed to depths ranging from 6.0 to 7.6 mbgs. It was determined that the subject site is underlain by ice contact silt, silty sand to sand deposits. A shallow aquifer (A1 aquifer) is present, with a deep water table throughout the site. Groundwater elevations encountered on site ranged between 263.53 to 264.82 m (3.75 to 7.47 mbgs) and the hydraulic conductivity of the overburden materials ranged from 1.1×10^{-2} cm/s to 6.5×10^{-4} cm/s. The average groundwater depth is about 5.7 mbgs and the recommended horizontal hydraulic conductivity is 4.3×10^{-3} cm/s.

Detailed infiltration testing will be completed within the footprint of the proposed Low Impact Development (LID) features at the infiltration plane prior to construction to confirm sizing and drawdown times. In the interim, the rising head numbers presented in the table below were utilized.



LEGEND:

PROPERTY BOUNDARY

DRAINAGE BOUNDARIES

SUBWATERSHED DIVIDE PER HEWITT'S SIS

MAJOR OVERLAND FLOW ROUTE

101 — CATCHMENT ID

2.95 — DRAINAGE AREA IN HECTARES

N

0 50 100 150 200

Metres

BURNSIDE

Figure Title			
CROWN COMMUNITIES - PHASE 1			
PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN			

Client	Drawn	Checked	Date	Figure No.
CROWN COMMUNITIES	MH	JS	24/08/12	**FIG2**
	Scale: 1:2500		Project No.: 057940	

Table 1: Hydraulic Conductivity Utilized for Infiltration Calculations

Borehole ID	Hydraulic Conductivity (cm/s)	Location
MW1-21	2.60E-05	Northwest
MW5-21	9.22E-03	Northwest
MW2-21	9.76E-06 1.22E-05	Southeast
BH5	1.10E-02	Southeast

Refer to Appendix A for the detailed reports.

3.0 Proposed Site Grading

A site grading plan has been prepared for the interim condition of Phase 1 within the subject site, with consideration to the ultimate grading of the entire development. Generally, in both the interim and ultimate condition, the grading of the site has been prepared to match boundary conditions, meet the City's grading design standards, minimize steps into the proposed buildings, and meet the corresponding drainage requirements. Please refer to the sections below for specific details on each condition.

3.1 Interim Site Grading

Since Phase 1 is located in the centre of the site, the ultimate grading strategy was taken into account when completing the interim grading design. Street A (future Lower Street) has therefore been designed to its proposed ultimate condition to ensure that the grading and servicing does not require re-design under ultimate conditions.

The Phase 1 Site Plan has been graded to direct all overland flow towards Street A. Note, some grading of the north end of Phase 1 will impede on the Rainsong Phase 1 lands. Similarly, some grading at the South limit of Street A will impede on Rainsong Phase 2 lands, therefore, permissions / coordination will be required.

Under interim conditions, Phase 1 will be in a cut state compared to the existing undeveloped areas of Phases 2 and 3. It should be noted that other than constructing the interim stormwater management facility, Phases 2 and 3 will remain untouched and will continue to drain per original drainage characteristics.

It should also be noted that under interim conditions, and until the Yonge Street urbanization is completed (discussed in the next section), the existing road crossing culvert conflicts with the proposed Street A connection to Yonge Street. Therefore, a new road crossing culvert is proposed. Refer to Section 5.2 for more details on sizing.

Please refer to Civil Engineering Submission Set for the Interim Site Grading Plan.

3.2 Yonge Street Urbanization

The City of Barrie has proposed the urbanization and widening of Yonge Street between Mapleview Drive East and Lockhart Road. Ainley & Associates have been retained to complete the preliminary and detailed design of the project. The plan is to provide transportation improvements in the form of widening Yonge Street to five lanes, adding a cycle track / multi-use trail, a sidewalk and urbanization. The Yonge Street project has been divided into two phases. Phase 1 of the project is from Mapleview Drive East to about halfway across the frontage of the subject site (1012 Yonge Street). The Phase 2 project limits are approximately from 971 Yonge Street to Lockhart Road.

Burnside has reviewed the preliminary designs and noted that the original design of Yonge Street is intended to remain the same. Therefore, the existing low point on Yonge Street is intended to remain in approximately the same location. Under interim conditions, double catchbasins are proposed at the end of Street A. Under ultimate conditions, 100-year capture catchbasins are proposed at the low point on Yonge Street and all flows will be redirected east towards SWMF5, through ASA Developments lands. This generally follows the original drainage strategy for the roadway. In order to conform with the Hewitt's SIS, these pipes should be adequately sized for the 100-year event.

3.3 Ultimate Site Grading

As stated in the previous section, the ultimate grading of the entire site, including all three phases of development, was taken into account when completing the grading of the Phase 1 Site Plan and associated interim condition. The ultimate grading of the remainder of the proposed development will be in line with the methodology laid out in the FSSR prepared by GHD. In summary, the FSSR states that the overall grading will match the drainage patterns as presented in the Hewitt's SIS, directing all storm and sanitary drainage easterly. At the time of the FSSR, the approved design of Yonge Street was not available (only conceptual / preliminary drawings were available), therefore, all grading was completed to match into the existing grades of Yonge Street. When the ultimate grading design information for Yonge Street becomes available, the design will need to be reviewed / adjusted as necessary to match into proposed grades.

4.0 Stormwater Management Design Parameters / Terms of Reference

The following sections present the parameters and terms of reference for the stormwater management design. This section incorporates the City, LSRCA, and MECP requirements for the proposed SWM design. In addition to these regulatory guidelines, the SWM strategy presented in the Hewitt's SIS also applies to this development.

4.1 Quality Control and Extended Detention

Quality control and extended detention have been designed in accordance with the following design recommendations and requirements per the City, LSRCA, MECP, and Hewitt's SIS guidelines:

- All SWM facilities must provide, as a minimum, Enhanced Protection Level (Level 1), which corresponds to a long-term average removal rate of 80% of total suspended solids (TSS). The MECP SWM Manual (Table 3.2) specifies water quality storage requirements for various SWM facility types.
- Removal of phosphorous (controlling post-development loading to pre-development levels and best efforts for 80% removal) is required.
- Management of suspended solids, winter salt, temperature, and other contaminants such as oil, grease, gas, and heavy metals, is required.
- Stream erosion via extended detention is required.

4.2 Quantity Control

The City and LSRCA require post-development to pre-development stormwater flow control for the 2-year through 100-year storm events. The Hewit's SIS specified target release rates for the entirety of the Secondary Plan Area based on receiving watercourses and existing catchments for the 2-year through 100-year return periods.

4.3 Stormwater Management Facility Grading

Grading within SWMFs must be designed in accordance with the City of Barrie Standard D780 and MECP guidelines:

- Permanent pool depth: 1.0 m minimum (2.5 m maximum).
- Extended detention depth: 1.5 m maximum.
- Active storage depth: 2.0 m maximum.
- Side slopes: 5:1 maximum active storage (adjacent to road); 4:1 maximum active storage (not adjacent to road); 6:1 maximum for 0.5 m vertical above and below the normal water level; 3:1 maximum permanent pool and forebay berms.
- Freeboard depth: 0.3 m minimum from maximum routed water level.

Berms around the facility shall be designed with a minimum top width of 2.0 m with a 3:1 maximum side slope on the outside. For heights exceeding 2.0 m, the berm must be designed by a qualified engineer.

4.4 Stormwater Conveyance

Stormwater conveyance shall be designed as per the City's design standards as presented below:

- Storm sewers are to be provided to convey, as a minimum, the 1:5-year design storm to a sufficient outlet.
- The major system overland flow route to the SWMF shall be designed to safely convey the Regulatory overland flow.
- External drainage is the developer's responsibility to demonstrate safe conveyance.
- The maximum allowable flow depth for local roads and collector roads are 0.20 m and 0.10 m above the crown of the road, respectively.
- Should the overland flow route to the SWMF consist of the access road and path, then the flow depth shall not exceed 0.30 m or a velocity of 0.65 m/s.

4.5 Volume Control

Per LSRCA SWM guidelines, all major developments must demonstrate a best-efforts approach to volume control. Volume control can be achieved through infiltration or filtration of the 25 mm event as presented in Section 3.2.4 of the guidelines. The goal of volume control, for sites without restrictions, is to capture and retain / treat on-site, the post-construction direct runoff from 25 mm of rainfall from all impervious surfaces. Preference is given to infiltration via LID features / best management practices (BMPs) rather than filtration practices. Within Section 3.2.5 various stormwater control techniques are presented as supported methods.

The subject phase of this development can be described as a site with restrictions due to the extent of the proposed development. There is limited space available for infiltration measures. Therefore, a best-efforts approach towards the 25 mm target will be applied. The runoff volume control target (RVCT) is presented in the table below.

Table 2: Runoff Volume Control Target

Return Period	Phase	Volume Required (m^3)
25 mm	**Phase 1** (1.97ha @ 83.9%)	413.2
	Phase 2 (1.46 ha @ 82.1%)	299.7
	Phase 3 (1.51 ha @ 85.5%)	322.8
	Total (4.94 ha @ 83.9%)	1035.7

Therefore, for the interim phase 1 area of 1.97 ha, with a percent impervious value of 83.9%, the RVCT is 413.2 m^3. For the ultimate phase (phases 1, 2 and 3), area of 4.94 ha with a percent impervious value of 83.9%, the RVCT is 1,035.7 m^3.

4.6 Groundwater Recharge / Water Balance

In accordance with the City and LSRCA, all new developments greater than 5 ha shall provide post-development to pre-development infiltration / recharge on-site, where soils permit.

4.7 Erosion and Sediment Control

Erosion control measures must be implemented in accordance with MECP, City, and LSRCA requirements, to minimize the impact from development sites to receiving water courses.

4.8 Impervious Ground Cover

To determine the quality and stream erosion control storage requirements, a weighted percent impervious value was calculated based on the land use presented in the Site Plan (included in Appendix A).

Within the subject phase of this development there are landscaped areas, private condominium roads, and multi-storey buildings. The weighted percent impervious value of Phase 1 (interim and ultimate) was tabulated to be 84% impervious. To determine the quality and stream erosion requirements of the entire interim condition, the remainder of the site in its existing state needed to be taken into consideration. Therefore, the interim SWM facility's weighted percent impervious value was calculated to be 67%. It should be noted that the weighted percent impervious value for the Interim SWMF drainage area in the below table also conservatively includes the full build out of Phase 3 with a percent impervious value calculated to be 86%. This area was included as it would be the maximum ultimate area that could be tributary to the facility.

Table 3: Land Use Percent Impervious Breakdown

<table>
<tr><th>Scenario</th><th>Area Classification</th><th>Area (ha)</th><th>Percent Impervious (%)</th></tr>
<tr><td rowspan="4">Phase 1 Interim (full build out)</td><td>Impervious Area (Buildings, Sidewalk, Asphalt, Outdoor Amenity)</td><td>1.46</td><td>100</td></tr>
<tr><td>Pervious Area Above Structures</td><td>0.41</td><td>43</td></tr>
<tr><td>Pervious Area</td><td>0.07</td><td>0</td></tr>
<tr><td>Total</td><td>1.94</td><td>84</td></tr>
<tr><td rowspan="4">Phase 3 (full build out)</td><td>Impervious Area (Buildings, Sidewalk, Asphalt, Outdoor Amenity)</td><td>1.18</td><td>100</td></tr>
<tr><td>Pervious Area Above Structures</td><td>0.26</td><td>43</td></tr>
<tr><td>Pervious Area</td><td>0.07</td><td>0</td></tr>
<tr><td>Total</td><td>1.51</td><td>86</td></tr>
</table>

Scenario	Area Classification	Area (ha)	Percent Impervious (%)
Phase 2 (Existing Conditions)	Undeveloped	0.81	0
	Pond Block	0.43	55
	Total	1.24	17
Total Area to Interim SWMF		4.69	67
Uncontrolled Lower Street ROW	Impervious Area (Sidewalk, Driveway)	0.18	100
	Pervious Area	0.07	0
	Total	0.25	72
Phase 1 (Ultimate)	Impervious Area (Buildings, Sidewalk, Asphalt, Outdoor Amenity)	1.48	100
	Pervious Area Above Structures	0.41	43
	Pervious Area	0.08	0
	Total	1.97	84
Phase 2 (Ultimate)	Impervious Area (Buildings, Sidewalk, Asphalt, Outdoor Amenity)	1.04	100
	Pervious Area Above Structures	0.37	43
	Pervious Area	0.05	0
	Total	1.46	82
Phase 3 (Ultimate)	Impervious Area (Buildings, Sidewalk, Asphalt, Outdoor Amenity)	1.18	100
	Pervious Area Above Structures	0.26	43
	Pervious Area	0.07	0
	Total	1.51	86
Total Ultimate Area to SWMF#5		4.94	84

It should be noted that the percent impervious values utilized (that are not City Standard) are more conservative than those presented in D700. The pervious areas above the underground structure were conservatively considered with 0.5 runoff coefficient which translates into an imperviousness value of 43%.

5.0 Stormwater Management

The following sections detail the design of the existing, interim and proposed stormwater infrastructure relative to the subject site.

It should be noted that this section includes both the interim Phase 1 design and an overview of the ultimate Phase 1 and overall development stormwater management plan for the subject site. In summary, the interim condition of the site will comprise its own interim stormwater management facility, while in the ultimate condition, the site is tributary to and will be serviced by SWMF5.

5.1 Interim Storm Drainage Strategy

An interim drainage strategy has been considered due to the conflicts in development timing of the ultimate downstream required infrastructure for the subject site. This interim strategy includes the introduction of an interim SWM facility, situated in the Phase 2 lands, to accommodate the combination of full build-out from Phases 1 and 3, with Phase 2 remaining undeveloped. The temporary stormwater management facility will provide quality and quantity control treatment of stormwater runoff. In addition to the temporary facility, permanent low impact development (LID) measures have also been proposed to help achieve the SWM requirements.

The bottom elevation of the facility's main cell and forebay are 264.45 m and 265.45 m, respectively. A permanent pool elevation of 266.45 m has been provided, making the main cell and forebay static water levels 2.00 m and 1.00 m respectively. The top of the facility is 268.05 m, providing a total available active storage depth of 1.60 m. Side slopes of 5:1 are proposed throughout the facility with the exception of the 6:1 safety shelf that is situated 0.50 m above and below the permanent pool elevation. 3:1 sloping has been proposed external to the facility. A 3 m wide berm has been provided at the top of the facility while a 2 m wide forebay berm separates the forebay and main cell at an elevation of 266.95 m. A forebay weir at the permanent pool / normal water elevation of 266.45 m has been provided as well as an emergency spill weir at an elevation of 267.75 m. All relevant elevations are summarized in the table below.

Table 4: Interim Facility Ponding Elevations

SWMF Elevation	Feature/Storm Event	Volume (m^3)
264.45	Bottom of Main Cell	0
265.45	Bottom of Forebay	449
266.45	NWL/Permanent Pool/Forebay Weir Invert	1,345
267.04	100-Year HWL	2,517
267.75	Emergency Spill Weir / Freeboard	4,160
268.05	Top of Facility	5,078

A storm sewer inlet headwall, set at an invert elevation of 266.45 m, has been proposed at the southwest corner of the facility. Since the outlet elevation in the existing Yonge Street ditch is above the storm sewer inverts in Phase 1, stormwater will pond up to a depth of 1.97 m in MH12 before spilling into the pipe that discharges to the SWMF. To ensure no backwater effects on the site, a flap gate will be installed on the incoming sewer. The outlet to the Yonge Street ditch will drain via gravity at a 0.37% slope. Please refer to Civil Engineering Design Set for details.

5.2 Quantity Control

In accordance with LSRCA requirements, quantity control, which includes peak flow control, stormwater conveyance, and volume control is provided on the site and described in the following sections.

5.2.1 Peak Flow Control

Under interim conditions, peak flow control has been provided in the form of an interim stormwater management facility. The Modified Rational Method (MRM) was used to calculate the required active storage volume to ensure the 100-year storm post-development flow would not exceed the pre-development rate. To confirm the design flow target, the rational method was used to estimate the pre-development flow from the 1.78 ha drainage area tributary to Hewitt's Creek. A pre-development flow of 303.34 L/s was calculated. Subtracting an uncontrolled flow of 117.79 L/s (i.e., 0.25 ha @ RC = 0.94) to account for the uncontrolled drainage area, the remaining allowable release rate is 185.34 L/s. The target release rate from the interim SWMF is therefore 185.34 L/s. Using the MRM, the required active storage volume to meet the SWMF target flow under interim conditions, without the full build out of Phase 3 lands, is 1,160 m^3. As previously mentioned, the SWMF has been designed to also accommodate up to the assumed build-out of Phase 3 lands. Therefore, the total required storage including the assumed build-out of Phase 3 is 2,297 m^3. Table 5 below summarizes these findings.

Table 5: Interim Storage Requirements

		Pre-Development	**Post-Development**	
Design Storm	Phase	Flow (L/s)	Controlled + Uncontrolled Flow (L/s)	Required Active Storage (m^3)*
100-Year	Phase 1	303.34	185.34 + 117.79	1,160

**Required interim storage without Phase 3 full build-out*.

To achieve the required storage, a wet pond has been proposed for the interim condition. Within this pond design a total of 3,733 m^3 of active storage has been provided (2,815 m^3 excluding freeboard) in addition to 1,345 m^3 of permanent pool (discussed in the quality control section) for a total volume of 5,078 m^3.

Detailed calculations can be found in Appendix B.

5.3 Stormwater Conveyance

Minor System

The storm sewer network on Street A has been assessed to ensure that it meets the City's standards for storm sewer capacity. Typically, the minor system (the storm sewer network) within the City of Barrie is designed to capture and convey the 5-year event. However, within the Hewitt's SIS, this area was indicated as a 100-year capture area. Therefore, the storm sewer network on Street A has been designed as such. It should be noted that this is valid in both the interim and ultimate scenario. A storm sewer design sheet has been prepared and can be found in Appendix C.

As it relates to both the interim and ultimate Phase 1 condition, once a mechanical consultant has been retained, coordination will be required to size the catchbasins within the site plan for the 100-year storm flows and assess potential ponding extents. In addition to coordination with Ballymore Building (Barrie) Corporation's consultant.

Major System

Typically, within the City of Barrie, the proposed right-of-ways (ROW) convey overland from all major storm events including the 100-year storm (less the 5-year storm) to the SWMF.

As it relates to both the interim and ultimate Phase 1 condition, once a mechanical consultant has been retained coordination will be required to ensure the safe conveyance of the Regional Event through the site plan, Street A and across Yonge Street.

As discussed in Section 3.0, a new culvert crossing Yonge Street is being proposed to convey the 100-year controlled flow from the interim pond, the uncontrolled 100-year flow from Street A and the 5-year flow from the existing drainage tributary to the low point on Yonge Street. The culvert has been sized to accommodate the 100-year event as per the City of Barrie standard requiring no overtopping of flows on Arterial roads during the 100-year storm event. Therefore, the culvert is sized using Flowmaster and it was determined that a 1050 mm diameter culvert would be required, or twin 525 mm culverts.

In the ultimate scenario, all stormwater drainage will be tributary to the storm sewer network, therefore, the(se) culvert(s) will not be required.

5.4 Volume Control

As per LSRCA requirements and as mentioned in Section 3.2.5, the post construction direct runoff volume from 25 mm of rainfall from all impervious surfaces shall be captured, retained, and treated on-site.

The total impervious area of the interim Phase 1 site plan was determined to be 16,530 m^2, as seen in Figure 3. The runoff volume from 25 mm of rainfall for the impervious area results in

413.2 m^3. Of the total required 413.2 m^3, approximately 155 m^3 of runoff generated from the roof areas is proposed to be infiltrated and the remaining 258.2 m^3 of runoff is proposed to be detained on-site and slowly release to the municipal storm sewer system.

The 155 m^3 generated from the roofs is proposed to be infiltrated via an infiltration gallery located in the northwest corner of the property, in the Phase 3 lands. This infiltration gallery will only receive clean rooftop drainage. It has been sized to provide a sufficient footprint for a drawdown time target of 48 hours or less while maximizing the separation from the LID measure to the water table. Details of the infiltration gallery are provided in Table 6. Please refer to Appendix C for more details.

Table 6: Infiltration Gallery Design Details

Location	Proposed Footprint (m^2)	Proposed Depth (m)	Proposed Volume (m^3)	Required Volume (m^3)
Northwest corner in Phase 3 lands	85.3	4.6	157	155

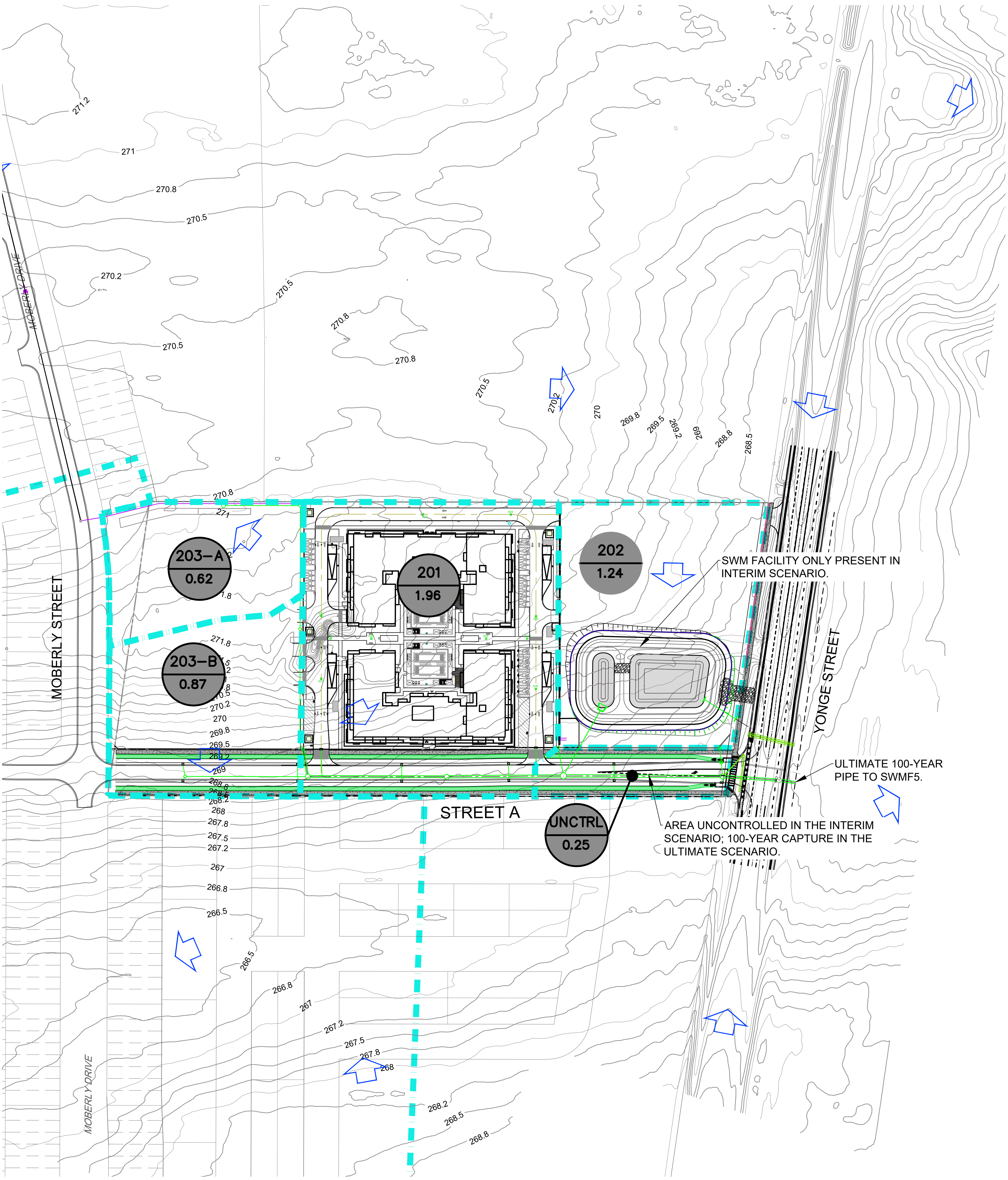
The infiltration gallery is intended to be built in stages, added on to at each Phase until all rooftops within the entire development are directed towards this area.

Under interim conditions, an emergency overflow from the infiltration gallery is proposed to spill into the second leg of storm sewer on Street A via a 450 mm storm sewer. Once Phase 3 is at detailed design stage, this emergency overflow will be re-routed. Coordination with the mechanical consultant will be required prior to approval of the Phase 3 site plan.

An alternate option to providing the required infiltration volume in the interim scenario, includes the introduction of an infiltration trench between the interim SWM facility and the Street A ROW. The required footprint and depth of the infiltration trench in that proposed location are calculated to be 440 m^2 and 0.88m in order to provide the required volume.

The remaining 258.2 m^3 of runoff volume will need to be detained within the building itself via a stormwater tank, which will be slowly released to the limit of the site where it will be filtered through a filtration device prior to entering the municipal storm sewer.

Please refer to Appendix C for more details.



LEGEND:

PROPERTY BOUNDARY

PROPOSED STORM SEWER

MAJOR OVERLAND FLOW ROUTE

DRAINAGE BOUNDARIES

204 / 2.95 — CATCHMENT ID / DRAINAGE AREA IN HECTARES

BURNSIDE

Figure Title

CROWN COMMUNITIES - PHASE 1

INTERIM POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

Client	Drawn	Checked	Date	Figure No.
CROWN COMMUNITIES	MH	JS	24/08/12	**FIG3**
	Scale: 1:2000		Project No.: 057940	

5.5 Quality Control

As per the City, LSRCA, MECP and Hewitt's SIS requirements, quality control is comprised of three sub-requirements which include TSS removal, phosphorus control and management of winter salt and other contaminants. Please refer to the sections below for more information.

5.5.1 Total Suspended Solids (TSS) and Stream Erosion

Permanent Pool / TSS Removal

A wet pond design satisfies quality control requirement via the forebay and permanent pool. Both elements have been designed in accordance with the MECP's guidelines. The permanent pool volume required to achieve Enhanced Level (Level 1) water quality protection (i.e., 80% TSS removal rate) for the interim Phase 1 condition is based on a total weighted percent impervious of approximately 58% for the area's tributary to the interim facility. The total required permanent pool volume is calculated at 197 m^3/ha, which corresponds to a required volume of 630 m^3 based on a drainage area of 3.20 ha. The total provided permanent pool is 1,345 m^3 at a normal water elevation of 266.45 m. It should be noted that the forebay area is 22% of the total permanent pool area and the volume is 10% of the total volume, both of which meet the MECP guidelines of maximum 33% and 20%. The forebay has been designed with a 2.5:1 length to width ratio, 1.0 m depth, appropriate velocity and volume. Please refer to Appendix B for detailed calculations.

Extended Detention / Stream Erosion

The extended detention / stream erosion requirement has been provided via capturing and either infiltrating or retaining the 25 mm event on-site for Phase 1. No extended detention attenuation is proposed to be provided within the interim SWM facility. Instead, clean water will be collected from all rooftops and directed towards the infiltration / filtration gallery in the northwest corner (or if the alternative option described in Section 5.4 is chosen, a reverse slope pipe will convey the equivalent roof top volume to a centralized infiltration gallery beside the facility). The remaining 25 mm runoff volume will be directed towards a stormwater tank and released at the appropriate extended detention release rate per the SIS (which specifies a unitary discharge rate of 0.6 L/s/ha for the Hewitts Creek Subwatershed). The design details specific to the proposed extended detention tank, with regards to volume and outflow shall be coordinated with the mechanical engineer.

The same approach will be taken with the ultimate design of each phase.

Treatment Train

As per the stormwater management criteria indicated within the LSRCA guidelines, stormwater must be treated to provide the MECP Enhanced Protection Level which corresponds to a TSS removal of 80%.

A summary of the assumed / approved TSS removal rates for various water quality control measures is included below:

- SWMF (wet facility) at 80%.
- Infiltration Gallery (for rooftop drainage only) at 80%.
- Filtration Unit (Jellyfish or equivalent) at 80%.

Stormwater runoff is generated by the proposed rooftops, landscaped areas, and parking areas on-site. To meet the TSS removal requirements for Phase 1, an interim wet pond has been provided. In addition, a filtration unit has been proposed to be placed upstream of the interim wet pond at the ROW limit. The filtration unit has been sized to achieve 80% TSS removal.

Based on the TSS removal rates noted above, the interim Phase 1 condition will have a TSS removal rate of 82.8%, which meets the required 80% target. Please refer to Appendix C for more detailed calculations.

The only difference between the interim and ultimate condition of Phase 1 is the removal of the SWMF. Therefore, in the ultimate condition the treatment train will have a TSS removal rate of 72.3%. The ultimate condition does not meet the 80% removal rate due to the municipal ROW. If the calculations were taken just at property line of the municipal ROW, the TSS removal rate would be 86.3%. It should be noted that under ultimate conditions this area is tributary to SWMF5 which will be a quantity and quality control wet SWM facility.

It should be noted that 0.25 ha of uncontrolled drainage is unable to be conveyed to and treated by the proposed treatment train in the interim scenario.

Detailed calculations can be found in Appendix C.

5.5.2 Phosphorus Control

LSRCA guidelines require post-development phosphorus loads be less than pre-development loading rates, with best efforts to achieve an overall 80% removal rate. A phosphorus budget was completed utilizing the MECP Phosphorus Budget Tool, developed by Hutchinson Environmental Sciences Limited (V2.0 Release Update – March 30, 2012). The budget was completed to include buildout of both the Phase 1 and Phase 3 blocks.

The pre-development phosphorus loading rate from the 0.92 ha of the site plan that, under existing conditions, is within the Hewitt’s Creek subwatershed was determined to be 0.17 kg/yr. Unmitigated phosphorus loading under post-development conditions was found to be 2.58 kg/yr.

Treatment efficiencies related to phosphorus removal are presented in Appendix E of the LSRCA guidelines and summarized below:

- SWMF (wet facility) at 63%.
- Infiltration Gallery (for rooftop drainage only) at 60%.

- Filtration Unit (Jellyfish or equivalent) at 72%.

The drainage areas and assumed removal efficiencies were applied within the Phosphorus Budget Tool to estimate the mitigated post-development phosphorus load. The Tool reported an anticipated loading of 0.80 kg/yr, representing a 69.0% net reduction of the post-development loading for the area draining to SWMF in the interim condition.

The only difference between the interim and ultimate condition of Phase 1 is the removal of the SWMF. Therefore, the Tool reported an anticipated loading of 1.20 kg/yr, representing a 78.6% net reduction of the post-development loading for the area.

The LSRCA Phosphorus Offsetting Policy specifies that post-development phosphorus loadings must match or be less than pre-development phosphorus loadings. Therefore, Phosphorus Offsetting will be required as per the policy.

It should be noted that 0.25 ha of uncontrolled drainage is unable to be conveyed to and treated by the proposed treatment train and will therefore, be discharging uncontrolled and untreated in the interim condition.

The complete pre- and post-development phosphorus summary is provided in Appendix C.

5.5.3 Other Contaminants

To combat winter salt loading, the proposed Jellyfish (or equivalent filtration unit) shall provide treatment of proposed site discharge flows to provide best efforts to conform with Table 2 of the City of Barrie's Sewer-Use By-law.

5.6 Water Balance

A hydrogeological study was complete by Burnside in 2024, which confirmed the annual pre-development and post-development infiltration (using the Thornthwaite Method) for the entirety of the development. Table 7 below presents the information relevant to the interim Phase 1 condition. For details on the entire proposed development refer to Section 3.0.

Table 7: Phase 1 Water Balance Summary Table

Pre-Development		Post-Development (Unmitigated)		
Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)	Total Infiltration Deficit (m^3/a)
4,021	3,992	12,292	1,297	2,696

The infiltration gallery is proposed to accommodate runoff from a 25 mm storm event from the roof areas. The roofs generate approximately 4,916 m^3 of runoff annually. The 25 mm event represents approximately 95% of rainfall events yearly (~72% of the total precipitation).

Therefore, the proposed infiltration gallery will accommodate 3,539 m^3 for infiltration annually, which exceeds the deficit present on-site for this phase.

6.0 Erosion and Sediment Control

Erosion and Sediment Control (ESC) will be implemented for all construction activities, including earth moving, foundation excavation, servicing construction, and building construction. Construction access for the site is to be limited as much as possible.

The entire working area is to have perimeter ESC fencing and signage installed to delineate the working area and mitigate sediment runoff from the site. For necessary construction traffic, a construction entrance will be built as shown on the ESC drawing. A construction mud mat is to be installed to reduce the movement of soil and debris from the site. During active construction, dust and mud tracking shall be reviewed on a daily basis. Yonge Street will be cleaned and swept frequently as instructed by the site inspector or the City of Barrie.

Once servicing of the site has been completed, geotextile is to be installed on all catchbasin grates, frequently monitored through construction, and replaced when damaged or clogged to prevent sediment from entering the sewers. The storm sewer network is to have sewers flushed and cleaned prior to the completion of site servicing and building construction. It should be noted that the infiltration gallery will be kept offline until the construction is completed and the site is stabilized.

All ESC measures will be inspected on a weekly basis and after every significant rainfall event. Measures that are not functioning properly will be repaired in a timely manner to minimize sediment from leaving the Site. Additionally, after hours contact numbers are to be posted on-site for emergencies.

It should be noted that disturbed areas should be minimized to the extent possible and temporarily or permanently stabilized or restored as the work progresses. Disturbed areas must be replanted using native species within 30 days of construction completion.

Please refer to the Erosion and Sediment Control plan included in the Civil Engineering Set for more details.

7.0 Conclusion and Recommendations

This report confirms the proposed stormwater management strategy in both the interim and ultimate condition can support the proposed interim Phase 1 development.

The following conclusions are presented:

- All grading designs have been completed to conform to Municipal Standards and promote positive drainage towards the ultimate outlet.
- The proposed storm drainage system has been designed in compliance with the Hewitt's Subwatershed Impact Study, MECP Guidelines, City of Barrie Design Criteria and Lake Simcoe Region Conservation Authority Criteria.
- An interim stormwater management facility is proposed to service the Phase 1 lands. The facility has been designed as a wet pond complete to provide the required quality and quantity controls.
- Under ultimate conditions, the site (4.94 ha) is tributary to SWMF5.
- Peak flow control will be provided in the interim by the SWMF by adhering to the allowable discharge rates specified in the Hewitt's SIS.
- Erosion control is proposed to be provided via SWM tanks within the building footprint.
- A Filtration Unit (Jellyfish or approved equivalent) has been proposed to provide quality control for the site.
- An infiltration gallery is proposed within the Phase 3 lands and will receive the rooftop drainage from the subject phase, to help achieve the 25 mm volume control, water balance and quality control requirements for the site. An alternative approach to this infiltration gallery is an infiltration trench proposed between the interim SWM facility and the Street A ROW in the interim scenario.
- Phosphorus offsetting is required for the subject phase as the post-development loading (0.80 kg/yr) is greater than pre-development loading (0.17 kg/yr). It is recommended that any phosphorus offsetting is settled at the ultimate condition stage.
- No water balance offsetting is required for the subject Phase as the 2,696 m^3/year deficit is provided by the infiltration gallery (3,539 m^3/year).
- Erosion and sediment controls will be provided, monitored, and maintained throughout all stages of construction.

The proposed SWM measures discussed in this report can be implemented to meet all required criteria.

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Appendix A

Background Excerpts

Hewitt's Secondary Plan Area Subwatershed Impact Study Lover's, Hewitt's and Sandy Cove Creeks

Hewitt's Landowner's Group
c/o Bratty and Partners
7501 Keele Street, Suite 200
Vaughan ON L4K 1Y2

R.J. Burnside & Associates Limited
128 Wellington Street West, Suite 301
Barrie ON   L4N 8J6 CANADA

in partnership with:

Azimuth Environmental Consulting Inc.
642 Welham Road
Barrie ON   L4N 9A1 CANADA

September 2016
300032860.0000

LEGEND

- STAKED NHS LIMITS (2015)
- NHS BUFFER LIMITS
- CoB GENERATED BUFFER LIMITS (2013)
- 2031 BOUNDARY
- PROPOSED 100 YR FLOOD LIMITS
- PROPOSED REGIONAL FLOOD LIMITS

DASHED FLOOD LINES ARE APPROXIMATE ONLY, BASED ON INTERPOLATED DATA BETWEEN FINGERLAKES AND 1091369 ONTARIO INC. DETAILED TOPOGRAPHIC DATA. FLOODLINES ARE SUBJECT TO CHANGE BASED ON ADDITION OF DETAILED TOPOGRAPHIC SURVEY.

- 263.99 EXISTING ELEVATION
- 263.99 PROPOSED ELEVATION
- PROPOSED OVERLAND FLOW ROUTE

NOTE:
THE REGULATORY EVENT IS THE REGIONAL STORM EVENT

0 60 120 180 240
Metres

NOTE: "SCALE ONLY VALID FOR 24" x 36" SIZED PLOTS"

BURNSIDE

Client: HEWITT'S CREEK LANDOWNERS GROUP INC.

Figure Title: HEWITT'S SECONDARY PLAN AREA SUBWATERSHED IMPACT STUDY
PROPOSED CONDITION GRADING PLAN (2 OF 3)

Drawn	Checked	Date	Figure No.
AO	CC	17/09/14	FIG 7
Scale: H 1:3,000		Project No.: 300032860	

R.J. Burnside & Associates Limited 3 Ronell Crescent Collingwood ON L9Y 4J6 CANADA
telephone (705) 446-0515 **fax** (705) 446-2399 **web** www.rjburnside.com

BURNSIDE
[THE DIFFERENCE IS OUR PEOPLE]

November 18, 2022

Via: e-mail (Andrew.Gameiro@barrie.ca)

Andrew Gameiro
Senior Planner
City of Barrie
70 Collier Street
Barrie ON L4M 4T5

Dear Mr. Gameiro:

Re: Crown Communities Developments Inc. – 1012 Yonge Street
Hewitt's Secondary Plan, City of Barrie
SIS Conformity Clearance
RJB Project No.: 300032860.0000

In support of the re-zoning applications made for the subject lands, I confirm that based on my general review of the submission materials prepared by GHD, and my discussions with Crown Communities, the submission is in general conformance with the Burnside SIS, in terms of servicing strategy and stormwater management.

Since the previous submission, the proponent has revised the servicing strategy and is now proposing to service the site with respect to sanitary and storm drainage, as originally anticipated in the SIS (via ASA lands to Kneeshaw).

It is noted that there is ongoing work within the landowners group to coordinate water looping for the developments along Yonge Street (including Crown) in advance of Yonge Street re-construction proceeding.

This will involve a watermain feeding the site from the west (via Madelaine, and / or Mattamy and Rainsong lands), in addition to a watermain on Kneeshaw connecting to Yonge Street via ASA lands.

These details will be worked through with the landowners involved and the City of Barrie to ensure that adequate water distribution is provided in advance of Yonge Street construction.

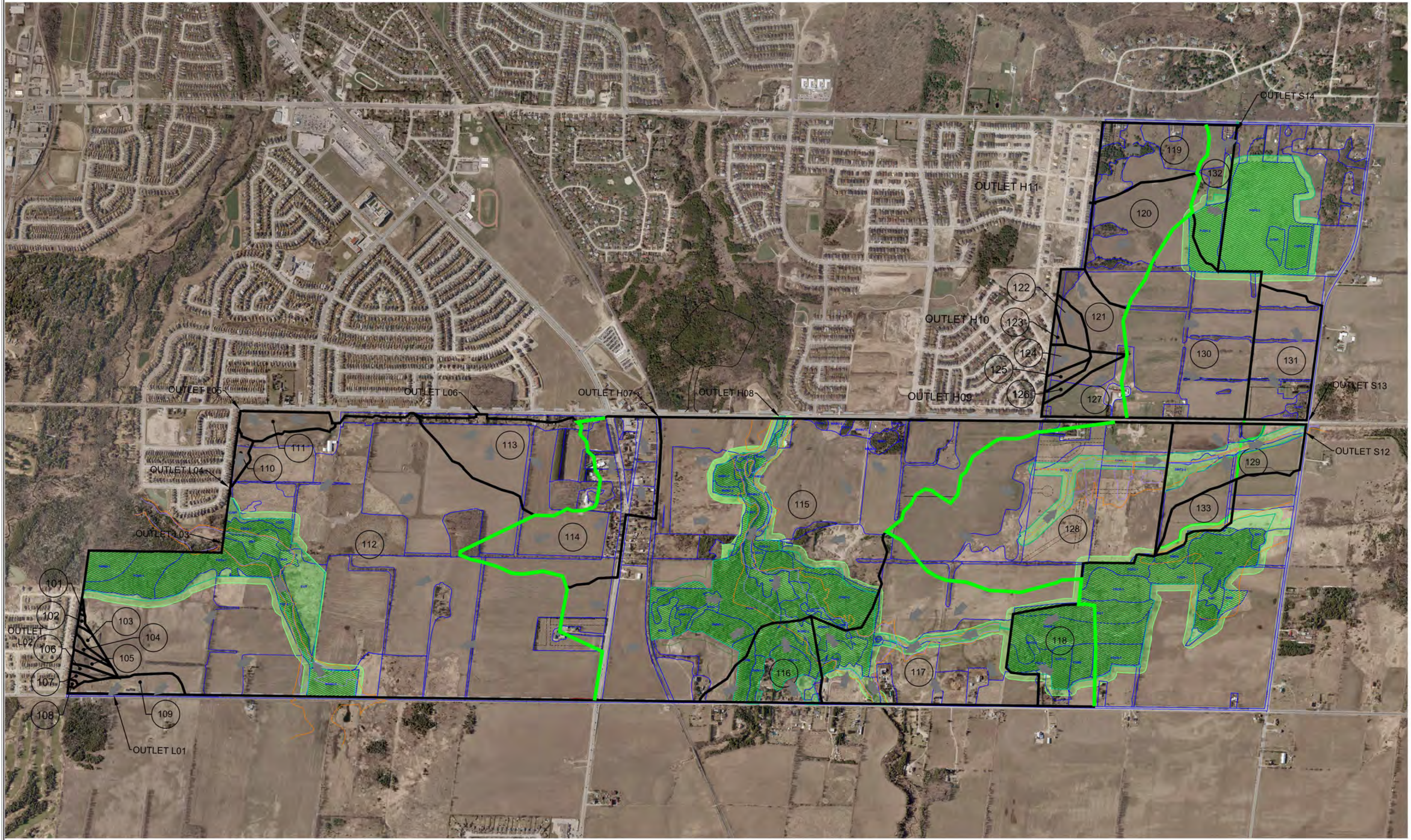
Please contact the undersigned if you have any questions or require anything further to this effect.

Yours truly,

R.J. Burnside & Associates Limited

James Orr, P.Eng.
Hewitt's Creek Landowner's Group Engineer
JO:kd

cc: Adam Taverna, Crown Communities (adam@thecrowncommunities.com)
Winston Thai, GHD (Winston.Thai@ghd.com)
Ray Duhamel, Hewitt's Creek Landowner's Group (rduhamel@jonesconsulting.com)



110 DRAINAGE AREA ID

DRAINAGE BOUNDARY

EXISTING CONTOURS

ELC BOUNDARIES

WATERSHED BOUNDARY

STAKED 2015 NHS LIMITS

NHS BUFFER LIMITS

COB GENERATED NHS BUFFER LIMITS (2013)

EXISTING 100yr STORM FLOOD LIMIT

EXISTING REGIONAL STORM FLOOD LIMIT

DASHED FLOOD LINES ARE APPROXIMATE ONLY, BASED ON INTERPOLATED DATA BETWEEN FINGERLAKES AND 1091369 ONTARIO INC. DETAILED TOPOGRAPHIC DATA. FLOODLINES ARE SUBJECT TO CHANGE BASED ON ADDITION OF DETAILED TOPOGRAPHIC SURVEY.

OVERLAND FLOW ROUTE

N

0 100 200 400 600

Metres

NOTE: "SCALE ONLY VALID FOR 24" x 36" SIZED PLOTS"

BURNSIDE

Client
HEWITT'S CREEK LANDOWNERS GROUP INC.

Figure Title
HEWITT'S SECONDARY PLAN AREA SUBWATERSHED IMPACT STUDY
EXISTING CONDITIONS DRAINAGE PLAN

Drawn	Checked	Date	Figure No.
BH	MZ	16/09/07	FIG 5
Scale		Project No.	
H 1:7,500*		300032860	

5.4.7.2 Hewitt’s Creek

Table 12 Hewitt's Creek, Proposed Condition Modelling Results

Hewitt's Creek Proposed Model Summary		24 Hour SCS Type II Storm					
	Area(ha)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
RJB Allowable Unitary Discharge Rate (m^3/s/ha)		**0.006**	**0.011**	**0.016**	**0.023**	**0.029**	**0.036**
Catchment 5 Total Allowable Discharge (m^3/s)	***34.4***	***0.21***	***0.38***	***0.54***	***0.79***	***1.00***	***1.23***
Uncontrolled Flows to SWMF 5 (m^3/s)	34.4	3.50	5.19	6.50	8.13	9.37	10.63
Proposed Flows from SWMF 5 (m^3/s)		0.10	0.14	0.28	0.54	0.78	1.07
Catchment 5 Total Proposed Discharge (m^3/s)	***34.4***	***0.10***	***0.14***	***0.28***	***0.54***	***0.78***	***1.07***
Catchment 6 Total Allowable Discharge (m^3/s)	***14.6***	***0.09***	***0.16***	***0.23***	***0.33***	***0.42***	***0.52***
Uncontrolled Flows to SWMF 6 (m^3/s)	14.6	1.36	1.94	2.46	3.07	3.54	4.02
Proposed Flows from SWMF 6 (m^3/s)		0.04	0.05	0.11	0.24	0.36	0.51
Catchment 6 Total Proposed Discharge (m^3/s)	***14.6***	***0.04***	***0.05***	***0.11***	***0.24***	***0.36***	***0.51***
Catchment 7 Total Allowable Discharge (m^3/s)	***26.3***	***0.05***	***0.10***	***0.14***	***0.20***	***0.25***	***0.31***
Uncontrolled Flows to SWMF 7 (m^3/s)	8.7	0.86	1.30	1.60	2.01	2.31	2.63
Uncontrolled Flows to SWMF 7 (Catch 7a) (m^3/s)	17.6	2.10	3.00	3.78	4.69	5.39	6.08
Proposed Flows from SWMF 7 (m^3/s)	26.3	0.07	0.11	0.22	0.40	0.57	0.75
Catchment 7 Total Proposed Discharge (m^3/s)	***26.3***	***0.07***	***0.11***	***0.22***	***0.40***	***0.57***	***0.75***
Catchment 8 Allowable Flows (m^3/s)	***25.9***	***0.16***	***0.29***	***0.41***	***0.59***	***0.75***	***0.92***
Uncontrolled Flows to SWMF 8 (m^3/s)	18.3	1.61	2.33	2.81	3.46	3.99	4.57
Proposed Flows from SWMF 8 (m^3/s)		0.01	0.01	0.01	0.05	0.10	0.19
Uncontrolled Flows to SWMF 8a (m^3/s)	1.0	0.00	0.02	0.14	0.21	0.26	0.31
Uncontrolled Flows to SWMF 8b (m^3/s)	0.2	0.00	0.00	0.00	0.01	0.03	0.05
Uncontrolled Flows to SWMF 8c (m^3/s)	4.5	0.00	0.00	0.04	0.07	0.11	0.14
Uncontrolled Flows to SWMF 8d (m^3/s)	0.2	0.01	0.02	0.03	0.04	0.05	0.06
[A]Uncontrolled Flows to SWMF 8e (m^3/s)	1.7	0.01	0.02	0.03	0.04	0.05	0.06
Catchment 8 Total Proposed Discharge (m^3/s)	***25.9***	***0.03***	***0.07***	***0.25***	***0.42***	***0.60***	***0.81***
Catchment 9 Allowable Flows (m^3/s)	***31.9***	***0.20***	***0.35***	***0.50***	***0.73***	***0.93***	***1.14***
Uncontrolled Flows to SWMF 9 (m^3/s)	31.4	2.37	3.50	4.40	5.50	6.35	7.20
Proposed Flows from SWMF 9 (m^3/s)		0.07	0.16	0.28	0.47	0.63	0.82
Uncontrolled Flows to SWMF 9a (m^3/s)	0.4	0.00	0.01	0.05	0.08	0.10	0.12
Catchment 9 Total Proposed Discharge (m^3/s)	***31.9***	***0.07***	***0.17***	***0.33***	***0.55***	***0.73***	***0.94***
Catchment 10 Allowable Flows (m^3/s)	***40.4***	***0.25***	***0.45***	***0.63***	***0.92***	***1.18***	***1.44***
Uncontrolled Flows to SWMF 10 (m^3/s)	39.3	3.64	5.48	6.78	8.49	9.81	11.14
Proposed Flows from SWMF 10 (m^3/s)		0.10	0.15	0.28	0.53	0.75	0.98
Uncontrolled Flows to SWMF 10a (m^3/s)	1.1	0.09	0.19	0.26	0.33	0.39	0.44
Catchment 10 Total Proposed Discharge (m^3/s)	***40.4***	***0.19***	***0.34***	***0.54***	***0.86***	***1.14***	***1.42***
Catchment 15 Allowable Flows (m^3/s)	***26.7***	***0.16***	***0.30***	***0.42***	***0.61***	***0.78***	***0.95***
Uncontrolled Flows to SWMF 15 (m^3/s)	22.2	2.04	2.96	3.72	4.63	5.32	6.03
Proposed Flows from SWMF 15 (m^3/s)		0.07	0.13	0.22	0.38	0.53	0.70
Uncontrolled Flows to SWMF 15a (m^3/s)	4.5	0.00	0.01	0.06	0.11	0.15	0.20
Catchment 15 Total Proposed Discharge[B] (m^3/s)	**26.7**	**0.07**	**0.14**	**0.28**	**0.49**	**0.68**	**0.90**
Catchment 16 Allowable Flows (m^3/s)	***22.89***	***0.14***	***0.25***	***0.36***	***0.52***	***0.67***	***0.82***
Uncontrolled Flows to SWMF 16 (m^3/s)	21.34	2.11	2.99	3.57	4.31	4.86	5.41
Proposed Flows from SWMF 16 (m^3/s)		0.04	0.08	0.15	0.28	0.40	0.53
Uncontrolled Flows to SWMF 16a (m^3/s)	1.55	0.07	0.10	0.12	0.14	0.16	0.18
Catchment 16 Total Proposed Discharge[C] (m^3/s)	***22.89***	***0.11***	***0.18***	***0.27***	***0.42***	***0.56***	***0.71***
Discharge to Existing Subdivisions							
Catchment 203 to Mapleview Drive (via Yonge St.)							
Pre-Development Flows to Mapleview (m^3/s)	*31.39*	*0.78*	*1.22*	*1.53*	*1.95*	*2.29*	*2.64*
Post-Dev. Catchment 203 Flows to Mapleview (m^3/s)	**16.07**	**0.68**	**0.97**	**1.30**	**1.67**	**1.97**	**2.27**
Catchment 204 to Mapleview Drive (at Maplecort)							
Pre-Development Flows to Mapleview (m^3/s)	*6.54*	0.09	0.13	0.21	0.29	0.35	0.43
Post-Dev. Catchment 204 Flows to Mapleview (m^3/s)	**0.29**	**0.00**	**0.00**	**0.01**	**0.02**	**0.02**	**0.03**
Catchment 205 to Maplecort Dev. (Unicorn Lane)[D]							
Pre-Development (124) Flows to Unicorn (m^3/s)	*1.8*	*0.00*	*0.00*	*0.03*	*0.06*	*0.08*	*0.10*
Post-Dev. Catchment 205 Flows to Unicorn (m^3/s)	**0.3**	**0.01**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**

Notes

A - Catchment 8E requires LID controls to meet unitary discharge rates

B - Catchment 15 to discharge to Winchester Terrace in Hamptons on Big Bay Development via 675 mm dia. pipe @1.9%, 1.2 cms capacity

C - Catchment 16 to discharge to Versailles Cres. in Hamptons on Big Bay Development via 750 mm dia. pipe @0.9%, 1.1 cms capacity

D - Maplecort Development accounted for up to 0.40 cms during 100 year event at this location. Additional LID required to reduce peak flows in 2 and 5 year events to pre dev levels

Catchment 5 & 5-EXT/SWMF #5

SWMF#5 is proposed to be located on the west side of Yonge Street in Phase 3 lands owned by a non-participating group member. Conceptual development plans have not been made available to Burnside for review and as such all design for this facility has been completed based on Land Use Schedule 9C from the July 2015 OMB decision. A portion of the catchment (northwest corner of Lockhart and Yonge Street) is owned by Rainsong and is proposed as a school block.

Catchment 5 consists of medium/high density residential, the southern half of the Yonge Street mixed use corridor, the institutional (school) block at the northwest corner of Yonge Street and Lockhart Road, and the remainder of the recreational centre block that will not be treated by SWMF #4. We have assumed that the existing culvert crossing on Yonge Street at Carpe Diem Orchards and the existing culvert crossing under the GO Transit Rail line (where the NHS limits touch the edge of the GO Transit railway corridor) will be abandoned or altered in favour of directing flow to SWMF #5. In addition we have assumed that 100 year conveyance will be required south along Yonge Street, east along Lockhart and north through the proposed development lands to SWMF#5.

The current SWMF block and design meets the assumed needs of the development area, however without additional conceptual details including the internal grading of the site, road network, and lotting concept it is not possible to comment further on the appropriate size and configuration of the SWMF. The block and design provided in this report demonstrate that a drainage area of this size and land use designation could be accommodated.

Additional details will need to be developed and presented by the land owner for this facility.

Catchment 6/SWMF #6

SWMF#6 is proposed to be located on the west side of Hewitt's Creek primarily in the Phase 1 Crisdawn Construction lands, and partially in the 2303757 Ontario Inc. lands. This facility is intended to provide quality and quantity control primarily for the southern part of the Crisdawn Construction Inc. lands on the west side of Hewitt's Creek, the 2303757 Ontario Inc. lands and a portion of the non-participating member development lands south of 2303757 Ontario Inc.

Catchment 6 consists of roughly equal proportion of residential development and mixed use areas, with one small park. The 4 ha of land that drained east under the railway tracks (part of existing Catchment 115) via the 900 mm dia. culvert is to be redirected north along the west side of the train tracks and the 900 mm dia. culvert abandoned.

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Appendix B

Interim Pond Sizing & Details

Appendix B

R.J Burnside & Associates Limited

Project No.: 300057940
Date: 8/9/2024

1012 Yonge Street

Crown (Barrie) Development Inc.

City of Barrie

Design Stage Interim Design

Calculation Sheets Included in Design Stage

- Impervious Calculation
- Permanent Pool
- Permanent Pool Check
- Modified Rational Method
- Pond Volume Stage Storage
- Forebay Sizing
- Forebay Weir Sizing
- Emergency Spillway Weir Sizing
- Stage Storage Discharge

Designed By: S.Fanous
Checked By: M.Haw/J.Smith
Submission: First Detailed Design
Submission Date: 8/15/2024
Revision No.: 0

Project:	**1012 Yonge Street**
Location:	City of Barrie
Project #:	300057940
Designed By:	S.Fanous
Checked By:	M.Haw
Date:	8/16/2024

BURNSIDE

Impervious Calculations per Phase - Ultimate Condition

Phase 1	*Area (ha)*	*% Impervious*	*Impervious Value Source*
Buildings	0.62	100%	D700
Sidewalk	0.16	100%	D700
Driveway and Surface Parking	0.35	100%	D700
Outdoor Amenity	0.11	100%	D700
Pervious Area above underground parking	0.41	43%	Estimated
Lower Street ROW	*Area (ha)*	*% Impervious*	*Impervious Value Source*
Sidewalk	0.11	100%	D700
Driveway	0.12	100%	D700
Pervious Area	0.08	0%	D700
Total Area	**1.97**		
Composite Impervious		**83.9%**	
Phase 2	*Area (ha)*	*% Impervious*	*Impervious Value Source*
Buildings	0.67	100%	D700
Sidewalk	0.08	100%	D700
Driveway and Surface Parking	0.08	100%	D700
Outdoor Amenity	0.05	100%	D700
Pervious Area above underground parking	0.37	43%	Estimated
Lower Street ROW	*Area (ha)*	*% Impervious*	*Impervious Value Source*
Sidewalk	0.08	100%	D700
Driveway	0.08	100%	D700
Pervious Area	0.05	0%	D700
Total Area	**1.46**		
Composite Impervious		**82.1%**	
Phase 3	*Area (ha)*	*% Impervious*	*Impervious Value Source*
Buildings	0.34	100%	D700
St.Townhouses	0.04	100%	Estimated
Sidewalk	0.09	100%	D700
Driveway and Surface Parking	0.26	100%	D700
Outdoor Amenity	0.28	100%	Estimated
Pervious Area above underground parking	0.26	43%	Estimated
Lower Street ROW	*Area (ha)*	*% Impervious*	*Impervious Value Source*
Sidewalk	0.09	100%	D700
Driveway	0.08	100%	D700
Pervious Area	0.07	0%	D700
Total Area	**1.51**		
Composite Impervious		**85.5%**	
TOTAL SITE AREA			
Total Area	**4.94**	**83.9%**	
Composite Impervious			

Project:	**1012 Yonge Street**
Location:	City of Barrie
Project #:	300057940
Designed By:	S.Fanous
Checked By:	M.Haw
Date:	8/16/2024

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Runoff Coefficient and Impervious Calculations for Interim Phase 1

INTERNAL CONTROLLED PH1	Major and Minor *Area (ha)*	*Runoff Coefficient*	*% Impervious*	*Notes*
Buildings	0.62	0.95	100%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Sidewalk	0.27	0.95	100%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Driveway and Surface Parking	0.46	0.95	100%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Outdoor Amenity	0.11	0.95	100%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Pervious Area above underground parking	0.43	0.50	43%	Assumed
Remaining Pervious Area	0.07	0.25	0%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Total Area	**1.96**			
Composite Impervious/Runoff Coefficient		**0.83**	**83.8%**	

INTERNAL CONTROLLED PH2 AREA UNDEVELOPPED	*Area (ha)*	*Runoff Coefficient*	*% Impervious*	*Impervious Value Source*
Pond Block	0.43	0.55	50%	Assumed
Remaining Pervious Area	0.81	0.25	0%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Total Area	**1.24**			
Composite Impervious/Runoff Coefficient		**0.35**	**17.3%**	

UNCONTROLLED LOWER ST. ROW	*Area (ha)*	*Runoff Coefficient*	*% Impervious*	*Impervious Value Source*
Sidewalk	0.09	0.95	100%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Driveway	0.09	0.95	100%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Pervious Area	0.07	0.25	0%	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Total Area	**0.25**			
Composite Impervious/Runoff Coefficient		**0.75**	**72.0%**	

Summary	**Area (ha)**	**Runoff Coefficient C5**	**Runoff Coefficient C100***	**Impervious**
Quantity Control	3.20	0.64	0.80	58%
Quality Control	3.20	0.64	N/A	58%
OverControl	0.25	0.75	0.94	72%

**C100 = 1.25 x C5*

Project:	**1012 Yonge Street**
Location:	City of Barrie
Project #:	300057940
Designed By:	S.Fanous
Checked By:	M.Haw/J.Smith
Date:	8/16/2024
Updated:	8/15/2024

Permament Pool Requirement - Phase 1 Interim

MECP Table 3.2 Water Quality Storage Requirements Based on Receiving Waters.

Percent Impervious	58.0	%
Area	3.20	ha
Protection Level	Enhanced (Level 1) Protection	
Pond Type	Wet Pond	
Extended Detention Credit	0	cu.m/ha

Enhanced (Level 1) Protection
Wet Pond

Impervious Level (%)	Storage Volume (cu.m./ha)	Imperviousness (%)	Permanent Pool Storage Volume (cu.m./ha)	Total Permanent Pool Required (cu.m)
35	140	**58.0**	**197.0**	**630**
55	190			
70	225			
85	250			
95	276	*Extrapolated*		

Project:	**1012 Yonge Street**
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Designed By:	S.Fanous
Checked By:	M.Haw/J.Smith
Date:	8/9/2024
Updated:	8/15/2024

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MECP Criteria Check for Permanent Pool

Refer to MECP SWM Planning and Design Manual (2003)

Pond Type: Wet Pond

Refer to Stage-Storage Analysis for the below information

	Volume (m3)	Area (m2)
Forebay Permanent Pool	137	290
Main Cell Permanent Pool	1208	1057
Total Permanent Pool	**1345**	**1347**

Minimum Criteria

Forebay area is	22 %	of total permanent pool area
Maximum forebay area is	33 %	of total permanent pool area

Preferred Criteria

Forebay volume is	10 %	of total permanent pool volume
Maximum forebay volume is	20 %	of total permanent pool volume

Therefore, the minimum/preferred applicable criteria per MECP guidelines is **satisfied**

BURNSIDE

Project: 1012 Yonge Street
Project No.: 300057940
Modelled By: S.Fanous/ M.Haw
Date: 2024/08/09

RATIONAL METHOD
PRE-DEVELOPMENT SITE FLOWS

Rainfall IDF Coefficients 100 -year

A =		A =	1383.628
C =		B =	4.905
		C =	0.754

Rational Method Calculation

Area =	1.78	ha
Runoff Coefficient, C =	0.34	
C*A =	0.61	
Time of Concentration, t_c =	10.0	min
Rainfall Intensity, i =	180.44	mm/hr
Target Release Rate =	303.34	L/s

Project:	1012 Yonge Street
Project No.:	300057940
Modelled By:	S.Fanous/ M.Haw
Date:	2024/08/09

RATIONAL METHOD
POST-DEVELOPMENT UNCONTROLLED SITE FLOWS

Rainfall IDF Coefficients	100	-year		
A =			A =	1383.628
C =			B =	4.905
			C =	0.754

Rational Method Calculation

Area =	0.25	ha
Runoff Coefficient, C =	0.94	
C*A =	0.24	
Time of Concentration, t_c =	10.0	min
Rainfall Intensity, i =	180.44	mm/hr
Target Release Rate =	117.79	L/s

Project:	1012 Yonge Street
Project No.:	300057940
Modelled By:	S.Fanous/ M.Haw
Date:	2024/08/15

MODIFIED RATIONAL METHOD
POST-DEVELOPMENT CONTROLLED FLOWS

Rainfall IDF Coefficients 100 -year

A =		A =	1383.628
C =		B =	4.905
		C =	0.754

Rational Method Calculation

Area =	3.20	ha
Runoff Coefficient, C =	0.80	
C*A =	2.56	
Time of Concentration, t_c =	10.0	min
Storm Duration Increment =	5.0	min
Target Release Rate =	303	L/s
Constant Inflow =		L/s
Uncontrolled Outflow =	118	L/s
Max. Allowable Outflow =	185.34	L/s

Storm Duration (min)	Rainfall Intensity (mm/hr)	Max. Runoff Flow (L/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Volume Required (m^3)	Drawdown Time (hrs)
10.0	180.44	1283.11	770	111	659		
15.0	145.08	1031.67	928	139	789		
20.0	122.52	871.28	1046	167	879		
25.0	106.74	759.01	1139	195	944		
30.0	94.99	675.49	1216	222	993		
35.0	85.87	610.64	1282	250	1032		
40.0	78.56	558.63	1341	278	1063		
45.0	72.55	515.89	1393	306	1087		
50.0	67.51	480.05	1440	334	1107		
55.0	63.21	449.52	1483	361	1122		
60.0	59.51	423.15	1523	389	1134		
65.0	56.27	400.13	1560	417	1143		
70.0	53.41	379.82	1595	445	1150		
75.0	50.87	361.76	1628	473	1155		
80.0	48.60	345.57	1659	500	1158		
85.0	46.54	330.98	1688	528	1160		
90.0	44.68	317.75	1716	556	1160	1160	3.74
95.0	42.99	305.68	1742	584	1159		
100.0	41.43	294.63	1768	612	1156		
105.0	40.00	284.47	1792	639	1153		
110.0	38.68	275.08	1816	667	1148		
115.0	37.46	266.39	1838	695	1143		
120.0	36.32	258.31	1860	723	1137		
125.0	35.27	250.77	1881	751	1130		
130.0	34.28	243.73	1901	778	1123		
135.0	33.35	237.14	1921	806	1115		
140.0	32.48	230.94	1940	834	1106		

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Project: 1012 Yonge Street
Project No.: 300057940
Modelled By: S.Fanous/ M.Haw
Date: 2024/08/16

RATIONAL METHOD
10-year Post-Development Uncontrolled Flow For Forebay Sizing

Rainfall IDF Coefficients 10 -year

A =		A =	976.898
C =		B =	4.745
		C =	0.760

Rational Method Calculation

Area =	3.20	ha
Runoff Coefficient, C =	0.64	
C*A =	2.05	
Time of Concentration, t_c =	10.0	min
Rainfall Intensity, i =	126.38	mm/hr
Target Release Rate =	719	L/s

Project: **1012 Yonge Street**
Location: City of Barrie
Project #: 300057940
Designed By: S.Fanous
Checked By: M.Haw/J.Smith
Date: 8/16/2024
Updated: 8/15/2024

BURNSIDE

Stormwater Management Facility Storage Calculations

Base of Pond: **264.45**
N.W.L.: **266.45** masl
Increment for Volume: 0.05 m
Required Permanent Pool Volume: 630.4 m^3
Permanent Pool Volume Provided: **1345.2** m^3

Description	**Elevation**	**Stage**	**Elev Above PP**	**Deep Outlet**	**Total Area**	**Avg. Area**	**Incremental Storage**	**Cumulative Storage**	**Cumulative Storage above NWL**
	(m)	(m)	(m)	(m2)	(m2)	(m2)	m^3	m^3	m^3
Bottom of Main Cell	**264.45**	0.00		**301**	300.80				0.00
Bottom of Forebay	**265.45**	1.00		**598**	598.00	449.40	449.40	449.40	0.00
	265.95	1.50		**819**	819.00	708.50	354.25	803.65	0.00
NWL	**266.45**	2.00	0.00	**1347**	1347.00	1083.00	541.50	1345.15	0.00
	266.95	2.50	0.50	**2016**	2016.00	1681.50	840.75	2185.90	840.75
	267.45	3.00	1.00	**2590**	2590.00	2303.00	1151.50	3337.40	1992.25
Freeboard	**267.75**	3.30	1.30	**2894**	2894.00	2742.00	822.60	4160.00	2814.85
	268.05	3.60	1.60	**3213**	3213.00	2901.50	1740.90	5078.30	3733.15
Top of Pond	**268.05**	3.60	1.60	**3892**	3892.00	3552.50	0.00	5078.30	3733.15

Project:	**1012 Yonge Street**
Location:	City of Barrie
Project #:	300057940
Designed By:	S.Fanous
Checked By:	M.Haw/J.Smith
Date:	8/16/2024
Updated:	8/15/2024

BURNSIDE

2) Dispersion Length **Dist = (8 * Q) / (d * Vf)**

(Equation 4.6,MOE 2003)

where:	Dist =	Forebay length (m)		
	Q =	inlet flowrate (cms)		
	d =	depth of permanent pool in forebay (m)		
	Vf =	desired forebay velocity (m/s)		
given:	Q =	0.719	cms	*10yr interim inflow
	d =	1	m	
	Vf =	0.5	m/s	
therefore:	Dist =	11.5	metres	
	Width=	5.8	metres	
	Min Bottom Width=	1.4	metres	*AE page 6-27
	Pond Side Slopes:	4.54	(A combination of 6:1 and 3:1)	
	Calc. Top Width=	10.518	metres	
	Calc. Top Length=	26.295	metres	

Actual Forebay Design:

	Length=	28	meters		
	Width=	11	meters		
	Volume=	137	m3		

Check Average velocity in forebay <= 0.15 m/s

	Pond Side Slopes:	4.54	H : 1 V		
Q = V x A	Q =	0.719	A =	6.7	sq.metres
therefore:	V =	0.1076	m/s		
Design:		**OK**			

Project:	**1012 Yonge Street**
Location:	City of Barrie
Project #:	300057940
Designed By:	S.Fanous
Checked By:	M.Haw/J.Smith
Date:	8/16/2024
Updated:	8/15/2024

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Forebay Spillway Sizing

Q = Cd*L*H^(1.5)

Cd =	1.705	Weir Coefficient	
Inlet Elevation =	266.45	m	(Normal Water Level)
Top Elevation =	266.95	m	(Top of Forebay Berm)
H =	0.50	m	
Q =	719	l/s	10yr event inflow to pond
	0.719	cms	
L =	**1.19**	**m**	(Minimum spillway width)
	5.00	m	(Provided spillway width)
Q(actual) =	**3.014**	cms	(Based on provided spillway width)

Emergency Spillway Sizing

Q = Cd*L*H^(1.5)

Cd =	1.705	Weir Coefficient	
Inlet Elevation =	267.75	m	(Invert of the Weir)
Top Elevation =	268.05	m	(Top of Berm)
H =	0.30	m	
Q =	1283	l/s	100-year event inflow to pond
	1.283	cms	
L =	**4.58**	**m**	(Minimum spillway width)
	8.00	m	(Provided spillway width)
Q(actual) =	**2.24**	cms	(Based on provided spillway width)

Project: **1012 Yonge Street**
Location: City of Barrie
Project # 300057940
Designe(S.Fanous
Checked M.Haw/J.Smith
Date: 8/16/2024
Updated: 8/15/2024

BURNSIDE

Emergency Spillway Depths

Spillway Roughness 0.035 (based on grass surface)

100 YEAR FLOW DEPTHS

	Spillway Side Slopes V (m)	Spillway Side Slopes H (m)	Bottom Width (m)	Peak Flow* (cu.m/s)	Flow Depth (m)	Spillway Data: Slope (%)	Area (sq. m)	Wetted Perimeter (m)	Velocity (m/s)	Capacity (cu.m/s)
Typ. Pond Slope	1	3	8	2.07	0.096	20	0.793	8.61	2.61	2.07
Outside of Pond Block	1	3	8	2.07	0.14	5	1.205	8.90	1.72	2.07

Project:	**1012 Yonge Street**
Location:	City of Barrie
Project #:	300057940.00
Designed By:	S.Fanous
Checked By:	M.Haw/J.Smith
Date:	8/15/2024
Updated:	8/15/2024

BURNSIDE

Stage - Storage - Outflow Relationship for SWM Pond

Permanent Pool Elevation: **266.45** m

Orifice Outlets:

		Orifice #1	
Flood Control Orifice Diameter	------------------------------	**0.28**	m
Flood Control Orifice Diameter	------------------------------	280	mm
Flood Control Inlet	------------------------------	**266.45**	m above pp (ED Elev)
Flood Control Orifice Area	------------------------------	0.06	m2
Flood Control Orifice Elevation	------------------------------	**266.38**	m
Flood Control Orifice Coeff	------------------------------	**0.64**	

Water Surface Elevation m	Depth above PP m	Depth of ED Orifice m	Depth of Flood Orifice m	Pond Storage Volume cum	Flood Control Orifice #1 cms	Total Orifice Flow cms	Total Pond Outflow cms
266.45	**0.00**	0.00	0.00	**0.00**		0.000	0.000
266.55	**0.10**	0.10	0.00	**196.10**	0.030	0.030	0.030
266.65	**0.20**	0.20	0.00	**395.21**	0.063	0.063	0.063
266.75	**0.30**	0.30	0.00	**594.33**	0.084	0.084	0.084
266.85	**0.40**	0.40	0.00	**793.45**	0.100	0.100	0.100
266.95	**0.50**	0.50	0.00	**992.57**	0.114	0.114	0.114
267.04	**0.59**	0.59	0.00	**1171.77**	0.126	0.126	0.126
267.14	**0.69**	0.69	0.00	**1370.89**	0.137	0.137	0.137
267.24	**0.79**	0.79	0.00	**1570.01**	0.148	0.148	0.148
267.34	**0.89**	0.89	0.00	**1769.13**	0.158	0.158	0.158
267.44	**0.99**	0.99	0.00	**1968.24**	0.167	0.167	0.167
267.54	**1.09**	1.09	0.00	**2167.36**	0.176	0.176	0.176
267.64	**1.19**	1.19	0.00	**2366.48**	0.185	0.185	0.185
267.74	**1.29**	1.29	0.00	**2565.60**	0.193	0.193	0.193
267.84	**1.39**	1.39	0.00	**2764.72**	0.201	0.201	0.201
267.94	**1.49**	1.49	0.00	**2963.83**	0.208	0.208	0.208
268.04	**1.59**	1.59	0.00	**3162.95**	0.215	0.215	0.215

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Appendix C

Stormwater Management Calculations

100 Year

A = 1383.628
B = 4.905
C = 0.754
Runoff Coefficient Adjustment = 1.25

CITY of BARRIE
ULTIMATE STORM SEWER DESIGN SHEET (D702A v1.1)
1012 Yonge Street
August 16, 2024

Acceptable
Review
Incorrect

File No: 300057940
Design Sheet: 100-year
Calculated By: S.F.
Checked By: M.H./J.S.

Catchment Area	Street Name	Maintenance Hole Number		Runoff Calculations									Hydraulic Calculations						
				Runoff Coefficent C	Runoff Coefficient w/ Adjustment C'	Area A	Incremental C'*A	Total C'*A	Time of Concentration Total	Time of Concentration Flow Time In Pipe	Intensity	Total Q	Diameter	Mannings N	Length	Slope	Q_{pipe}	Velocity	Capacity Check Q / Q_{pipe}
		From	To			Ha			minutes	minutes	mm/hr	m^3/s	mm		m	%	m^3/s	m/s	%
S1	PHASE 3 & PART OF PHASE 1 AREA WITHOUT ROOFS	MH16	MH14	0.790	0.988	1.340	1.323	2.953	11.542	0.106	167.530	1.374	1050	0.013	14.2	0.50	1.931	2.230	71.2%
S2	LOWER STREET	MH15	MH14	0.790	0.988	0.260	0.257	0.257	10.000	0.467	180.438	0.129	375	0.013	62.9	2.00	0.248	2.245	51.9%
S3	LOWER STREET	MH14	MH13	0.790	0.988	0.260	0.257	3.467	11.648	0.532	166.719	1.605	1050	0.013	71.2	0.50	1.931	2.230	83.1%
S4	LOWER STREET	MH13	MH12	0.790	0.988	0.210	0.207	3.674	12.180	0.409	162.789	1.661	1200	0.013	59.8	0.50	2.757	2.438	60.3%
S5	PART OF PHASE 1 AREA WITHOUT ROOFS	MH17	MH12	0.790	0.988	0.440	0.435	0.435	10.000	0.176	180.438	0.218	525	0.013	14.8	0.50	0.304	1.405	71.6%
S6	LOWER STREET	MH12	MH11	0.790	0.988	0.098	0.097	4.205	12.589	0.559	159.912	1.868	1200	0.013	81.8	0.50	2.757	2.438	67.8%
S7	PHASE 2 AREA WITHOUT ROOFS	MH18	MH11	0.790	0.988	0.590	0.583	0.583	10.000	0.161	180.438	0.292	600	0.013	14.8	0.50	0.434	1.536	67.3%
S8	LOWER STREET	MH11	MH10	0.790	0.988	0.160	0.158	4.946	13.148	0.198	156.162	2.145	1200	0.013	28.9	0.50	2.757	2.438	77.8%
	TO INTERIM POND	MH12	HW1	0.000	0.000	0.000	0.000	4.109	12.589	0.293	159.912	1.825	1200	0.013	38.8	0.41	2.496	2.207	73.1%

To be installed as twin 600mm

Project:	**1012 Yonge Steet**
Project #:	300057940
Designed By:	S. Fanous
Checked By:	M. Haw
Date:	8/9/2024

Infiltration Requirement - Roof Areas - All Phases

Phase	**Roof Area (ha)**
Phase 1 (interim)	0.62
Phase 2	0.67
Phase 3	0.34
Total	**1.63**

Project:	**1012 Yonge Street**
Project #:	300057940
Designed By:	S. Fanous
Checked By:	M. Haw
Date:	8/9/2024

BURNSIDE

IG - Infiltration Rate & Drawdown Time - Phase 1 - Interim

Infiltration Values

Mean Infiltration Values from Hydrogeological Assessment - September 21, 2022

Sand 155 mm/hr

Infiltration rate at the proposed bottom elevation of the infiltration gallery must be divided by a safety correction factor:

therefore, safety correction factor is ------- 3.5

(Table C 3, Appendix C, Stormwater Management Criteria, TRCA, August 2012)

Design infiltration Rate determined by dividing mean infiltration rate at bottom of infiltration gallery by the safety correction factor:

Design Infiltration Rate = 44.4 mm/hr

Maximum depth of storage determined by multiplying design infiltration rate desired drawdown time of 48hr divided by void ratio of 40%:

Maximum depth of storage= 5.32 m

Size Infiltration Gallery

Infiltration Rate (m/hr)	Infiltration Rate (m^3/hr)	Area of Infiltration (m^2)	Volume of Infiltration (m^3)	Drawdown Time (hrs)*	Provided Depth of Storage (m)
0.0444	3.7371	84.2	155.0	41.5	4.60

Storage Required (25mm event)

Runoff 25 mm

Roof Area to IG 0.62 ha

Drainage Area (ha) x Runoff (mm) x 10

155.0 m^3

* Design infiltration rate is used to determine the maximum depth of the water storage component of the infiltration gallery, based on desired drawdown period of 48 hours.

Project:	**1012 Yonge Street**	
Project #:	300057940	
Designed By:	S. Fanous	BURNSIDE
Checked By:	M. Haw	
Date:	8/9/2024	

IG - Infiltration Rate & Drawdown Time - Phase 2

Infiltration Values

Mean Infiltration Values from Hydrogeological Assessment - September 21, 2022

Sand 155 mm/hr

Infiltration rate at the proposed bottom elevation of the infiltration gallery must be divided by a safety correction factor:

therefore, safety correction factor is ------- 3.5

(Table C 3, Appendix C, Stormwater Management Criteria, TRCA, August 2012)

Design infiltration Rate determined by dividing mean infiltration rate at bottom of infiltration gallery by the safety correction factor:

Design Infiltration Rate = 44.4 mm/hr

Maximum depth of storage determined by multiplying design infiltration rate desired drawdown time of 48hr divided by void ratio of 40%:

Maximum depth of storage= 5.32 m

Size Infiltration Gallery

Infiltration Rate (m/hr)	Infiltration Rate (m^3/hr)	Area of Infiltration (m^2)	Volume of Infiltration (m^3)	Drawdown Time (hrs)*	Provided Depth of Storage (m)
0.0444	4.0385	91.0	167.5	41.5	4.60

Storage Required (25mm event)

Runoff 25 mm

Roof Area to IG 0.67 ha

Drainage Area (ha) x Runoff (mm) x 10

167.5 m^3

* Design infiltration rate is used to determine the maximum depth of the water storage component of the infiltration gallery, based on desired drawdown period of 48 hours.

Project:	**1012 Yonge Street**
Project #:	300057940
Designed By:	S. Fanous
Checked By:	M. Haw
Date:	8/9/2024

IG - Infiltration Rate & Drawdown Time - Phase 3

Infiltration Values

Mean Infiltration Values from Hydrogeological Assessment - September 21, 2022

Sand 155 mm/hr

Infiltration rate at the proposed bottom elevation of the infiltration gallery must be divided by a safety correction factor:

therefore, safety correction factor is ------- 3.5

(Table C 3, Appendix C, Stormwater Management Criteria, TRCA, August 2012)

Design infiltration Rate determined by dividing mean infiltration rate at bottom of infiltration gallery by the safety correction factor:

Design Infiltration Rate = 44.4 mm/hr

Maximum depth of storage determined by multiplying design infiltration rate desired drawdown time of 48hr divided by void ratio of 40%:

Maximum depth of storage= 5.32 m

Size Infiltration Gallery

Infiltration Rate (m/hr)	Infiltration Rate (m^3/hr)	Area of Infiltration (m^2)	Volume of Infiltration (m^3)	Drawdown Time (hrs)*	Provided Depth of Storage (m)
0.0444	2.0494	46.2	85.0	41.5	4.60

Storage Required (25mm event)

Runoff 25 mm

Roof Area to IG 0.34 ha

Drainage Area (ha) x Runoff (mm) x 10

85.0 m^3

* Design infiltration rate is used to determine the maximum depth of the water storage component of the infiltration gallery, based on desired drawdown period of 48 hours.

Project:	**1012 Yonge Street**
Project #:	300057940
Designed By:	S. Fanous
Checked By:	M. Haw
Date:	8/9/2024

IG - Infiltration Rate & Drawdown Time - Phase 1 - Interim - Potential Option

Infiltration Values

Mean Infiltration Values from Hydrogeological Assessment - September 21, 2022

Sand 26 mm/hr

Infiltration rate at the proposed bottom elevation of the infiltration gallery must be divided by a safety correction factor:

therefore, safety correction factor is ------- 3.5

(Table C 3, Appendix C, Stormwater Management Criteria, TRCA, August 2012)

Design infiltration Rate determined by dividing mean infiltration rate at bottom of infiltration gallery by the safety correction factor:

Design Infiltration Rate = 7.3 mm/hr

Maximum depth of storage determined by multiplying design infiltration rate desired drawdown time of 48hr divided by void ratio of 40%:

Maximum depth of storage= 0.88 m

Size Infiltration Gallery

Infiltration Rate (m/hr)	Infiltration Rate (m^3/hr)	Area of Infiltration (m^2)	Volume of Infiltration (m^3)	Drawdown Time (hrs)*	Provided Depth of Storage (m)
0.0073	3.2225	440.3	155.0	48.1	0.88

Storage Required (25mm event)

Runoff 25 mm

Roof Area to IG 0.62 ha

Drainage Area (ha) x Runoff (mm) x 10

155.0 m^3

* Design infiltration rate is used to determine the maximum depth of the water storage component of the infiltration gallery, based on desired drawdown period of 48 hours.

Project:	**1012 Yonge Street**
Location:	City of Barrie
Project #:	300057940
Designed By:	S.Fanous
Checked By:	M.Haw
Date:	8/16/2024

Runoff Coefficient- External Area - EXT1

INTERNAL CONTROLLED PH1	Major and Minor *Area (ha)*	*Runoff Coefficient*	*Notes*
Half of Yonge Street	0.56	0.95	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Remaining Pervious Area	8.15	0.25	Runoff Coefficient based on Table 3.2 of City of Barrie Design standards
Total Area	**8.71**	**0.30**	

Project Name:	1012 Yonge Street
Project No.:	300057940
Location:	City of Barrie
Created By:	S.Fanous
Checked By:	M.Haw
Date Created:	16-Aug-2024
Date Modified:	16-Aug-2024

BURNSIDE

Tc Calculation for External Area - EXT1 - to Yonge St Culvert

Time of Concentration Input Parameters	
Runoff Coefficient	**0.30**
Length (m)	619.3
h_1 (m)	271.25
h_2 (m)	266.73
Dh (m)	**4.52**
Slope (%)	**0.73**

Tc Method	Airport Method
Tc (min)	**72.08**
Tp (hr)	**0.80**

Project:	1012 Yonge Street
Project No.:	300057940
Modelled By:	S.Fanous/ M.Haw
Date:	2024/08/16

RATIONAL METHOD
5-year External Area - EXT1 to Yonge St Culvert

Rainfall IDF Coefficients 5 -year

A =		A =	843.019
C =		B =	4.582
		C =	0.763

Rational Method Calculation

Area =	8.71	ha
Runoff Coefficient, C =	0.30	
C*A =	2.61	
Time of Concentration, t_c =	72.1	min
Rainfall Intensity, i =	30.75	mm/hr
Target Release Rate =	223	L/s

CulvertSizing

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.024
Channel Slope	0.003 m/m
Normal Depth	1,050.0 mm
Diameter	1,050.0 mm
Discharge	739.57 L/s

Culvert sized based on 100-year controlled and uncontrolled flow from site and 5-year external flow:

Qtotal = 118 L/s+185 L/s +223 L/s =526 L/s.

Results

Discharge	739.57 L/s
Normal Depth	1,050.0 mm
Flow Area	0.9 m²
Wetted Perimeter	3.3 m
Hydraulic Radius	262.5 mm
Top Width	0.00 m
Critical Depth	482.0 mm
Percent Full	100.0 %
Critical Slope	0.013 m/m
Velocity	0.85 m/s
Velocity Head	0.04 m
Specific Energy	1.09 m
Froude Number	(N/A)
Maximum Discharge	795.56 L/s
Discharge Full	739.57 L/s
Slope Full	0.003 m/m
Flow Type	Undefined

GVF Input Data

Downstream Depth	0.0 mm
Length	0.0 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 m/s
Upstream Velocity	0.00 m/s
Normal Depth	1,050.0 mm
Critical Depth	482.0 mm
Channel Slope	0.003 m/m
Critical Slope	0.013 m/m

Project: 1012 Yonge Street
Project No.: 057940
Modelled By: SF
Date: 2024/08/09

CATCHBASIN CAPACITY ANALYSIS

Sub Catchment ID	CBs ID	Area (ha)	100 Year Runoff Coefficient	InitialTc (min)	100 Year Intensity (mm/hr)	100 Year Flow to Catchment (cms)	Total Flow to CB (cms)	# of CBs	Road Slope (%)	Height above Inlet or Sag Depth (m)	Flow Captured at cms)	Flow bypassed (cms)
North Side of Lower Street												
A	CB1	0.05	0.99	10.00	180.4	0.025	0.025	Side Inlet CB on grade	1.85%	0.100	0.016	0.009
B	CB3	0.08	0.99	10.00	180.4	0.037	0.046	Side Inlet CB on grade	1.85%	0.12	0.023	0.023
C	CB5	0.09	0.99	10.00	180.4	0.046	0.069	Side Inlet CB on grade	0.50%	0.17	0.039	0.030
D	CB7	0.07	0.99	10.00	180.4	0.033	0.062	Side Inlet CB on grade	0.50%	0.165	0.037	0.026
E	CB9	0.05	0.99	10.00	180.4	0.023	0.049	Side Inlet CB on grade	1.00%	0.136	0.027	0.022
F	DCBMH11	0.08	0.99	10.00	180.4	0.040	0.062	Sag Side Inlet DCB	N/A	0.11	0.062	0.000
South Side of Lower Street												
G	CB2	0.05	0.99	10.00	180.4	0.026	0.026	Side Inlet CB on grade	1.85%	0.1	0.016	0.010
H	CB4	0.07	0.99	10.00	180.4	0.036	0.045	Side Inlet CB on grade	1.85%	0.12	0.023	0.023
I	CB6	0.08	0.99	10.00	180.4	0.042	0.064	Side Inlet CB on grade	0.5%	0.166	0.037	0.027
J	CB8	0.06	0.99	10.00	180.4	0.029	0.056	Side Inlet CB on grade	0.5%	0.16	0.034	0.022
K	CB10	0.05	0.99	10.00	180.4	0.026	0.047	Side Inlet CB on grade	1.0%	0.133	0.027	0.021
L	DCBMH12	0.08	0.99	10.00	180.4	0.041	0.062	Side Inlet CB on grade	N/a	0.11	0.062	0.000
Phase 1 Driveway												
M	DCBMH13	0.09	0.99	10.00	180.4	0.043	0.043	1 DCB Sag	N/a	0.20	0.125	0.000
N	DCBMH14	0.09	0.99	10.00	180.4	0.042	0.042	1 DCB Sag	N/a	0.20	0.125	0.000
SUM		0.98				**0.487**						
										`		

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

No.	Issue / Revision	Date	Auth.
1	ISSUED FOR CLIENT COORDINATION	24/08/06	EG

SITE PLAN
PREPARED BY: SRN ARCHITECTS INC.
DATE: 2024-05-22

TOPOGRAPHIC & LEGAL
PREPARED BY:GUIDO PAPA SURVEYING
TOPO DATE: JANUARY 4, 2019

BENCHMARK NOTES
ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE DERIVED FROM STATION 03120110014 (COSINE), HAVING AN ELEVATION OF 268.681m AND VERIFIED BY STATION 03120110013, HAVING AN ELEVATION OF 252.807m.

LEGEND:

- PROPOSED STORM MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED SINGLE CATCHBASIN / AREA DRAIN
- PROPOSED SIDE INLET CATCHBASIN
- PROPOSED DOUBLE CATCHBASIN
- HYD&V PROPOSED HYDRANT
- VB PROPOSED VALVE AND BOX
- LIMIT OF CONSTRUCTION
- 259 EXISTING CONTOURS
- 226.20 PROPOSED ELEVATION
- 225.86 EXISTING ELEVATION
- 44.0m @ 1.84% DIRECTION OF FLOW / PROPOSED SLOPE
- PROPOSED TRANSFORMER
- PROPOSED LIGHT STANDARD
- PROPOSED SIGN
- MAXIMUM 3:1 SLOPE UNLESS OTHERWISE NOTED

BURNSIDE

R.J. Burnside & Associates Limited
128 Wellington St. W., Suite 301
Barrie, Ontario, L4N 8J6
telephone 1-800-265-9662
web www.rjburnside.com

Client
CROWN (BARRIE) DEVELOPMENTS INC.
400 CREDITSTONE ROAD, UNIT 37
CONCORD, ON
L4K 3Z3

Drawing Title
1012 YONGE STREET
SITE GRADING PLAN

Drawn	Checked	Designed	Checked	Date
SD	SN	EG	SN	24/06/11

Project No.	Contract No.	Revision No.
300057940	CONTRACT NO.	0

Scale 1:500 (0, 5.0, 10.0, 20.0, 30.0m)

Drawing No. **GRD1**

File: U:\300057940\0003-PRD\SITE PLAN - PH1\300057940 - SITE GRADING PLAN - PH1.dwg

Inlet Report

CB1

Curb Inlet

Location	= On grade
Curb Length (m)	= 0.6000
Throat Height (mm)	= 152.4000
Grate Area (sqm)	= -0-
Grate Width (m)	= -0-
Grate Length (m)	= -0-

Gutter

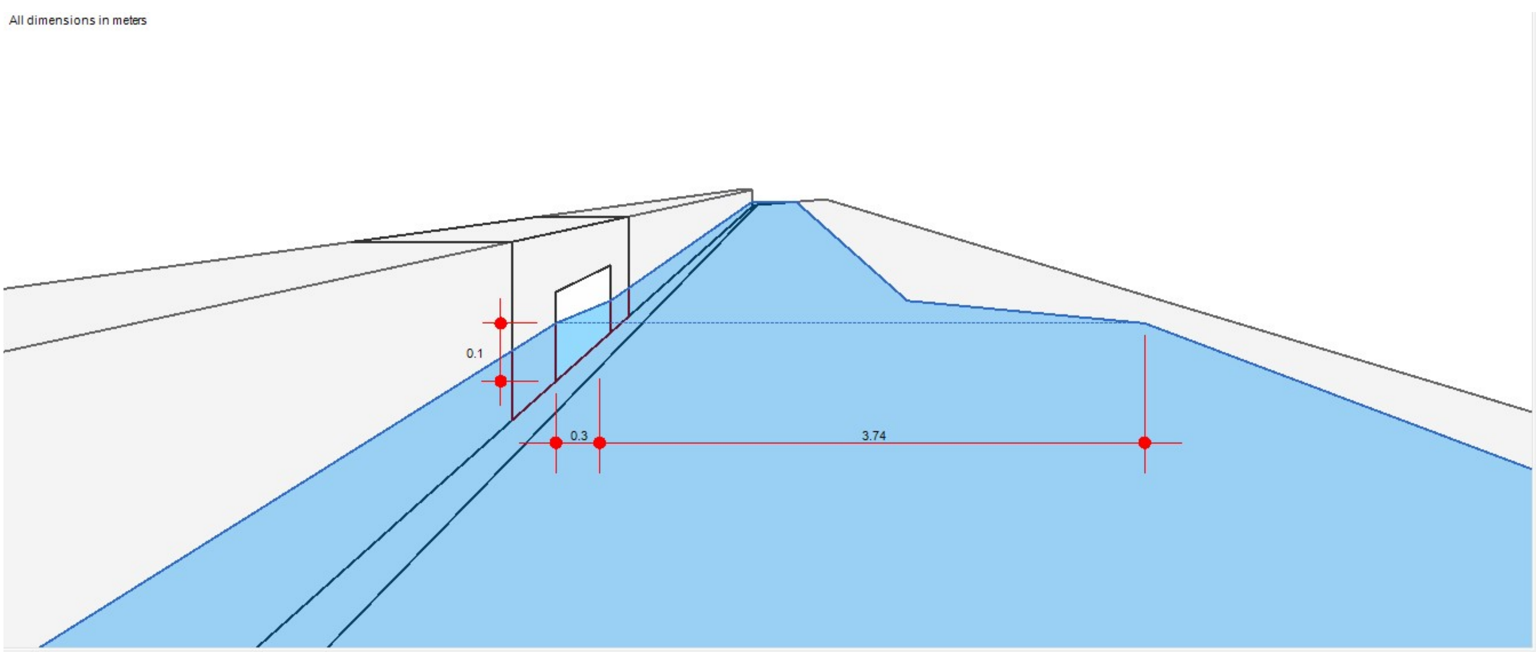
Slope, Sw (m/m)	= 0.080
Slope, Sx (m/m)	= 0.020
Local Depr (mm)	= -0-
Gutter Width (m)	= 0.3000
Gutter Slope (%)	= 0.0185
Gutter n-value	= 0.013

Calculations

Compute by:	Known Q
Q (cms)	= 0.0250

Highlighted

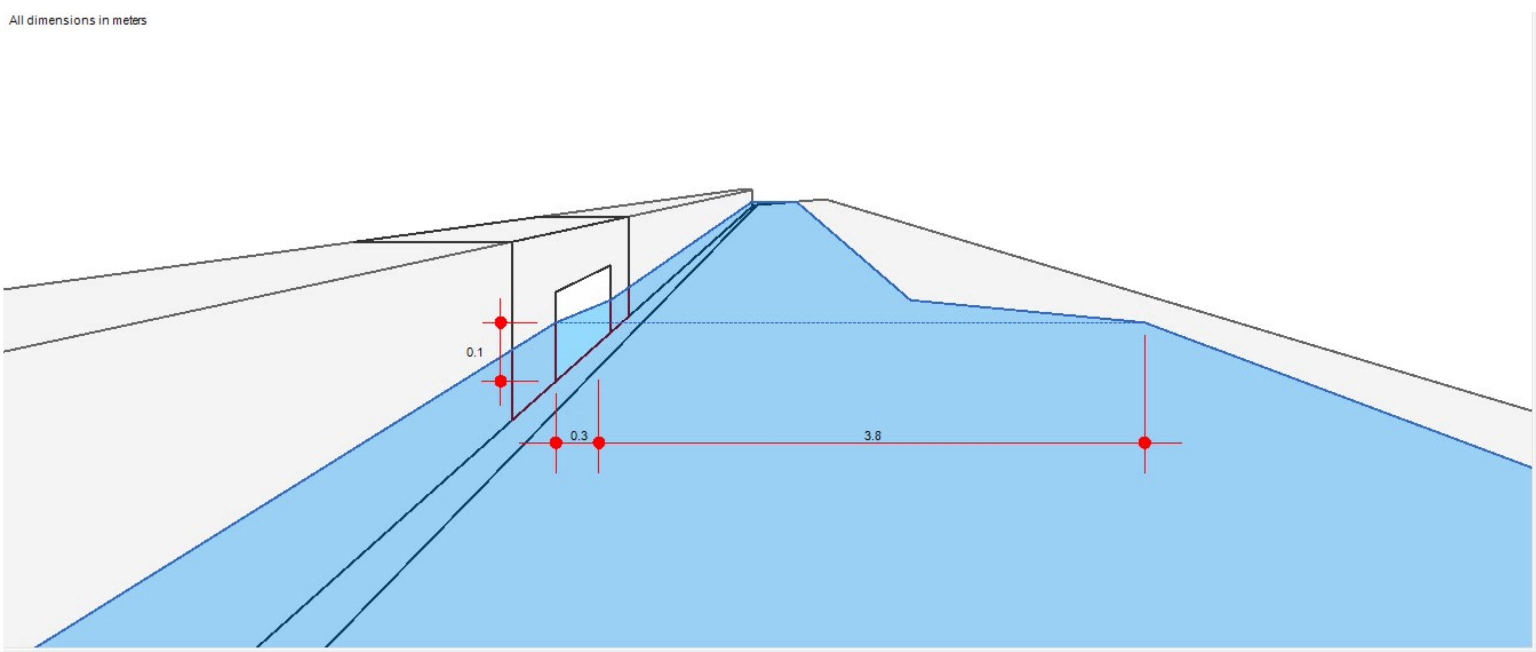
Q Total (cms)	= 0.0250
Q Capt (cms)	= 0.0160
Q Bypass (cms)	= 0.0090
Depth at Inlet (mm)	= 98.8466
Efficiency (%)	= 64
Gutter Spread (m)	= 4.0423
Gutter Vel (m/s)	= 0.1505
Bypass Spread (m)	= 2.7073
Bypass Depth (mm)	= 72.1462



Inlet Report

CB2

Curb Inlet			**Calculations**		
Location	=	On grade	Compute by:		Known Q
Curb Length (m)	=	0.6000	Q (cms)	=	0.0260
Throat Height (mm)	=	152.4000			
Grate Area (sqm)	=	-0-	**Highlighted**		
Grate Width (m)	=	-0-	Q Total (cms)	=	0.0260
Grate Length (m)	=	-0-	Q Capt (cms)	=	0.0164
			Q Bypass (cms)	=	0.0096
Gutter			Depth at Inlet (mm)	=	100.0963
Slope, Sw (m/m)	=	0.080	Efficiency (%)	=	63
Slope, Sx (m/m)	=	0.020	Gutter Spread (m)	=	4.1048
Local Depr (mm)	=	-0-	Gutter Vel (m/s)	=	0.1519
Gutter Width (m)	=	0.3000	Bypass Spread (m)	=	2.7789
Gutter Slope (%)	=	0.0185	Bypass Depth (mm)	=	73.5787
Gutter n-value	=	0.013			



Inlet Report

CB3

Curb Inlet

Location	=	On grade
Curb Length (m)	=	0.6000
Throat Height (mm)	=	152.4000
Grate Area (sqm)	=	-0-
Grate Width (m)	=	-0-
Grate Length (m)	=	-0-

Gutter

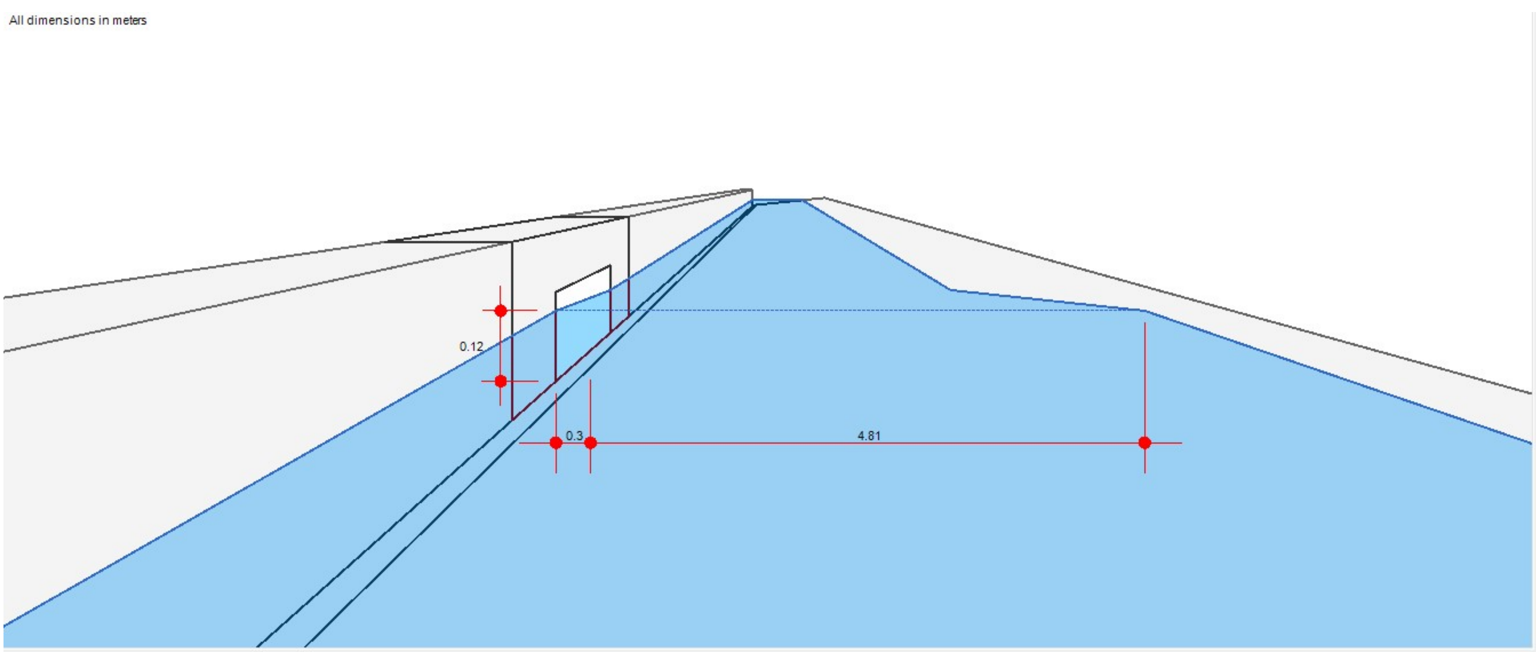
Slope, Sw (m/m)	=	0.080
Slope, Sx (m/m)	=	0.020
Local Depr (mm)	=	-0-
Gutter Width (m)	=	0.3000
Gutter Slope (%)	=	0.0185
Gutter n-value	=	0.013

Calculations

Compute by:		Known Q
Q (cms)	=	0.0460

Highlighted

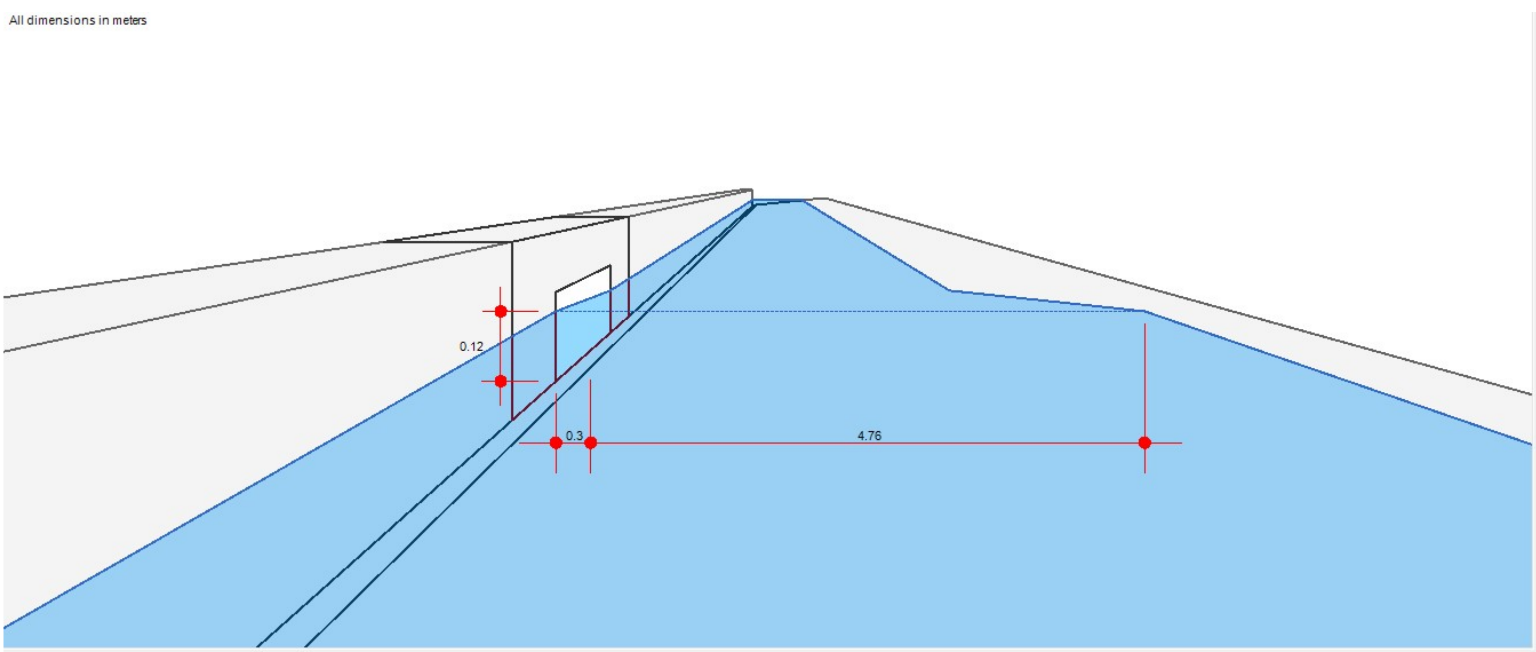
Q Total (cms)	=	0.0460
Q Capt (cms)	=	0.0229
Q Bypass (cms)	=	0.0231
Depth at Inlet (mm)	=	120.1522
Efficiency (%)	=	50
Gutter Spread (m)	=	5.1076
Gutter Vel (m/s)	=	0.1745
Bypass Spread (m)	=	3.9189
Bypass Depth (mm)	=	96.3778



Inlet Report

CB4

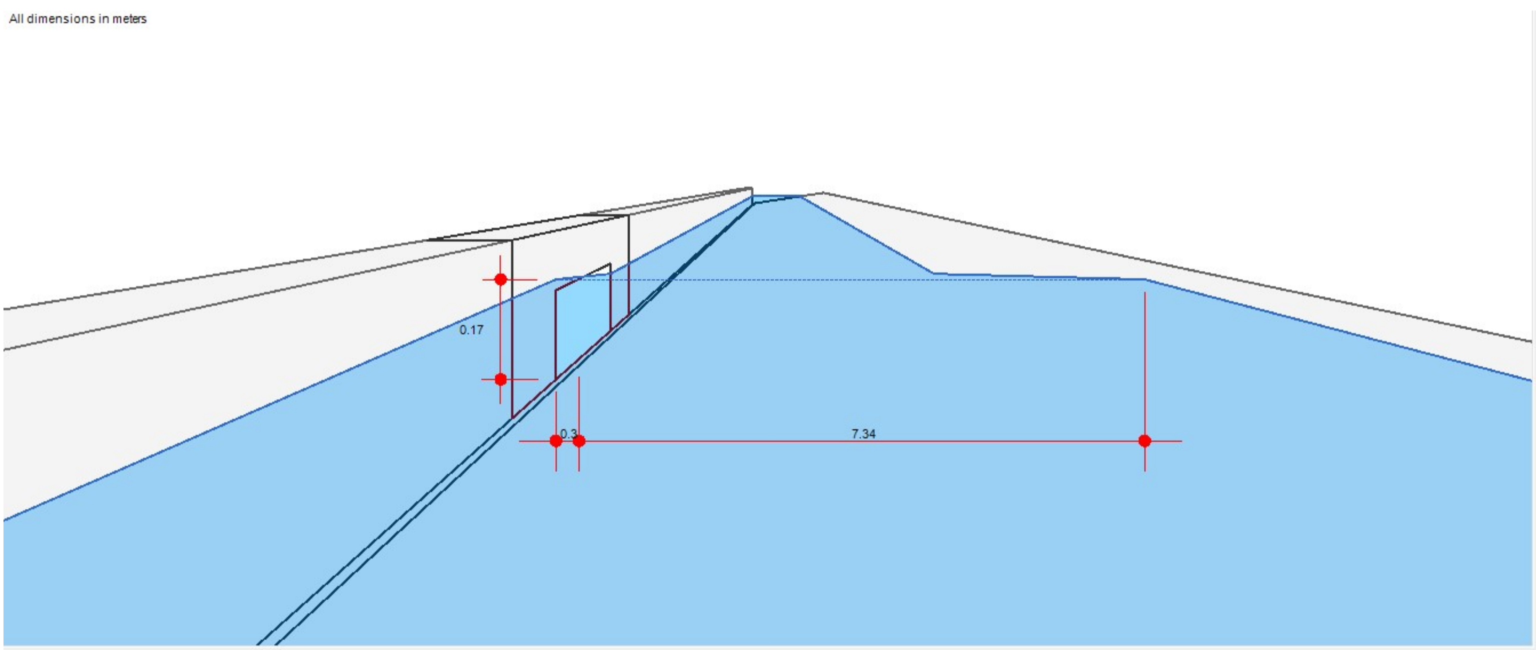
Curb Inlet		**Calculations**	
Location	= On grade	Compute by:	Known Q
Curb Length (m)	= 0.6000	Q (cms)	= 0.0450
Throat Height (mm)	= 152.4000		
Grate Area (sqm)	= -0-	**Highlighted**	
Grate Width (m)	= -0-	Q Total (cms)	= 0.0450
Grate Length (m)	= -0-	Q Capt (cms)	= 0.0226
		Q Bypass (cms)	= 0.0224
Gutter		Depth at Inlet (mm)	= 119.2987
Slope, Sw (m/m)	= 0.080	Efficiency (%)	= 50
Slope, Sx (m/m)	= 0.020	Gutter Spread (m)	= 5.0649
Local Depr (mm)	= -0-	Gutter Vel (m/s)	= 0.1736
Gutter Width (m)	= 0.3000	Bypass Spread (m)	= 3.8716
Gutter Slope (%)	= 0.0185	Bypass Depth (mm)	= 95.4329
Gutter n-value	= 0.013		



Inlet Report

CB5

Curb Inlet			**Calculations**		
Location	=	On grade	Compute by:		Known Q
Curb Length (m)	=	0.6000	Q (cms)	=	0.0690
Throat Height (mm)	=	152.4000			
Grate Area (sqm)	=	-0-	**Highlighted**		
Grate Width (m)	=	-0-	Q Total (cms)	=	0.0690
Grate Length (m)	=	-0-	Q Capt (cms)	=	0.0389
			Q Bypass (cms)	=	0.0301
Gutter			Depth at Inlet (mm)	=	170.7185
Slope, Sw (m/m)	=	0.080	Efficiency (%)	=	56
Slope, Sx (m/m)	=	0.020	Gutter Spread (m)	=	7.6359
Local Depr (mm)	=	-0-	Gutter Vel (m/s)	=	0.1178
Gutter Width (m)	=	0.3000	Bypass Spread (m)	=	5.5740
Gutter Slope (%)	=	0.0050	Bypass Depth (mm)	=	129.4790
Gutter n-value	=	0.013			



Inlet Report

CB6

Curb Inlet

Location	= On grade
Curb Length (m)	= 0.6000
Throat Height (mm)	= 152.4000
Grate Area (sqm)	= -0-
Grate Width (m)	= -0-
Grate Length (m)	= -0-

Gutter

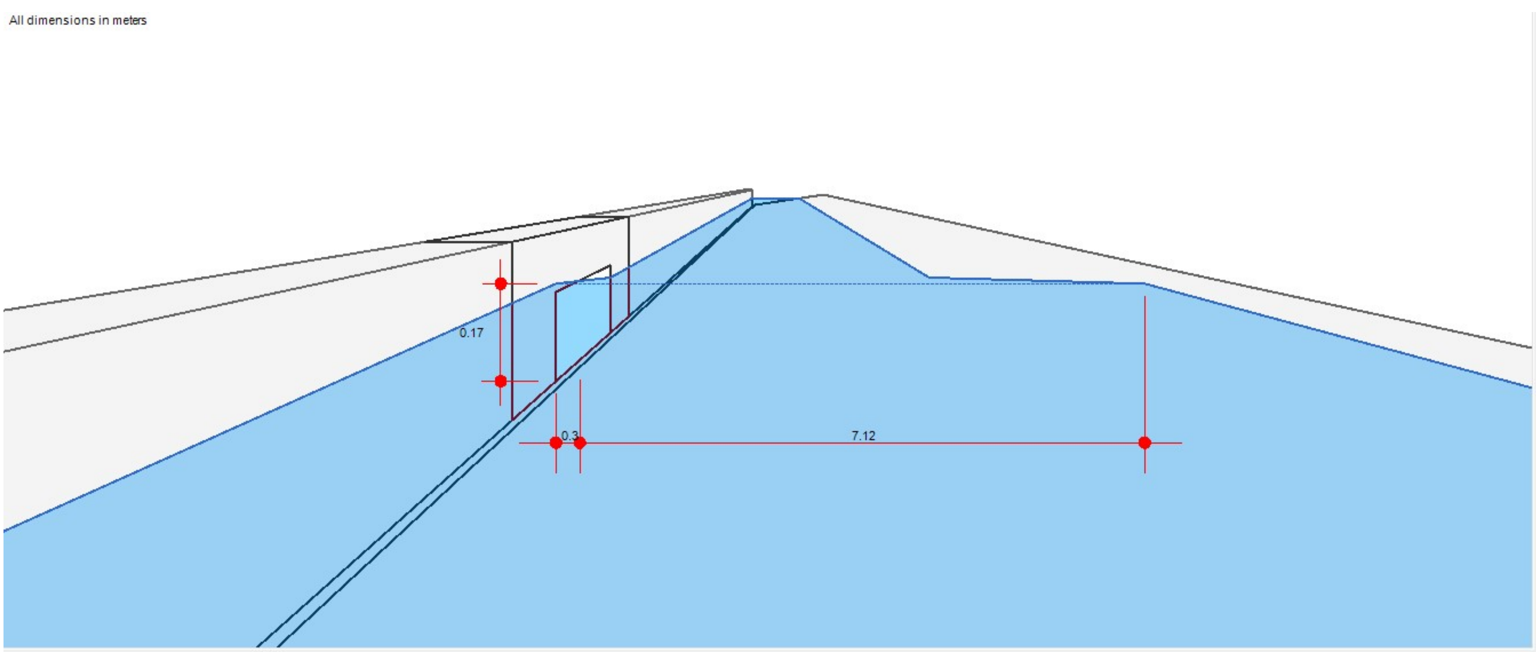
Slope, Sw (m/m)	= 0.080
Slope, Sx (m/m)	= 0.020
Local Depr (mm)	= -0-
Gutter Width (m)	= 0.3000
Gutter Slope (%)	= 0.0050
Gutter n-value	= 0.013

Calculations

Compute by:	Known Q
Q (cms)	= 0.0640

Highlighted

Q Total (cms)	= 0.0640
Q Capt (cms)	= 0.0372
Q Bypass (cms)	= 0.0268
Depth at Inlet (mm)	= 166.4513
Efficiency (%)	= 58
Gutter Spread (m)	= 7.4226
Gutter Vel (m/s)	= 0.1156
Bypass Spread (m)	= 5.3362
Bypass Depth (mm)	= 124.7242



Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 6 2024

CB7

Curb Inlet

Location	=	On grade
Curb Length (m)	=	0.6000
Throat Height (mm)	=	152.4000
Grate Area (sqm)	=	-0-
Grate Width (m)	=	-0-
Grate Length (m)	=	-0-

Gutter

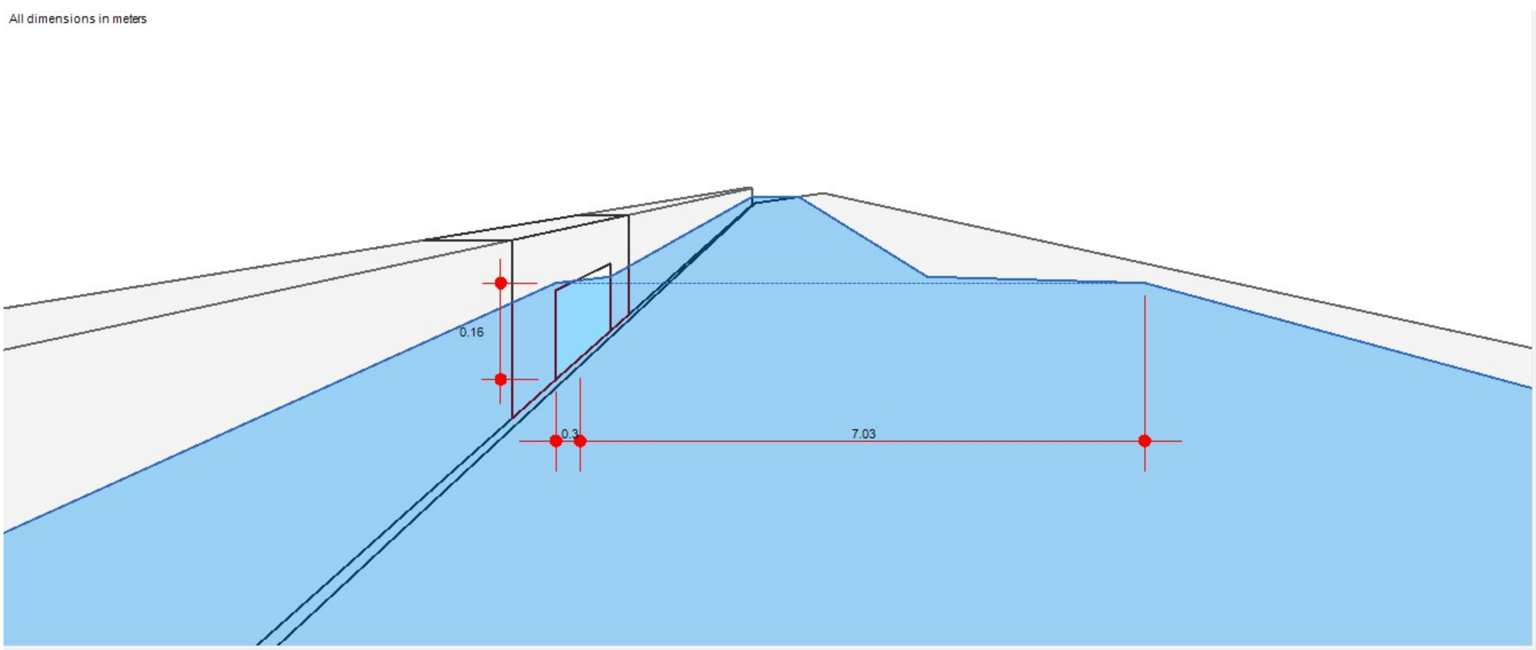
Slope, Sw (m/m)	=	0.080
Slope, Sx (m/m)	=	0.020
Local Depr (mm)	=	-0-
Gutter Width (m)	=	0.3000
Gutter Slope (%)	=	0.0050
Gutter n-value	=	0.013

Calculations

Compute by:		Known Q
Q (cms)	=	0.0620

Highlighted

Q Total (cms)	=	0.0620
Q Capt (cms)	=	0.0365
Q Bypass (cms)	=	0.0255
Depth at Inlet (mm)	=	164.6834
Efficiency (%)	=	59
Gutter Spread (m)	=	7.3342
Gutter Vel (m/s)	=	0.1147
Bypass Spread (m)	=	5.2387
Bypass Depth (mm)	=	122.7734



Inlet Report

CB8

Curb Inlet

Location	= On grade
Curb Length (m)	= 0.6000
Throat Height (mm)	= 152.4000
Grate Area (sqm)	= -0-
Grate Width (m)	= -0-
Grate Length (m)	= -0-

Gutter

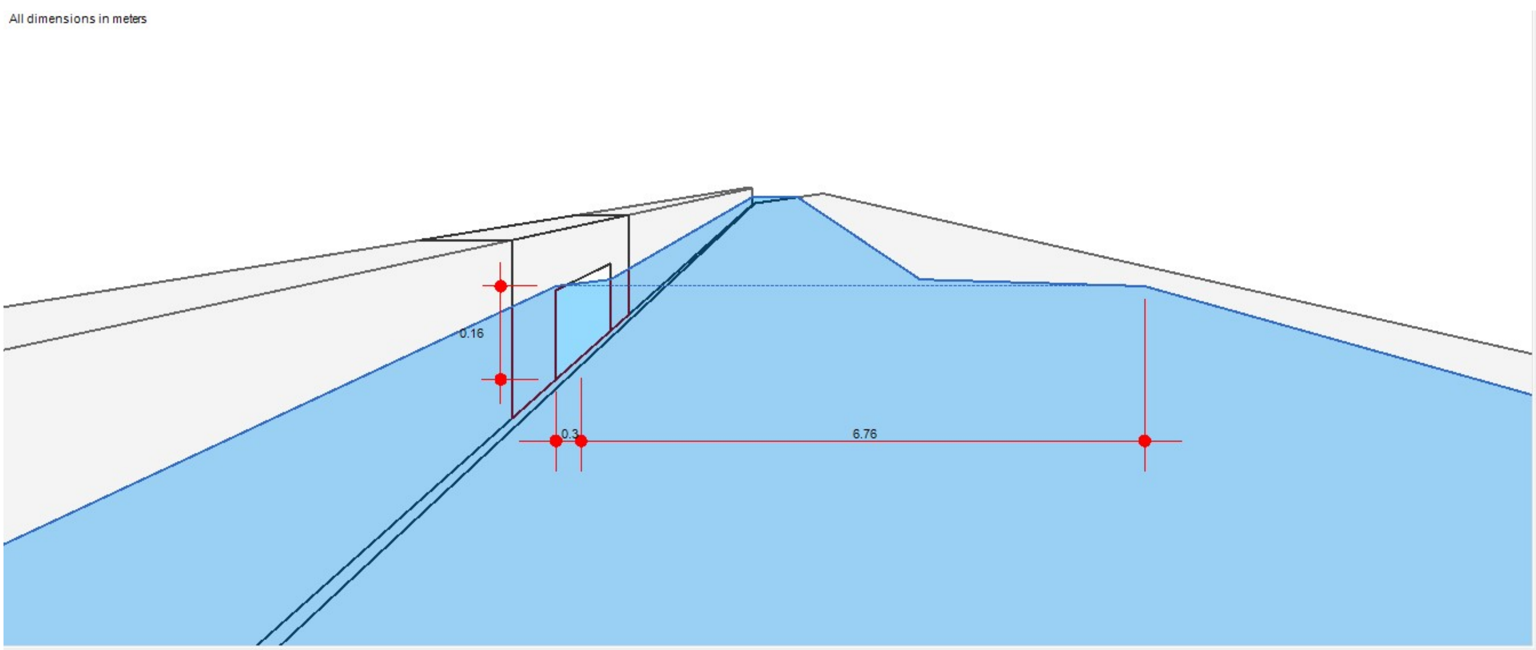
Slope, Sw (m/m)	= 0.080
Slope, Sx (m/m)	= 0.020
Local Depr (mm)	= -0-
Gutter Width (m)	= 0.3000
Gutter Slope (%)	= 0.0050
Gutter n-value	= 0.013

Calculations

Compute by:	Known Q
Q (cms)	= 0.0560

Highlighted

Q Total (cms)	= 0.0560
Q Capt (cms)	= 0.0342
Q Bypass (cms)	= 0.0218
Depth at Inlet (mm)	= 159.1361
Efficiency (%)	= 61
Gutter Spread (m)	= 7.0568
Gutter Vel (m/s)	= 0.1118
Bypass Spread (m)	= 4.9278
Bypass Depth (mm)	= 116.5555



Inlet Report

CB9

Curb Inlet

Location	= On grade
Curb Length (m)	= 0.6000
Throat Height (mm)	= 152.4000
Grate Area (sqm)	= -0-
Grate Width (m)	= -0-
Grate Length (m)	= -0-

Gutter

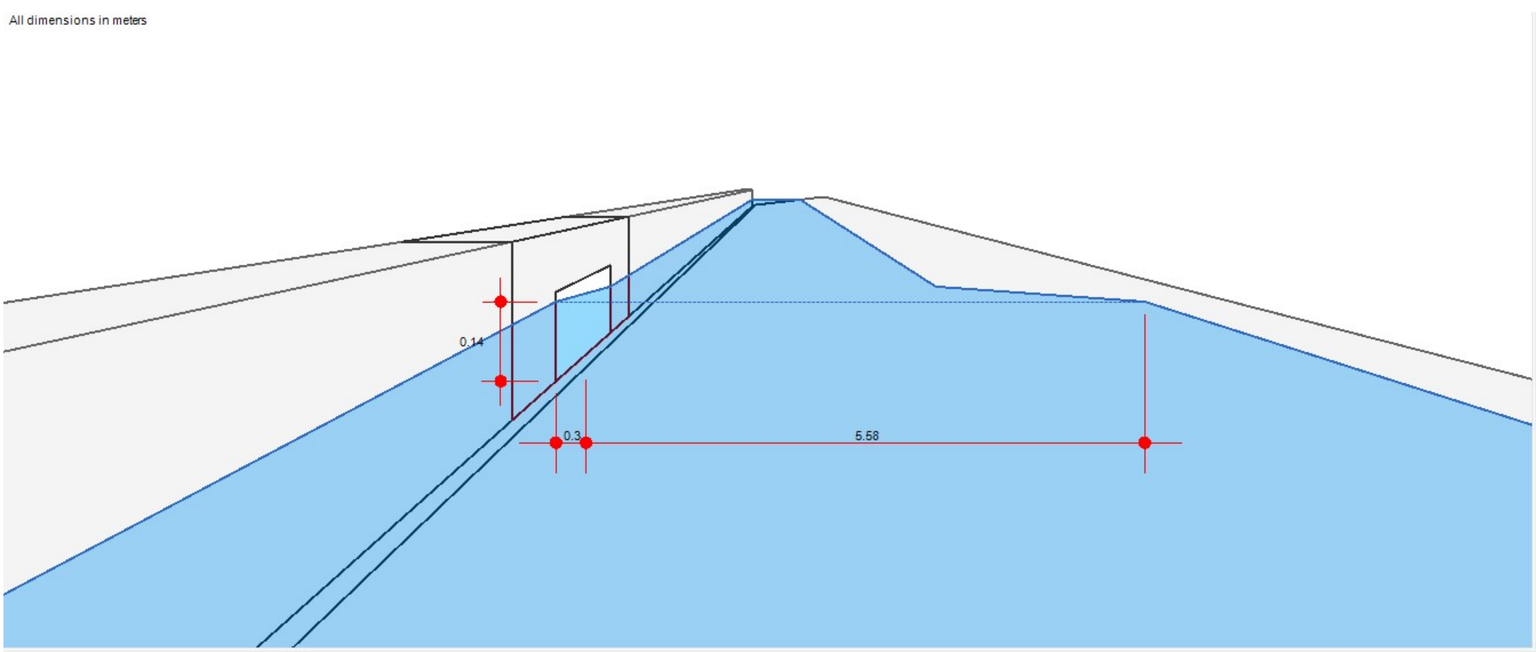
Slope, Sw (m/m)	= 0.080
Slope, Sx (m/m)	= 0.020
Local Depr (mm)	= -0-
Gutter Width (m)	= 0.3000
Gutter Slope (%)	= 0.0100
Gutter n-value	= 0.013

Calculations

Compute by:	Known Q
Q (cms)	= 0.0490

Highlighted

Q Total (cms)	= 0.0490
Q Capt (cms)	= 0.0272
Q Bypass (cms)	= 0.0218
Depth at Inlet (mm)	= 135.6360
Efficiency (%)	= 56
Gutter Spread (m)	= 5.8818
Gutter Vel (m/s)	= 0.1405
Bypass Spread (m)	= 4.3167
Bypass Depth (mm)	= 104.3330

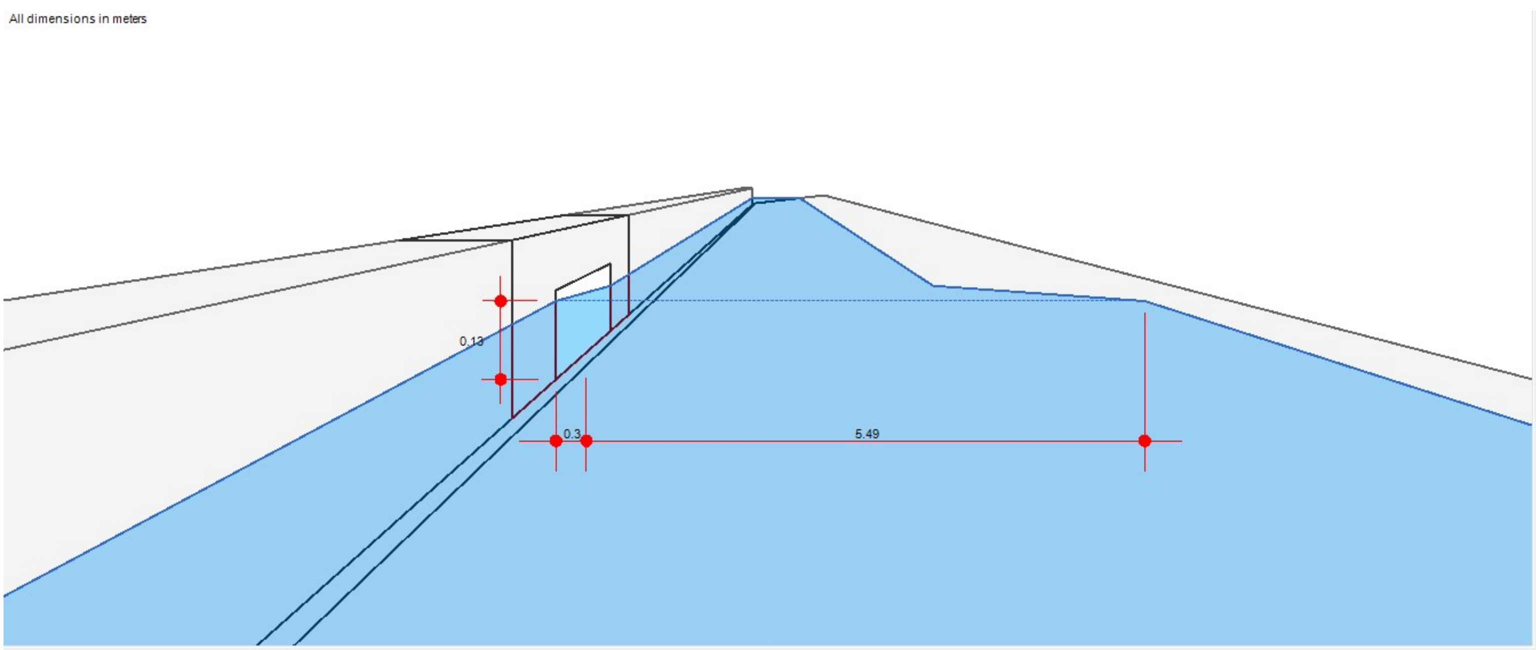


Inlet Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 6 2024

CB10

Curb Inlet		**Calculations**	
Location	= On grade	Compute by:	Known Q
Curb Length (m)	= 0.6000	Q (cms)	= 0.0470
Throat Height (mm)	= 152.4000		
Grate Area (sqm)	= -0-	**Highlighted**	
Grate Width (m)	= -0-	Q Total (cms)	= 0.0470
Grate Length (m)	= -0-	Q Capt (cms)	= 0.0265
		Q Bypass (cms)	= 0.0205
Gutter		Depth at Inlet (mm)	= 133.8072
Slope, Sw (m/m)	= 0.080	Efficiency (%)	= 56
Slope, Sx (m/m)	= 0.020	Gutter Spread (m)	= 5.7904
Local Depr (mm)	= -0-	Gutter Vel (m/s)	= 0.1391
Gutter Width (m)	= 0.3000	Bypass Spread (m)	= 4.2130
Gutter Slope (%)	= 0.0100	Bypass Depth (mm)	= 102.2604
Gutter n-value	= 0.013		



Inlet Report

DCBMH11

Curb Inlet

Location	=	Sag
Curb Length (m)	=	1.2000
Throat Height (mm)	=	152.4000
Grate Area (sqm)	=	-0-
Grate Width (m)	=	-0-
Grate Length (m)	=	-0-

Gutter

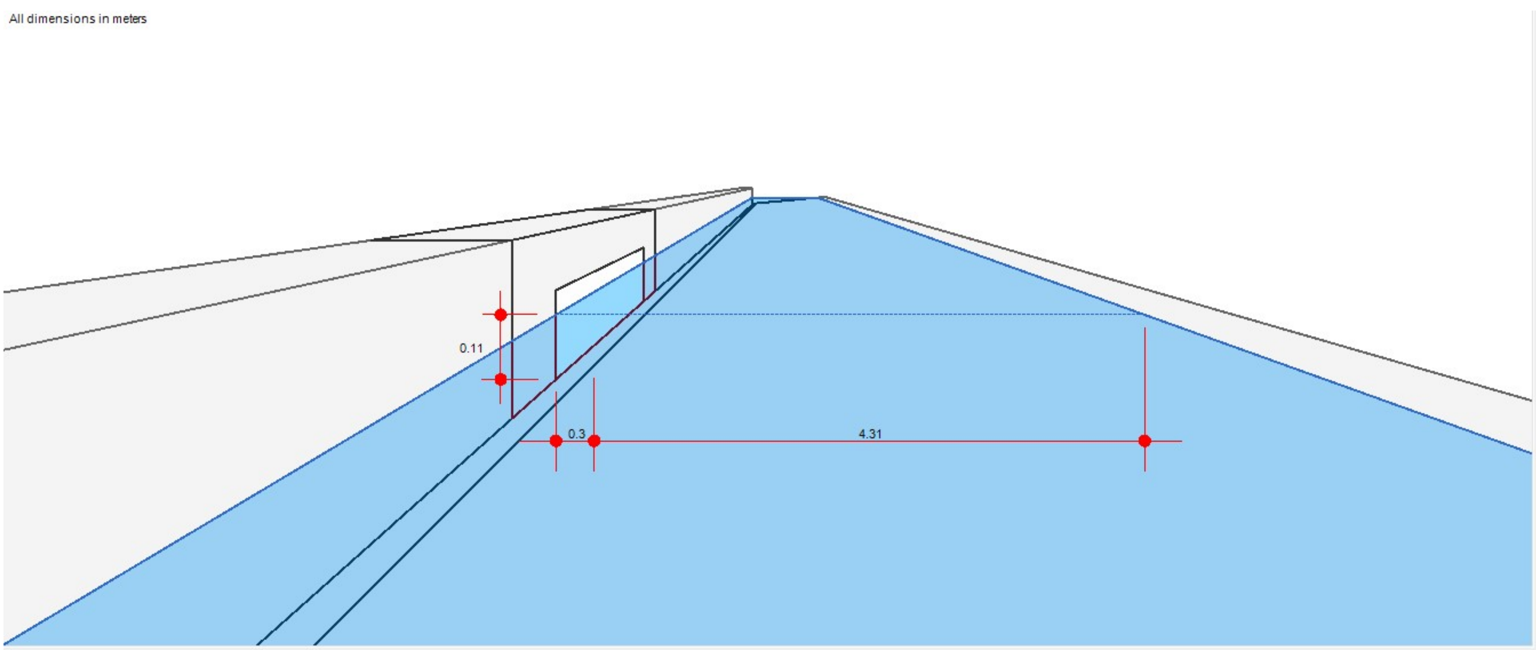
Slope, Sw (m/m)	=	0.080
Slope, Sx (m/m)	=	0.020
Local Depr (mm)	=	-0-
Gutter Width (m)	=	0.3000
Gutter Slope (%)	=	-0-
Gutter n-value	=	-0-

Calculations

Compute by:		Known Q
Q (cms)	=	0.0620

Highlighted

Q Total (cms)	=	0.0620
Q Capt (cms)	=	0.0620
Q Bypass (cms)	=	-0-
Depth at Inlet (mm)	=	110.2877
Efficiency (%)	=	100
Gutter Spread (m)	=	4.6144
Gutter Vel (m/s)	=	0.1405
Bypass Spread (m)	=	-0-
Bypass Depth (mm)	=	-0-



Inlet Report

DCBMH12

Curb Inlet

Location	=	Sag
Curb Length (m)	=	1.2000
Throat Height (mm)	=	152.4000
Grate Area (sqm)	=	-0-
Grate Width (m)	=	-0-
Grate Length (m)	=	-0-

Gutter

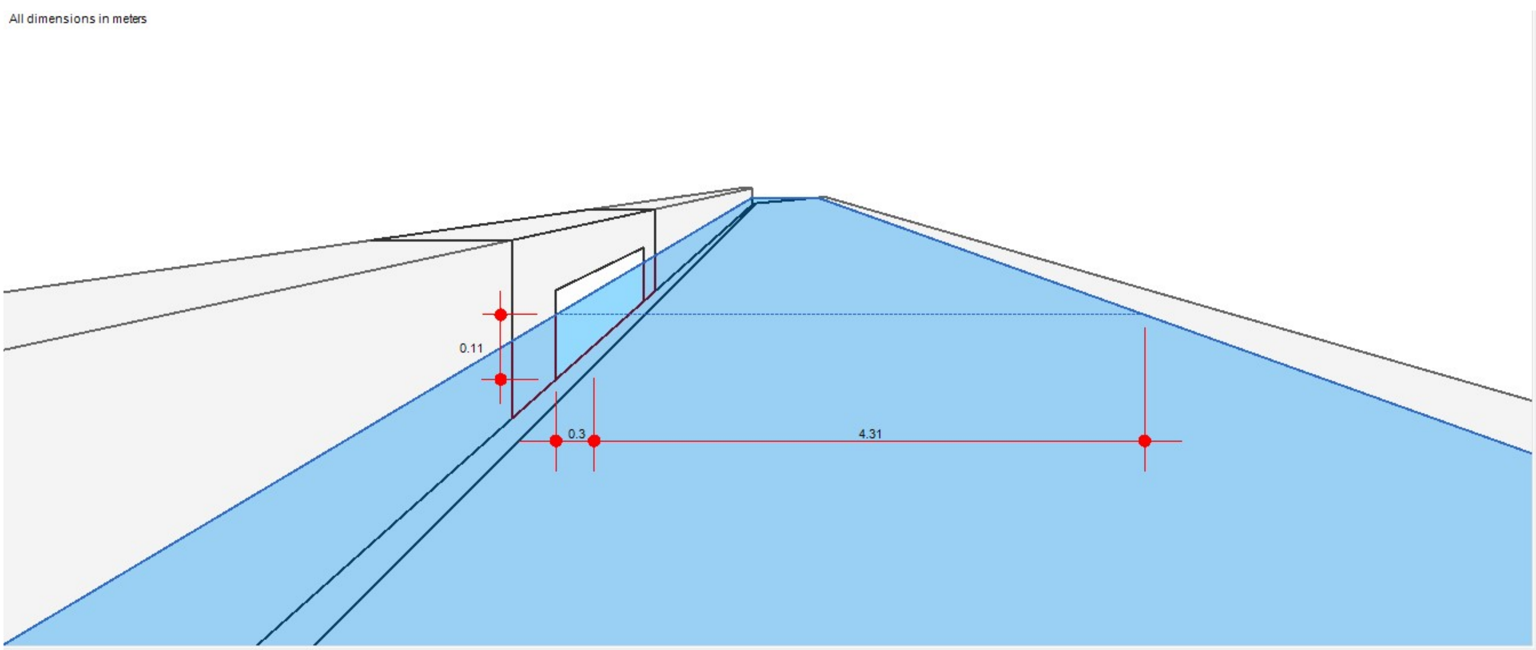
Slope, Sw (m/m)	=	0.080
Slope, Sx (m/m)	=	0.020
Local Depr (mm)	=	-0-
Gutter Width (m)	=	0.3000
Gutter Slope (%)	=	-0-
Gutter n-value	=	-0-

Calculations

Compute by:		Known Q
Q (cms)	=	0.0620

Highlighted

Q Total (cms)	=	0.0620
Q Capt (cms)	=	0.0620
Q Bypass (cms)	=	-0-
Depth at Inlet (mm)	=	110.2877
Efficiency (%)	=	100
Gutter Spread (m)	=	4.6144
Gutter Vel (m/s)	=	0.1391
Bypass Spread (m)	=	-0-
Bypass Depth (mm)	=	-0-



Project:	**1012 Yonge Street**
Location:	City of Barrie
Project #:	300057940
Designed By:	S.Fanous
Checked By:	M.Haw/J.Smith
Date:	8/16/2024

BURNSIDE

Total Suspended Solids Calculations

Feature	Treatment Efficiency (%)	Source
Wet Pond (WP)	80	MECP Guidelines
Infiltration Gallery (IG)	80	https://dep.nj.gov/wp-content/uploads/stormwater/bmp/nj_swbmp_4-print.pdf
Filtration Unit (F)	80	ETV Verification Statement

Phase 1 Interim Treatment Train

Treatment Train No.	Area IDs	Treatment Train	Area (ha)	Overall Efficiency (%)
1	Roof Area	IG(80) + F(80) + WP(80)	0.62	99.2
2	Phase 1	F(80) + WP(80)	1.03	96.0
3	Street A	WP(80)	0.31	80.0
4	Remaining Area (less SWMF)	WP(80)	0.81	80.0
Uncontrolled		N/A	0.25	0.0
		Total	**3.02**	**82.8**

Phase 1 Ultimate Treatment Train*

Treatment Train No.	Area IDs	Treatment Train	Area (ha)	Overall Efficiency (%)
1	Roof Area	IG(80) + F(80)	1.63	96.0
2	Phase 1, 2 & 3	F(80)	2.51	80.0
3	Street A		0.80	0.0
		Total	**4.94**	**72.3**

*Note: Presented is the TSS removal rate leaving the Site, this does not incorporate any downstream TSS removal (i.e, downstream ultimate SWMF5).

Database Version:	**V 2.0 Release Update**
Update Date:	**30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: **Crown Developments Interim Phase 1**
Subwatershed: **Hewitts Creek**

Total Pre-Development Area (ha):	**0.92**	Total Pre-Development Phosphorus Load (kg/yr):	**0.17**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	0.76	0.19	0.14
Low Intensity Development	0.16	0.13	0.02

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	0.25	1.32	NONE	0%	0.33
High Intensity - Residential	0.62	1.32	Treatment Train Approach	96%	0.04
			Infiltration Gallery, filtration unit & interim stormwater mangement facility.		
High Intensity - Residential	1.03	1.32	Other	70%	0.41
			Filtration unit & interim stormwater management facility.		
Transition	1.12	0.06	Wet Detention Ponds	63%	0.02

Post-Development Area Altered:	**3.02**
Total Pre-Development Area:	**0.92**
Unaffected Area:	**-2**

Post-Development Area exceeds Pre-Developed Area

	P Load (kg/yr)
Pre-Development:	**0.17**
Post-Development:	**2.58**
Change (Pre - Post):	**-2.41**

1459% Net Increase in Load

Post-Development (with BMPs):	**0.80**
Change (Pre - Post):	**-0.63**

383.51% Net Increase in Load

DEVELOPMENT:	**Crown Developments Interim Phase 1**
Subwatershed:	**Hewitts Creek**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**0.17**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**0.80**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-0.63**
Conclusion:	**384% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Not approve development as site specific appropriate

Project DEVELOPMENT Summary

DEVELOPMENT: **Crown Developments Interim Phase 1 - replicate Scenario 8/11/2024 5:14:36 PM**
Subwatershed: **Hewitts Creek**

Total Pre-Development Area (ha):	**0.92**	Total Pre-Development Phosphorus Load (kg/yr):	**0.17**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	0.76	0.19	0.14
Low Intensity Development	0.16	0.13	0.02

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	1.63	1.32	Treatment Train Approach	96%	0.09
			Infiltration Gallery & filtration unit		
High Intensity - Residential	2.55	1.32	Other	70%	1.01
			Filtration unit		
Low Intensity Development	0.76	0.13	NONE	0%	0.10
			Street A		

Post-Development Area Altered: **4.94**
Total Pre-Development Area: **0.92**
Unaffected Area: **-4**
Post-Development Area exceeds Pre-Developed Area

	P Load (kg/yr)
Pre-Development:	**0.17**
Post-Development:	**5.62**
Change (Pre - Post):	**-5.45**
	3300% Net Increase in Load
Post-Development (with BMPs):	**1.20**
Change (Pre - Post):	**-1.04**
	628.37% Net Increase in Load

DEVELOPMENT:	**Crown Developments Interim Phase 1 - replicate Scenario 8/11/2024 5:14:36 PM**
Subwatershed:	**Hewitts Creek**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**0.17**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**1.20**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-1.04**
Conclusion:	**628% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Not approve development as site specific appropriate

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix D

Manufactured Treatment Devices

Appendix D

Jellyfish® Filter

Jellyfish® Filter Overview

About Imbrium® Systems

Imbrium® Systems is dedicated to protecting Canada's waterways. Based on our knowledge and experience in the Canadian stormwater industry, we have the ability to provide the most effective stormwater treatment technologies that capture and retain harmful pollutants from urban runoff before it enters our streams, rivers, lakes, and oceans.

Imbrium's engineered treatment solutions have been third-party tested and verified in accordance with the ISO 14034 Environmental Technology Verification (ETV) protocol to ensure performance in real-world conditions as designed. Our team of highly skilled engineers and partners provide the highest level of service from design to installation and long-term maintenance.

By working with Imbrium and our partners, you can expect superior treatment technology, unparalleled customer service, compliance with local stormwater regulations, and cleaner water. To find your local representative, please visit **ImbriumSystems.com/localrep**.

Learn About the Jellyfish® Filter

Go online and watch our animation to learn how the Jellyfish Filter works. The animation also highlights important features of the Jellyfish Filter including...

- Applications
- Performance test results
- Inspection and maintenance
- Regulatory approvals

To view the Jellyfish Filter animation, visit:
ImbriumSystems.com/jellyfish

Filtration as a Stormwater Management Strategy

Stormwater regulations are increasingly calling for more robust treatment levels. In addition to the removal of suspended solids, many regulations now require best management practices to remove significant amounts of nutrients, metals, and other common pollutants found in stormwater runoff. Meeting these regulations often requires the use of a filtration solution.

Low Impact Development (LID) and Green Infrastructure (GI) are complimented by filtration solutions. Benefits of LID and GI systems include retaining runoff and aesthetic appeal. Keeping LID and GI sites free from trash, fine sediment, oils, and debris while functioning as designed can be time consuming and costly.

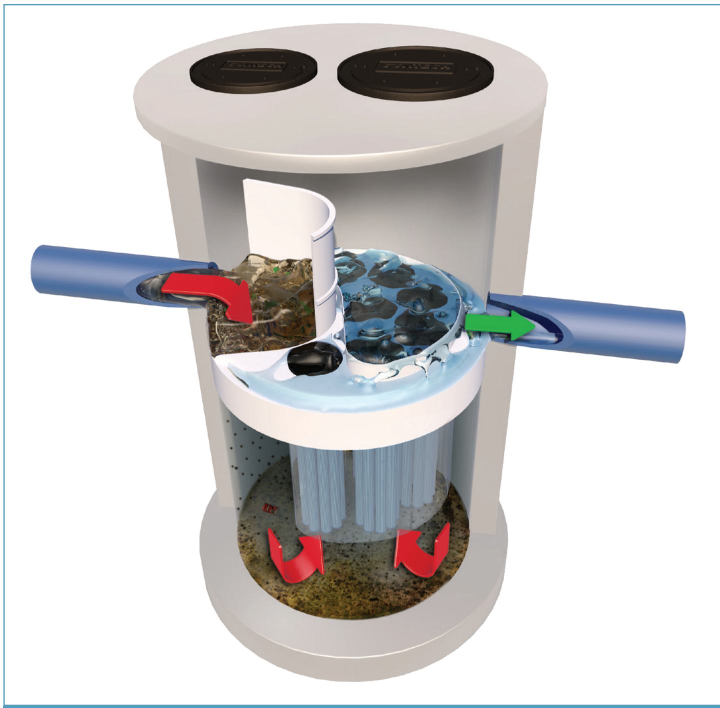
As a result, the practice of combining LID and GI with filtration is becoming more common. Providing a single point of maintenance promotes proper system functionality and increases the aesthetic appeal by removing unsightly trash and debris.

A Jellyfish Filter Curb Inlet pretreats runoff entering a bioretention system.

The Jellyfish® Filter - Setting New Standards in Stormwater Treatment

The Jellyfish Filter is a stormwater quality treatment technology featuring high surface area and high flow rate membrane filtration at low driving head. By incorporating pretreatment with light-weight membrane filtration, the Jellyfish Filter removes floatables, trash, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate-bound pollutants; including phosphorus and nitrogen, metals and hydrocarbons.

The Jellyfish Filter uses high surface area membrane cartridges that are lightweight, durable, rinsable, and reusable. The patented up-flow hydraulic design and passive backwash feature combined with the cartridge technology ensures long-lasting performance.



The Jellyfish Filter.

Jellyfish® Filter Features and Benefits

Features	Benefits
High surface area membrane filtration	Low flux rate promotes cake filtration and slows membrane occlusion
High design treatment flow rate per cartridge (up to 5 L/s)	Compact system with a small footprint, lower construction cost
Low driving head (typically 457 mm or less)	Design flexibility, lower construction cost
Lightweight cartridges with passive backwash	Easy maintenance and low life-cycle cost

Jellyfish® Filter Applications

- Urban development
- Highways, airports, seaports, and military installations
- Commercial and residential development, infill and redevelopment, and stormwater quality retrofit applications
- Pretreatment for Low Impact Development (LID), Green Infrastructure (GI), infiltration, and rainwater harvesting and reuse systems
- Industrial sites and high rise towers

A Jellyfish Filter pretreats a bioretention/bioswale system at a commercial site in Ontario, Canada.

A Jellyfish Filter provides treatment to high rise tower before detention storage or water re-use in British Columbia, Canada.

A Jellyfish Filter provides treatment at an industrial park in Quebec, Canada.

Jellyfish® Filter Field Performance Test Results

Pollutant of Concern	% Removal
Total Trash	99%
Total Suspended Solids (TSS)	90%
Total Phosphorus (TP)	77%
Total Nitrogen (TN)	51%
Total Copper (TCu)	>80%
Total Zinc (TZn)	>50%

Sources:
TARP Field Study – 2012 JF 4-2-1 Configuration
MRDC Floatables Testing – 2008 JF6-6-1 Configuration
TAPE Field Study – 2020 JF6-6-1 Configuration

The pleated tentacles of the Jellyfish Filter provide a large surface area for pollutant removal.

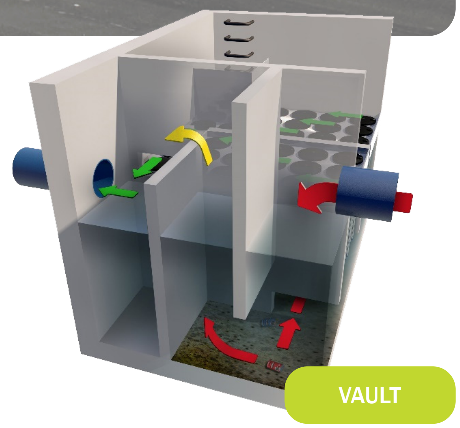
Jellyfish® Filter Certifications and Verifications

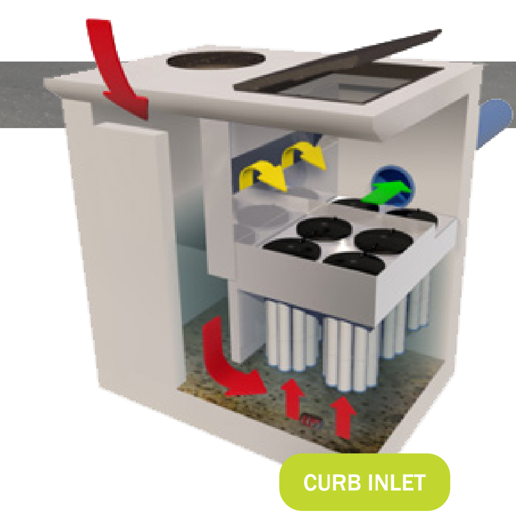
The Jellyfish Filter is approved through numerous state, provincial, and federal agencies and verification programs, including:

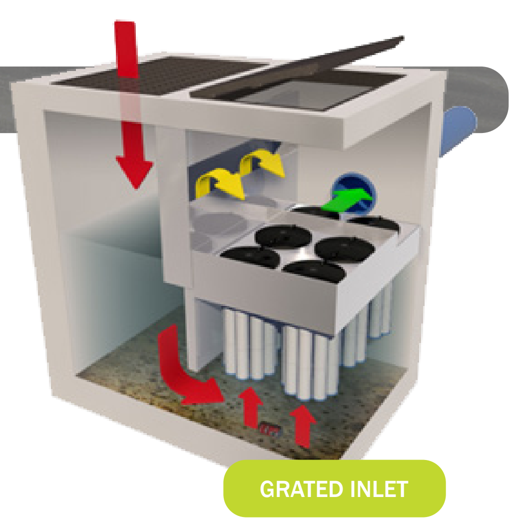
- **Canada ISO 14034 Environmental Management – Environmental Technology Verification (ETV)**
- Ontario Ministry of the Environment – New Environmental Technology Evaluation (NETE) – Certification
- New Jersey Corporation for Advanced Technology (NJCAT) – Field Performance Verification per TARP Tier II Protocol
- Washington State Department of Ecology (TAPE –GULD)
- Maryland Department of the Environment (MD DOE)
- Texas Commission on Environmental Quality (TCEQ)
- Virginia Department of Environmental Quality (VA DEQ)
- New York Department of Environmental Conservation (DEC)

Jellyfish® Filter Configurations

The Jellyfish Filter is available in a variety of configurations. Typically, 457 mm (18 inches) of driving head is designed into the system. For low drop sites, the designed driving head can be less.







Lightweight Jellyfish Filter Configurations

Custom configurations include tanks made from fiberglass for site specific applications.

A Jellyfish Filter was constructed from fiberglass to reduce the weight of the system, allowing for a suspended installation above an underground parking structure. The reduced weight eliminated the need for structural changes, and suspending the Jellyfish resulted in no loss of parking space, maximizing real-estate value.

Other custom configurations include:

- On-line capability (internal bypass)
- Peak Diversion Vault Configurations

Jellyfish® Filter Maintenance

Inspection and maintenance activities for the Jellyfish Filter typically include:

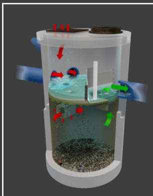
- Visual inspection of deck, cartridge lids, and maintenance access wall.
- External rinsing and re-installing of filter cartridges.
- Vacuum extraction of oil, floatable trash/debris, and sediment from the manhole sump.
- Replacement of filter cartridge tentacles as needed. Cartridge replacement intervals vary by site; typical replacement is anticipated every 2-5 years.

The Jellyfish Filter cartridge is light and easy to clean.

Watch the Jellyfish Filter inspection and maintenance video at

ImbriumSystems.com/jellyfish-maintenance

Explore More with Imbrium:

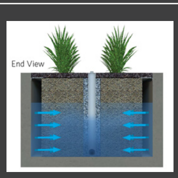


STORMCEPTOR® EF OIL-GRIT SEPARATOR

The enhanced flow Stormceptor® EF effectively targets sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals, Stormceptor delivers protection 24/7.

FILTERRA® BIORETENTION

The Filterra® Bioretention System is an engineered biofiltration device with components that make it similar to bioretention in pollutant removal and application, but has been optimized for high volume/flow treatment in a compact system.



MODULAR WETLANDS® BIOFILTRATION

The Modular Wetlands® Linear is the only biofiltration system to utilize patented horizontal flow, allowing for a small footprint, high treatment capacity, and design versatility. It is also the only biofiltration system that can be routinely installed downstream of storage for additional volume control and treatment.

LEARN MORE

- Access project profiles, photos, videos, and more online at **ImbriumSystems.com/jellyfish.**

REQUEST DESIGN ASSISTANCE

- Call us at 416-960-9900 to talk to one of our engineers for technical support or design assistance.

START A PROJECT

- Submit your system requirements on our product Design Worksheet at **ImbriumSystems.com/pdw.**

FIND A LOCAL REPRESENTATIVE

- Visit **ImbriumSystems.com/localrep** for contact information for your local Imbrium representative.

imbrium®

+1 416-960-9900
ImbriumSystems.com

Get Social With Us!

Imbrium® Systems is an engineered stormwater treatment company that designs and manufactures stormwater treatment solutions that protect water resources from harmful pollutants. By developing technologies to address the long-term impact of urban runoff, Imbrium ensures our clients' projects are compliant with government water quality regulations. For information, visit www.imbriumsystems.com or call +1 416-960-9900.

MADE IN CANADA
By Canadians, for Canadians.

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LangleyConcreteGroup.com **British Columbia**	**Lafarge.com** **Alberta | Manitoba** **Ontario | Saskatchewan**	**RinkerPipe.com** **Ontario**	**LecuyerBeton.com** **Quebec**	**Strescon.com** **New Brunswick |** **Novia Scotia**

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Jellyfish® Filter

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

Registration: GPS-ETV_V2022-03-01

In accordance with

ISO 14034:2016

**Environmental Management —
Environmental Technology Verification (ETV)**

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 1, 2022
Vancouver, BC, Canada

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

Technology description and application

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

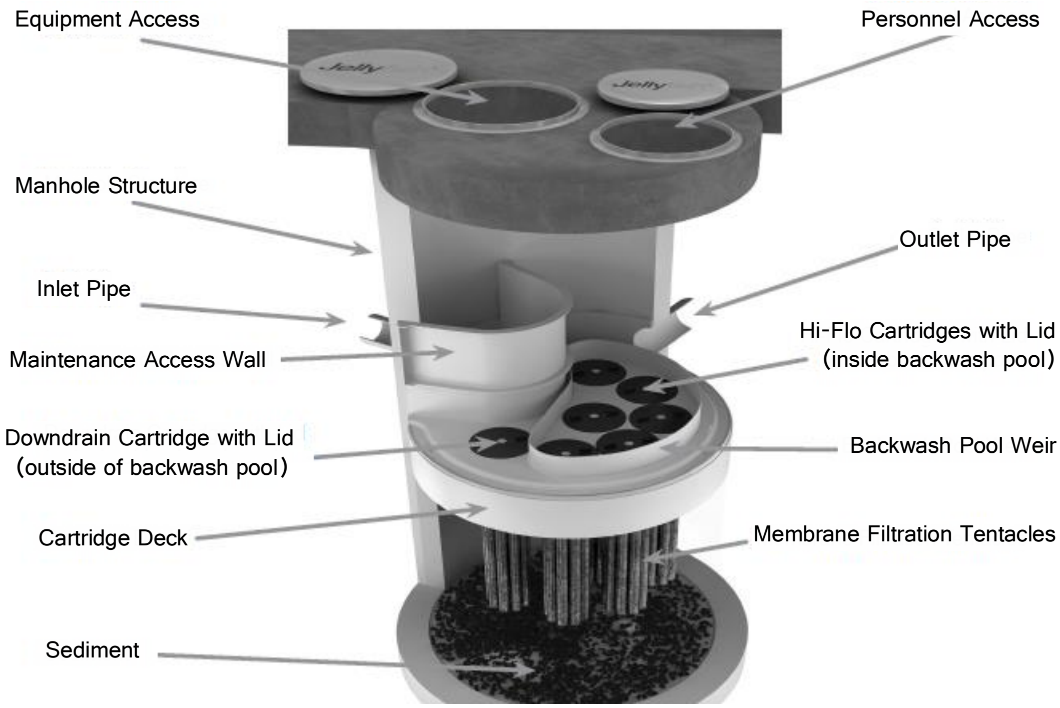

Figure 1. **Cut-away graphic of a Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge**

Figure 1 depicts a cut-away graphic of a typical 6-ft diameter Jellyfish® Filter manhole with 6 hi-flo cartridges and 1 draindown cartridge (JF6-6-1). Stormwater influent enters the system through the inlet pipe and builds a pond behind the maintenance access wall, with the pond elevation providing driving head. Flow is channeled downward into the lower chamber beneath the cartridge deck. A flexible separator skirt surrounds the filtration zone where the filtration tentacles of each cartridge are suspended, and the volume between the vessel wall and the outside surface of the separator skirt comprises a pre-treatment channel. As flow spreads throughout the pre-treatment channel, floatable pollutants accumulate at the surface of the pond behind the maintenance access wall and also beneath the cartridge deck in the pre-treatment channel, while coarse sediments settle to the sump. Flow proceeds under the separator skirt and upward into the filtration zone, entering each filtration tentacle and depositing fine suspended sediment and associated particulate-bound pollutants on the outside surface of the membranes. Filtered water proceeds up the center tube of each tentacle, with the flow from each tentacle combining under the cartridge lid, and discharging to the top of the cartridge deck through the cartridge lid orifice. Filtered effluent from the hi-flo cartridges enters a pool enclosed by a 15-cm high weir, and if storm intensity and resultant driving head is sufficient, filtered water overflows the weir and proceeds across the cartridge deck to the outlet pipe. Filtered effluent discharging from the draindown cartridge(s) passes directly to the outlet pipe, and requires only a minimal amount of driving head (2.5 cm) to provide forward flow. As storm intensity subsides and driving head drops below 15 cm, filtered water within the backwash pool reverses direction and passes backward through the hi-flo cartridges, and thereby dislodges sediment from the membrane which subsequently settles to the sump below the filtration zone. During this passive backwashing process, water in the lower chamber is displaced only through the draindown cartridge(s). Additional self-cleaning processes include gravity, as well as vibrational pulses emitted when flow exits the orifice of each cartridge lid, and these combined processes significantly extend the cartridge service life and maintenance cleaning interval. Sediment removal from the sump by vacuum is required when sediment depths reach 30 cm, and cartridges are typically removed, externally rinsed, and recommissioned on an annual basis, or as site-specific maintenance conditions require. Filtration tentacle replacement is typically required every 3 – 5 years.

Performance conditions

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

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

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

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

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

The 6-ft diameter test unit has sedimentation surface area of 2.62 m^2 (28.26 ft^2). Each of the seven filter cartridges employed in the test unit uses filtration tentacles of 137 cm (54 in) length, with filter surface area of 35.4 m^2 (381 ft^2) per cartridge, and total filter surface area of 247.8 m^2 (2667 ft^2) for the seven cartridges combined. The design treatment flow rate is 5 L/s (80 gal/min) for each of the six hi-flo cartridges and 2.5 L/s (40 gal/min) for the single draindown cartridge, for a total design treatment flow rate of 32.5 L/s (520 gal/min) at design driving head of 457 mm (18 in). This translates to a filtration flux rate (flow rate per unit filter surface area) of 0.14 L/s/m² (0.21 gal/min/ft²) for each hi-flo cartridge and 0.07 L/s/m² (0.11 gal/min/ft²) for the draindown cartridge. The design flow rate for each cartridge is controlled by the sizing of the orifice in the cartridge lid. The distance from the bottom of the filtration tentacles to the sump is 61 cm (24 in).

Performance claim(s)

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

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

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

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

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

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

Performance results

Performance Claims – Removal Efficiency for Total Suspended Solids

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

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

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

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

Performance Claims – Removal Efficiency for Total Phosphorus

Raw data summarizing the percent removal of total phosphorus (TP) by the Jellyfish® Filter at the design system hydraulic loading rate of 12.5 L/s/m² (18.4 gal/min/ft²) for 18 sample pairs deemed qualified are presented in **Table 4**. Data were analyzed and evaluated using a bootstrap approach of random sampling by replacement to estimate population distribution and thereby the upper and lower limit of the confidence interval.

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

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

Verification

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

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

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

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For more information on ISO 14034:2016 / ETV please contact:

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Vancouver, BC
V6C 3E2, Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com
www.globeperformance.com

UrbanPond® Concrete Stormwater Detention

The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

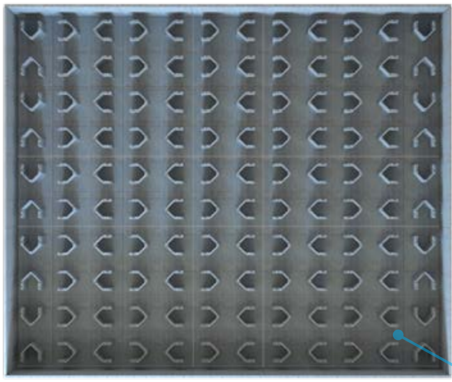
Innovative Concrete Stormwater Detention – UrbanPond®

UrbanPond, a traffic-rated underground stormwater storage system, is designed and produced with considerations such as height of cover, live and dead loads, proximity to adjacent structures, and required detention volume.

UrbanPond is a modular precast concrete underground storage system that mimics the function of ponds and open detention basins. It has high void percentages to maximize stormwater volume, and its robust precast form allows systems to be buried deeper without the need for specialized backfill, increased wall thicknesses, or extra rebar reinforcement.

Modules are available in 8′ x 8′ feet square or 8′ x 16′ rectangular configurations, giving designers more versatility to accommodate dense development, urban infill or high-volume projects. The modular design can be placed under roadways, parking lots and landscape areas in various shapes, sizes, and depths. The system's internal offset leg configuration provides channel-less water distribution for stormwater entering and exiting the system, and the robust precast form allows it to be buried.

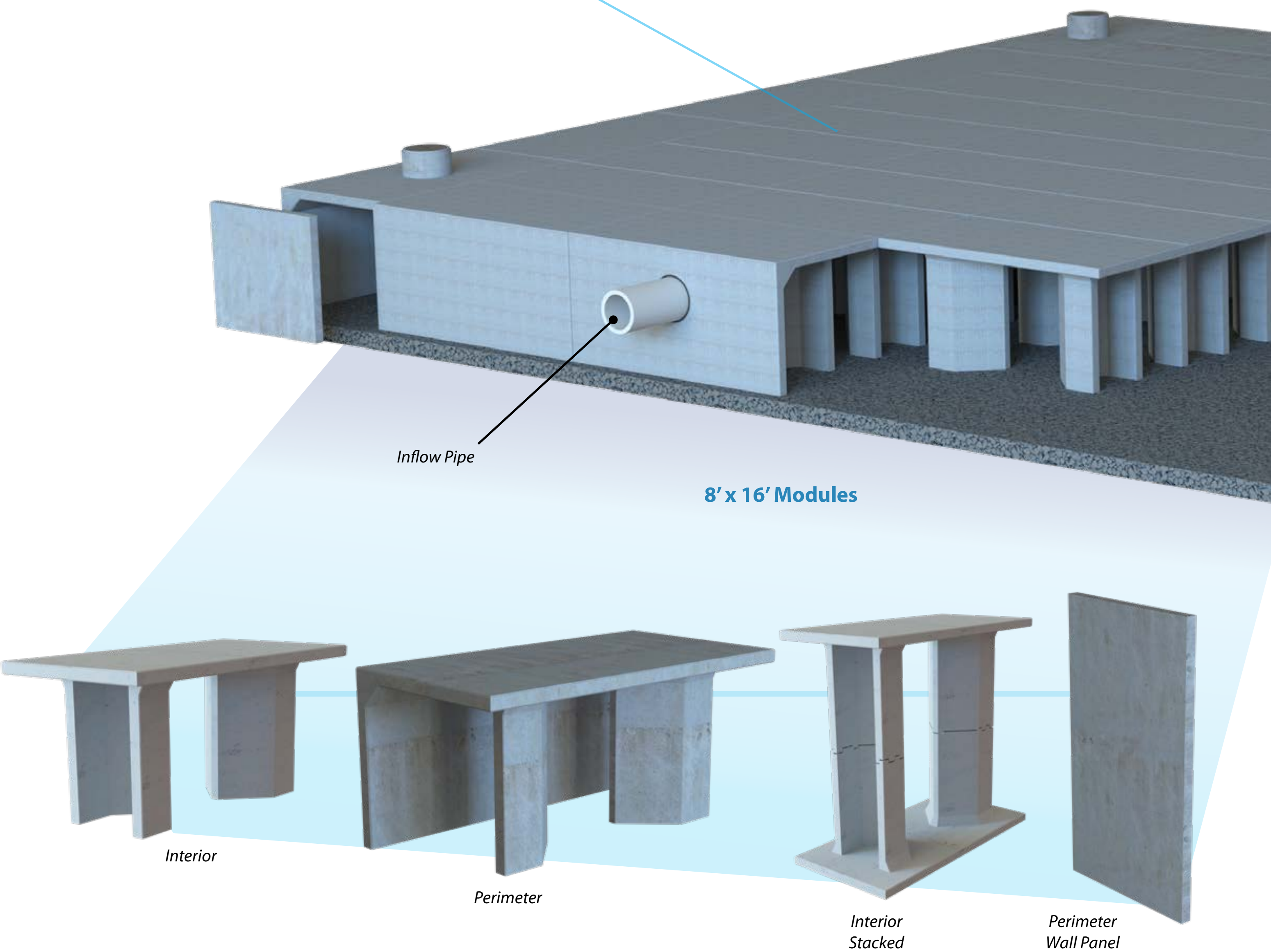
UrbanPond® Configurations



Top view without top slabs.

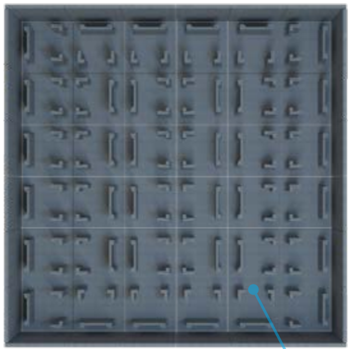
8' x 16' Module Assembly

The UrbanPond structure benefits from repeating tessellated shapes. Both the 8' x 8' and 8' x 16' modules can be combined for increased design versatility and efficiency.



Multiple configurations allow for easy site integration

TOP VIEW



Top view without top slabs.

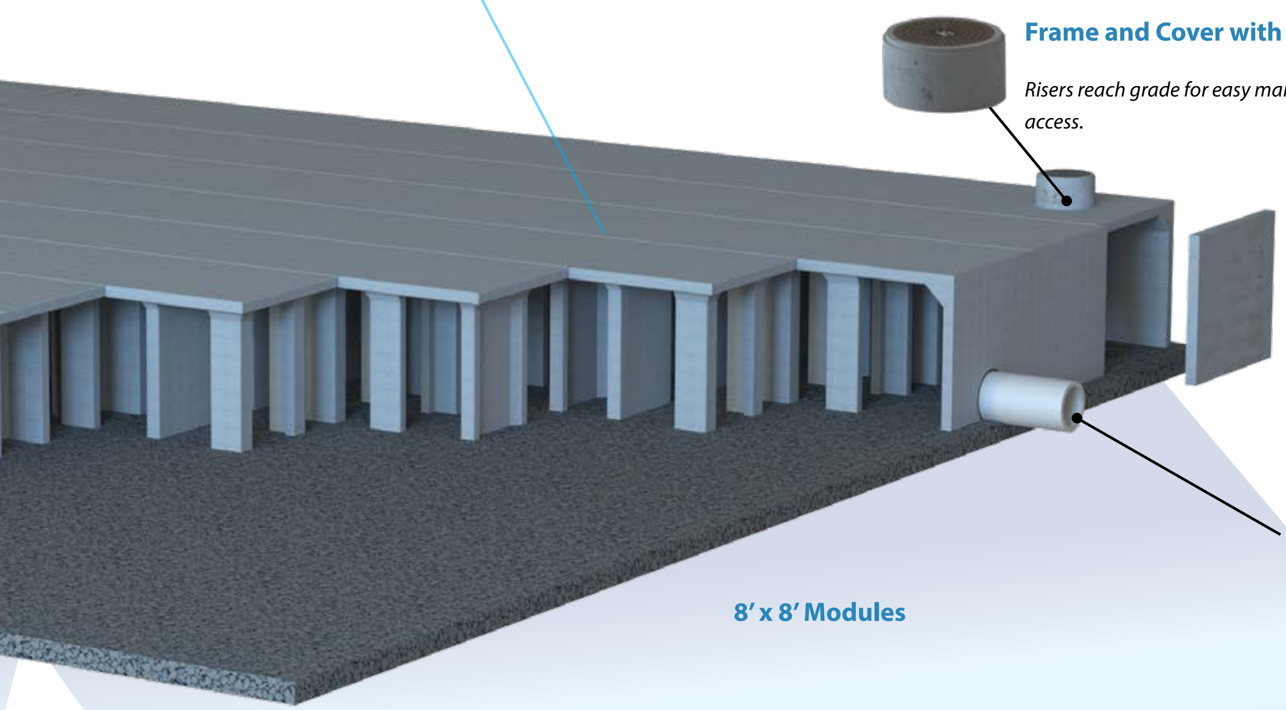
8' x 8' Module Assembly

The UrbanPond 8' x 8' modules' square tessellation repeats, covering a plane without any gaps or overlaps.

The offset leg configuration of the modules creates an open, channel-less internal space.

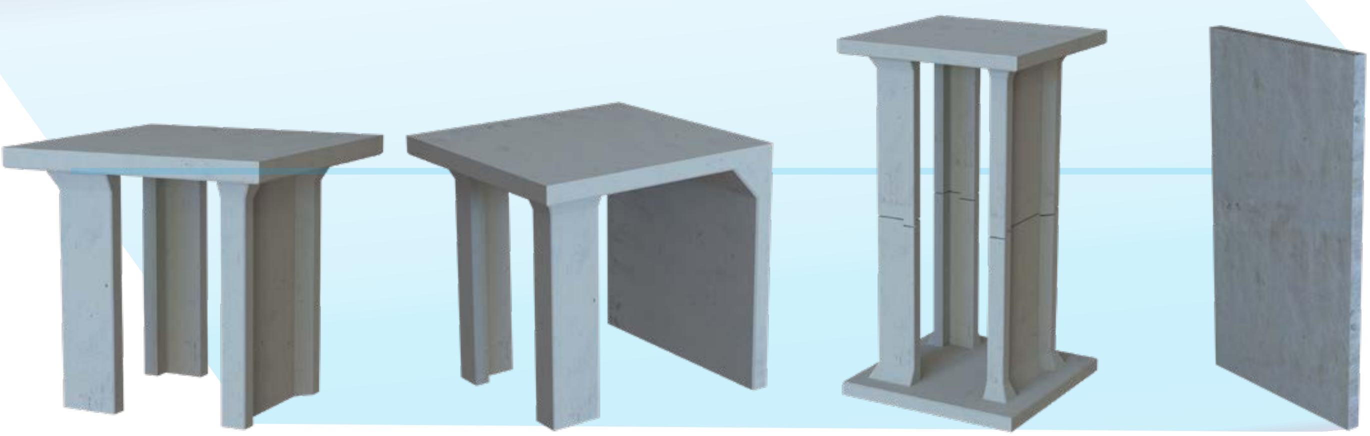
Frame and Cover with Risers

Risers reach grade for easy maintenance and inspection access.



Outflow Pipe

8' x 8' Modules



Interior | *Perimeter* | *Interior Stacked* | *Perimeter Wall Panel*

UrbanPond® Features and Benefits

FEATURE	BENEFIT
Various module sizes (8′ x 8′ and 8′ x 16′) to meet site constraints and installation requirements	Design flexibility while maximizing storage space
Optional built-in orifice control riser	Slowly discharges captured runoff to keep your site in compliance with local regulations
Designed to meet H-20 loading requirements	Superior strength & load capacity
Minimum cover of only 12″	Maximizes available depth
Can be backfilled with native soil	Eliminates the need to purchase rock required in other concrete systems

APPLICATION TIPS

- Best practice designs for subsurface infiltration include pretreatment to reduce cost and frequency of maintenance while ensuring the infiltration capacity of the facility.

UrbanPond® System Sizing

UrbanPond modules are available with inside heights ranging from 3 feet to 7 feet, in 6-inch increments, and the stacked UrbanPond modules are stackable up to 14 feet.

URBANPOND INSIDE HEIGHT (FT)	8′ X 8′ MODULE STORAGE VOLUME (CF)	8′ X 16′ MODULE STORAGE VOLUME (CF)
3	180	360
4	242	484
5	304	607
6	366	730
7	428	854
8	485	968
9	546	1091
10	608	1214
11	670	1338
12	732	1461
13	793	1584
14	855	1708

UrbanPond® Applications

Detention/Retention

Detention with controlled discharge utilizing built-in outlet orifice structures. Retention for long-term storage of runoff onsite to meet strict stormwater requirements.

Flood Control

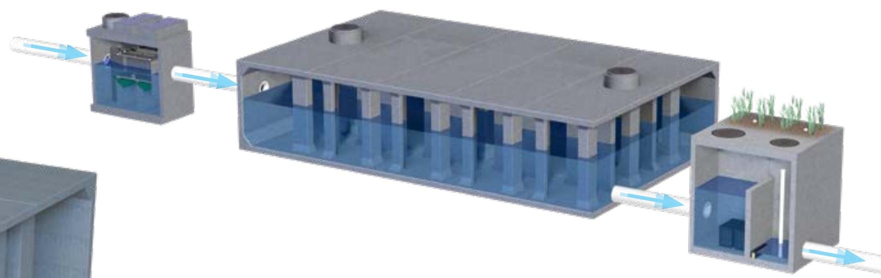
Flood Control of peak storm events to minimize downstream flooding and erosion.

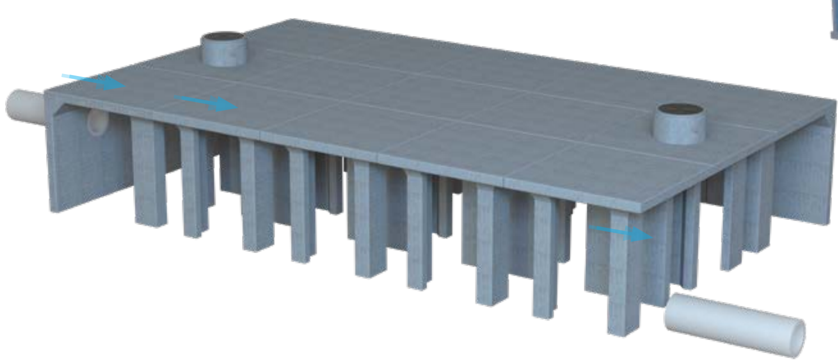
Treatment Train Design Options

The example shows an upstream Debris Separating Baffle Box (DSBB) to treat large flows, and capture trash, debris, and suspended solids, as well as hydrocarbons. The Modular Wetlands Linear is downstream, and the only biofiltration product that can be placed downstream of a detention system.

Infiltration Galleries

UrbanPond infiltration galleries are designed to maximize the transfer of water for percolation into native soils and groundwater recharge. The features include 30" diameter infiltration openings in each module.





UrbanPond® Maintenance

UrbanPond is designed to be maintained from the finished surface via a vacuum truck. Access ports are strategically placed throughout the system to facilitate maintenance. Modules can be modified to act as clear wells or pretreatment chambers for capturing trash, debris, and sediment. This consolidates maintenance requirements to a select few modules. Standard manholes, hinged manholes, and other access hatches are available.

UrbanPond® systems are designed with multiple port locations for easy maintenance.

A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

TAKE THE NEXT STEP

For more information: www.ContechES.com

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